mineral resources

Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

And

ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT

SUBMITTED IN TERMS OF REGULATIONS 31 & 32 OF THE ENVIRONMENTAL IMPACT ASSESSMENT REGULATIONS, GN 982 (AS AMENDED), OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, NO 107 OF 1998 (AS AMENDED)

NAME OF APPLICANT: TYGERKLOOF MINING (CHANGED TO IMERYS REFRACTORY MINERALS SOUTH AFRICA, TYGERKLOOF MINE)

TEL NO: (012) 643-5940
POSTAL ADDRESS: P.O. Box 8118, Centurion, 0046
PHYSICAL ADDRESS: Portion 5 of the farm Tygerkloof 354 KQ, Thabazimbi Local Municipality, Limpopo

MINING RIGHT REFERENCE: LP30/5/1/2/3/2/1 (10093) MR

July 2019

BECS Environmental (Pty) Ltd
In association with BECS Services (Pty) Ltd

IMERYS
Refractory Minerals

PO Box 72960, Lynnwood Ridge, 0040;
Cell: 072 191 6074, Fax: 012 361 0645
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1 IMPORTANT NOTICE

In terms of the Mineral and Petroleum Resources Development Act (Act 28 of 2002 as amended) (MPRDA), the Minister must grant a prospecting or mining right if among others the mining "will not result in unacceptable pollution, ecological degradation or damage to the environment".

Unless an Environmental Authorisation can be granted following the evaluation of an Environmental Impact Assessment (EIA) and an Environmental Management Programme report (EMP) in terms of the National Environmental Management Act (Act 107 of 1998) (NEMA), it cannot be concluded that the said activities will not result in unacceptable pollution, ecological degradation or damage to the environment.

In terms of section 16(3)(b) of the EIA Regulations, 2014, any report submitted as part of an application must be prepared in a format that may be determined by the Competent Authority and in terms of section 17 (1) (c) the competent Authority must check whether the application has taken into account any minimum requirements applicable or instructions or guidance provided by the competent authority to the submission of applications.

It is, therefore, an instruction that the prescribed reports required in respect of applications for an environmental authorisation for listed activities triggered by an application for a right or a permit are submitted in the exact format of, and provide all the information required in terms of, this template. Furthermore, please be advised that failure to submit the information required in the format provided in this template will be regarded as a failure to meet the requirements of the Regulation and will lead to the Environmental Authorisation being refused.

It is furthermore an instruction that the Environmental Assessment Practitioner (EAP) must process and interpret his/her research and analysis and use the findings thereof to compile the information required herein. (Unprocessed supporting information may be attached as appendices). The EAP must ensure that the information required is placed correctly in the relevant sections of the Report, in the order, and under the provided headings as set out below, and ensure that the report is not cluttered with uninterpreted information and that it unambiguously represents the interpretation of the applicant.

2 OBJECTIVES OF THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

The objective of the EIA process is to, through a consultative process—

a. determine the policy and legislative context within which the activity is located and document how the proposed activity complies with and responds to the policy and legislative context;
b. describe the need and desirability of the proposed activity, including the need and desirability of the activity in the context of the preferred location;
c. identify the location of the development footprint within the preferred site based on an impact and risk assessment process inclusive of cumulative impacts and a ranking process of all the identified development footprint alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects of the environment;
d. determine the—-
    i. nature, significance, consequence, extent, duration, and probability of the impacts occurring to inform identified preferred alternatives; and
    ii. the degree to which these impacts—
        aa. can be reversed;
        bb. may cause irreplaceable loss of resources, and
        cc. can be avoided, managed or mitigated;
e. identify the most ideal location for the activity within the preferred site based on the lowest level of environmental sensitivity identified during the assessment;
f. identify, assess, and rank the impacts the activity will impose on the preferred location through the life of the activity;
g. identify suitable measures to manage, avoid or mitigate identified impacts; and
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ADDENDUM 5: DEPARTMENT CORRESPONDENCE

All department correspondence was attached to the EMP for the mining right. To be submitted only if DMR requests this.

ABBREVIATIONS

AQMP	Air Quality Management Plan
CBA	Critical Biodiversity Areas
DD	Data deficient
DMR	Department of Mineral Resources
DRDLR	Department of Rural Development and Land Reform
DWS	Department of Water and Sanitation
EA	Environmental authorisation
EAP	Environmental Assessment Practitioner
ECA	Environmental Conservation Act 73 of 1989 as amended
EDD	Expanded Durov diagram
EIA	Environmental Impact Assessment

EIA/EMP	Environmental Impact Assessment Report/Environmental Management Programme
EIA	Early Iron Age
ESA	Ecological Support Areas
ESR	Environmental scoping report
GA	General authorisation
HIA	Heritage Impact Assessment
I&APs	Interested and affected parties
IDP	Integrated Development Plan
IEA	Integrated environmental authorisation
IWUL	Integrated Water Use License
IWULA	Integrated Water Use License Application
LED	Local Economic Development
LHRA	Limpopo Heritage Resources Agency
MA	Minerals Act no 50 of 1991
MPRDA	Mineral and Petroleum Resources Development Act No 28 of 2002 (as amended)
MPRDR	Mineral and Petroleum Resources Development Regulations, GN 527 of 2004 (as amended) i.t.o. the Mineral and Petroleum Resources Development Act No 28 of 2002 (as amended)
MWP	Mining works programme
NDEA	National Department of Environmental Affairs
NEMA	National Environmental Management Act No 107 of 1998 (as amended)
NEMAQA	National Environmental Management: Air Quality Act No 39 of 2004 (as amended)
NEMBA	National Environmental Management Biodiversity Act No 10 of 2004 (as amended)
NEMWA	National Environmental Management Waste Act 59 of 2009 (as amended)
NFA	National Forest Act No 84 of 1998
NHRA	National Heritage Resources Act No 25 of 1999
NT	Near Threatened
NVFFA	National Veld Fires and Forest Act No 101 of 1998 (as amended)
NWA	National Water Act no 36 of 1998 (as amended)
RoD	Record of decision
SAHRA	South African Heritage Resources Agency
SLP	Social and labour plan
TDS	Total dissolved solids
WDM	Waterberg District Municipality
WSA	Water Services Authority
WSDP	Water Services Development Plan

Executive summary

Applicant

BECS Environmental has been appointed by Imerys Refractory Minerals South Africa (Pty) Ltd (IRMSA): Tygerkloof Mine, to revise the EMP to fulfil the requirements of Regulations 31 & 32 of the Environmental Impact Assessment Regulations, GN 982 (as amended), of the National Environmental Management Act, no 107 of 1998 (as amended). This revision is to change the mining method from roll-over mining (concurrent backfilling) to filling the pit with coarse and fine tailings. The listed activities thus remain the same as the quarry will be filled with mine residue. Further amendment includes the placement of overburden and topsoil sequence. The mine already has authorisation for the placement of overburden and topsoil; therefore, no new listed activity will be triggered.

Tygerkloof Mine is an existing mine with Mining Right Reference number LP30/5/1/2/3/2/1 (10093) MR on Portion 5 of the Farm Tygerkloof 354 KQ, Thabazimbi Local Municipality (TLM), within Waterberg District Municipality, Limpopo Province. Adjacent to Tygerkloof Mine is Rhino Andalusite Mine (RAM), also part of IRMSA. This is an already existing mine, operating under a mining right number 74MR, for more than 25 years. Adjacent to RAM is Roodedam Mine, also part of IRMSA. This is an already existing mine, operating under a mining right number 72MR, for more than 25 years.

Details of the applicant and landowner

Refer to Table 1 below for a description of the applicant, Figure 1 for an organogram of the applicant, and Table 2 for a description of the landowner of the proposed site.

Table 1: Description of the applicant

Project applicant	Imerys Refractory Minerals South Africa (Pty) Ltd
Trading name	Tygerkloof Mine
Company registration	1973 / 012351 / 07
Contact person	Hendrik Jones
Physical address	259 West Ave, Centurion
Postal address	P.O. Box 8118, Centurion, 0046
Telephone number	(012) 643-5940
Facsimile number	(012) 643 1966
E-mail address	hendrik.jones@imerys.com

Table 2: Description of the landowner

Farm name and portion	Portion 5 of the farm Tygerkloof 354 KQ
Landowner	Imerys Refractory Minerals South Africa (Pty) Ltd
Contact person	Hendrik Jones
Physical address	Farm Grootfontein Makoppa, Turn Off on the R510, Thabazimbi, 0380
Postal address	P.O. Box 8118, Centurion, 0046
Telephone number	(012) 643-5940

Facsimile number	(012) 643 1966
E-mail address	hendrik.jones@imerys.com

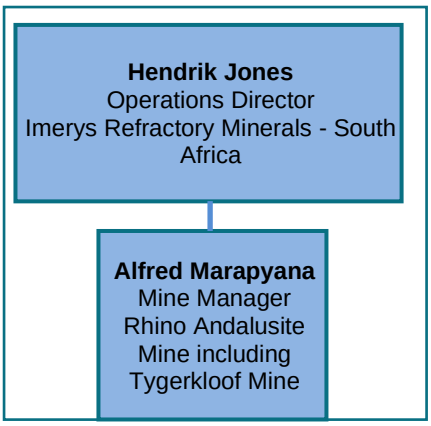


Figure 1: Tygerkloof Mine organogram

Project description

The Tygerkloof Mine includes an open quarry with overburden adjacent to the quarry, as well as a haul road to transport ore form the quarry to the existing RAM. The quarry will be approximately 115.9ha. The overburden will cover and area of approximately 142.2ha. The already existing haul road will be extended at a width of approximately 12m, and a length of 3.5km, adjacent to the quarry. Portion 5 of the farm Tygerkloof 354 KQ is approximately 594ha, therefore 44% of the total area will be disturbed for mining activities.

EMP changes

Changes from mining right

The proposed amendment of the mining method is to store all overburden adjacent to the quarry, in the already approved overburden footprint. The quarry will be filled with coarse and fine tailings. The mining method and EMP is further amended to change the sequence of placement of overburden and topsoil. The approved footprints for overburden and topsoil stockpile will still be used.

Summary of changes to impacts, significance and management thereof

Geology and the mineral resource: Loss of geology and mineral resource

The impact and risk methodology have been updated to a new format. The impact on geology will remain the same.

Soils, land capability, surrounding land use and landscape character: Removal of topsoil

Updated procedures and plans. The proposed amendment of the mining method is to store all overburden adjacent to the quarry, in the already approved overburden footprint. Coarse and fine tailings will be backfilled into the quarry. The approved footprints for overburden and topsoil stockpile will still be used. The impact and risk methodology have been updated to a new format.

Soils, land capability, surrounding land use and landscape character: Soil disturbance

The significance rating has been changed to the new format. The proposed amendment of the mining method is to store all overburden adjacent to the quarry, in the already approved overburden footprint. The approved footprints for overburden and topsoil stockpile will still be used. The sequence of storing as per the layout plan has changed somewhat.

Soils, land capability, surrounding land use and landscape character: Loss of topsoil and land capability

The significance rating has been changed to the new format.

Vegetation: Loss of floristic communities (affecting floristic richness, floristic structure, and ecological condition) and loss of declining, protected and near threatened plant taxa

The significance rating has been changed to the new format. The proposed amendment of the mining method is to store all overburden adjacent to the quarry, in the already approved overburden footprint. The impact on the animal and vegetation life will remain the same. Erosion management moved to Surface water section.

Fauna: Loss of fauna richness during clearing of vegetation and loss of fossorial and stenotopic taxa with restricted dispersal abilities

The significance rating has been changed to the new format. Mining activities will take place at night and will continue after 22:00. No lights are placed on site. During night-time, only the lights form the machinery will be used. The lights are for night-working. The management measures for lighting are therefore removed. Waste management moved to section 12.1.

Fauna: Deterring animals from utilising nearby resources

The significance rating has been changed to the new format. Mining activities will take place at night and will continue after 22:00. This will disturb nocturnal animals. The following management measure is removed: ‘Allow movement of animals during operation and increase the permeability of the road network.’

Air quality: Impact on air quality

Significance rating as per the original EMP is used. The following management is changed: ‘*For the control of vehicle entrained dust it is recommended that water (at an application rate of 1litre/m2-hour), be applied in combination with addition of chemicals. Literature reports an emissions reduction efficiency of 80%.’*

Groundwater: Impact on groundwater quality and levels

The significance rating has been changed to the new format. The proposed amendment of the mining method is to store all overburden adjacent to the quarry, in the already approved overburden footprint.

The approved footprints for overburden and topsoil stockpile will still be used, therefore, the impact on groundwater will remain the same.

Groundwater: Reduction in groundwater recharge

The significance rating has been changed to the new format.

Surface water: Potential of flooding

The significance rating has been changed to the new format. The impact will remain the same.

Surface water: Erosion and siltation

The significance rating has been changed to the new format.

Environmental noise: Environmental noise generation

The significance rating has been changed to the new format. Management measures have been amended to indicate working hours 24 hours a day.

Archaeological, historical and cultural aspects: Destruction of heritage or archaeological resources

The significance rating has been changed to the new format. No suitably qualified professional inspects the area for any potential archaeological or heritage resources; however, a heritage specialist did indeed conduct an impact assessment as part of the EIA, therefore, the following is removed: '*During the stripping of topsoil from the mining area, a suitably qualified professional must inspect the area for any potential archaeological or heritage resources'.*

Visual aspect: Change in topography

The significance rating has been changed to the new format. The proposed amendment of the mining method is to store all overburden adjacent to the quarry, in the already approved overburden footprint.

General: Soil and surface water pollution

The significance rating has been changed to the new format. Mining method amended from roll-over mining to placement of overburden and sloping at closure.

Changes in monitoring

Monitoring has been updated with the impact and management measures.

Rehabilitation

The rehabilitation plan has been updated to indicated that the quarry will be filled with coarse and fine tailings. The overburden will be sloped at end of life of mine.

The following has been removed:

During stripping and stockpiling the following principles should be aimed for:

- ***Prevent mixing of high quality topsoil (A and B-horizons) with low quality underlying material to ensure sufficient volumes of high quality soil for rehabilitation.*** *The quality of soil earmarked for rehabilitation purposes significantly deteriorates when the high-quality topsoil is mixed with the underlying poorer quality material (clay layers, calcrete, plinthite, weathered rock etc). This results in significant deterioration in the quality of the soil's physical and chemical properties and a decline in the soil fertility necessary for re-vegetation. The deterioration in soil quality also significantly* increases the susceptibility of rehabilitated soils for erosion and seal and crust formation.

This has been replaced with:
Topsoil is stripped with a dozer which would therefore not remove the OB material as it is more competent than the topsoil and requires an excavator for removal. This soil is stored as indicated in the layout plan for rehabilitation purposes.

Listed and specified activities

GN R. 546, 18 June 2010, activity 12: The wording has been amended to read as follow: *The quarries will be extended over a period of ten years and will be backfilled and* ***using coarse and fine tailings****. The total area of disturbance will be 115.9ha for the quarries. A total area of 142.2ha overburden will be stored adjacent to the quarries.*
No change to the parameters of the listed activity authorisation.

GN R. 546, 18 June 2010, activity 13: The wording has been amended to read as follow: *The quarries will be extended over a period of ten years and will be backfilled and* ***using coarse and fine tailings****. The total area of disturbance will be 115.9ha for the quarries. A total area of 142.2ha overburden will be stored adjacent to the quarries.*
No change to the parameters of the listed activity authorisation.

GN R. 546, 18 June 2010, activity 14: The wording has been amended to read as follow: *The quarries will be extended over a period of ten years and will be backfilled and* ***using coarse and fine tailings****. The total area of disturbance will be 115.9ha for the quarries. A total area of 142.2ha overburden will be stored adjacent to the quarries.*
No change to the parameters of the listed activity authorisation.

GN R 454, 18 June 2010, activity 5: The wording has been amended to read as follow: *The triggering a section 21g IWULA under the NWA for the placement of overburden and placement of coarse and fine tailings in quarry, not overburden.*
No change to the parameters of the listed activity authorisation.

Legal requirements

Tygerkloof Mine has a mining right in terms of the Mineral and Petroleum Resources Development Act, no 28 of 2002 (as amended) (MPRDA) as well as environmental authorisation (EA) in terms of the National Environmental Management Act. No 107 of 1998 (as amended) (NEMA). The EA includes the placement of overburden on an area of 142.2ha.

Tygerkloof Mine is applying for a Section 102 in terms of the MPRDA amendment of the mining right and environmental authorisation:

A reconnaissance permission, prospecting right, mining right, mining permit, retention permit, technical corporation permit, reconnaissance permit, exploration right, production right, prospecting work programme, exploration work programme, production work programme, mining work programme environmental management programme or an environmental authorisation issued in terms of the National Environmental Management Act, 1998, as the case may be, may not be amended or varied (including by extension of the area covered by it or by the additional of minerals or a shares or seams, mineralised bodies or strata, which are not at the time the subject thereof) without the written consent of the Minister.

According to Regulation 31 of the Environmental Impact Assessment (EIA) Regulations, GN 982 of 2014 (as amended):

An environmental authorisation may be amended by following the process prescribed in this Part if the amendment will result in a change to the scope of a valid environmental authorisation where such change will result in an increased level or change in the nature of impact where such level or change in nature of impact was not—

a) assessed and included in the initial application for environmental authorisation; or

b) taken into consideration in the initial environmental authorisation;

and the change does not, on its own, constitute a listed or specified activity.

The EMP is therefore amended to reflect these changes.

PART A

SCOPE OF ASSESSMENT AND ENVIRONMENTAL IMPACT ASSESSMENT REPORT

a) Details of the Environmental Assessment Practitioner

This section includes the following: Details of the environmental assessment practitioner (EAP); expertise of the EAP, which includes the qualifications of the EAP (with evidence) and a summary of the EAP's experience - in carrying out the EIA Procedure; and a declaration that the EAP is independent in a form as may be specified by the competent authority. Refer to Addendum 5C for environmental authorisation.

BECS Environmental was appointed as an independent consultant (EAP) to meet the requirements as set out in regulation 13 of the EIA Regulations. Refer to Table 3 below for a description of the EAP and refer to Addendum 2 for a detailed CV of the EAP, which includes the expertise including qualifications and experience.

Table 3: Description of the environmental assessment practitioner

Name of company	BECS Environmental
Postal address	PO Box 72960, Lynnwood Ridge, 0040
Telephone number	012 361 9970
Cell phone number	072 191 6074
Facsimile number	012 361 0645
E-mail address	salome@becsenv.co.za
Name of responsible EAP	Salome Beeslaar
Expertise of EAP	B.Sc Environmental Science (UP), B.Sc Honours Geography (UP), M.Sc Geography (UP), Professional Scientist (Environmental Science)
Name of second responsible EAP	Deshree Pillay
Expertise of EAP	B. Sc Environmental Science (UP), B. Sc Honours Geography & Environmental Science (UP)

I, Salome Beeslaar (8310190032081), hereby declare that I have no conflict of interest related to the work of this report. Specially, I declare that I have no business, personal, or financial interests in the property and/or mining right being assessed in this report and that I have no personal or financial connections to the relevant property owners or mine. I declare that the opinions expressed in this report are my own and a true reflection of my professional expertise and that there are no circumstances that may compromise my objectivity in performing such work.

_____

Salome Beeslaar
MSc – Geography
SACNASP (400385/14)
15 July 2019

b) Description of the property

Tygerkloof Mining is on portion 5 of the farm Tygerkloof 354 KQ, in the TLM, within the Waterberg District Municipality (WDM), in the south-western part of the Limpopo Province in the Savannah Biome. This site is adjacent, to the west of the already existing RAM. This mine is linked to the R510 Road via the dirt road adjacent to RAM, which leads to Makoppa., and is situated approximately 110km from Rustenburg and 15km south-west of Thabazimbi. Tygerkloof Mine is located south, of the south-eastern slope of the foothills of the Witfonteinrand Mountain. It is situated near the Pilanesberg National Park. This area is mainly applied for agriculture although platinum, iron and andalusite is also mined in the area.

Refer to Table 4 below for a description of the property. A locality map of the Tygerkloof Mine is provided below in Figure 2.

Table 4: Farm names, 21-Digit Surveyor General codes, and coordinates

Farm names of existing mine	Portion 5 of the farm Tygerkloof 354 KQ,
Size of property	594ha
Local municipality	Thabazimbi Local Municipality
District Municipality	Waterberg District Municipality
Province	Limpopo Province
Distance and direction from nearest town	20km from Thabazimbi
21-digit Surveyor General Code and extent for each farm portion	T0KQ00000000035400005
Coordinates	24˚ 43' 35"S; 27˚ 13' 58"E

c) Locality map

Refer to Figure 2 below for a locality map of Tygerkloof Mine.

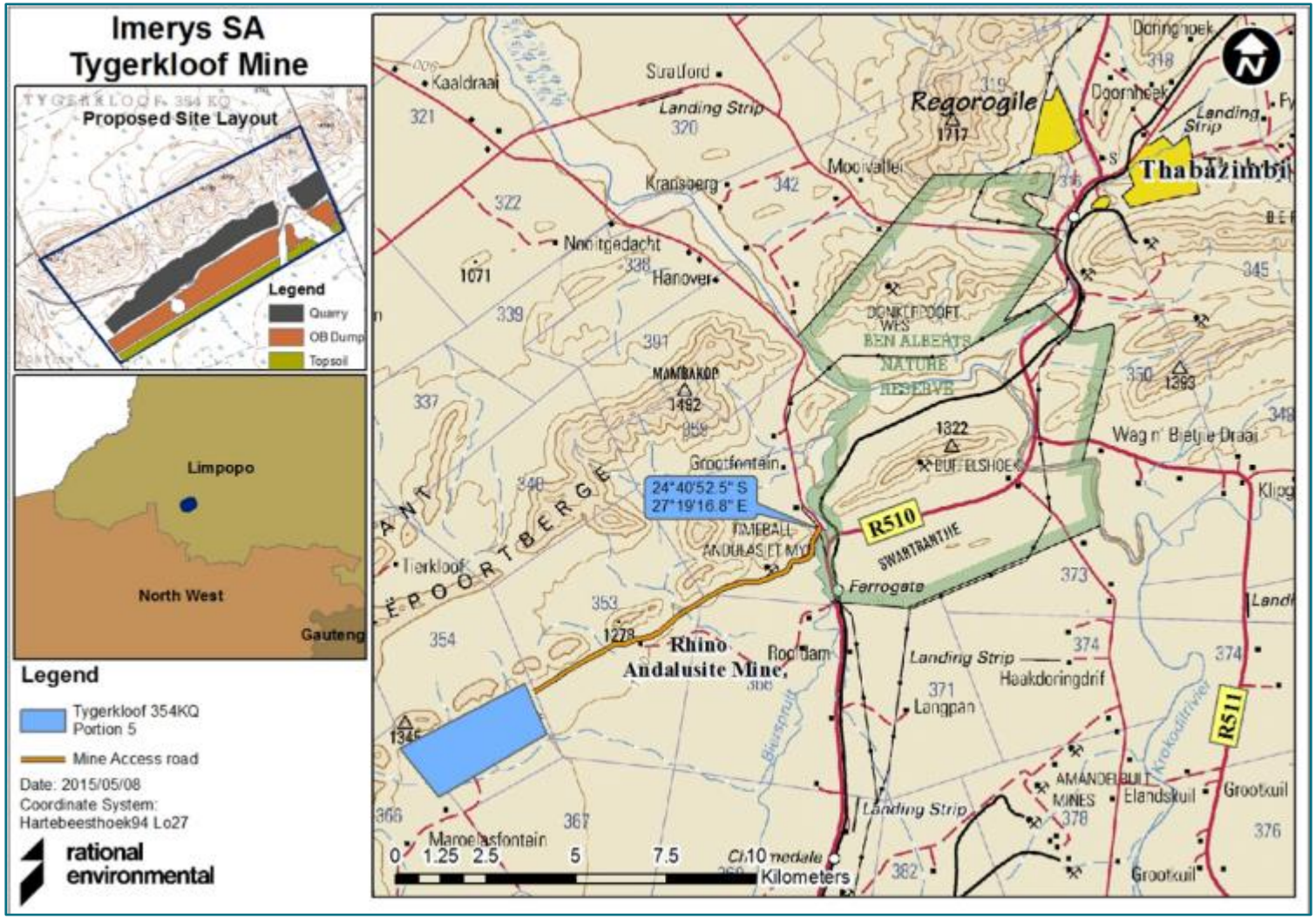


Figure 2: Locality map of Tygerkloof Mine

d) Description of the scope of the proposed overall activity

(i) Listed and specified activities

This EMP amendment does not include any additional listed activities to be authorised. Tygerkloof Mine has authorisation for the listed activities indicated in in Table 5 below.

Table 5: Listed activities in terms of the NEMA for which Tygerkloof Mine has authorisation

Relevant notice	Activity No	Activity	Description
GN R. 544, 18 June 2010	26	Any process or activity identified in terms of section 53(1) of the National Environmental Management: Biodiversity Act, No 10 of 2004 (NEMBA).	Activities 12, 13, 14 & 19 under GN 546 are triggered.
GN R. 544, 18 June 2010	47	The widening of a road by more than 6m, or the lengthening of a road by more than 1km (ii) where no reserve exists, where the existing road is wider than 8m excluding widening or lengthening occurring inside urban areas.	The haul road will be extended approximately 3.5km. This road has a width of 12m.
GN R. 545, 18 June 2010	5	The construction of facilities or infrastructure for any process or activity which requires a permit or license in terms of national or provincial legislation governing the generation or release of emissions, pollution or effluent and which is not identified in GN 544 of 2010 or included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, No 59 of 2008 (NEMWA) in which case that Act will apply.	Overburden from the mining operations will be stored adjacent to the quarry. This will trigger a section 21g IWULA under the NWA.
GN R. 546, 18 June 2010	12	The clearance of an area of 300m² or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation. (b) In Free State, Limpopo and Mpumalanga provinces: (iv) Outside urban areas, in: (ee) Critical biodiversity areas (CBAs) as identified in systematic biodiversity plans adopted by the CA or in bioregional plans	The quarries will be extended over a period of ten years and will be backfilled and using coarse and fine tailings. The total area of disturbance will be 115.9ha for the quarries. A total area of 142.2ha overburden will be stored adjacent to the quarries.
GN R. 546, 18 June 2010	13	The clearance of an area of 1ha or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation, except where such removal of vegetation is required for:	The quarries will be extended over a period of ten years and will be backfilled and using coarse and fine tailings. The total area of disturbance will be 115.9ha for the quarries. A

Relevant notice	Activity No	Activity	Description
		(1) the undertaking of a process or activity included in the list of waste management activities published in terms of section 19 of the NEMWA, in which case the activity is regarded to be excluded from this list. (2) the undertaking of a linear activity falling below the thresholds mentioned in Listing Notice 1 in terms of GN 544 of 2010 (a) CBAs and ecological support areas (ESAs) as identified in systematic biodiversity plans adopted by the CA.	total area of 142.2ha overburden will be stored adjacent to the quarries.
GN R. 546, 18 June 2010	14	The clearance of an area of 5ha or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation, except where such removal of vegetation is required for: (1) purposes of agriculture or afforestation inside areas identified in spatial instruments adopted by the CA for agriculture or afforestation purposes; (2) the undertaking of a process or activity included in the list of waste management activities published in terms of section 19 of the NEMWA in which case the activity is regarded to be excluded from this list; (3) the undertaking of a linear activity falling below the thresholds in Notice 544 of 2010. (a) In Eastern Cape, Free State, KwaZulu-Natal, Gauteng, Limpopo, Mpumalanga, Northern Cape, Northwest and Western Cape: (i). All areas outside urban areas.	The quarries will be extended over a period of ten years and will be backfilled and using coarse and fine tailings. The total area of disturbance will be 115.9ha for the quarries. A total area of 142.2ha overburden will be stored adjacent to the quarries.
GN R. 546, 18 June 2010	19	The widening of a road by more than 4m, or the lengthening of a road by more than 1km. (a) In Eastern Cape, Free State, KwaZulu-Natal, Limpopo, Mpumalanga and Northern Cape provinces: (ii) Outside urban areas, in: (ee) CBAs as identified in systematic biodiversity plans adopted by the CA or in bioregional plans.	The road will be extended with approximately 3.5km at a width of 12m.

(ii) Description of the activities to be undertaken

(a) Project description as per approved EMP and mining right

The activities include the mining of andalusite in an open quarry over a timeframe of 10 years. The mining method used is open cast rip and doze operation. Topsoil is loaded by back-actor and dumped at the designated topsoil dump. The remaining overburden is removed along with "contact" ore (weathered ore) to designated waste dumps. Any in-quarry waste or low-grade ore is also removed to these dumps. Benches are typically 5m wide and 10m high. The quarry will be approximately 115.9ha. The quarry will be filled with coarse and fine tailings. Overburden from the mining operations will be stored adjacent to the quarry on the southern side of the open quarry. The overburden will cover and area of approximately 142.2ha. The already existing haul road from RAM will be extended at a width of approximately 12m, and a length of 3.5km, adjacent to the quarry, between the open quarry and the overburden. No new buildings or any other associated infrastructure will be constructed. All processing activities will take place on the already existing RAM site.

(b) Amendment to project description

The proposed amendment of the mining method is to store all overburden adjacent to the quarry, in the already approved overburden footprint. The quarry will be filled with coarse and fine tailings. The mining method and EMP is further amended to change the sequence of placement of overburden and topsoil. The approved footprints for overburden and topsoil stockpile will still be used. Refer to Figure 3 below indicating the amended sequence of storage.

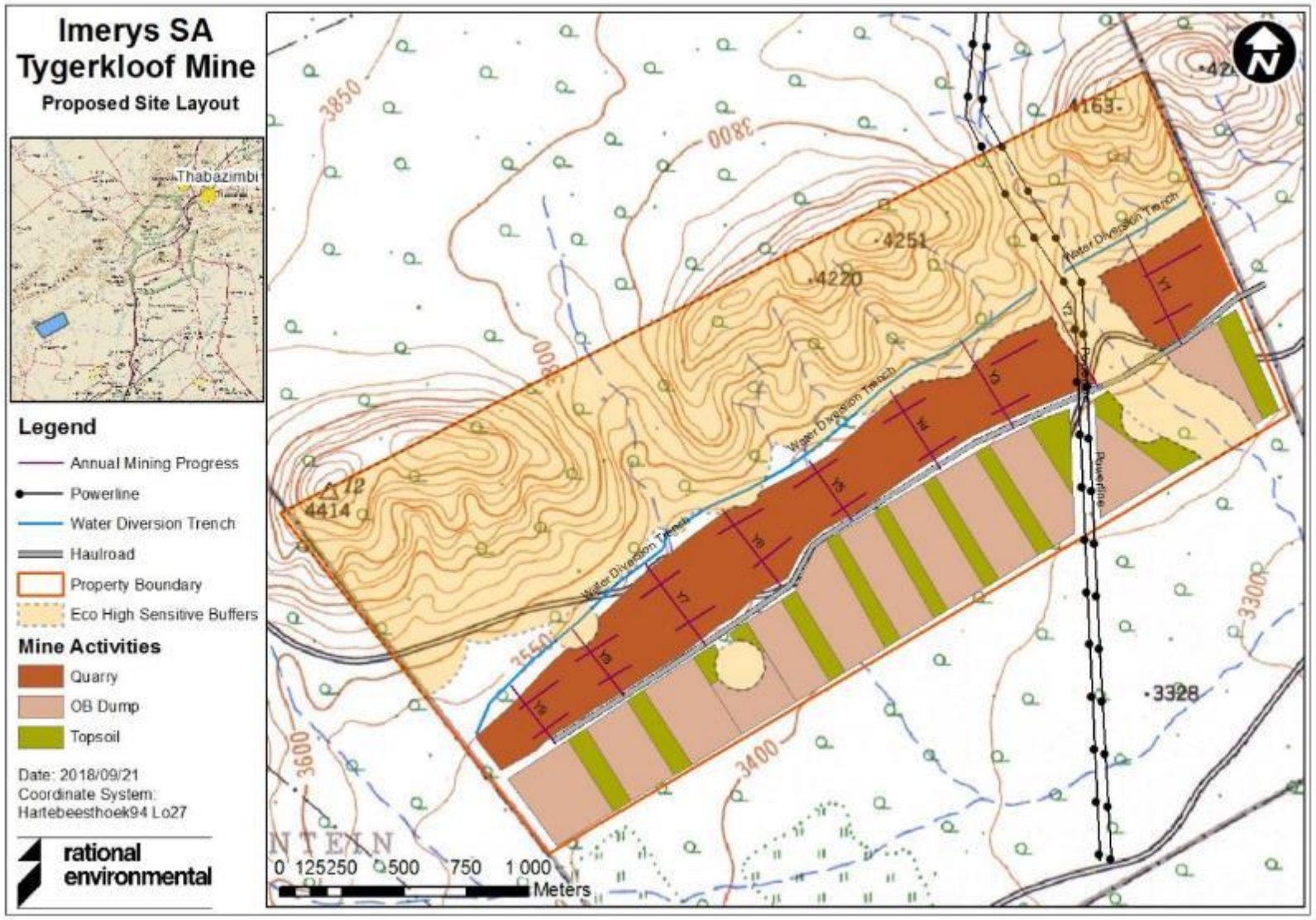


Figure 3: Site layout plan for Tygerkloof Mining

e) Policy and legislative context

Applicable legislation and guidelines used to compile the report	Description of legislation and guidelines used to compile the report	Reference where applied	How does this development comply with and respond to the policy and legislative context
Authorisation applications			
MPRDA	According to the MPRDA, Tygerkloof Mine must have a mining right as well as an approved EMP. Due to changes from the Minerals Act no 50 of 1991 (MA) to the MPRDA in 2002, all mining rights had to be converted in 2009 from the old MA to the new MPRDA. Any mining right application submitted after 8 December 2014 must be done in terms of NEMA and not MPRDA. This application will include the listed activities pertaining to mining (i.e. Activity 17 of GN 984 of the EIA Regulations). These applications are still submitted to Department of Mineral Resources (DMR). Furthermore, any changes in the mining right, EMP, mining works programme (MWP), or EA, must be authorised through a Section 102 (in terms of the MPRDA) amendment.	Mining right: Addendum 5A Granting letter Addendum 5B	The mine has an approved mining right. This mining right has also been converted to the new MPRDA requirements.
NEMA and the Environmental Conservation Act 73 of 1989 as amended (ECA)	The first listed activities which required an EA (referred to as a record of decision (RoD) in the past) commenced in 1998. These activities were published in the EIA Regulations of 1998 (GN1183). In 2006, the ECA activities and EIA Regulations were replaced by the first NEMA EIA Regulations.	Environmental Authorisation Addendum 5C	The mine has an approved environmental authorisation for all listed activities. No new activities are applied for as part of this EMP amendment.

Applicable legislation and guidelines used to compile the report	Description of legislation and guidelines used to compile the report	Reference where applied	How does this development comply with and respond to the policy and legislative context
	The second set of NEMA EIA activities replaced the first set of NEMA EIA activities in 2010. The ECA activities, as well as the first and second NEMA EIA activities, excluded the application for an EIA when applying for a mining right; however, there are various other activities that could potentially trigger an EIA. The third set of NEMA EIA activities commenced on 8 December 2014. According to these listings, an applicant must apply for both a mining right as well as an EA for any new mine, and a prospecting right as well as an EA for any new prospecting activities.		
National Water Act no 36 of 1998 (as amended) (NWA)	Section 21 of the NWA sets out the water uses for which an Intergrated water use license (IWUL) is required. These water uses commenced on 1 October 1998, and include permissible water uses (water uses for which no licencing or registration is necessary), general authorisations (GA) (water uses for which registration only is required), and water use licenses (water used for which both registration and licencing is required). An existing lawful water use is any water use that commenced 2 years or more prior to the NWA and authorised under the old Act. These water uses are deemed lawful. In 1999, the GN 704 Regulations i.t.o. NWA	Correspondence with Department of Water and Sanitation (DWS) Addendum 5D	An Intergrated water use license Application (IWULA) process is followed in terms of the NWA. This application was submitted in 2015 and authorisation is pending.

Applicable legislation and guidelines used to compile the report	Description of legislation and guidelines used to compile the report	Reference where applied	How does this development comply with and respond to the policy and legislative context
	were published. These Regulations pertained to all mining rights, and exemptions of water uses if necessary.		
NEMWA	Waste management permits for certain waste activities were required form 1989 i.t.o. the ECA. These permits were repealed by the publishing of the first listed waste management activities licensing in 2009 (GN 718 of 2009 i.t.o. NEMWA). These listings were replaced by new listings in 2013 (GN 921 of 2013 i.t.o. NEMWA). If a site has a permit under ECA, this is still applicable until the National Department of Environmental Affairs (NDEA) requests an update on the new legislation (NEMWA).	N/A	No waste licence was triggered during the original application. No new waste licence is triggered with the amendment.
National Heritage Resources Act no 25 of 1999 (NHRA)	All required permits as per the Act.	N/A	A heritage study was undertaken as part of the original mining right application. This was attached to the previous EMP.
Section 15(1) of the National Forest Act No 84 of 1998 (NFA)	No person may cut, disturb, damage or destroy any protected tree; or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, or any forest product derived from a protected tree, except under a licence granted by the Minister.	N/A	No permit is necessary for the proposed activities. The specialist study refers to protected trees, however, these trees must not be removed during the mining.
Mining			

Applicable legislation and guidelines used to compile the report	Description of legislation and guidelines used to compile the report	Reference where applied	How does this development comply with and respond to the policy and legislative context
Mine residue management: Regulation 73 of the Minerals and Petroleum Resources Development Regulations (GN 349 of 2011 i.t.o. MPRDA) (MPRDR), GN 632 of 2015 i.t.o. NEMWA.	The assessment of impacts relating to the management of residue deposits must form part of the EMP. Mine residue must be characterised to identify any potentially significant health or safety hazard and environmental impact that may be associated with the residue when deposited. The design of the residue stockpile and deposit shall be undertaken by a competent person. The process of investigation and selection of a site for residue stockpiling and residue deposits must entail several factors as per the legislation. This will include geotechnical investigations and groundwater investigations. From these investigations, a preferred site must be identified. Further investigation on the preferred site is also necessary. This must be carried out by a competent person. A competent person must be qualified by virtue of his or her knowledge, expertise, qualifications, skills and experience; and is familiar with the provisions of the Act and other related legislation and has been trained to recognise any potential or actual problem in the performance of the work.	Part A(g)(v)	A registered engineer is appointed as the competent person on dams and residue. The mine has a code of practice (CoP) which indicates the zones of influence as well as the safety classification. For the TDFs. The impacts of the mine residue are contained within this EIA/EMP as well as previously approved EMPs.
Rehabilitation and closure:	A closure plan must be submitted 5 years before closure to DMR and NDEA. An EMP and rehabilitation plan must be submitted 5 years before	Part B(1)(d)	The LoM is more than 5 years, however, the mine is in the process of compiling an annual rehabilitation plan as part of the new NEMA

Applicable legislation and guidelines used to compile the report	Description of legislation and guidelines used to compile the report	Reference where applied	How does this development comply with and respond to the policy and legislative context
Section 24R of NEMA, Appendix 5 of the EIA Regulations, sections 43 & 56 of MPRDA	commencing with closure to DWS. Closure objectives form part of the draft EMP, and must identify the key objectives for mine closure to guide the project design, development and management of environmental impacts; provide broad future land use objective(s) for the site, and provide proposed closure costs. Imerys must ensure that details of rehabilitation of the residue deposit are provided in the EMP.		requirements. This plan will include closure objectives as well as rehabilitation of the mine and mine residue. These closure objectives and rehabilitation are included in this EIA/EMP.
Financial provision: Section 24P of the NEMA, Regulations pertaining to financial provisioning for prospecting, exploration, mining, or production operations (GN 1147 of 2015 i.t.o. NEMA	The EMP must address the requirements as determined in the regulations, pertaining to the financial provision for the rehabilitation. The mine must annually update and review the quantum of the financial provision in consultation with a competent person, as required in terms of the approved EMP, or as requested by the Minister.	Part A(s)	The financial provision is updated annually. The financial provision update for 2018 will make provision for these activities.
Water management			
Water management and pollution control: GN 527 of 2004 i.t.o. MPRDA	An assessment of impacts relating to water management and pollution control at mining operations must form part of the EMP. No TDF shall be established on the bank of any stream, river, dam, pan, wetland or lake without written permission and upon such conditions as determined and as approved in the EMP. Toilet facilities shall be located in such a manner that no water or other	Part A(g)(v)	The impacts of water pollution are contained within this EIA/EMP.

Applicable legislation and guidelines used to compile the report	Description of legislation and guidelines used to compile the report	Reference where applied	How does this development comply with and respond to the policy and legislative context
	pollution is caused. GN 704 Regulations of 1999 i.t.o. NWA place: restrictions on locality; restrictions on the use of material; capacity requirements of clean and dirty water systems; protection of water resources; and security and additional measures.		
Biodiversity management			
Protection of threatened or protected species: Sections 56-58 & 87-93 of National Environmental Management Biodiversity Act No 10 of 2004 (as amended) (NEMBA), section 12 of NFA	The Minister may, by notice in the Gazette, publish a list of critically endangered, endangered, vulnerable and/or protected species. No person may (a) cut, disturb, damage, destroy or remove any protected tree; or (b) collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a licence granted by the Minister.	Part A(g)(v)	The mine has conducted specialist, protected trees have been identified and may not be removed.
Alien and invasive species: GN 1048 of 1984 i.t.o. CARA, GN 507, GN 508 & GN 509 of 2013, & GN 598 & GN 599 of 2014 i.t.o. NEMBA sections 65-77 of NEMBA	Category 1a Listed Invasive Species must be combatted or eradicated. Category 1b Listed Invasive Species must be controlled. Category 2 Listed Invasive Species require a permit to carry out a restricted activity within an area specified in the Notice or an area specified in the permit. Category 3 Listed Invasive Species are subject to exemption.	Part A(g)(v)	Alien invasive species are included in a specialist study.
Soil management			
Contaminated land: GN 527 of 2004 i.t.o. MPRDA, and sections 35-41 of NEMWA	The assessment of impacts relating to soil pollution and erosion control must form part of both the EMP. The acidification, salination and mineralisation of	Part A(g)(v)	The impacts on soil are contained within this EIA/EMP.

Applicable legislation and guidelines used to compile the report	Description of legislation and guidelines used to compile the report	Reference where applied	How does this development comply with and respond to the policy and legislative context
	soils through seepage of polluted water must take place as approved in the EMP. The spillage of hazardous chemicals onto soils or its escape or migration into surrounding soils from the approved deposition area must be prevented. Oils, grease and hydraulic fluids must be disposed of. Oils, grease and hydraulic fluid spills must be cleaned up by removing all contaminated soil and disposing such soil in a waste disposal receptacle or at a licensed facility. The chemical and physical properties of topsoil to be used for the purposes of rehabilitation must not be changed by introducing foreign material, gravel, rock, rubble or mine residue to such soil. An owner of land that is significantly contaminated, or a person who undertakes an activity that caused the land to be significantly contaminated, must notify the department of that contamination as soon as that person becomes aware, of that contamination		
Heritage resources management			
Section 52 of MPRDA, and Sections 34 & 35 of NHRA	An EMP must include impacts on heritage aspects. No person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant provincial heritage resources authority. Any person who	Part A(g)(v)	A heritage study was previously undertaken for the mine. No heritage resources were discovered at the overburden site. All other activities occur in already disturbed areas.

Applicable legislation and guidelines used to compile the report	Description of legislation and guidelines used to compile the report	Reference where applied	How does this development comply with and respond to the policy and legislative context
	discovers archaeological or palaeontological objects or material or a meteorite must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.		
Emergency incidents			
Section 30 of NEMA, section 20 of NWA S20, and Section 18 of National Veld Fires and Forest Act No 101 of 1998 (as amended) (NVFFA)	In the event of an emergency, the mine must: report through the most effective means reasonably available; 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 on the environment and public health. Any owner who has reason to believe that a fire on his or her land or the land of an adjoining owner may endanger life, property or the environment, must immediately notify the fire protection officer or, any member of the executive committee of the fire protection association, if one exists for the area; and	EIA/EMP	The mine has a new environmental emergency procedure. This procedure will be implemented on the mine.

Applicable legislation and guidelines used to compile the report	Description of legislation and guidelines used to compile the report	Reference where applied	How does this development comply with and respond to the policy and legislative context
	the owners of adjoining land; and do everything in his or her power to stop the spread of the fire.		

f) Need and desirability of the proposed activities

As per the Guideline on Needs and Desirability in terms of the EIA Regulations (published 20 October 2014), the following table has been compiled:

Table 6: Need and Desirability of the proposed project

Guideline requirement	Comments on requirement
1. How will this development (and its separate elements/aspects) impact on the ecological integrity of the area?	
1.1 How were the following ecological integrity considerations taken into account?	
1.1.1 Threatened Ecosystems,	An ecological evaluation for the Tygerkloof Mine Report was conducted (Pachnoda Consulting cc, 2015). Threatened, near threatened (NT) and declining plant taxa were identified along with the ecological status of each floristic community which revealed species of protected trees. Areas of ecological sensitivity were identified with special conservation concern. An existing Spatial Development Framework for Thabazimbi was done in 2007 and an existing Spatial Development Framework for Waterberg was conducted in 2009 which both demonstrate the increasingly important role of mining in the local economy.
1.1.2 Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands, and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure,	
1.1.3 CBAs and Ecological Support Areas (ESAs),	
1.1.4 Conservation targets,	
1.1.5 Ecological drivers of the ecosystem,	
1.1.6 Environmental Management Framework,	
1.1.7 Spatial Development Framework, and	
1.1.8 Global and international responsibilities relating to the environment (e.g. RAMSAR sites, Climate Change, etc.).	
1.2 How will this development disturb or enhance ecosystems and/or result in the loss or protection of biological diversity? What measures were explored to firstly avoid these negative impacts, and where these negative impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts? What measures were explored to enhance positive impacts?	Refer to Part A(v) for a complete description of the impacts and risks identified including the nature, significance, consequence, extent, duration and probability of the impacts. Refer to Part B(d) for the description of impact management objectives including management statements.
1.3 How will this development pollute and/or degrade the biophysical environment? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts? What measures were explored to enhance positive impacts?	Refer to Part A(v) for a complete description of impacts and risks identified including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts
1.4 What waste will be generated by this development? What measures were explored to firstly avoid waste, and where waste could not be avoided altogether, what measures were explored to minimise, reuse and/or recycle the waste? What measures have been	No additional non-mining waste than that already generated by the mine. The mine will adhere to the Water and Waste management as set out in the IWWMP.

Guideline requirement	Comments on requirement
explored to safely treat and/or dispose of unavoidable waste?	
1.5 How will this development disturb or enhance landscapes and/or sites that constitute the nation's cultural heritage? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts? What measures were explored to enhance positive impacts?	Refer to part A(1.3) for a concise description of the specific land uses, cultural and heritage aspects and infrastructure on the site and neighbouring properties/farms in respect of which the potential exists for the socio-economic conditions of other parties to be affected by the proposed mining operation.
1.6 How will this development use and/or impact on non-renewable natural resources? What measures were explored to ensure responsible and equitable use of the resources? How have the consequences of the depletion of the non-renewable natural resources been considered? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts? What measures were explored to enhance positive impacts?	Refer to Part A(g)(v) for a complete description of the impacts on the environment. The EMP part of the EIA/EMP will include how measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts; and what measures were explored to enhance positive impacts. A 'Phase I Cultural heritage resources impact assessment was conducted to establish if any potential resources were found, but none were of significance (African Heritage Consultants CC, 2015).
1.7 How will this development use and/or impact on renewable natural resources and the ecosystem of which they are part? Will the use of the resources and/or impact on the ecosystem jeopardise the integrity of the resource and/or system taking into account carrying capacity restrictions, limits of acceptable change, and thresholds? What measures were explored to firstly avoid the use of resources, or if avoidance is not possible, to minimise the use of resources? What measures were taken to ensure responsible and equitable use of the resources? What measures were explored to enhance positive impacts?	Refer to Part A(g)(v) for a complete description of the impacts on the environment. The EMP part of the EIA/EMP will include how measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts; and what measures were explored to enhance positive impacts.
1.7.1 Does the proposed development exacerbate the increased dependency on increased use of resources to maintain economic growth or does it reduce resource dependency (i.e. de-materialised growth)? (note: sustainability requires that settlements reduce their ecological footprint by using less material and energy demands and reduce the amount of waste they generate, without compromising their quest to improve their quality of life)	Mining is not a sustainable activity. Mineral resource is removed as part of mining. All other resources are replaced during rehabilitation. Refer to Part A (2.10) for a complete description on the socio-economic context.

Guideline requirement	Comments on requirement
1.7.2 Does the proposed use of natural resources constitute the best use thereof? Is the use justifiable when considering intra- and intergenerational equity, and are there more important priorities for which the resources should be used (i.e. what are the opportunity costs of using these resources this the proposed development alternative?)	
1.7.3 Do the proposed location, type and scale of development promote a reduced dependency on resources?	
1.8 How were a risk-averse and cautious approach applied in terms of ecological impacts?	Specialist studies were undertaken and included into this process.
1.8.1 What are the limits of current knowledge (note: the gaps, uncertainties and assumptions must be clearly stated)?	All gaps in knowledge, the adequacy of predictive methods and underlying assumptions, and uncertainties encountered in compiling the required information will be included in the EIA/EMP. Risks were assessed in full detail and suggestions were made on the best risk-averse approach.
1.8.2 What is the level of risk associated with the limits of current knowledge?	
1.8.3 Based on the limits of knowledge and the level of risk, how and to what extent was a risk-averse and cautious approach applied to the development?	
1.9 How will the ecological impacts resulting from this development impact on people's environmental right in terms following	Specialist studies were undertaken and included into this process. Refer to Part A(1)(v) & (2.12) for an in-depth socio-economic analysis. The SDP of Thabazimbi and Waterberg contains information on the needs of the socio-economic component. An 'Environmental Noise Impact Assessment Report' was done (Varicon cc, 2015). The site is near the R510 Road from Rustenburg to Ellisras (Lephalale). Mining activities of the current mine (RAM) are visible from the R510 which may reduce property value in the area. The end land use is to return the area to the community for grazing which will also be a positive impact.
1.9.1 Negative impacts: e.g. access to resources, opportunity costs, loss of amenity (e.g. open space), air and water quality impacts, nuisance (noise, odour, etc.), health impacts, visual impacts, etc. What measures were taken to firstly avoid negative impacts, but if avoidance is not possible, to minimise, manage and remedy negative impacts?	
1.9.2 Positive impacts: e.g. improved access to resources, improved amenity, improved air or water quality, etc. What measures were taken to enhance positive impacts?	
1.10 Describe the linkages and dependencies between human wellbeing, livelihoods and ecosystem services applicable to the area in question and how the development's ecological impacts will result in socio-economic impacts (e.g. on livelihoods, loss of heritage site, opportunity costs, etc.)?	
1.11 Based on all of the above, how will this development positively or negatively impact on	

Guideline requirement	Comments on requirement
ecological integrity objectives/targets/considerations of the area?	
1.12 Considering the need to secure the ecological integrity and a healthy biophysical environment, describe how the alternatives identified (in terms of all the different elements of the development and all the different impacts being proposed), resulted in the selection of the "best practicable environmental option" in terms of ecological considerations?	There is no alternative type of activity to this project or location. The overburden will not be concurrently backfilled during operation. Coarse and fine tailings will be backfilled into the quarry. The sequence of placement of overburden and topsoil is amended. The approved footprints for overburden and topsoil stockpile will still be used. This is the best practicable environmental option in this scenario.
1.13 Describe the positive and negative cumulative ecological/biophysical impacts bearing in mind the size, scale, scope and nature of the project in relation to its location and existing and other planned developments in the area?	There is no strategic environmental assessment for the area, which will include the impacts of all the activities in the area. The cumulative impacts are only assumptions from the EAP.
2.1 What is the socio-economic context of the area, based on, amongst other considerations, the following considerations?	The IDP, Spatial priorities and desired spatial patterns, Spatial characteristics, and Municipal Economic Development Strategy will be discussed in the final EIA/EMP.
2.1.1 The Integrated Development Plan (IDP) (and its sector plans' vision, objectives, strategies, indicators and targets) and any other strategic plans, frameworks of policies applicable to the area,	
2.1.2 Spatial priorities and desired spatial patterns (e.g. need for integrated of segregated communities, need to upgrade informal settlements, need for densification, etc.),	
2.1.3 Spatial characteristics (e.g. existing land uses, planned land uses, cultural landscapes, etc.), and	
2.1.4 Municipal Local Economic Development Strategy (LED Strategy).	
2.2 Considering the socio-economic context, what will the socio-economic impacts be of the development (and its separate elements/aspects), and specifically also on the socio-economic objectives of the area?	No new jobs will be created; however, the extension of the quarry into the new mine will ensure ongoing employment of the already employed personnel in the area.
2.2.1 Will the development complement the local socio-economic initiatives (such as local economic development (LED) initiatives), or skills development programs?	The area has variety of natural resources and has the potential to create countless opportunities for the local population to encourage entrepreneurship and economic development in line with the LED.
2.3 How will this development address the specific physical, psychological, developmental, cultural and social needs and interests of the relevant communities?	

Guideline requirement	Comments on requirement
2.4 Will the development result in equitable (intra- and inter-generational) impact distribution, in the short- and long-term? Will the impact be socially and economically sustainable in the short- and long-term?	All concerns raised by the registered Interested and affected parties (I&APs) and stakeholders will be included to assess the socio-economic context.
2.5 (Not applicable)	
2.6 How were a risk-averse and cautious approach applied in terms of socio-economic impacts?	
2.6.1 What are the limits of current knowledge (note: the gaps, uncertainties and assumptions must be clearly stated)?	
2.6.2 What is the level of risk (note: related to inequality, social fabric, livelihoods, vulnerable communities, critical resources, economic vulnerability and sustainability) associated with the limits of current knowledge?	
2.6.3 Based on the limits of knowledge and the level of risk, how and to what extent was a risk-averse and cautious approach applied to the development?	
2.7 How will the socio-economic impacts resulting from this development impact on people's environmental right in terms following:	
2.7.1 Negative impacts: e.g. health (e.g. HIV-Aids), safety, social ills, etc. What measures were taken to firstly avoid negative impacts, but if avoidance is not possible, to minimise, manage and remedy negative impacts?	
2.7.2 Positive impacts. What measures were taken to enhance positive impacts?	
2.8 Considering the linkages and dependencies between human wellbeing, livelihoods and ecosystem services, describe the linkages and dependencies applicable to the area in question and how the development's socioeconomic impacts will result in ecological impacts (e.g. over utilisation of natural resources, etc.)?	
2.9 What measures were taken to pursue the selection of the "best practicable environmental option" in terms of socio-economic considerations?	Specialist studies were undertaken and included into this process to ensure equitable access to environmental resources, benefits and services to meet basic human needs and ensure human wellbeing.
2.10 What measures were taken to pursue environmental justice so that adverse environmental impacts shall not be distributed in such a manner as to unfairly discriminate against any person, particularly vulnerable and disadvantaged persons (who are the	

Guideline requirement	Comments on requirement
beneficiaries and is the development located appropriately)? Considering the need for social equity and justice, do the alternatives identified, allow the "best practicable environmental option" to be selected, or is there a need for other alternatives to be considered?	
2.11 What measures were taken to pursue equitable access to environmental resources, benefits and services to meet basic human needs and ensure human wellbeing, and what special measures were taken to ensure access thereto by categories of persons disadvantaged by unfair discrimination?	
2.12 What measures were taken to ensure that the responsibility for the environmental health and safety consequences of the development has been addressed throughout the development's life cycle?	
2.13 What measures were taken to:	
2.13.1 ensure the participation of all I&APs,	Refer to Part A(g)(ii) The process followed adheres to the National Environmental Management Act 107-1998 - National guideline on minimum information (20180209-GGN-41432-00086) and the 2012, IEM Guideline Series 7, Public participation, GN 807. The mine has a social and labour plan (SLP) in place.
2.13.2 provide all people with an opportunity to develop the understanding, skills and capacity necessary for achieving equitable and effective participation,	
2.13.3 ensure participation by vulnerable and disadvantaged persons	
2.13.4 promote community wellbeing and empowerment through environmental education, the raising of environmental awareness, the sharing of knowledge and experience and other appropriate means	
2.13.5 ensure openness and transparency, and access to information in terms of the process	
2.13.6 ensure that the interests, needs and values of all I&APs were taken into account, and that adequate recognition were given to all forms of knowledge, including traditional and ordinary knowledge, and	
2.13.7 ensure that the vital role of women and youth in environmental management and development were recognised and their full participation therein were be promoted	
2.14 Considering the interests, needs and values of all the I&APs, describe how the development will allow for opportunities for all the segments of the community (e.g. a mixture of low-, middle-, and high-income housing opportunities) that is consistent with the priority	

Guideline requirement	Comments on requirement
needs of the local area (or that is proportional to the needs of an area)?	
2.15 What measures have been taken to ensure that current and/or future workers will be informed of work that potentially might be harmful to human health or the environment or of dangers associated with the work, and what measures have been taken to ensure that the right of workers to refuse such work will be respected and protected?	All contractors, sub-contractors and workers will continue to attend compulsory environmental awareness training and inductions. This training will highlight the dangers associated with the workplace. Procedures relating to environmental risks will also be put in place and will be regularly updated.
2.16 Describe how the development will impact on job creation in terms of, amongst other aspects:	
2.16.1 the number of temporary versus permanent jobs that will be created,	No new jobs will be created; however, the extension of the quarry into the new mine will ensure ongoing employment of the already employed personnel in the area.
2.16.2 whether the labour available in the area will be able to take up the job opportunities (i.e. do the required skills match the skills available in the area),	
2.16.3 the distance from where labourers will have to travel,	
2.16.4 the location of jobs opportunities versus the location of impacts (i.e. equitable distribution of costs and benefits), and	
2.16.5 the opportunity costs in terms of job creation (e.g. a mine might create 100 jobs, but impact on 1000 agricultural jobs, etc.).	
2.17 What measures were taken to ensure:	
2.17.1 that there were intergovernmental coordination and harmonisation of policies, legislation and actions relating to the environment, and	DMR is the only applicable authority for the proposed integrated environmental authorisation (IEA) and thus the only organ of state. DWS is, however the competent authority for the IWULA.
2.17.2 that actual or potential conflicts of interest between organs of state were resolved through conflict resolution procedures?	
2.18 What measures were taken to ensure that the environment will be held in public trust for the people, that the beneficial use of environmental resources will serve the public interest, and that the environment will be protected as the people's common heritage?	Refer to Part A(g)(ii) for the public participation process which indicated that all the people were consulted regarding the development. The impact assessment addresses the socio-economic concern applicable.
2.19 Are the mitigation measures proposed realistic and what long-term environmental legacy and managed burden will be left?	Impacts and mitigation measures were obtained from various specialists. It is assumed that the mitigation measures proposed are realistic.
2.20 What measures were taken to ensure that the costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health	The mine has an updated financial provision which is renewed on an annual basis. The financial provision allocates money to the rehabilitation process and remedying pollution.

Guideline requirement	Comments on requirement
effects will be paid for by those responsible for harming the environment?	
2.21 Considering the need to secure ecological integrity and a healthy bio-physical environment, describe how the alternatives identified (in terms of all the different elements of the development and all the different impacts being proposed), resulted in the selection of the best practicable environmental option in terms of socio-economic considerations?	The preferred alternative will ensure the best practicable environmental option in terms of socio-economic considerations is implemented
2.22 Describe the positive and negative cumulative socio-economic impacts bearing in mind the size, scale, scope and nature of the project in relation to its location and other planned developments in the area?	All concerns raised by the registered I&APs and stakeholders were included to assess the socio-economic context.

g) Motivation for the preferred development footprint within the approved site including a full description of the process followed to reach the proposed development footprint within the approved site

i) Details of the development footprint alternatives considered

The following definition of "alternatives" is given in the EIA Regulations: *"alternatives", in relation to a proposed activity, means different means of meeting the general purpose and requirements of the activity, which may include alternatives to the -*

(a) property on which or location where the activity is proposed to be undertaken;

(b) type of activity to be undertaken;

(c) design or layout of the activity;

(d) technology to be used in the activity; or

(e) operational aspects of the activity; and

(f) includes the option of not implementing the activity;"

The overburden will not be concurrently backfilled during operation. Coarse and fine tailings will be backfilled into the quarry. The sequence of placement of overburden and topsoil is amended. The approved footprints for overburden and topsoil stockpile will still be used.

(a) The property on which or location where it is proposed to undertake the activity

There is no alternative property or location to this project.

(b) The type of activity to be undertaken

There is no alternative type of activity to this project.

(c) The design or layout of the activity

The overburden will not be concurrently backfilled during operation; however, coarse and fine tailings will be backfilled into the quarries. The sequence of placement of overburden and topsoil is amended. The approved footprints for overburden and topsoil stockpile will still be used.

(d) The technology to be used in the activity

There is no technology alternative to this project.

(e) The operational aspects of the activity

There is no alternative to the operational aspects of this project.

(f) The option of not implementing the activity

There is no alternative to the operational aspects of this project.

ii) Details of the public participation process followed

According to the Publication of Participation Guideline (NEMA), and I&AP is:

"(a) any person, group or persons or organisations interested in or affected by an activity, and (b) any organ of state that may have jurisdiction over any aspect of the activity".

This definition is more detailed in the Guideline for consultation with communities and I&APs (MPRDA):

"Interested and affected' parties include, but are not limited to; (i) Host Communities, (ii) Landowners (Traditional and Title Deed owners), (iii) Traditional Authority, (iv) Land Claimants, (v) Lawful land occupier, (vi) The Department of Land Affairs, (vii) Any other person (including on adjacent and non-adjacent properties) whose socio-economic conditions may be directly affected by the proposed prospecting or mining operation (viii) The Local Municipality, (ix) The relevant Government Departments, agencies and institutions responsible for the various aspects of the environment and for infrastructure which may be affected by the proposed project."

iii) Summary of issues raised by interested and affected parties

1 Identification of interested and affected parties

Refer to Table 7 below for all I&APs and stakeholders identified, and Addendum 4A for a GoogleEarth Image indicating all adjacent properties. All of these I&APs and stakeholders were consulted as part of this amendment.

Table 7: List of interested and affected parties and stakeholders

Interested and Affected Parties	Comments summary and date	EAPs response to issues as mandated by the applicant and date	Action plan forward to incorporate comments and section in this ESR	Registered I&AP or stakeholder
Affected parties				
Landowner/s or lawful occupier/s of the land and adjacent land				
Imerys Refractory Minerals South Africa	N/A	N/A	N/A	N/A
Lawful occupier/s of the land				
Imerys Refractory Minerals South Africa	N/A	N/A	N/A	N/A
Landowners or lawful occupiers on adjacent properties				
Portion 1 Maroeloesfontein, Portion 2 Buffelsfontein 353 KQ, Portion 4 Tygerkloof 354 KQ - National Government of the Republic of South Africa (Baruakhomo Community)	None	N/A	N/A	N/A
Portion 3 Buffelsfontein 353 KQ - Imerys Refractory Minerals South Africa	N/A	N/A	N/A	N/A
Municipal councillor – ward 3				
Stephen Lerumo	None	N/A	N/A	Stakeholder
TLM - Municipal manager				
CG Booysen	None	N/A	N/A	Stakeholder
WDM - Municipal manager				
Elizabeth Kelly	None	N/A	N/A	Stakeholder
Organs of state				
DWS: Thabazimbi Catchment Management Association: Nametso Kgabileng	The mine is waiting for its IWUL. DWS did not have any comments on the Tygerkloof EMP.	N/A	N/A	Stakeholder
Department of Rural Development and Land Reform (DRDLR)				
Tinyiko Makamu	There were no land claims on the property at the time of the mining right application	N/A	N/A	Stakeholder
Limpopo Department of Economic Development, Environment and Tourism				

Interested and Affected Parties	Comments summary and date	EAPs response to issues as mandated by the applicant and date	Action plan forward to incorporate comments and section in this ESR	Registered I&AP or stakeholder
Masungi Tshuketana	The mine received its environmental authorisation on 30 May 2016.	N/A	N/A	Stakeholder
Other Competent Authorities affected				
South African Heritage Resources Agency (SAHRA)	None	N/A	N/A	Stakeholder
Limpopo Heritage Resources Agency (LHRA)	None	N/A	N/A	Stakeholder
Limpopo Department of Agriculture, Forestry and Fisheries (DAFF): Ntsoane	None	N/A	N/A	Stakeholder
Other affected parties				
Historical disadvantaged communities				
None identified	N/A	N/A	N/A	N/A
Land claimants				
None identified during the mining right application.	N/A	N/A	N/A	N/A
Interested parties				
None identified	N/A	N/A	N/A	N/A

2 The details of the engagement process for the mining right and EIA application

An advertisement was published in the local newspaper “Platinum Bushvelder” on 7 June 2019. One site notice was placed at the entrance to RAM. Letters and information on the amended EMP were distributed to all adjacent landowners, and stakeholders on 5 June 2019 via email. Refer to Addendum 4B for a copy of the advertisement and proof thereof, Addendum 4C for a copy, photos and map of site notice placed at site; Addendum 4D for a copy and proof of letters sent.

A public and stakeholders meeting was held on 11 July 2019, 10h00, at RAM. No I&APs attended the meeting. See Addendum 4E for the meeting presentation, and attendance register.

No I&AP requested the EMP therefore it will not be sent to any I&AP. The DMR will receive 3 copies of the EMP one copy is submitted to DWS, one copy to DAFF, and one copy to LEDET. Proof of submission will be forwarded to DMR. The EMP will be uploaded onto SAHRIS.

3 Summary of the issues raised by interested and affected parties, and an indication of the manner in which the issues were incorporated, or the reasons for not including them

None.

iv) The Environmental attributes associated with the development footprint alternatives

The environmental attributes described below include socioeconomic, social, heritage, cultural, geographical, physical and biological aspects. Refer below for the following:

a. Type of environment affected by the proposed activity - its current geographical, physical, biological, socio- economic, and cultural character;
b. Description of the current land uses;
c. Description of specific environmental features and infrastructure on the site; and
d. Environmental and current land use map - which shows all environmental, and current land use features.

1.1 Geology

Information for section was obtained from the Mining Works Programme (MWP) (Samrec, 2014). The area is underlain by a succession of steeply dipping shale and quartzite of the Timeball Hill Formation (Pretoria Group) of the Transvaal Sequence. To the north, these sediments are bounded by a banded ironstone formation beyond which the dolomite succession (Malmani Subgroup) of the Transvaal Sequence occurs. The Timeball Hill shale and quartzite are bounded to the south by the mafic rocks of the Marginal Zone of the Bushveld Complex. The andalusite ore body is developed along strike within the alumina rich shale band developed at the base of the banded ironstone ridge.

A number of north-west striking faults intersect the ore body in places. These faults frequently form the saddles within the ridge. A narrow diabase dyke has intruded in a similar orientation to the faults. Available geological maps show that a diabase sill occurs immediately south of the mining activities. The sill is conformable to the steeply dipping (55° towards the south-east) shale bands.

1.2 Climate

Information for this section was obtained from 'Information in support of application for rectification of existing mine residue disposal' (Shangoni Management Services, 2011) & 'Air Quality Specialist Report for the Proposed Tygerkloof Mine, Thabazimbi, Limpopo Province' (Airshed Planning Professionals, 2015).

1.2.1 Rainfall

According to the MM5 data set, annual rainfall is estimated at 455 mm. Precipitation peaks during the summer months and lowest during the winter months (Figure 4). This assessment included the mitigating effect of rainfall on dust from unpaved roads. The US EPA estimates emissions reduction

efficiency from the number of days per year that rainfall exceeds 0.254mm. According to the MM5 data an average of 26 days per year receive rainfall in excess of 0.254mm/day.

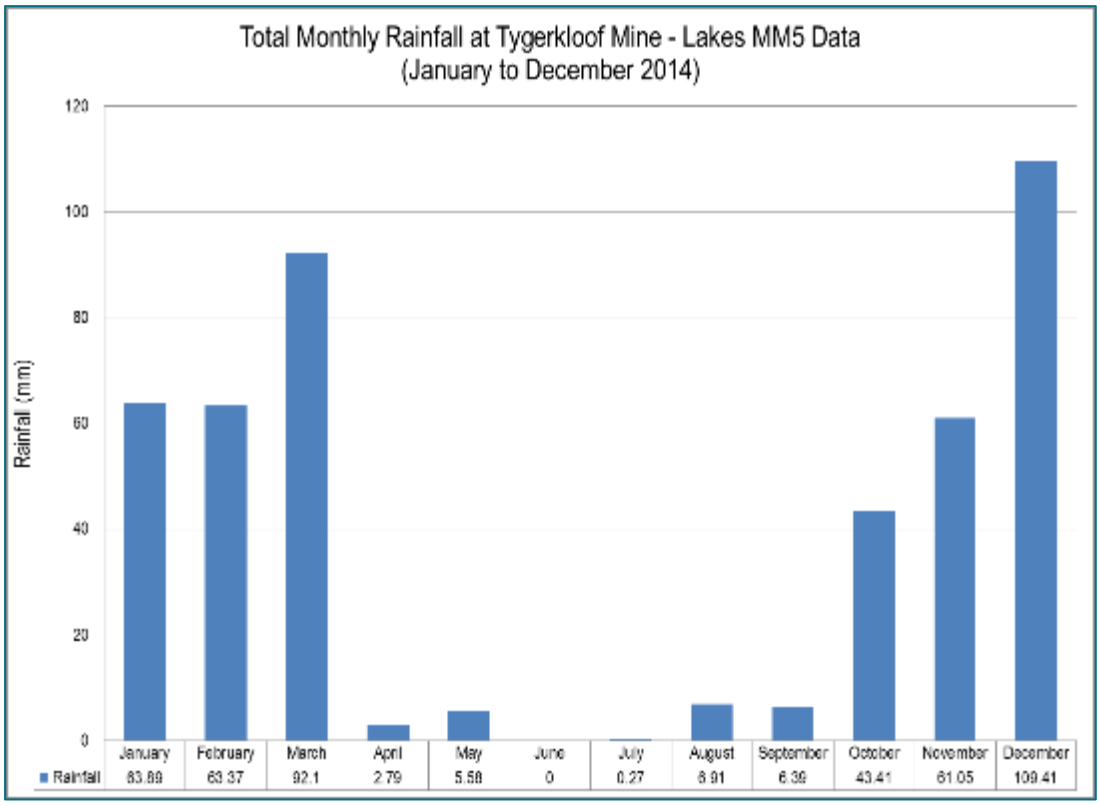


Figure 4: Monthly rainfall and relative humidity (MM5 data, 2014)

1.2.2 Temperatures

Diurnal and average monthly temperature trends are presented in Figure 5. Monthly mean, maximum and minimum temperatures are given in Table 8. Temperatures ranged between 1.5°C and 32.9°C. During the day, temperatures increase to reach maximum at around 15:00 in the afternoon. Ambient air temperature decreases to reach a minimum at around 04:00 i.e. just before sunrise.

Table 8: Monthly temperature summary (MM5 Data, 2014)

Monthly Minimum, Maximum and Average Temperatures (°C) MM5 Data (2014)												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Minimum	17.5	17.1	15.9	9.9	6.7	2.8	1.5	3.5	7.3	9.7	12.8	17.0
Average	25.4	24.6	22.9	19.0	16.4	12.6	12.0	15.2	19.5	21.4	23.6	24.7
Maximum	32.9	31.4	30.5	27.8	25.3	23.9	21.4	26.2	29.3	32.2	31.7	32.5

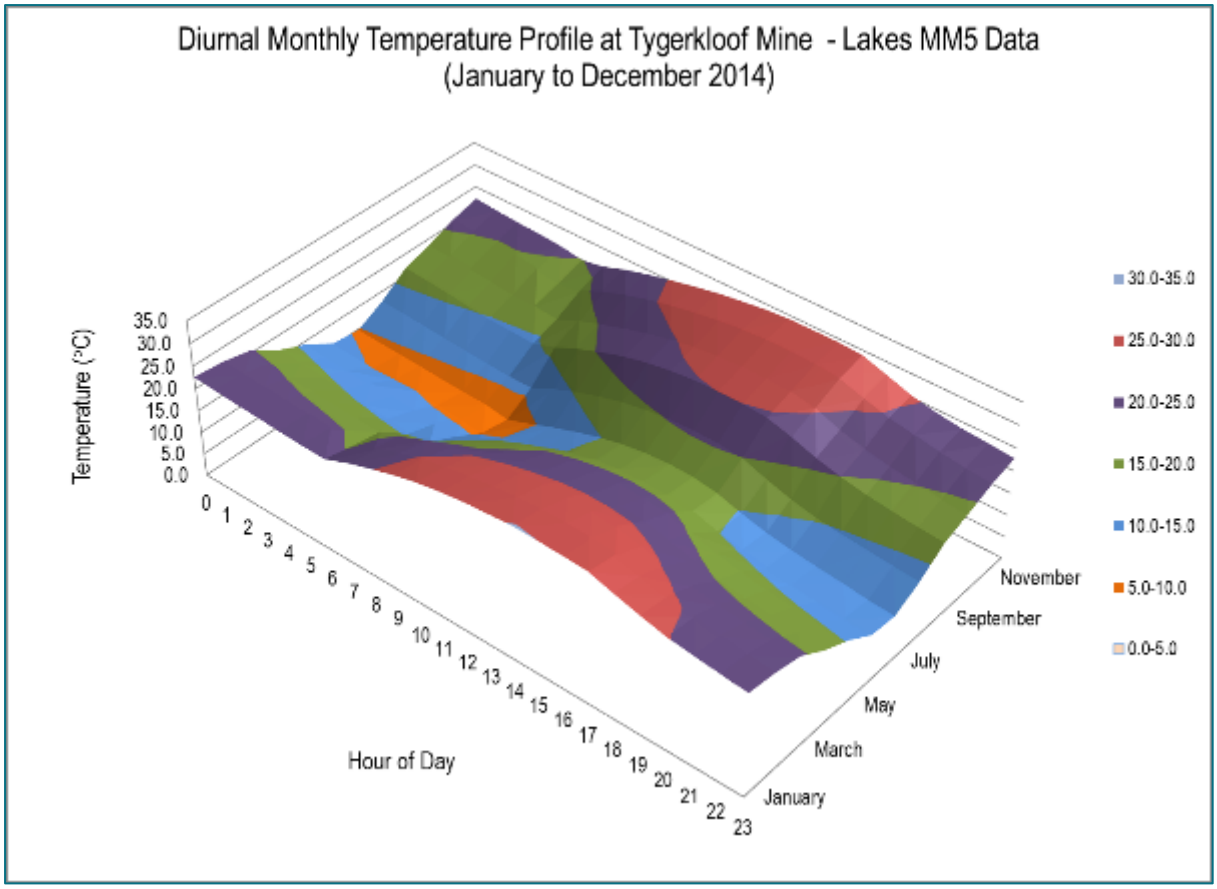


Figure 5: Diurnal temperature profile (MM5 Data, 2014)

1.2.3 Wind direction and speed

The wind roses comprise 16 spokes, which represent the **directions from which** winds blew during a specific period. The colours used in the wind roses below, reflect the different categories of wind **speeds**; the yellow area, for example, representing winds in between 4m/s and 5m/s. The dotted circles provide information regarding the **frequency** of occurrence of wind speed and direction categories. The frequency with which calms occurred, i.e. periods during which the wind speed was below 1m/s are also indicated.

The period wind field and diurnal variability in the wind field are shown in Figure 6 while the seasonal variations are shown in Figure 7. During the January to December 2014 period, the wind field was dominated by winds from the north and north-northwest, with an average wind speed of 3.0m/s. The strongest winds (more than 6m/s) were also from the north and north-northwest and occurred mostly during the day (06:00 to 18:00). Calm conditions occurred 14.12% of the time. A distinct increase in winds from the south occurred at night (18:00 to 06:00).

Seasonally, the wind flow pattern conforms to the period average wind flow pattern. The seasonal wind field shows considerable seasonal differences in the wind fields. During autumn and winter, the dominant winds are from the north-northwest, while in spring and summer, the northerly winds dominate.

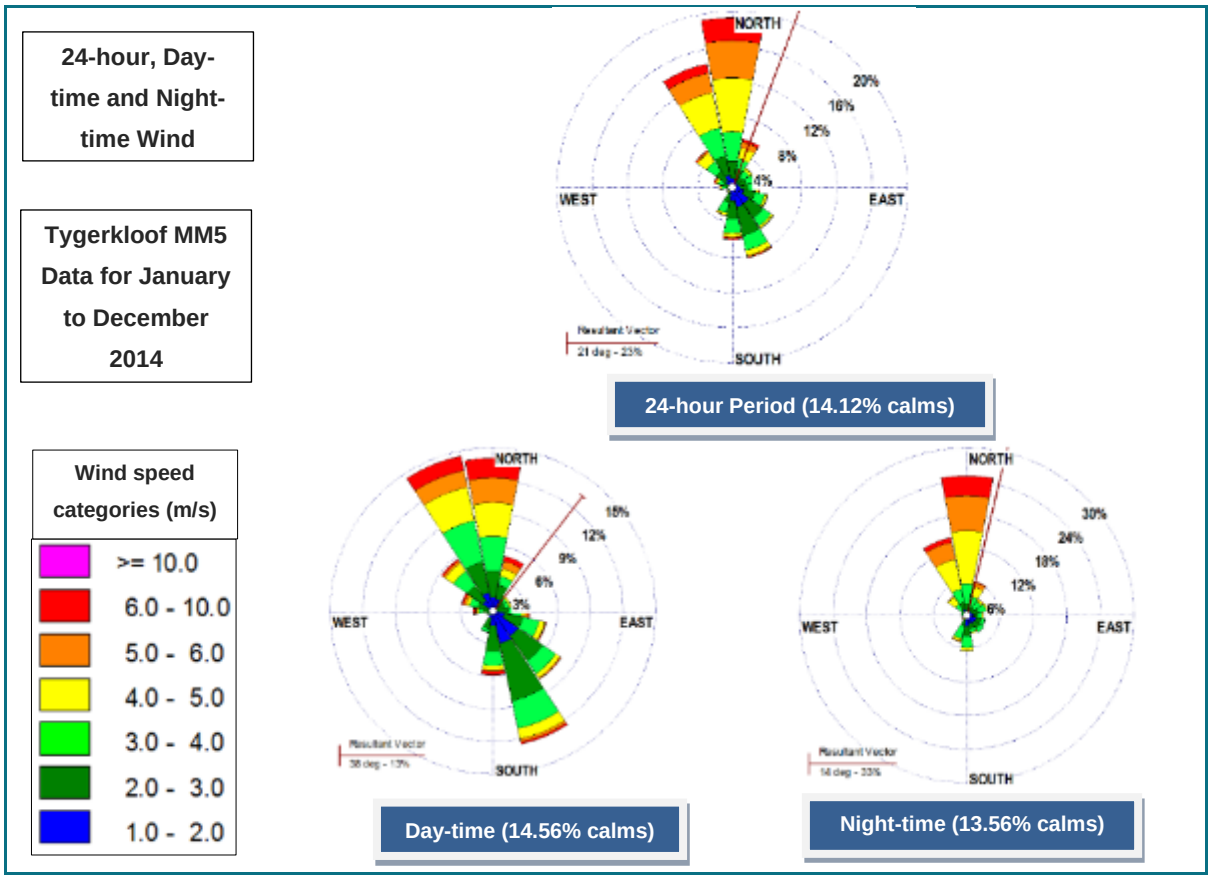


Figure 6: Period, day- and night-time wind roses (MM5 Data, January to December 2014)

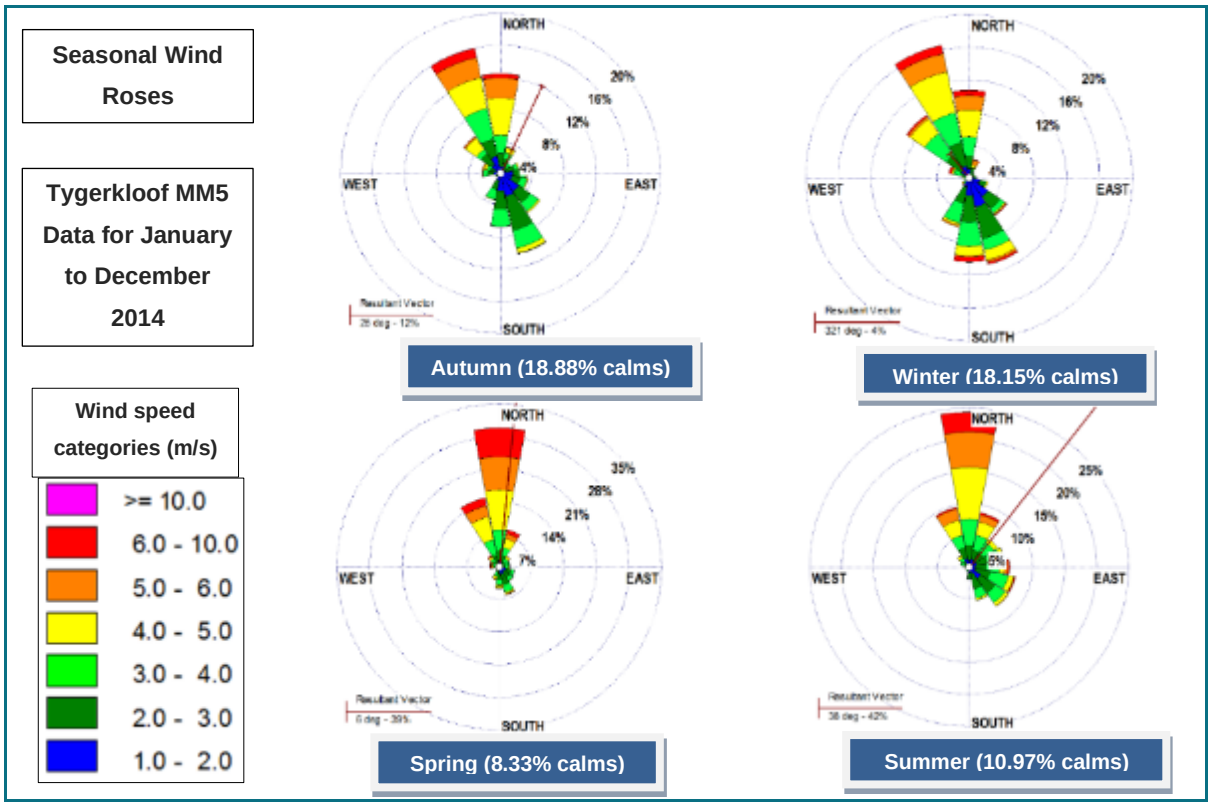


Figure 7: Seasonal wind roses (MM5 Data, January to December 2014)

1.2.4 Evaporation

The monthly evaporation for Thabazimbi is not available. The monthly evaporation for Swartklip Rustenburg Platinum Mine, about 80 km from Thabazimbi, is given in Table 9 below.

Table 9: Mean monthly evaporation

MONTH	SYMONS PAN (mm)	"A" PAN (mm)
January	183	219
February	156	186
March	145	173
April	118	141
May	98	117
June	77	98
July	83	115
August	114	167
September	156	208
October	192	256
November	191	248
December	200	247

1.2.5 Incidence of extreme climatic conditions

The incidence of hail varies from light to severe hailstorms, although the latter are very rare. Frost occurs in the low-lying areas of Thabazimbi. Strong winds occur sporadically, mainly from the south, and blow at a mean speed of 4.7 to 6.4m/s.

1.3 Topography

Information for this section was obtained from ‘Information in support of application for rectification of existing mine residue disposal’ (Shangoni Management Services, 2011); and ‘Report on geohydrological investigation as part of the EIA, environmental management plan (EMP) and IWULA (Groundwater Complete, 2015).

The site falls within a low mountainous terrain morphological unit. The northern part of the site is a mountainous area, namely the Witfonteinrand range. The site slopes from the range into a southern direction. Surface elevations vary from approximately 1,040 to 1,340 meters above mean sea level (mamsl).

1.4 Soil

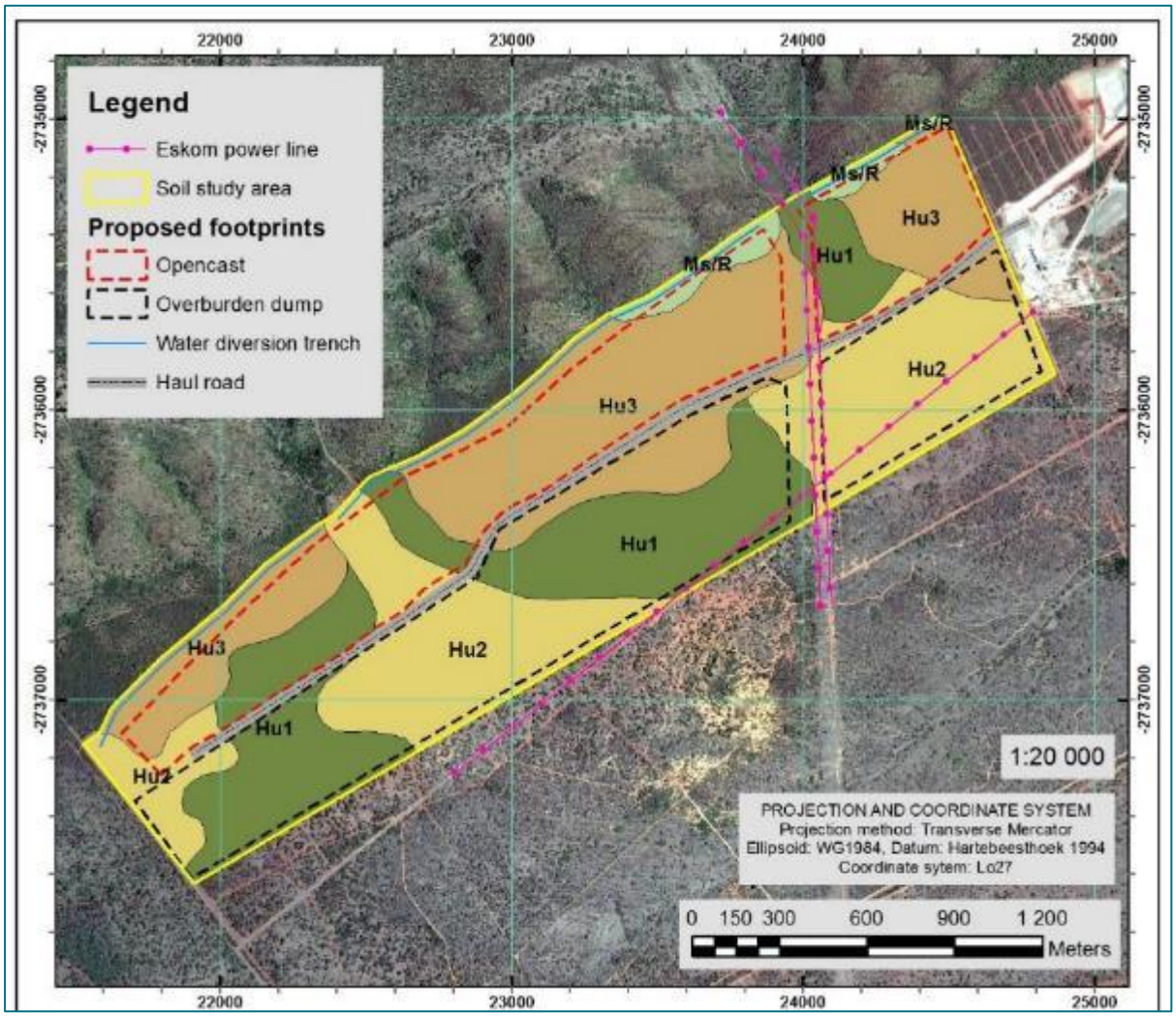
Information for this section was obtained from the ‘Soil Study Report’ (Gudani Consulting, 2015).

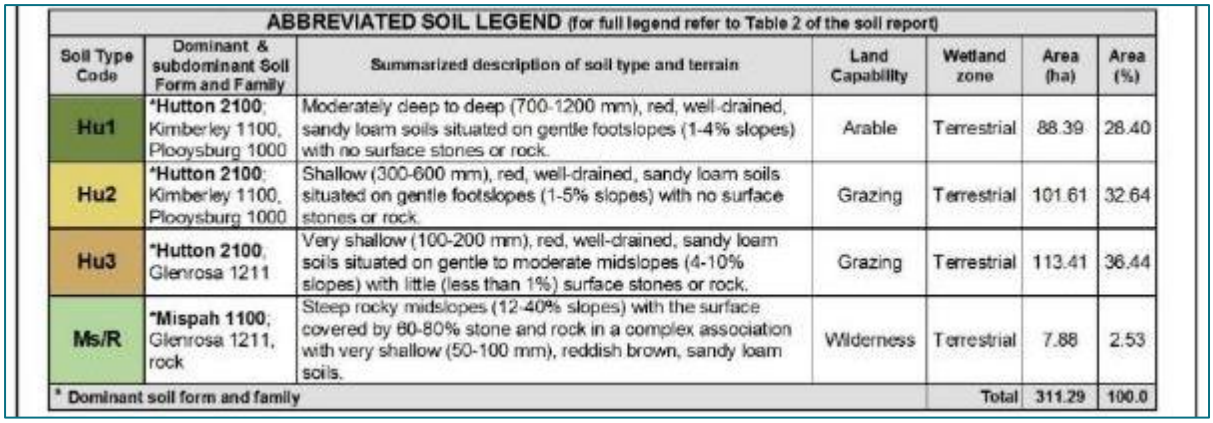
1.4.1 Soil types within the proposed quarry and overburden dump footprints

A total of 4 homogeneous soil units, based on dominant soil form, effective soil depth, internal drainage, terrain unit and slope percentage were identified during field observations and were symbolised as Hu1,

Hu2, Hu3 and Ms/R. The homogeneous units are referred to as soil types and are shown in Figure 9 which contains an abbreviated soil legend. A comprehensive soil legend is provided in Table 10 which described the soils in terms of the following aspects:

- Dominant soil forms and families and subdominant soil forms;
- The estimated clay content of the A and B or E or G-horizons;
- A broad description of the dominant soil form and terrain in terms of the effective soil depth, internal drainage, soil colour, soil texture class, terrain unit and average slope percentage range;
- A description of the soil horizon sequences;
- The derived erodibility class and dry land crop production potential;
- The land capability and wetland zone classification; and
- The area and percentage comprised by each soil type.





ABBREVIATED SOIL LEGEND (for full legend refer to Table 2 of the soil report)

Soil Type Code	Dominant & subdominant Soil Form and Family	Summarized description of soil type and terrain	Land Capability	Wetland zone	Area (ha)	Area (%)
Hu1	*Hutton 2100; Kimberley 1100, Plooysburg 1000	Moderately deep to deep (700-1200 mm), red, well-drained, sandy loam soils situated on gentle footslopes (1-4% slopes) with no surface stones or rock.	Arable	Terrestrial	88.39	28.40
Hu2	*Hutton 2100; Kimberley 1100, Plooysburg 1000	Shallow (300-600 mm), red, well-drained, sandy loam soils situated on gentle footslopes (1-5% slopes) with no surface stones or rock.	Grazing	Terrestrial	101.61	32.64
Hu3	*Hutton 2100, Glenrosa 1211	Very shallow (100-200 mm), red, well-drained, sandy loam soils situated on gentle to moderate midslopes (4-10% slopes) with little (less than 1%) surface stones or rock.	Grazing	Terrestrial	113.41	36.44
Ms/R	*Mispah 1100; Glenrosa 1211, rock	Steep rocky midslopes (12-40% slopes) with the surface covered by 60-80% stone and rock in a complex association with very shallow (50-100 mm), reddish brown, sandy loam soils.	Wilderness	Terrestrial	7.88	2.53
* Dominant soil form and family				Total	311.29	100.0

Figure 8: Detailed soil map of the proposed open pit and overburden dump areas

1.4.2 Soil chemistry

The positions of the soil sampling points are shown on Figure 6 (Gudani Consulting, 2015) as yellow dots and the coordinates are included in Appendix D (Gudani Consulting, 2015).

A sample of the A-horizon of the dominant soil types was taken at 4 localities and the analytical results are shown in Table 11. The averages of the cations, potassium (K), calcium (Ca), magnesium (Mg) and sodium (Na) as well as phosphorus (P), pH and resistance were calculated and highlighted in green.

Table 10: Detailed soil legend – proposed open pit and overburden dump footprints

Soil legend										
Soil Type Code	Dominant & subdominant Soil Form and Family	% Clay per horizon A, E, G, B	Summarised Description of Dominant Soil Forms in terms of effective depth, soil colour, soil texture and terrain unit	Description of soil horizon sequences of dominant soil forms	Erodibility	Dry land crop production potential	Land Capability	Wetland zone	Area (ha)	Area (%)
Hu1	*Hutton 2100; Kimberley 1100, Plooysburg 1000	A: 15-20 B: 15-20	Moderately deep to deep (700-1200 mm), red, well-drained, sandy loam soils situated on gentle footslopes (1-4% slopes) with no surface stones or rock.	Brownish red, sandy loam, Orthic A-horizons, underlain by red, sandy loam, apedal B-horizons underlain by highly weathered fractured rock	Low	Moderate	Arable	Terrestrial	88.39	28.40
Hu2	*Hutton 2100; Kimberley 1100, Plooysburg 1000	A: 15-20 B: 15-20	Shallow (300-600 mm), red, well-drained, sandy loam soils situated on gentle footslopes (1-5% slopes) with no surface stones or rock.	Brownish red, sandy loam, Orthic A-horizons, underlain by red, sandy loam, apedal B-horizons underlain by highly weathered fractured rock	Low	Low-moderate	Grazing	Terrestrial	101.61	32.64
Hu3	*Hutton 2100; Glenrosa 1211	A: 15-20	Very shallow (100-200 mm), red, well-drained, sandy loam soils situated on gentle to moderate midslopes (4-10% slopes) with little (less than 1%) surface stones or rock.	Brownish red, sandy loam, Orthic A-horizons, underlain by a gravely/stony red, sandy loam, apedal B-horizon containing more than 60% gravel and stones.	Low to moderate	Low	Grazing	Terrestrial	113.41	36.44
Ms/R	*Mispah 1100; Glenrosa 1211, rock	A: 15-20	Steep rocky midslopes (12-40% slopes) with the surface covered by 60-80% stone and rock in a complex association with very shallow (50-100 mm), reddish brown, sandy loam soils.	Reddish brown, sandy loam, Orthic A-horizons, underlain by solid hard rock or fractured rock.	High	Very low to none	Wilderness	Terrestrial	7.88	2.53
* Dominant soil form and family			Total						311.29	100.01

Table 11: Soil chemical analyses

Samp Point	Soil Form	Hor	Depth	K	Ca	Mg	Na	*Titr.Acid	*Acid saturat.	R_S (resistance)	P (Bray1) mg/kg	pH (H_2O)
				mg/kg	mg/kg	mg/kg	mg/kg					
				Ammonium acetate				cmol(+)/kg	%	ohm		
Sampling points in cultivated land												
E8	Hu2100	A	0-250	74	598	62	0.6	0		2830	7.3	5.94
J9	Hu2100	A	0-250	49	681	83	0.77	0		3190	6.4	5.68
L13	Hu2100	A	0-250	55	488	58	0.53	0.05	1.6113	2100	6.8	5.49
Q20	Hu2100	A	0-250	68	409	55	0.42	0.15	5.3239	1790	8.1	5.4
Averages				61.5	544	64.5	0.58	0.05	1.73	2478	7.2	5.62
*Analyses done when pH is below 5.5												

1.4.2.1 Soil fertility status

The averages of the cations (K, Ca, Mg and Na), P, pH and resistance were compared to general fertility guidelines in Table 12. The average concentration of K, Ca, Mg is moderate-low which reflects the general natural soil fertility status. The low average Na concentration of 0.58mg/kg indicates an absence of sodic soil conditions and the high resistance indicates an absence of saline soil conditions. The average pH value of 5.6 reflects acid soil conditions which indicate a moderate leached status and correlates with the moderate-low status of base cations. The average P value of 7.2 is low and indicates the general low P status of uncultivated land in the majority of South Africa.

Table 12: Soil fertility compared to broad fertility guidelines

Element or measurement	Guidelines (mg/kg)						Fertility rating	
	Low			High			Average (mg/kg)	Rating
K	<40			>250			61.5	Moderate-low
Ca	<200			>3000			544	Moderate-low
Mg	<50			>300			64.5	Moderate-low
Na	<50			>200			0.58	Low
P	<8			>35			7.2	Low
Resistance (R_S)	<200			>300			2478	High
pH(H_2O)	Very acid	Acid	Slightly acid	neutral	Slightly alkaline	Alkaline		
	<4	5-5.9	6-6.7	6.8-7.2	7.3-8	>8	5.62	Acid

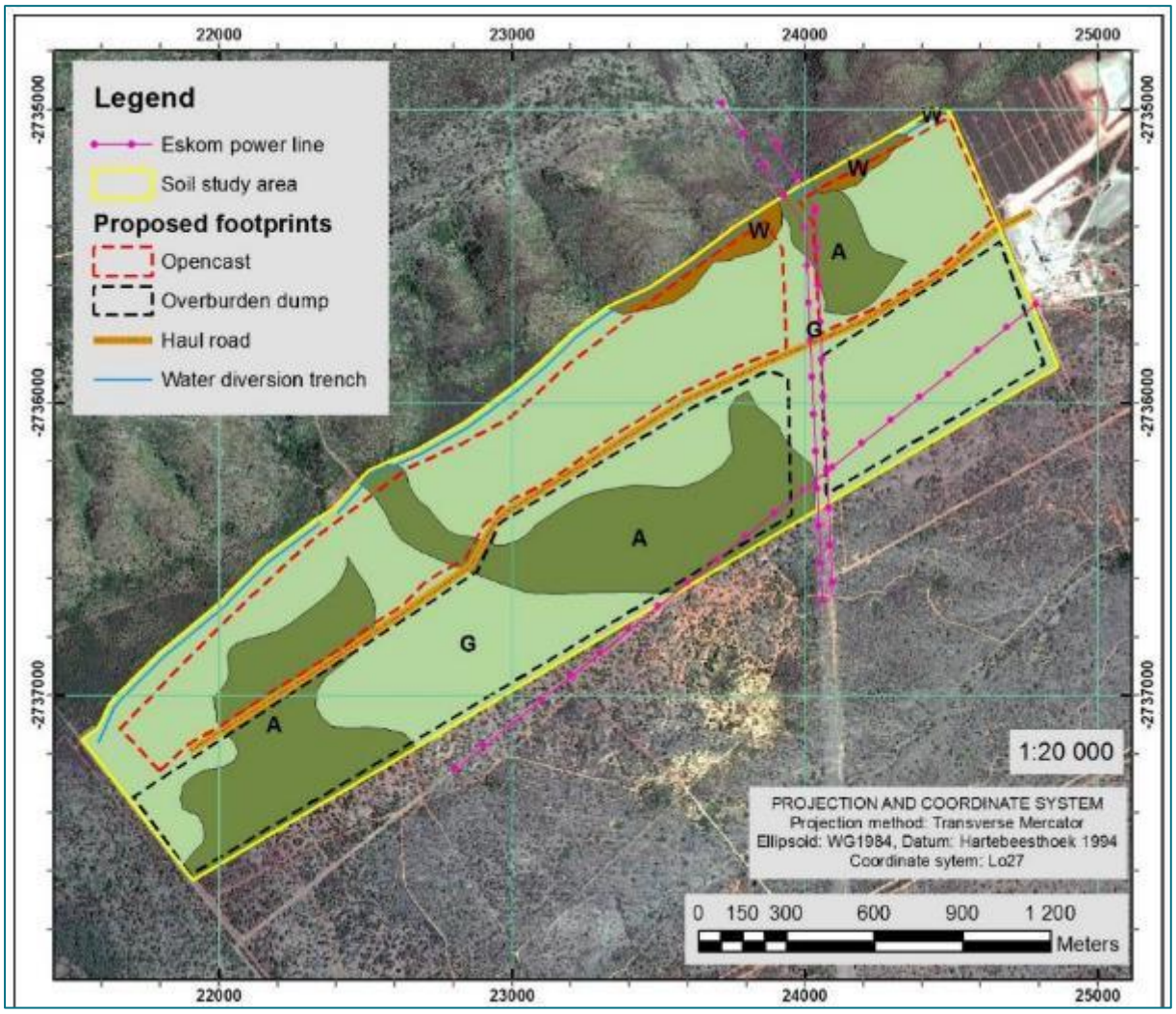
1.5 Land capability

Information for this section was obtained from the 'Soil Study Report' (Gudani Consulting, 2015).

1.5.1 Land capability of the proposed open pit and overburden dump footprints

The location and extent of land capability classes within the proposed quarry and overburden dump footprints are shown in Figure 9. The land capability of the proposed quarry and overburden dump footprints are summarised in Table 13 which shows the soil types grouped into each land capability

class, a broad description of the soil group, the number of units per land capability class, and the area and percentage comprised by each land capability class.



LEGEND: LAND CAPABILITY

Land Capability Code	Land Capability Class	*Soil Types	Broad Soil Description	Unit Count	Area (ha)	Area (%)
A	Arable	Hu1	Moderately deep to deep (700-1200 mm), red, well-drained, sandy loam soils situated on gentle footslopes (1-4% slopes) with no surface stones or rock.	3	88.39	28.4
G	Grazing	Hu2, Hu3	Very shallow (100-200 mm) and shallow (300-600 mm), red, well-drained, sandy loam soils situated on gentle footslopes (1-5% slopes) and gentle to moderate midslopes (4-10% slopes) with no or little (less than 1%) surface stones or rock.	2	215.02	69.08
WL	Wetland	-	-	0	0.00	0.00
W	Wilderness	Ms/R	Steep rocky midslopes (12-40% slopes) with the surface covered by 60-80% stone and rock in a complex association with very shallow (50-100 mm), reddish brown, sandy loam soils.	3	7.88	2.53
*See soil map, Figure 3			Total	8	311.29	100.0

Figure 9: Land capability map of the proposed open pit and overburden dump footprints

Table 13: Land capability classes – proposed open pit and overburden dump footprints

Land Capability Code	Land Capability Class	*Soil Types	Broad Soil Description	Unit Count	Area (ha)	Area (%)
A	Arable	Hu1	Moderately deep to deep (700-1200 mm), red, well-drained, sandy loam soils situated on gentle footslopes (1-4% slopes) with no surface stones or rock.	3	88.39	28.4
G	Grazing	Hu2, Hu3	Very shallow (100-200 mm) and shallow (300-600 mm), red, well-drained, sandy loam soils situated on gentle footslopes (1-5% slopes) and gentle to moderate midslopes (4-10% slopes) with no or little (less than 1%) surface stones or rock.	2	215.02	69.08
WL	Wetland	-	-	0	0.00	0.00
W	Wilderness	Ms/R	Steep rocky midslopes (12-40% slopes) with the surface covered by 60-80% stone and rock in a complex association with very shallow (50-100 mm), reddish brown, sandy loam soils.	3	7.88	2.53
			Total	8	311.29	100.01

1.5.2 Wetland and riparian delineation

Land capability was assessed in categories of arable land, grazing land, wetlands/riparian zones and wilderness land. Wetlands and riparian zones were therefore delineated as part of the soil and land capability assessment based on soil properties. Auger observations were made systematically towards possible wetland zones in order to locate the point where soil properties reflect signs of wetness within 500mm from the surface or where soil, topography or vegetation indicate the boundary of the riparian zone.

No soil types were found in the area that reflects properties related to temporary, seasonal or permanent wetland zones. (See Appendix C of the specialist report for details on soil properties related to wetland zones).

1.5.3 Derived dry land crop production potential and long-term potential yields

The derived dry land crop production potential and potential crop yields (based on soil properties) of soil types within the proposed open pit area are summarised in Table 14. These soil qualities were rated as high, moderate and low with classifications in-between these.

Table 14: Derived dry land crop potential and long-term potential yields

Soil Type (Code)	Dry land crop production potential class	Potential long-term yields for maize (t/ha/a)	Grazing capacity for cattle (ha/lsu)
Hu1	Moderate	2-4	10-12
Hu2	Low-moderate	2-3	
Hu3	Low	Not suitable	

Soil Type (Code)	Dry land crop production potential class	Potential long-term yields for maize (t/ha/a)	Grazing capacity for cattle (ha/lsu)
Ms/R	Very low to none	Not suitable	

1.6 Vegetation

Information for this section was obtained from the 'Ecological Evaluation for the Tygerkloof Mine Report' (Pachnoda Consulting cc, 2015).

1.6.1 Regional vegetation description

The proposed site corresponds to the Savanna Biome and more particularly to the Central Bushveld Bioregion as defined by Mucina & Rutherford (2006). It comprehends two ecological types known as the (1) Waterberg Mountain Bushveld and (2) Dwaalboom Thornveld (Mucina & Rutherford, 2006) (Figure 5 of report – Pachnoda, 2015).

1. Waterberg Mountain Bushveld

This vegetation type is predominantly confined to the northern section of the proposed site, and is restricted to the Waterberg Mountains including a number of outlier hills and ridges of the Vlieëpoortberge and Boshofsberge near Thabazimbi. The floristic composition is complex and varies between *Faurea saligna – Protea caffra* bushveld on the high slopes, grading into mixed *Diplorhynchus condylocarpon* woodland on the mid and foot slopes while *Burkea africana – Terminalia sericea* savanna occurs on the low-lying valleys and areas of deep sand.

This unit is not threatened since more than 9% is formally conserved within the Marakele National Park and Moepel Nature Reserve. However, more than 3% of this woodland type is transformed by cultivation.

2. Dwaalboom Thornveld

This vegetation type is restricted to the southern section of the study site and occurs on the flats north of the Dwarsberge and ridges associated with the Crocodile River. However, it is centred near the Dwaalboom area but also extends eastward and north of Pilanesberg to Northam. The floristic and structural attributes of Dwaalboom Thornveld is fairly homogenous and consists of low to medium high microphyllous bushveld that is dominated by taxa of the genus *Vachellia* and *Senegalia* (=*Acacia*). The herbaceous layer is dominated by graminoid taxa as opposed to forb species.

However, fine-scale phytosociological differences do occur and is driven by the clay content of the soil. For example, *Vachellia tortilis* and *V. nilotica* tend to dominate soils with a clay content of 21% or less, while the vegetation appears stunted (<1m) and sparse on soils containing more than 55% clay. The latter is dominated by *V. tenuispina*. On the other hand, *Acacia erubescens* dominates sandy soils.

This unit is not threatened since more than 6% is formally conserved within the Madikwe Game Reserve. Nearly 14% of this woodland type is transformed by cultivation and bush encroachment due to overgrazing by cattle.

1.6.2 Limpopo Conservation Plan

According to the Limpopo Conservation Plan Version 2 (Desmet *et al*., 2013), it is evident that the proposed site is classified as part of a "CBA 2". A CBA 2 is an area that is "optimal' (as opposed to "irreplaceable") for achieving provincial conservation targets, and represent areas where there are spatial options for achieving targets.

CBA 2 areas should be maintained in a natural state with little to no net loss of biodiversity. Therefore, any current land use activity should not be intensified and should be managed in a way to minimise the impact on threatened species or ecological processes. Compatible land-use include current agricultural practices, intensive and extensive livestock production, game ranching and ecotourism as long as the current ecological integrity of the area is maintained. *However, the following land-use practices is incompatible: Urban and residential development, business, industrial and mining development and linear infrastructure.* Nevertheless, some of these activities could be allowed following a detailed impact assessment and the identification of alternative areas to meet the CBA network targets.

1.6.3 Vegetation units

The dominant vegetation composition and structure on the study site comprises of five major communities simulated by environmental drivers such as the presence of outcrops and topography, slope, past disturbance regimes and proximity to drainage lines (Figure 10 of this report, & Figure 11 & 12 and Appendix 1 of the specialist report (Pachnoda Consulting cc, 2015)):

1. Dense to open *Dichrostachys cinerea* - *Peltophorum africanum* thicket and woodland on low lying plains:
    a. Dense short *Dichrostachys cinerea – Panicum maximum* thicket;
    b. Open *Peltophorum africanum – Dombeya rotundifolia* woodland; and
    c. Short *Dichrostachys cinerea – Combretum zeyheri* shrub on recently disturbed land.
2. *Senegalia caffra* - *Chrysophyllum serrulata* mountain bushveld on rocky, shallow soils:
    a. Open mixed *Combretum zeyheri – Diheteropogon amplectens* savannoid grassland; and
    b. Mixed *Senegalia caffra – Chrysophyllum serrulata* mountain bushveld.
3. Dense *Berchemia zeyheri – Acalypha glabrata* riparian woodland along drainage lines and ravines.

In general, *Dichrostachys cinerea* subsp. *africana*, *Combretum zeyheri, Combretum molle*, *Peltophorum africanum, Senegalia caffra, Chrysophyllum serrulata, Combretum apiculatum* and *Ximenia americana* were the dominant taxa observed.

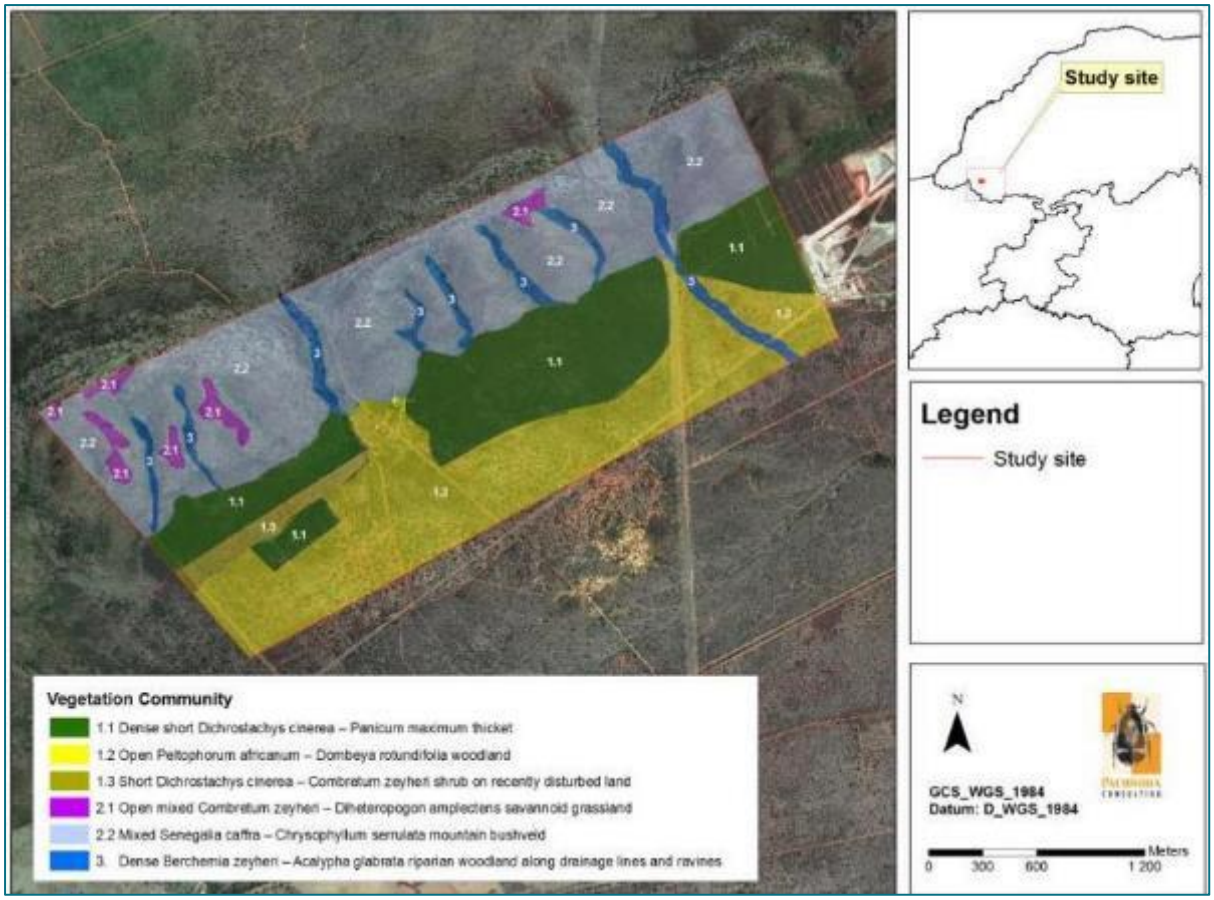


Figure 10: A map illustrating the vegetation units identified on the proposed study site

The surface area (size) of each vegetation community is summarised in Table 15. Refer to Figure 13 of the specialist report (Pachnoda Consulting cc, 2015) for diversity comparisons between the different floristic units/communities. It is evident from the rarefaction curves that high floral diversities are maintained by units showing little evidence of severe disturbances (mountain bushveld, savannoid grassland and open woodland) while those subjected to past transformation events tend to maintain low diversities (thickets). In addition, the species richness on the mountain bushveld was the highest as evidenced by the elevated rarefaction curves in comparison to the other communities (Figure 13 of the specialist report (Pachnoda Consulting cc, 2015)).

Table 15: The surface area (ha) of each defined vegetation unit in relation to the proposed study site

Major Vegetation Community	**Area (ha)**	**%**
1. Dense to open *Dichrostachys cinerea - Peltophorum africanum* thicket and woodland on low lying plains	315.47	53.37%
2. *Senegalia caffra - Chrysophyllum serrulata* mountain bushveld on rocky, shallow soils	246.00	41.61%
3. Dense *Berchemia zeyheri – Acalypha glabrata* riparian woodland along drainage lines and ravines	29.69	5.02%
Vegetation Sub-community	**Area (ha)**	**%**
1.1. Dense short *Dichrostachys cinerea – Panicum maximum* thicket	138.96	23.51%

1.2. Open *Peltophorum africanum – Dombeya rotundifolia* woodland	164.00	27.74%
1.3. Short *Dichrostachys cinerea – Combretum zeyheri* shrub on recently disturbed land	12.51	2.12%
2.1. Open mixed *Combretum zeyheri – Diheteropogon amplectens* savannoid grassland	12.92	2.19%
2.2. Mixed *Senegalia caffra – Chrysophyllum serrulata* mountain bushveld	233.08	39.43%
Total*:*	591.16	100.00

1.6.3.1 Dense to open Dichrostachys cinerea - Peltophorum africanum thicket and woodland on low lying plains

1. Dense short *Dichrostachys cinerea – Panicum maximum* thicket

This community covers approximately 24% of the total surface of the proposed area where it is confined to the foot slopes of the nearby mountain ranges on the northern part of the site, and is almost entirely dominated by a short, dense canopy of *Dichrostachys cinerea* subsp. *africana* (*c*. 4-5m) (Figure 14 of the specialist report (Pachnoda Consulting cc, 2015)). The entire unit is reminiscent of past disturbances, presumably caused by severe overgrazing and incompatible wildlife management principles, which resulted in widespread bush encroachment of microphyllous thicket.

Apart from a monotonous woody canopy of *D. cinerea*, was the basal layer poor in species richness. Noteworthy graminoids include shade tolerant taxa such as *Panicum maximum* and annual grasses such as *Aristida adscensionis*. The forb layer is poorly defined and consists mainly of *Melhania acuminata*.

The conservation importance of this community is *low*. It is species poor and of low importance to game or livestock grazing owing to the absence of a well-defined graminoid layer. Species of conservation concern were rare and consist of scattered individuals (low densities) of the nationally protected tree *Sclerocarya birrea subsp. africana* (Marula) which persists as relict canopy constituents.

2. Open *Peltophorum africanum – Dombeya rotundifolia woodland*

This community covers approximately 28% of the total surface of the study site where it is confined to relatively flat areas on Hutton soils. It is described as a moderately tall woodland (*c*. 6-8m) with an open canopy dominated by *Peltophorum africanum, Dombeya rotundifolia, Vachellia nigrescens, V. burkei, Ziziphus mucronata* and *Combretum zeyheri* (Figure 15 of the specialist report (Pachnoda Consulting cc, 2015)). The graminoid layer is poorly defined and overgrazed owing to the highly palatability of the composition.

The shrub layer is low and in places fairly dense, thereby leading to characteristic "bush clumping" and provides protection against browsing to palatable taxa. Noteworthy shrubs include *Grewia flavescens* and *G. flava*, while typical graminoids include *Eragrostis rigidior, E. lehmanniana, Aristida adscensionis* and *Heteropogon contortus*.

The conservation importance of this community is *moderate*. It is species rich and sustains many tree species that are nationally protected including *Elaeodendron transvaalense* that is Near Threatened. The high palatability of the species composition, high floristic richness and rehabilitation potential of the unit makes it a valuable component for game ranching.

3. Short *Dichrostachys cinerea – Combretum zeyheri* shrub on recently disturbed land

This community covers a small section of the study site (approximately 2%) where it is confined to flat areas that were recently cleared of vegetation. It is described as a short dense scrubland (*c*. 1-2m) dominated by pioneer taxa with a high tendency to become bush encroachers at an advanced successional stage, in particular *Dichrostachys cinerea* (Figure 16 (Pachnoda Consulting cc, 2015)). It is an early successional stage which will at a later stage conform to *Dichrostachys cinerea – Panicum maximum* thicket.

The canopy layer is poorly defined and comprised of relic tree species such as *Combretum zeyheri*, *Peltophorum africanum* and *Ximenia americana* which were prior to disturbance regimes constituents of an open *Peltophorum africanum – Dombeya rotundifolia* woodland. The graminoid layer is characterised by secondary taxa such as *Eragrostis trichophora, E. rigidior, E barbinodis* and *Aristida adscensionis*.

The conservation importance of this community is *low*. It is reminiscent of a transformed and transient woodland and nearly impenetrable. Although the floristic richness was high, most of these species are pioneers or opportunistic taxa which flourish during disturbances. However, it should be emphasised that the dead trees provide potential breeding habitat for cavity-nesting bird species.

1.6.3.2 *Senegalia caffra - Chrysophyllum serrulata* mountain bushveld on rocky, shallow soils

1. Open mixed *Combretum zeyheri – Diheteropogon amplectens* savannoid grassland

This community is confined to the open rocky slopes and ridges on the northern section of the study site (Figure 17 (Pachnoda Consulting cc, 2015)) and covers approximately 2% of the total surface area. The stunted structure of the canopy layer and surface extent of the graminoid cover are regulated by fires and environmental extremities induced by aspect and soil conditions (e.g. soil nutrition, texture and leaching). It is considered unique to the region with more than 50% of its composition, especially the graminoid composition being absent from typical “bushveld” units. In addition, it supports a high richness of primary graminoid species.

The graminoid layer is earmarked by a well-defined primary composition of ‘decreaser’ grass taxa such as *Loudetia flavida, Trachypogon spicatus, Diheteropogon amplectens* and *Andropogon schirensis*. It is rich in forb taxa, not only at a species level, but is also owing to a high diversity of plant families pertaining to the Asteraceae (*Helichrysum spp., Athrixia elata*), Crassulaceae and Fabaceae (e.g. *Indigofera* and *Tephrosia*). The increased diversity of plant taxa is encouraged by the high spatial

heterogeneity provided by the numerous outcrops and rock promontories. These provide stable microclimatic conditions for the colonisation of "shade-tolerant" pteridophytes (e.g. *Cheilanthes pentagona*). Other noteworthy woody species pertaining to this unit include *Englerophytum magalismontanum, Faurea saligna*, *Burkea africana, Combretum zeyheri* and *Ochna pulchra*.

The conservation importance of this community is *high and undisputable*. It sustains a graminoid composition of primary (pristine) ecological condition while also supporting many provincially protected geophytic taxa.

2. Mixed *Senegalia caffra – Chrysophyllum serrulata* mountain bushveld

This community is widespread and prominent on the rocky hills that occur on the northern section of the study site (*c*. 39% of the total surface area), and conforms to an open woody canopy (*c*. 5-8m) dominated by *Senegalia caffra, Combretum apiculatum, C. molle* and *Kirkia wilmsii.* In addition, the herbaceous layer is rich in 'decreaser' grass taxa and is dominated by *Setaria lindenbergiana, Chrysophyllum serrulata* along with taxa of the genus Enneapogon (Figure 18 (Pachnoda Consulting cc, 2015)). Subtle differences in the dominant basal composition are apparent along ill-defined drainage lines as evidenced by an over-dominance of *Panicum deustum.*

This woodland is common on steep slopes of 30° or more, and forms a distinct eco-tone or transitional community between the savannoid grasslands on rocky slopes and the lower-lying open woodland. Therefore, its composition is often shared with both of these floristic units.

The conservation importance of this community is *high*. It sustains a floristic composition indicative of a primary (pristine) ecological condition while also supporting many provincially protected geophytic taxa. In addition, part of its composition includes range-restricted taxa such as *Erythrophysa transvaalense* (a Central bushveld endemic) and regional rarities such as *Calodendron capense*.

1.6.3.3 Dense *Berchemia zeyheri – Acalypha glabrata* riparian woodland along drainage lines and ravines

This community is restricted to the various drainage lines ad ravines on the study site, and conforms to a tall, closed-canopy woodland with a poorly defined graminoid layer (Figure 19 (Pachnoda Consulting cc, 2015)). Typical canopy constituents include *Spirostachys africana, Berchemia zeyheri, Ficus burkei* and *Strychnos usambarensis,* and noteworthy shade-tolerant species such as *Barleria obtusa, Acalypha glabrata* and *Calpurnia aurea.*

The conservation importance of this community is *high*. The floristic composition shows strong biogeographic affinities with azonal forest groups such as the Northern Afrotemperate Forests of the Waterberg, Magaliesberg and Suikerbosrand (Mucina & Rutherford, 2006) based on the eminent dominance of *Calpurnia aurea*, *Isoglossa grantii*, *Chaetachme aristata* and *S. usambarensis*. In addition, it is the only vegetation unit that supports the provincially protected tree *Spirostachys africana*

(Tamboti). The linear configuration of this unit facilitate ecological connectivity with other units, while it also act as important dispersal corridors for fauna taxa, thereby maintaining genetic cohesion among populations of the same species.

1.6.4 Threatened, near threatened and declining plant taxa

Only one near threatened and one declining species were recorded on the study (see Table 4 (Pachnoda Consulting cc, 2015)). *The near-threatened Elaeodendron transvaalense (Transvaal Saffron) is a small tree which were observed in low densities in the open Peltophorum africanum – Dombeya rotundifolia* woodland (see Figure 21 (Pachnoda Consulting cc, 2015)). This species is a very popular species used for muthi (sensu Raimondo *et al*., 2009). The other taxon includes the declining *Boophone disticha* which is observed in low numbers from the mixed *Senegalia caffra – Chrysophyllum serrulata* mountain bushveld and is also expected to be present in the open mixed Combretum zeyheri – *Diheteropogon amplectens* savannoid grassland (see Figures 11 of this report and Figure 21 (Pachnoda Consulting cc, 2015)). It is highly valued for its medicinal properties.

1.6.5 Protected plant species

Five plant species were observed and listed as protected (Table 5 (Pachnoda Consulting cc, 2015)) under Schedule 12 of the Limpopo Environmental Management Act (No 7 of 2003) during the respective survey period. It is evident from Table 5 (Pachnoda Consulting cc, 2015) that the majority of protected plant species are localised and restricted to the mixed S*enegalia caffra – Chrysophyllum serrulata* mountain bushveld.

A permit is required to remove or disturb a protected plant. It is recommended that protected plants in danger of becoming destroyed during any of the planned mining activities be removed prior to the commencement of construction activities and translocated to suitable habitat, or used during the rehabilitation phase.

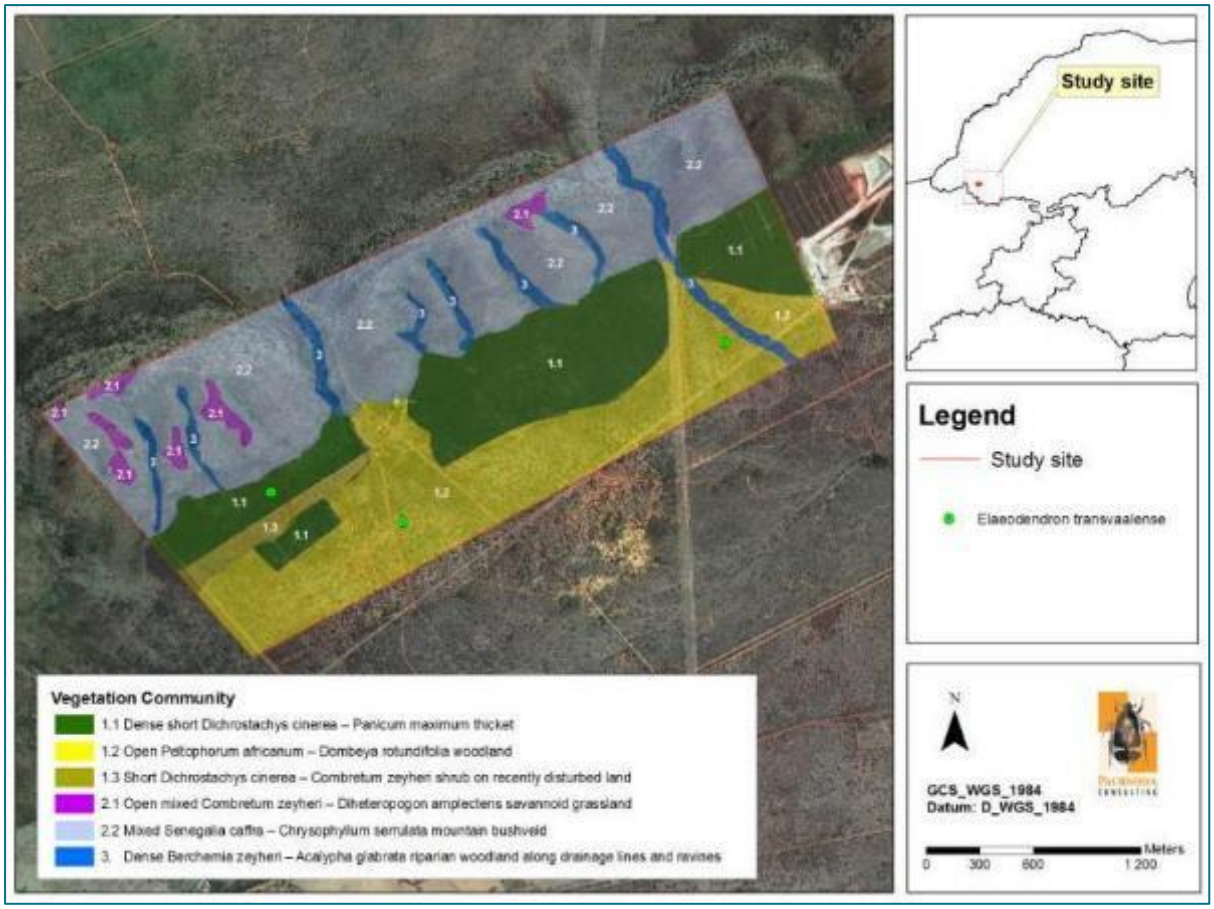


Figure 11: The approximate spatial distribution of observed near threatened plant taxa on the study site

1.6.6 Protected tree species

Five tree species (Table 6 (Pachnoda Consulting cc, 2015)) appear on Schedule A of the national list of protected tree species as promulgated by the National Forests Act, 1998 (No 84 of 1998). The main reasons for this list are to provide strict protection to certain species while others require control over harvesting and utilisation. In most instances these species occur widely and are not threatened (not Red Data listed), but should be considered during the project based on their legal status.

In terms of the National Forests Act of 1998, a licence should be granted by the Department of Forestry (or a delegated authority) prior to the removal, damage or destruction of any individual. Therefore, such activities (as mentioned above) should be directed to the responsible Forestry official in each province or area.

It is unavoidable that a number of individuals are likely to become lost or removed during the proposed mining phase (if permission is granted). Even though they are regionally well distributed, effort should be put in place to conserve at least examples of tall canopy constituents represented by *Vachellia erioloba* and *Combretum imberbe*.

1.6.7 Medicinal plant species

Although most of these plant species are regionally widespread and abundant, some are declining and should be envisaged as priority conservation entities. Table 16 lists those species considered to be of economical or cultural value (according to Van Wyk *et al*., 1997; Pooley, 1998).

Table 16: A list of medicinal species observed on the study site (according to Van Wyk *et al*., 1997; Pooley, 1998). Important (heavily utilised) species are highlighted in grey

Species Identified within Van Wyk *et al*. (1997)		
Species	Parts used	Treatment
Vachellia karroo	Bark, leaves & gum	Stomach ailments such as diarrhoea and dysentery. Bark, gum & leaves used as an astringent for colds and conjunctivitis.
Sclerocarya birrea subsp. *caffra*	Bark and fruit	Treatment of various ailments, including malaria. Fruit rich in Vitamin C.
Dicoma anomala	Leaves	Used to treat fever.
Elaeodendron transvaalense	Bark	Used for stomach cramps, diarrhoea and fever.
Gomphocarpus tomentosus	Leaves	Treatment of headaches, tuberculosis and general body aches.
Helichrysum spp.	Leaves & stems	Treatment of coughs, colds, fever, infections and menstrual pain.
Heteropyxis natalensis	Leaves	Treatment of colds.
Jatropha zeyheri	Rhizomes	Treatment of fever and wounds.
Terminalia sericea	Roots	An infusion is made to treat pneumonia and wounds.
Vernonia oligocephala	Leaves and twigs	Used to treat abdominal pain and colic.
Euclea undulata	Roots	Used as a remedy for headaches and toothaches.
Pellaea calomelanos	Leaves and rhizomes	Treatment of colds and asthma.
Xerophyta retinervis	Stems	Used to treat asthma.
Ziziphus mucronata	Roots, leaves and bark	Treatment of respiratory ailments.

Species Identified within Pooley (1998)	
Species	Treatment
Boophone disticha	Treatment of pain, wounds and used as a narcotic.
Schizocarphus nervosus	Treatment of rheumatic fever and dysentery.
Scadoxus puniceus	Used to treat coughs, poultices, headaches and stomach ailments.
Commelina africana	Used for a wide variety of ailments including fevers, fits, heart complaints and bladder infections.

1.6.8 Endemic and near-endemic taxa

According to Mucina & Rutherford (2006), taxa such as *Grewia rogersii, Pachystigma triflorum* and *Oxygonum dregeanum* subsp. *canescens* var. *pilosum* are endemic to the Waterberg Mountain

Bushveld. These species are likely to occur (in particular *G. rogersii*) on areas of rocky soils (in particular the mixed *Senegalia caffra – Chrysophyllum serrulata* mountain bushveld) although not confirmed during the site visits.

The Central Bushveld Endemic, *Erythrophysa transvaalensis* was recorded from the northern aspects of mixed *Senegalia caffra – Chrysophyllum serrulata* mountain bushveld (see Figure 22 (Pachnoda Consulting cc, 2015) and Figure 12).

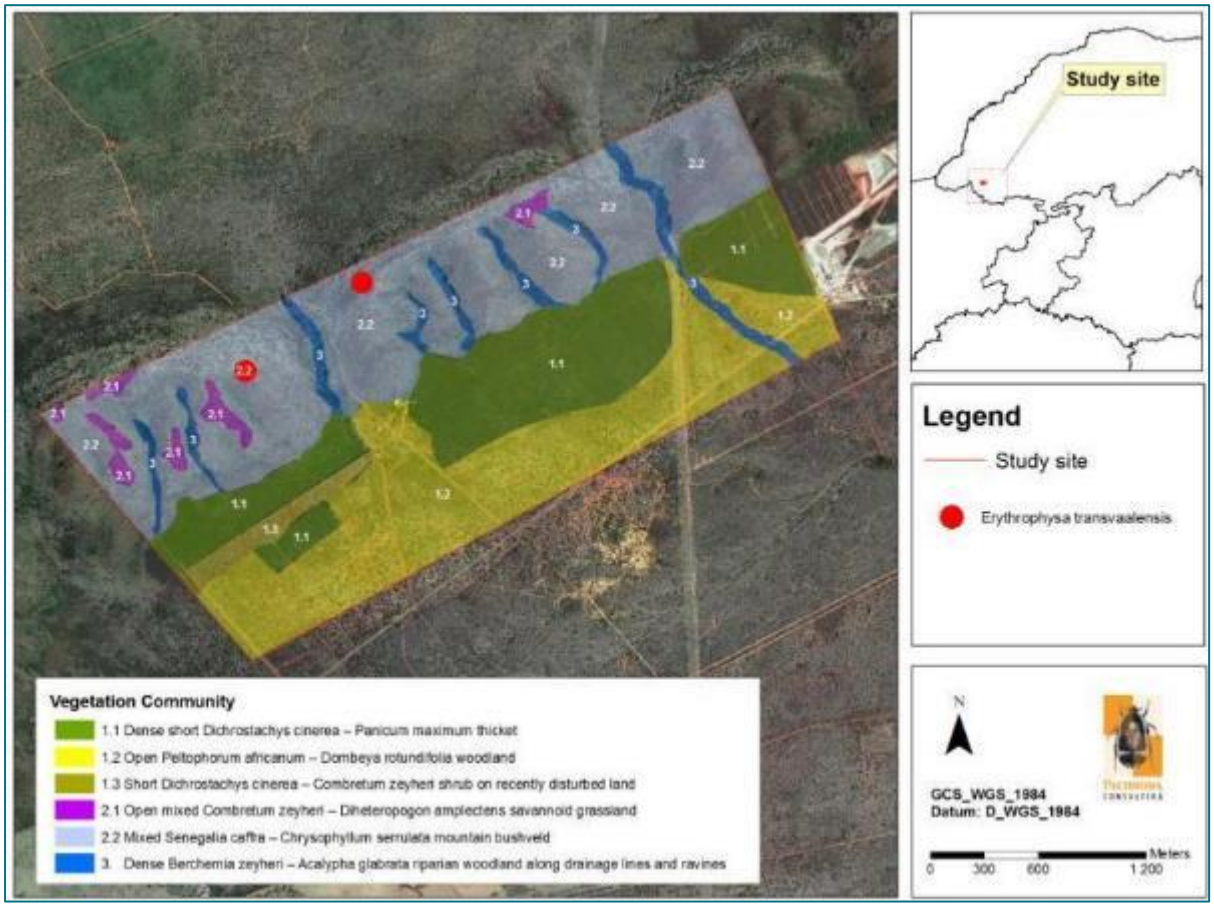


Figure 12: The approximate distribution of the central bushveld endemic, *Erythrophysa transvaalensis* on the study site

1.6.9 Declared weeds and invader plants

In general, the natural vegetation units on the site were relatively free of alien and invasive plant taxa. However, observed minor ruderal weed species include *Tagetes minuta, Schkuhria pinnata, Pupalia lappacea* and *Zinnia peruviana*. These species are all annuals (they completely die off during the dry season) and are of temporary nature.

1.6.10 Ecological condition and succession

An analysis of the ecological status of each floristic community revealed that the mountain bushveld and savannoid grassland seres on ridges (open mixed *Combretum zeyheri – Diheteropogon*

amplectens savannoid grassland and mixed *Senegalia caffra – Chrysophyllum serrulata* mountain bushveld) are characterised by a high percentage of Decreaser grass species (see Figure 24 (Pachnoda Consulting cc, 2015)). *These two units are represented by late-succession compositions, and share a species-rich graminoid layer when compared to the other communities.*

Nevertheless, the highly transformed units dominated by *Dichrostachys cinerea* shrub and thickets are earmarked by low levels of utilisation (grazing) as evidenced by the high cover of Increaser 1 grasses. The low levels of utilisation is best explained by the density of the woody layer which makes it difficult for livestock and large grazing taxa to access the graminoid layer.

The open woodland unit (open *Peltophorum africanum – Dombeya rotundifolia* woodland) is characterised by high levels of grazing by game as evidenced by the high cover of Increaser 2 grasses. An analysis of the ecological succession showed that both the mountain bushveld and savannoid grassland units are dominated by late-successional (primary or “near-climax”) taxa (see Figure 25 (Pachnoda Consulting cc, 2015)).

In summary, the open mixed *Combretum zeyheri – Diheteropogon amplectens* savannoid grassland and mixed *Senegalia caffra – Chrysophyllum serrulata* mountain bushveld consist of primary compositions.

1.6.11 Ecological Sensitivity

Areas of high ecological sensitivity

The following habitat units and floristic communities are considered to be of high ecological sensitivity (Figure 14):

- Open mixed *Combretum zeyheri – Diheteropogon amplectens* savannoid grassland;
- Mixed *Senegalia caffra – Chrysophyllum serrulata* mountain bushveld; and
- Dense *Berchemia zeyheri – Acalypha glabrata* riparian woodland along drainage lines and ravines

These units are of high sensitivity based on the following arguments:

- The mountain bushveld and savannoid grassland units show high floristic richness when compared to the other units. More than 80% of the species composition is composed of late-successional taxa. In addition, more than 35 % of the floristic composition is composed of decreaser grasses;
- The mountain bushveld and savannoid grassland units provide habitat for declining and near-threatened plant species;
- The mountain bushveld unit overlaps with the home range of the regionally vulnerable Verreaux's Eagle (*Aquila verreauxii*) and globally near threatened Brown Hyaena (*Parahyaena brunnea*);

- The mountain bushveld and savannoid grassland units provide potential habitat for two near threatened lizard species and five reptile taxa endemic to the Waterberg region;
- The mountain bushveld is part of a ca. 110km ridge corridor extending in the west from the Noupoort mountains, eastwards past the Rookpoort Mountains to the Hoekberg Mountains near Modimolle. It forms an extensive and important regional dispersal corridor for fauna in the landscape while also providing resilience towards climate change; and
- The riparian woodland units are located along drainage lines of linear configuration and facilitate animal dispersal and ecological connectivity. It also provides refuge for avifaunal taxa with high affinities towards forest and closed-canopy (mesic) habitat types.

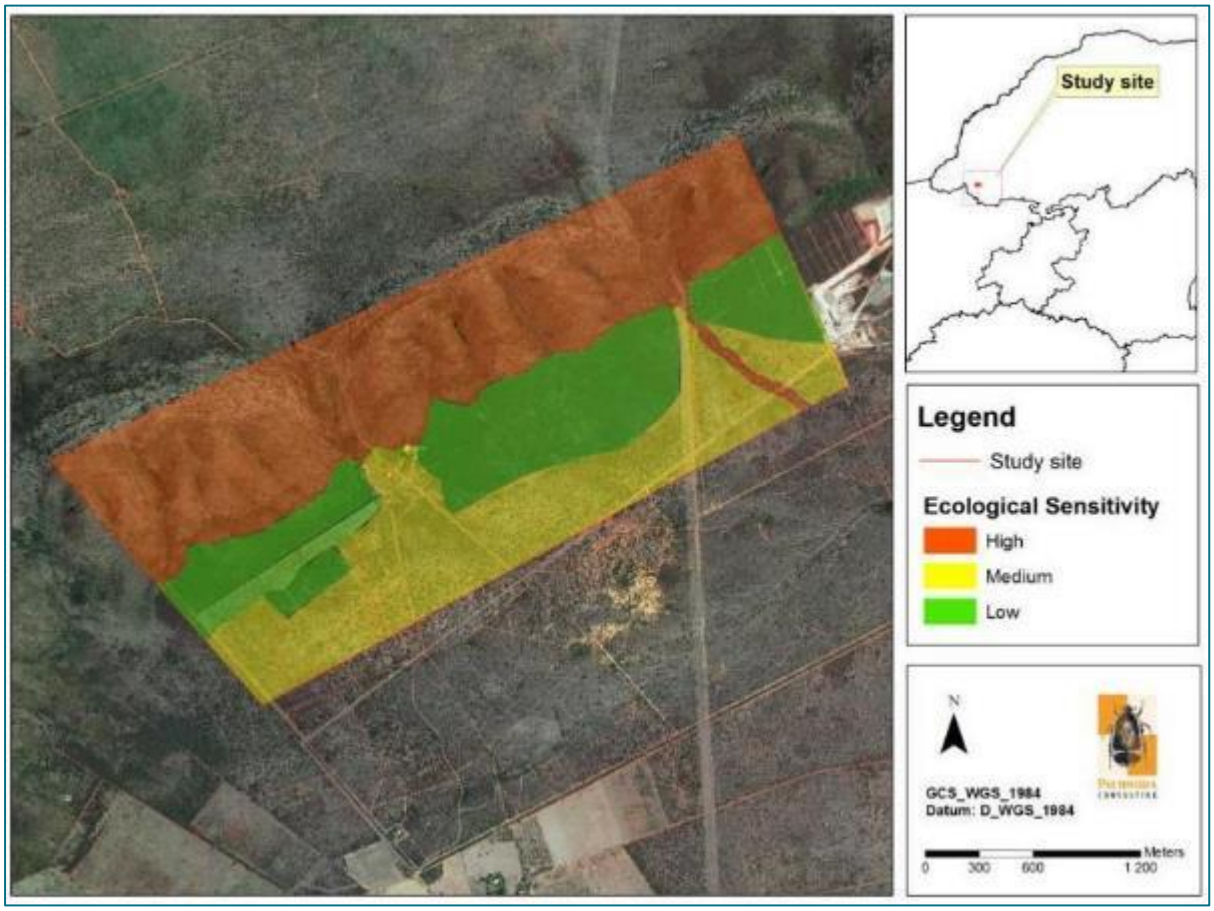


Figure 13: Ecological sensitivity map

Areas of medium ecological sensitivity

The following habitat types and floristic communities are considered to be of medium ecological sensitivity (Figure 13):

Open *Peltophorum africanum – Dombeya rotundifolia* woodland.

These units are of medium sensitivity based on the following arguments:

- The open woodland provides habitat for a high diversity of taxa with widespread distributions;

- The open woodland provides habitat for a number of national protected tree species including one near-threatened tree species (*Elaeodendron transvaalensis*);
- Over 60% of the graminoid composition is composed of secondary grasses which are indicative of inappropriate grazing regime and stocking rates.

Areas of low ecological sensitivity

The following habitat types and floristic assemblages are considered to be of low ecological sensitivity (Figure 14):

Dense short *Dichrostachys cinerea – Panicum maximum* thicket; and

Short *Dichrostachys cinerea – Combretum zeyheri* shrub on recently disturbed land

These units are of low sensitivity based on the following arguments:

- These units hold floristic compositions consisting of typical pioneer species and bush encroacher taxa;
- Both units are transformed either through the clearing of vegetation or severe overgrazing;
- Overall species richness is low when compared to the other units.

1.7 Animal life

Information for this section was obtained from the 'Ecological Evaluation for the Tygerkloof Mine Report' (Pachnoda Consulting cc, 2015).

1.7.1 Mammals

A total of 65 mammal species could occur on the proposed site (excluding bats and introduced game; Appendix 2 (Pachnoda Consulting cc, 2015)) of which 25 species (38%) were confirmed during the survey period (Table 16 of this report & Figure 26 (Pachnoda Consulting cc, 2015)). In addition, four species are probably uncommon to absent on the study site owing to the absence of suitable habitat. Nevertheless, among those confirmed were seven antelope species, five rodents, one canine (jackal), one feline (cats), one hyaenid, two leporids (hares), one mustellid, aardvark, two suids (pigs), one hyrax (dassie) and three primates.

Bats (Chiroptera) are a highly specialised group of mammals and requires specialised equipment and ultra-sonic recorders/detectors to survey them. Therefore this group was omitted from the study. However, approximately 16 species could utilise the study site, of which six are regionally near threatened, one data deficient (DD) and one being vulnerable. It is possible that some of these taxa (especially the genus Rhinolophus) could roost in rock fissures and caves provided by the dolomite outcrops in the mountain bushveld. In addition, the riparian woodland should be considered as an important foraging habitat for many of the smaller insectivorous taxa.

Table 17: An inventory of mammalian taxa observed on study site during the site visit (23 - 27 February 2015)

Scientific Name	Vernacular Name	Observation Indicators	Observed Habitat
Aepyceros melampus	Impala	Visual sightings	Very common and widespread, mainly confined to the open woodland.
Micaelamys namaquensis	Namaqua Rock Mouse	Trapped	Widespread on outcrops
Canis mesomelas	Black-backed Jackal	Spoor & vocalisations	Widespread, although inconspicuous.
Cercopithecus pygerythrus	Vervet Monkey	Visual sightings	Widespread.
Cryptomys hottentotus	African Mole-rat	Soil heaps	Widespread.
Civettictis civetta	African Civet	Spoor (old)	Inconsicuous.
Galago moholi	Southern Lesser Galago	Visual sightings	Widespread.
Hystrix africaeaustralis	Cape Porcupine	Visual sightings and camera trapped	Widespread, all habitat types.
Lepus saxatilis	Shrub Hare	Droppings & Visual sightings	Widespread, mainly on flat topographies.
Mastomys coucha/natalensis	Multimammate Mouse	Trapped	Mainly confined to open woodland.
Oreotragus transvaalensis	Transvaal Klipspringer	Visual sightings	Restricted to mountain bushveld and savannoid grassland.
Orycteropus afer	Aardvark	Burrows & camera trapped.	Confined to low-lying areas on sandy substrate.
Panthera pardus	Leopard	Spoor (old)	Probably roaming over entire study site.
Papio cyanocephalus ursinus	Savanna Baboon	Droppings & visual sightings	Widespread, all habitat units
Parahyaena brunnea	Brown Hyaena	Spoor & camera trapped	All vegetation units.
Paraxerus cepapi	Tree Squirrel	Visual sightings	Widespread.
Phacochoerus africanus	Common Warthog	Visual sightings & spoor	Widespread, mainly confined to the low-lying areas.
Potamochoerus larvatus	Bushpig	Spoor & diggings	Restricted to riparian woodland.
Procavia capensis	Rock Hyrax	Visual sightings.	Outcrops.
Pronolagus randensis	Jameson's Red Rock Rabbit	Droppings	Mountain bushveld and savannoid grassland.
Raphicerus campestris	Steenbok	Visual sightings & spoor.	Widespread on low-lying areas.

Scientific Name	Vernacular Name	Observation Indicators	Observed Habitat
Redunca fulvorufula	Southern Mountain Reedbuck	Visual sightings	Confined to mountain bushveld and savannoid grassland.
Strepsiceros zambesiensis	Zambezi Kudu	Visual sightings, spoor & droppings	Widespread.
Sylvicapra grimmia	Common Duiker	Spoor, droppings & visual sightings	Widespread, all areas.
Tragelaphus sylvaticus	Bushbuck	Visual sightings.	Widespread, prevalent along the drainage lines.

Mammal taxa of conservation concern

The proposed area provides habitat for a variety of threatened and near-threatened taxa, of which two species were confirmed during the surveys. Based on the large variety of habitat types available, the study site is likely to sustain two globally near-threatened species (according to the IUCN, 2014), as well as one regionally threatened and four near-threatened species (see Appendix 2 (Pachnoda Consulting cc, 2015)) (according to Friedmann & Daly, 2004).

A brief annotated account is provided below for those species that could occur on the study site:

Brown Hyaena (*Parahyaena brunnea*)

The Brown Hyaena is listed as near threatened on the global IUCN Red List (Wiesel *et al*., 2008) since it requires extensive areas (sometimes in excess of 1,000km²) to maintain a viable population, especially where inter-specific competition for resources is fierce between other predator taxa. Such massive home ranges often coincide with livestock and agricultural areas where they are heavily persecuted by farmers. Therefore, persecution and the loss of habitat due to agricultural intensification are some of the primary threats faced by this species.

The numerical abundance of this species on the study area remains unclear, although anecdotal observations show that it is widespread in the area. It was recorded from both the mountain bushveld and the open woodland (based on spoor tracking and camera trapping). The territory of a young adult coincides with the study site and it is considered sedentary on the site since.

Leopard (*Panthera pardus*)

The Leopard, although a widespread and adaptable species, is listed as near threatened on the global IUCN Red List (Henschel *et al*., 2008). The global population estimate for *P. pardus* is non-existent or very unreliable, which is responsible for its placement in the “near-threatened” category. Furthermore, increased competition for space along with frequent human encounters (near farming communities) has seriously reduced the number of global subpopulations.

The presence of ridges and topographic complexity on the northern part of the study site (shelter), dense vegetation (shelter) and a generous availability of prey (it is catholic in its diet, taking prey from small invertebrates to large antelopes, including Kudu) prompted the definite occurrence of this species on the study site. It was confirmed on the site based on old spoor, although the landowner has confirmed its presence.

Honey Badger (*Mellivora capensis*)

The Honey Badger is listed as least concern on the global IUCN Red List although Friedmann and Daly (2004) have listed it as near-threatened.

Honey Badgers are widespread and generally very catholic in their habitat requirements. They are predominately nocturnal, solitary, and generally very unobtrusive in behaviour (Skinner & Chimimba, 2005). It is tolerant to modified habitat types and personal observations from the central Mpumalanga Highveld have shown that it can persist on areas dominated by agricultural activities (camera trapping, pers. obs.). This species is likely to be present and can occur almost anywhere due to its unobtrusiveness.

The regional conservation status of *M. capensis* is currently under revision, although supporting evidence suggests that it will be downgraded from near-threatened to least concern (pers. comm., M. Child of EWT).

South African Hedgehog (*Atelerix frontalis*)

The South African Hedgehog is listed as least concern on the global IUCN Red List although Friedmann and Daly (2004) have listed it as near threatened. This species occurs in a wide variety of habitat types, which makes prediction regarding its habitat requirements very difficult. However, illegal hunting, habitat transformation to make way for agricultural land, and hard-surfaced infrastructure (e.g. road mortalities) are probably the main reasons for its decline.

It is highly adapted to urban environments and frequently encountered in urban gardens (Skinner & Smithers, 1990) and will readily adapt to new development, if emphases are placed on preserving the natural function of the respective vegetation units while minimising the unnecessary use of exotic plant species and roads. It is considered a resident on the study site based on the widespread occurrence of suitable habitat (c. dry and rocky structure provided mountain bushveld and savannoid grassland).

Serval (*Leptailurus serval*)

The Serval is listed as least concern" on the global IUCN Red List although Friedmann and Daly (2004) have listed it as near threatened.

Servals show a wide distribution range, although they are limited by their obligate preference for surface water. Therefore, they are always found near water and in areas with sufficient shelter such as tall grass

(Skinner & Smithers, 1990) with an abundance of suitable prey – mainly Murid rodents (e.g. genera *Mastomys*, *Mus* and *Otomys*).

This species is a specialised rodent hunter, and appears to be tolerant towards agricultural activities and adapts readily to abandoned cultivation and secondary growth as long as they are not persecuted or persistently disturbed (in Wilson & Mittermeier, 2009). However, it is considered to be an uncommon to rare resident on the study site as explained by the absence of optimal habitat (moist grassland) and low density of rodent prey (pers. obs.).

The regional conservation status of *L. serval* is currently under revision, although supporting evidence suggests that it will be downgraded from near threatened to least concern (pers. comm., M. Child of EWT).

Data Deficient Taxa

All shrew species (genera *Crocidura*), the Short-snouted Elephant-shrew (*Elephantulus brachyrhynchus*), the Single-striped Mouse (*Lemniscomys rosalia*), Rock Dormouse (*Graphiurus platyops*) and the Bushveld Gerbil (*Tatera leucogaster*) are “Data Deficient” and likely to occur on the proposed site. Most of these species are perceived to be relatively widespread and abundant, but current modifications of suitable habitats and the paucity of scientific information on meta-population demographics place these species under the DD category. Many of these species could potentially associate with the tributaries while the Single-striped Mouse and Elephant-shrew could occur on grassy patches associated with the savannoid grassland units. The genus *Tatera* often colonises disturbed areas and are likely to occur within sandy areas dominated by secondary arid bushveld.

The regional conservation status of these taxa is currently under revision, and supporting evidence suggests that many will be downgraded to least concern (pers. comm., M. Child of EWT).

The vulnerable Ground Pangolin (*Manis temminckii*) is not discussed since there is very little known about its life-history and distributions. It is mainly encountered in well managed game farms.

Biodiversity value and ecological considerations

- The geographic position of the study site (located between a number of game farms) is responsible for a high diversity of angulate taxa, which attract species pertaining to higher trophic guilds (e.g. Leopard). However, poor management principles and intensive grazing on low-lying areas of the study site (southern parts) were responsible for a low primary prey production (e.g. rodentia) which explains the ominous absence of meso- and small carnivores (e.g. jackal, badgers, mongoose) on the study site;
- The topographical complexity and the “sense of wilderness” on the northern parts of the study site are responsible for the occurrence of two globally near-threatened scavenger-predator species, namely Leopard (*Panthera pardus*) and Brown Hyaena (*Parahyaena brunnea*);

- The absence of perennial surface water and inundated habitat (e.g. moist grassland and dams) is responsible for the absence of many "wetland-associated" taxa such the Marsh Mongoose (*Atilax paludinosus*), Cape Clawless Otter (*Aonyx capensis*) and *Otomys* spp.

1.7.2 Avifauna

Species richness and composition

According to the South African Bird Atlas Project, 169 bird species have been recorded from the proposed region of which 163 species were recorded during SABAP2 (2427CA Kaaldraai; Harrison *et al*., 1997) and 29 species during SABAP2 (pentad 2440_2710). This equates to 17.5% of the approximate 967 species listed for the southern African subregion. In addition, the SABAP2 database recorded on 29 species (www.sabap2.adu.org.za) in the area, which is significantly lower than the SABAP1 database. The SABAP2 statistic was obtained from one pentad grid representing a single ad hoc submission. However, the current survey produced 152 species (see Appendix 3 (Pachnoda Consulting cc, 2015)) despite the poor richness documented during the respective atlas periods along with 17 species not recorded during the current survey (Table 9 (Pachnoda Consulting cc, 2015)). The atlas data clearly illustrates the poor coverage in the area by citizen scientists. On a national scale, the species richness on the study area is considered to be very low (see Figure 27) (Pachnoda Consulting cc, 2015).

The observed totals are well within the limit (>50%) of the number of species likely to occur, and provide a realistic indication of the thoroughness and general coverage of the study site. The area was poorly represented by biome-restricted (see Table 18) and endemic bird species. Despite the poor richness of endemic species, the area accommodates species with local distribution patterns in the region (e.g. out of range distributions). These species are primarily restricted to closed-canopy environments and are confined to the forested habitat pertaining to the dense *Berchemia zeyheri – Acalypha glabrata* riparian woodland along drainage lines and ravines (e.g. Collared Sunbird *Hedydipna collaris* and Yellow-bellied Greenbul *Chlorocichla flaviventris*).

Table 18: Biome-restricted species (Barnes, 1998) observed on the study site

Species	Kalahari-Highveld	Zambezian
Burchell's Starling	X	
Kalahari Scrub-robin	X	
White-bellied Sunbird		X
White-throated Robin-chat		X
Kurrichane Thrush		X

An analysis of bird data generated from the point counts showed that the Cape turtle Dove (*Streptopelia capicola*), Dark-capped Bulbul (*Pycnonotus tricolor*), Laughing Dove (*Spilopelia senegalensis*), Chin-spot Batis (*Batis molitor*) and White-browed Scrub-robin (*Erythropygia leucophrys*) are dominant in the area (Table 19 summarises the 10 typical species observed on the study site). These species are

widespread and consist of (1) granivorous taxa (doves) and (2) insectivorous species that co-occur in nutrient-poor systems pertaining to the mountain bushveld and savannoid grassland units.

Table 19: The dominant bird species recorded on the study site.

Species	Average Abundance	Consistency	% Contribution
Cape Turtle Dove	0.94	0.76	23.65
Dark-capped Bulbul	0.81	0.51	14.16
Laughing Dove	0.59	0.54	11.57
Chinspot Batis	0.72	0.35	6.78
White-browed Scrub-robin	0.44	0.39	6.43
White-bellied Sunbird	0.44	0.34	4.54
Black-headed Oriole	0.28	0.2	3.05
Cinnamon-breasted Rock Bunting	0.41	0.23	2.85
Yellow-fronted Tinkerbird	0.34	0.25	2.82
African Grey Hornbill	0.41	0.2	2.14

Bird taxa of conservation concern

Table 120 provides an overview of bird species of “special conservation concern” recorded in the proposed area, as well as those previously recorded in the area based on their known distribution range and the presence of suitable habitat. According to Table 20, ten (10) species could occur on the study site, of which only three were confirmed during the survey. The confirmed species include the globally threatened White-backed Vulture (*Gyps africanus*) and Cape Vulture (*G. coprotheres*) and the regionally threatened Verreaux's Eagle (*Aquila verreauxii*) (Taylor, in press).

Table 20: Bird species of “special conservation concern” that could utilise the study site based on their known distribution range and the presence of suitable habitat. Species highlighted in grey were confirmed on the study site. Red list categories according to the IUCN (2014)* and Taylor (in press)**

Species	Global Conservation Status*	National Conservation Status**	Recorded during SABAP1	Recorded during SABAP2	Preferred Habitat	Potential Likelihood of Occurrence
Aquila rapax (Tawny Eagle)	-	Endangered	No	No	Lowveld and Kalahari savanna, especially game farming areas and reserves.	Regarded as a highly irregular foraging visitor on the study site.
Aquila verreauxii (Verreaux's' Eagle)	-	Vulnerable	No	No	Mountainous areas or areas with prominent outcrops with a high prey base (e.g. hyrax)	Confirmed, a regular foraging visitor.

Species	Global Conservation Status*	National Conservation Status**	Recorded during SABAP1	Recorded during SABAP2	Preferred Habitat	Potential Likelihood of Occurrence
Ardeotis kori (Kori Bustard)	Near-threatened	Near-threatened	Yes	No	Open savannoid woodland on flat areas and fallow land located in the Savanna.	An irregular foraging visitor.
Coracias garrulous (European Roller)	Near-threatened	Near-threatened	Yes	No	Open woodland and bushveld.	A fairly common to uncommon -non-breeding (summer) visitor to the open woodland and recently disturbed vegetation units. It is not threatened in South Africa.
Falco biarmicus (Lanner Falcon)	-	Vulnerable	Yes	No	Varied, but prefers to breed in mountainous areas.	A fairly regular foraging visitor. The study site provides breeding habitat (e.g. mountain bushveld).
Gyps africanus (White-backed Vulture)	Endangered	Endangered	Yes	No	Breeds on tall, flat-topped trees. Mainly restricted to large rural or game farming areas.	An irregular (non-breeding) foraging visitor on the study site.
Gyps coprotheres (Cape Vulture)	Vulnerable	Vulnerable	Yes	No	Varied but breeds on steep south or east facing cliffs.	A regular foraging visitor to the study site (regularly observed soaring overhead) from the breeding colony at Kransberg. The study site does not provide breeding habitat.
Polemaetus bellicosus (Martial Eagle)	Near-threatened	Endangered	Yes	No	Varied, from open karroid shrub to lowland savanna.	An irregular foraging visitor on the study area.
Leptoptilos crumeniferus (Marabou Stork)	-	Near threatened	No	No	Varied, from savanna to wetlands, pans and floodplains – dependant of	Vagrant to the study site. However, a common foraging visitor to a nearby vulture restaurant

Species	Global Conservation Status*	National Conservation Status**	Recorded during SABAP1	Recorded during SABAP2	Preferred Habitat	Potential Likelihood of Occurrence
					game farming areas	operated by the Thabazimbi Iron Ore Mine (TIOM)
Torgos tracheliotus (Lappet-faced Vulture)	Vulnerable	Endangered	No	No	Restricted to large game farming districts. More inclined towards the Lowveld and Kalahari Thornveld.	A highly irregular foraging visitor. More often observed at nearby vulture restaurant at the TIOM

A brief annotated account is provided below for those species with a high probability to occur on the study site:

Vultures

These include two scavenging birds of prey (African White-backed Vulture *Gyps africanus* and Cape Vulture *Gyps coprotheres*). The two Gyps species include large bodied taxa with large home ranges, and their occurrence is determined by the presence of mammalian carcasses which are often highly unpredictable and patchy. The latter explains why these birds are often highly transient in any particular area, depending on the availability of food. However, these species are often observed soaring overhead and attracted to a nearby vulture restaurant that is managed by the TIOM.

Lanner Falcon (*Falco biarmicus*)

F. biarmicus is currently classified as regionally "Vulnerable" (Taylor, 2014). *F. biarmicus* breeds mainly in mountainous areas and prefers deep ravines and sheer cliffs for nesting purposes. Although fairly common within its distribution range with approximately 1,400 pairs in the eastern part of South Africa (Tarboton & Allen, 1984), it is at risk due to persistent loss of open habitat to make way for agricultural land.

Although not observed during the survey period, *F. biarmicus* is predicted to be a fairly regular foraging visitor, and possibly overlooked breeding resident. The outcrops on the eastern part of the study site (in the vicinity of the overhead power line servitude) provide suitable breeding and roosting habitat for this species.

Verreaux's Eagle (Aquila verreauxii)

Previous published conservation assessments of the iconic Verreaux's Eagle (*A. verreauxii*) have found that the global population is stable. However, the national population is suspected to have declined tremendously during the past 12 years, with less than 10,000 adult individuals present in South Africa.

Therefore, according to current population trends, *A. verreauxii* should be placed in the "Vulnerable" category (Taylor, in press).

The study site overlaps with the home range of a sedentary pair of *A. verreauxii*. It is considered as a regular foraging visitor to the mountain bushveld and savannoid grassland seres on the northern section of the study site.

European Roller (*Coracias garrulus*)

The European Roller (*Coracias garrulus*) is regarded as a fairly common non-breeding (summer) visitor to the open *Peltophorum africanum – Dombeya rotundifolia* woodland, and short *Dichrostachys cinerea – Combretum zeyheri* shrub on recently disturbed land. However, this species is fairly unspecialised on its wintering (non-breeding) grounds, where it is prevalent in open woodland habitat. It is currently listed as near threatened (BirdLife International, 2012) owing to direct persecution while on migration over the Mediterranean (especially Oman) and Gujarat in India (del Hoyo et. al., 2001). It is also threatened by habitat loss, since large tracts of suitable breeding habitat are converted to agricultural monocultures. It is not considered to be threatened in its wintering habitat.

Biodiversity value and ecological considerations

- The study site supports a high diversity of bird species representing 90% of the regional richness (on a QDS and pentad level);
- The avifaunal community on the study site is not unique and poorly represented by South African endemics and biome-restricted species. The dominant composition is widespread in the region;
- The mountain bushveld and savannoid grassland on the northern section of the study site provide optimal foraging habitat for the Vulnerable Verreaux's Eagle (*A. verreauxii*). The study site overlaps with the home range of a pair of Verreaux's Eagle (*A. verreauxii*) that often utilises the area during hunting bouts;
- The riparian woodland along the various drainage lines support a bird composition of local interest that is commonly associated with forested or closed-canopy habitat types (e.g. Collared Sunbird *Hedydipna collaris*, Yellow-bellied Greenbul *Chlorocichla flaviventris* and African Firefinch *Lagonosticta rubricata*);
- The dead trees located on the short *Dichrostachys cinerea – Combretum zeyheri* shrub on recently disturbed land provides ephemeral breeding habitat for many obligate hole-nesting bird species (e.g. starlings, woodpeckers, barbets, rollers and Southern Grey-headed Sparrows Passer diffuses), including the Red-billed Oxpecker (*Buphagus erythrorhynchus*); and
- The ridges contained within the mountain bushveld (especially on the eastern section of the study site) provide ideal nesting habitat for Falconiiform taxa (e.g. Lanner Falcon, *Falco biarmicus*) and foraging habitat for charismatic birds of prey species (Verreaux's Eagle, *Aquila verreauxii*).

1.7.3 Amphibians

Fifteen (15) frog species are expected to occur on the study site (Appendix 4 (Pachnoda Consulting cc, 2015)) of which 10 were recorded from the QDS grids that overlap with the study site (2427CA). However, one species are peripheral to the study area (*Poyntonophrynus vertebralis*) and is believed to be sporadic on the study site. However, the lack of any perennial surface water on the study site and the poor water-retention potential of many of the observed depressions will discourage amphibian diversity or even occurrence on the site. Most of these species listed under Appendix 4 (Pachnoda Consulting cc, 2015) will only be detected during high precipitation events and will most likely only utilise the drainage lines and wetland-features (e.g. small dams) during dispersal.

Biodiversity value and ecological considerations

According to Minter *et al*. (2004), the amphibian richness on the study area is moderate (c. 11-20 species) with a very low prevalence of endemic species (c. 1-3 species). The study site is not considered as an important area for amphibian diversity.

The expected frog species breed mostly in temporary water bodies and inundated (moist/wet) grassland, and these features were respectively rare and absent on the study site.

Red listed, “near-threatened” and “data deficient” species

No threatened or near-threatened frog species are likely to be present (Appendix 4 (Pachnoda Consulting cc, 2015)) (Minter *et al.,* 2004).

Reptiles

Seventeen taxa (comprising of four snakes, eight lizards, three geckos, one tortoise and one terrapin) (Table 21) have been recorded from the QDG 2427CA which corresponds to the proposed site (Bates *et al*., 2014). However, this inventory is by no means comprehensive and many more species are likely to be present. Of the 17 species recorded in the area, eight were confirmed (Table 21).

According to the habitat diversity present, the study region is known to support between 12 - 14 reptile species with no endemic species to South Africa (Bates *et al*., 2014).

Results showed that the exposed rock crevices and promontories of the mountain bushveld and savannoid grassland have the potential to provide high richness values when compared to the other habitat units and critical important habitat for rupicolous taxa.

Table 21: An inventory of reptile species confirmed from QDG cell 2427CA, their probability of occurrence and presence of suitable habitat on the study site

Family	Scientific Name	Common name	Probability of occurrence
Agamidae	*Acanthocercus atricollis*	Southern Tree Agama	Confirmed
Atractaspididae	*Atractaspis bibronii*	Bibron's Stiletto Snake	High, likely to occur

Family	Scientific Name	Common name	Probability of occurrence
Colubridae	*Dispholidus typus*	Boomslang	High, likely to occur
Colubridae	*Psammophis subtaeniatus*	Western Yellow-bellied Sand Snake	Confirmed
Cordylidae	*Cordylus jonesii*	Jones' Girdled Lizard	Could occur
Elapidae	*Naja annulifera*	Snouted Cobra	High, likely to occur
Gekkonidae	*Hemidactylus mabouia*	Common Tropical House Gecko	High, likely to occur
Gekkonidae	*Homopholis wahlbergii*	Wahlberg's Velvet Gecko	High, likely to occur
Gekkonidae	*Lygodactylus capensis*	Common Dwarf Gecko	Confirmed
Gerrhosauridae	*Gerrhosaurus flavigularis*	Yellow-throated Plated Lizard	Confirmed
Pelomedusidae	*Pelusios sinuatus*	Serrated Hinged Terrapin	Low
Scincidae	*Trachylepis capensis*	Cape Skink	High, likely to occur
Scincidae	*Trachylepis punctatissima*	Speckled Rock Skink	Confirmed
Scincidae	*Trachylepis striata*	Striped Skink	Confirmed
Scincidae	*Trachylepis varia*	Variable Skink	Confirmed
Testudinidae	*Stigmochelys pardalis*	Leopard Tortoise	Confirmed
Varanidae	*Varanus albigularis*	Rock Monitor	High, likely to occur

Species of conservation concern and endemic taxa

A number of local endemics (Waterberg endemics) show distribution ranges peripheral to the study site and could be present on the mountain bushveld and savannoid grassland units. These include *Lygodatylus waterbergensis* (Waterberg Dwarf Gecko), *Pseudocordylus transvaalensis* (Northern Crag Lizard), *Smaug breyeri* (Waterberg Girdled Lizard), *Platysaurus minor* (Waterberg Flat Lizard) and *Xenocalamus bicolor australis* (Waterberg Quill-snouted snake) (Figure 28 (Pachnoda Consulting cc, 2015)).

According to a recent conservation assessment (see Bates *et al*., 2014), both *L. waterbergensis* and *P. transvaalensis* are classified as near threatened taxa.

It is therefore highly recommended that a herpetofauna specialist investigation be commissioned should the proposed development and activities overspill onto the mountain bushveld and savannoid grassland units with particular emphasis on establishing the status of these taxa on the site.

1.7.4 Invertebrates

Diurnal butterlfies

Fifteen (15) diurnal butterfly species is known to occur in the QDG 2427CA that is sympatric to the proposed site (Table 22). However, this list is incomplete and an additional 16 species were confirmed during the respective site visit (Table 23). None of the species are threatened or near-threatened.

Table 22: A list of butterfly species recorded on QDG 2427CA (Mecenero *et al*., 2013)

Family	Genus	Species	Subspecies	Common name	Conservation Status	Occurrence
Lycaenidae	*Anthene*	*amarah*	*amarah*	Black striped hairtail	Least Concern	Confirmed
Lycaenidae	*Axiocerses*	*amanga*	*amanga*	Bush scarlet	Least Concern	High
Lycaenidae	*Axiocerses*	*tjoane*	*tjoane*	Eastern scarlet	Least Concern	High
Lycaenidae	*Azanus*	*jesous*		Topaz babul blue	Least Concern	Confirmed
Lycaenidae	*Eicochrysops*	*messapus*	*mahallakoaena*	Cupreous blue	Least Concern	Confirmed
Lycaenidae	*Hypolycaena*	*philippus*	*philippus*	Purplebrown hairstreak	Least Concern	High
Lycaenidae	*Oraidium*	*barberae*		Dwarf blue	Least Concern	Probable
Lycaenidae	*Tarucus*	*sybaris*	*sybaris*	Dotted blue	Least Concern	Confirmed
Lycaenidae	*Tuxentius*	*calice*		White pie	Least Concern	High
Lycaenidae	*Tuxentius*	*melaena*	*melaena*	Black pie	Least Concern	Confirmed
Lycaenidae	*Virachola*	*dinochares*		Apricot playboy	Least Concern	High
Nymphalidae	*Byblia*	*ilithyia*		Spotted joker	Least Concern	Confirmed
Nymphalidae	*Charaxes*	*phaeus*		Demon charaxes	Least Concern	Confirmed
Nymphalidae	*Junonia*	*hierta*	*cebrene*	Yellow pansy	Least Concern	Confirmed
Nymphalidae	*Junonia*	*oenone*	*oenone*	Blue pansy	Least Concern	Confirmed

Table 23: A list of butterfly species observed on the study site apart from those recorded by Mecenero *et al.*, 2013

Family	Genus & species	Common Name	Distribution
Lycaenidae	*Lampides boeticus*	Long-tailed Blue	Widespread & common
Lycaenidae	*Leptotes babaulti*	Babault's Blue	Widespread & common
Lycaenidae	*Zizula hylax*	Gaika Blue	Widespread & common
Nymphalidae	*Stygionympha wichgrafi wichgrafi*	Wichgraf's Hillside Brown	Mountain bushveld
Nymphalidae	*Charaxes achaemenes achaemenes*	Bushveld Charaxes	Mountain bushveld
Nymphalidae	*Danaus chrysippus orientis*	African Monarch	Widespread & common
Nymphalidae	*Hypolimnas misippus*	Common Diadem	Widespread & common
Nymphalidae	*Hamanumida daedalus*	Guineafowl Butterfly	Very common
Nymphalidae	*Acraea neobule neobule*	Wandering Donkey Acraea	Widespread & common
Nymphalidae	*Vanessa cardui*	Painted Lady	Widespread & common
Pieridae	*Catopsillia florella*	African Migrant	Widespread & common
Pieridae	*Eurema brigitta brigitta*	Broad-bordered grass yellow	Widespread & common
Pieridae	*Teracolus eris eris*	Banded Gold Tip	Widespread & common
Pieridae	*Pinacopteryx eriphia eriphia*	Zebra White	Widespread & common
Pieridae	*Mylothris agathina agathina*	Common Dotted Border	Localised to well-wooded ravines and mountain bushveld
Papilionidae	*Papilio demodocus demodocus*	Citrus Swallowtail	Fairly common & widespread

Scorpion taxa

The majority of scorpion taxa are substrate specialists and are therefore good indicators of environmental change. These species are so-called stenotopic based on their high habitat specificity. Table 24 (and Figure 29 (Pachnoda Consulting cc, 2015)) lists those species observed and expected to occur on the study site. *Uroplectes carinatus* and *U. vittatus* were the two prominent (dominant) taxa on the study site.

Table 24: A list of scorpion taxa expected to be present on the study site

Family	Species	Status
Buthidae	*Parabuthus mossambicensis*	Expected, possibly widespread on low-lying areas
	Parabuthus transvaalicus	Widespread and common from rocky areas.
	Uroplectes carinatus	Widespread and common.
	Uroplectes planimanus	Expected to occur on rocky areas.
	Uroplectes olivaceus	Expected to occur on low-lying areas.
	Uroplectes triangulifer	Widespread, most areas.
	Uroplectes vittatus	Widespread and arboreal
Liochelidae	*Hadogenes troglodytes*	Occurs under exfoliating rock - not recorded but expected to occur.
	Opistacanthus asper	Uncommon, an arboreal species
Scorpionidae	*Opistophthalmus glabrifrons*	Expected.
	Opistophthalmus carinatus	Expected.

Mygalomorph (baboon) spiders

The baboon spider *Augacephalus junodi* was observed on the site (Figure 30 (Pachnoda Consulting cc, 2015)). This species are stenotopic and once mature, it loses the ability to construct burrows (the rastellum on their chelicerae is lost). Therefore, once a burrow is constricted, they remain (mainly the females) in this burrow for the rest of their lives, making them especially vulnerable towards habitat destruction. It is considered to be widespread on the study site although it is present in low densities (therefore easily overlooked). Only two burrows were observed during the survey period from mountain bushveld and open *Peltophorum africanum – Dombeya rotundifolia* woodland.

Augacephalus junodi is protected under Schedule 10 of the Limpopo Environmental Management Act No 7 of 2003.

Odonata (dragonflies & damselflies)

Only four dragonfly (Anisoptera) taxa were observed (Table 25). These species were only observed from a small reservoir that is used to provide drinking water to game. Nevertheless, the observed taxa are all "sweepstake" and opportunistic species and are able to rapidly colonise ephemeral resources when available (mainly to reproduce). These taxa are widespread, and based on the cumulative dragonfly biotic index (DBI), the ecological integrity of "wetland-associated" features on the study site are compromised and of low importance.

Table 25: A list of observed dragonfly taxa and associated dragonfly biotic index

Family	Species	DBI
Libellulidae	*Pantala flavescens*	0
Libellulidae	*Trithemis arteriosa*	0
Libellulidae	*Trithemis kirbyi*	0
Libellulidae	*Tramea bassilaris*	0
	Total:	0

1.8 Surface water

1.8.1 General description

Information for this section was obtained from 'Information in support of application for rectification of existing mine residue disposal' (Shangoni Management Services, 2011) & 'Storm water management plan' (Rational Environmental, 2015).

The proposed operation is located in the Limpopo catchment, Bierspruit Sub-catchment a part of the Crocodile Catchment, in the quaternary catchment area A2. The operation is located in the Crocodile (West) and Marico Water Management Area. Surface water draining from the site mostly takes place in the form of overland flow collecting in the network of non-perennials originating on the site. The non-perennials drain into the Bierspruit to the south of RAM, which in turn flows into the Crocodile River situated north-east from the site. Most of the runoff is diverted away from the quarries by means of trenches.

1.8.2 Rainfall depths and peak flows

The design rainfall depths are estimated for different return periods and durations at the weather station Thabazimbi (0587697 A), 11km North East of the site.

Table 26: Design rainfall depths at Thabazimbi

Duration (days)	Return period (years)						
	2	5	10	20	50	100	200
1	54	73	87	102	122	138	155
2	67	91	108	125	148	166	185
3	78	105	124	142	167	187	206
4	83	112	132	151	177	196	217
5	88	119	139	159	185	205	225
6	92	123	144	164	190	210	230
7	98	132	154	175	203	223	244

Flood peaks are calculated for the upstream catchments to determine the peak volume of water that will pass the site in the event of a rain event at different return periods. The flood peak is the maximum rate of inflow that can be expected from accumulated runoff in the catchment area. The alternative rational method is used to calculate the expected runoff during different flood return periods. Verification

of the results is done by means of the unit hydrograph and standard design flood (SDF) method. The Utility Program for Drainage, based on the SANRAL manual was used to model flood peaks.

Table 27: Quarry 3 Drain catchment flood peaks

Return period (years)	Time of concentration (hours)	Point rainfall (mm)	ARF (%)	Average intensity (mm/h)	Factor Ft	Runoff coefficient (%)	Peak flow (m^3/s)
1:2	0.58	22.67	100.00	39.40	0.75	34.6	1.014
1:5	0.58	38.25	100.00	66.47	0.80	36.9	1.825
1:10	0.58	50.03	100.00	86.94	0.85	39.2	2.536
1:20	0.58	61.82	100.00	107.42	0.90	41.5	3.318
1:50	0.58	77.40	100.00	134.48	0.95	43.8	4.385
1:100	0.58	89.18	100.00	154.96	1.00	46.1	5.318

Table 28: Quarry 7 Drain catchment flood peaks

Return period (years)	Time of concentration (hours)	Point rainfall (mm)	ARF (%)	Average intensity (mm/h)	Factor Ft	Runoff coefficient (%)	Peak flow (m^3/s)
1:2	0.45	20.85	100.00	46.60	0.75	34.6	0.850
1:5	0.45	35.18	100.00	78.62	0.80	36.9	1.530
1:10	0.45	46.02	100.00	102.83	0.85	39.2	2.127
1:20	0.45	56.86	100.00	127.05	0.90	41.5	2.782
1:50	0.45	71.18	100.00	159.07	0.95	43.8	3.677
1:100	0.45	82.02	100.00	183.28	1.00	46.1	4.459

1.83 Normal flow during dry weather

The normal dry weather flow in the affected water course is gentle.

1.8.4 Surface water quality

Various surface water quality results for two points – RA2 & RA3 - are given in Figure 14 to 21 below. RA2 is downstream water outside RAM, after it is mixed with the run-off water from RAM. RA3 is water upstream outside RAM before is mixed with the run-off water from the plant. RA3 is therefore a good indication of the baseline water qualities and a comparison between RA3 and RA2 indicates the impact of the existing mine activities (including plant activities) on the surface water quality. Water qualities are measured against both the South African National Standard (SANS 241-2011) as well as the Target Water Quality Guidelines (TWQG). Water qualities measured are pH, sulphates (SO_4), chlorides, total dissolved solids (TDS), nitrates (NO_3), *Escherichia coli* (*E. coli*), and total coliform bacteria.

1.8.4.1 Chemical analysis

pH:

According to Figure 14 below, all water qualities are within the pH limits for both the TWQG as well as the SANS 241-2011.

Chloride:

According to the TWQG, water with chloride levels less than 100mg/l has no aesthetic or health effects, whereby water with levels between 100mg/l and 200mg/l has no aesthetic or health effects, but a possible increase in the corrosion rate in domestic appliances. Water with levels between 200mg/l and 600mg/l has a distinctly salty taste, but no health effects, with a likelihood of noticeable increase in corrosion rates in domestic appliances. According to Figure 15 below, both the surface water qualities upstream and downstream of RAM show high levels of chloride. Water in 2009 had chloride levels below 100mg/l. The water upstream, which is not yet impacted by RAM activities, show higher levels of chloride than the water impacted by RAM activities.

Sulphate:

According to Figure 16 below, all water qualities are below the SO_4 limits for both the TWQG as well as the SANS 241-2011.

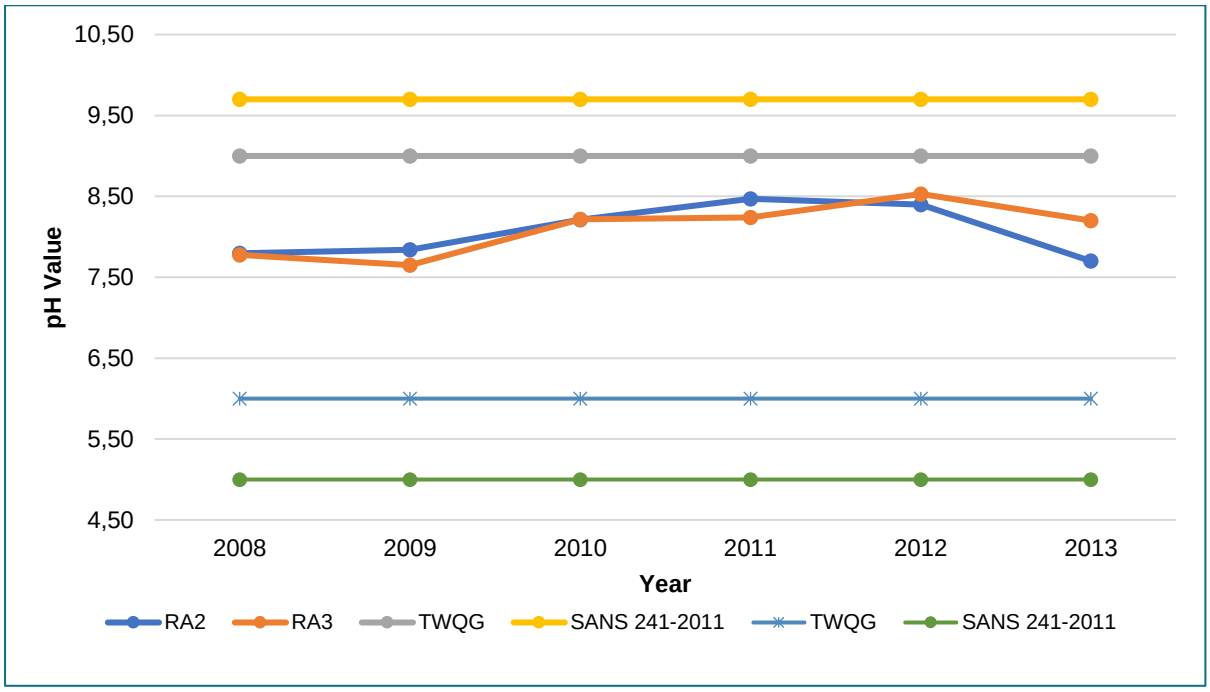


Figure 14: pH results of surface water for the years 2008 to 2013

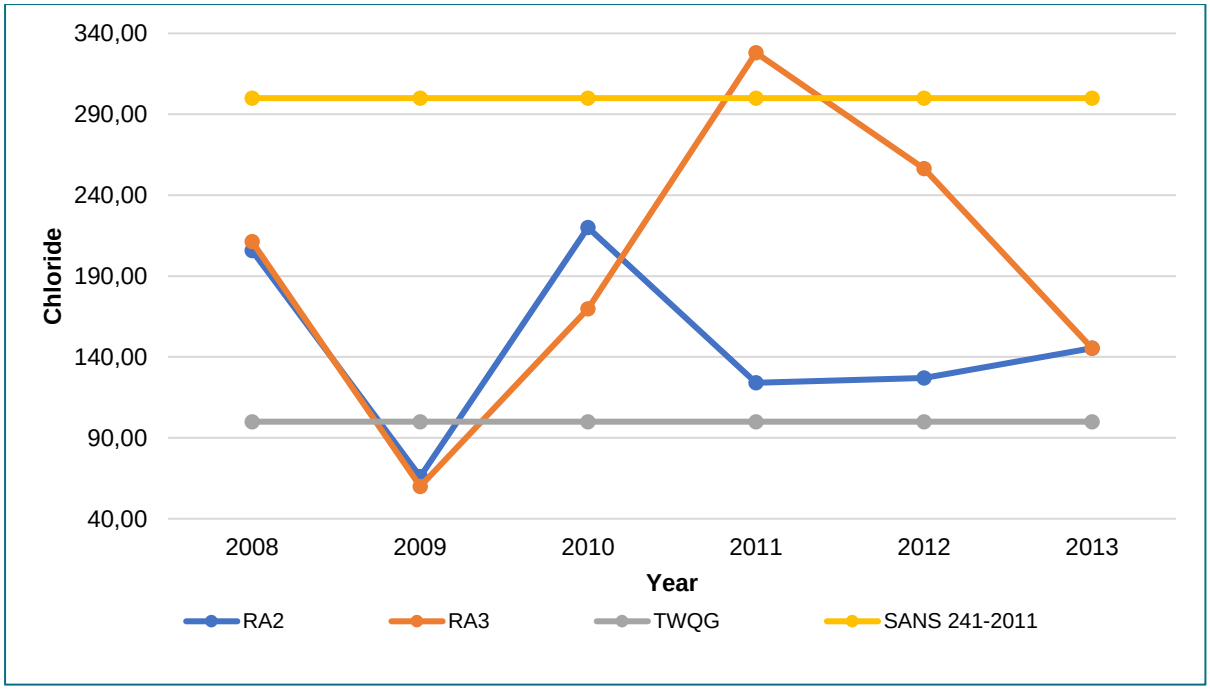


Figure 15: Chloride results of surface water for the years 2008 to 2013

Total dissolved solids or electrical conductivity:

According to the TWQG (1996):

'The TDS is a measure of the amount of various inorganic salts dissolved in water. The TDS concentration is directly proportional to the electrical conductivity (EC) of water. Since EC is much easier to measure than TDS, it is routinely used as an estimate of the TDS concentration.'

RAM measures the EC of the surface water qualities. The TWQG limits indicates TDS levels, therefore only the SANS 241-2011 limits are used. According to Figure 14 below the downstream water in 2010 is above the SANS 241-2011 limits, and the upstream water in 2011 is above these limits.

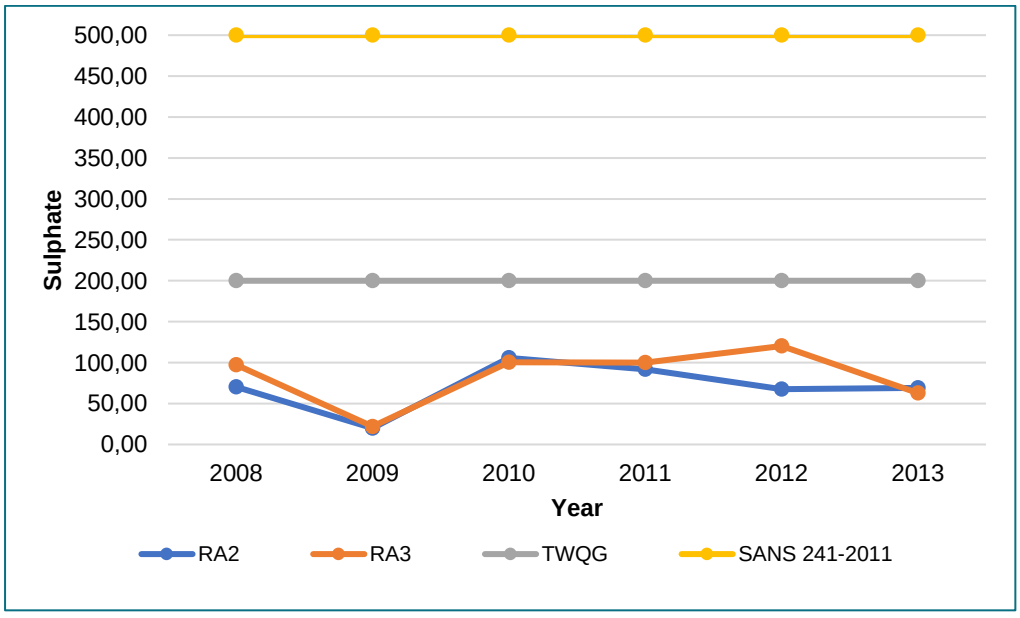


Figure 16: Sulphate results of surface water for the years 2008 to 2013

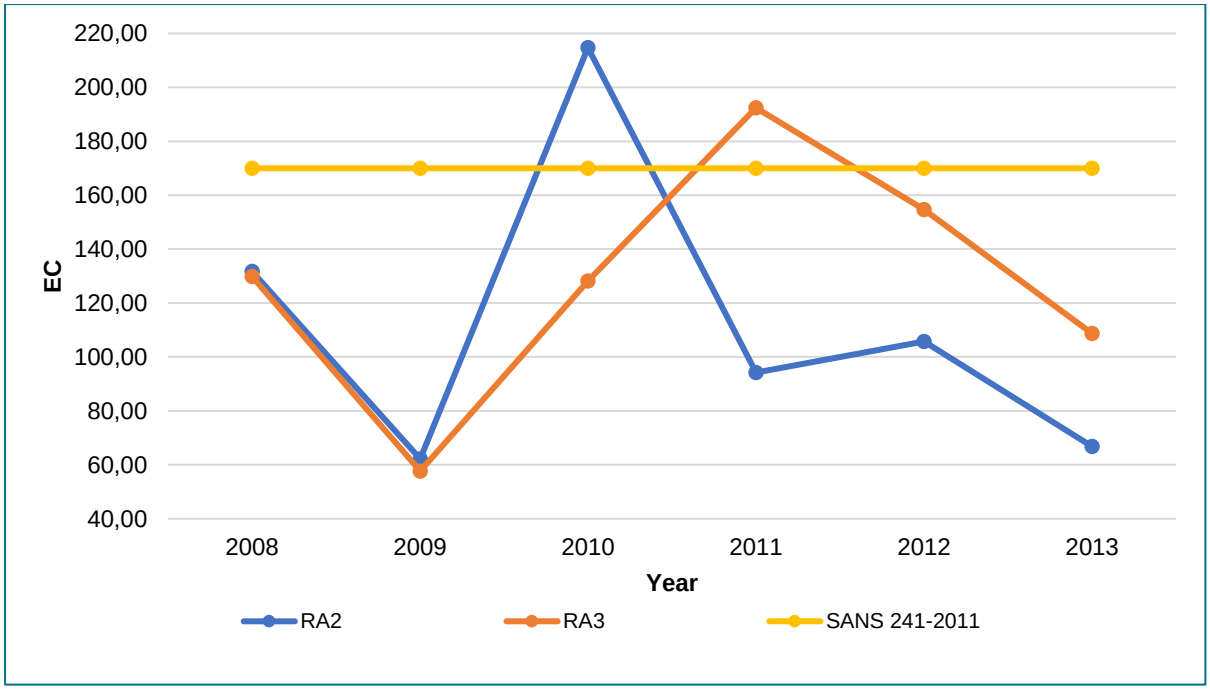


Figure 17: EC results of surface water for the years 2008 to 2013

Nitrates:

According to Figure 19 below the downstream water in 2011 is above both the TWQG and SANS 241-2011 limits, and the upstream water in 2012 is above the TWQG limits. High levels of NO_3 lead to the following effects (TWQG, 1996):

'Upon absorption, nitrite combines with the oxygen-carrying red blood pigment, haemoglobin, to form methaemoglobin, which is incapable of carrying oxygen. This condition is termed methaemoglobinaemia. The reaction of nitrite with haemoglobin can be particularly hazardous in infants under three months of age and is compounded when the intake of Vitamin C is inadequate.'

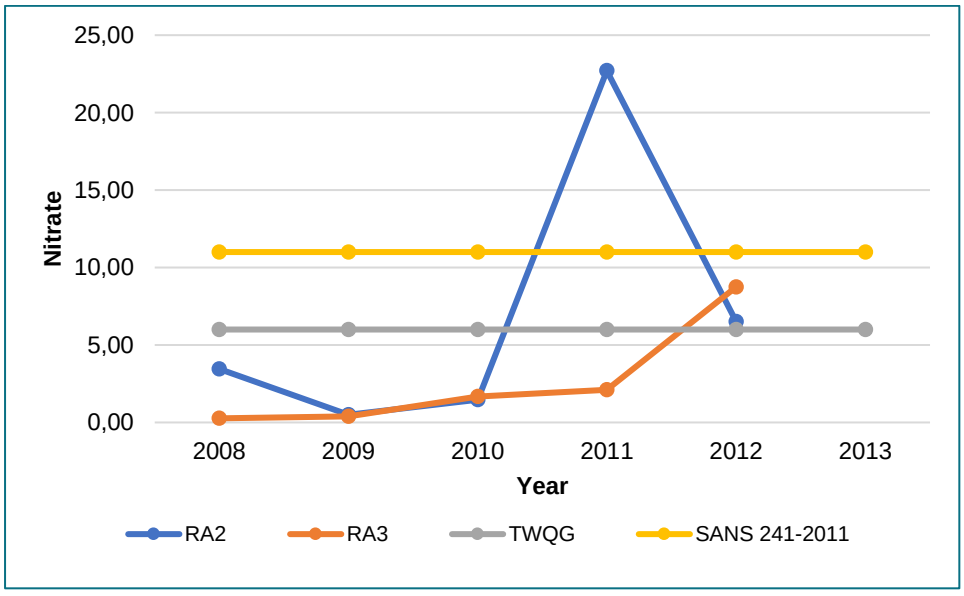


Figure 18: Nitrate results of surface water for the years 2008 to 2013

1.8.4.2 Bacteriological analysis

E. coli:

According to Figure 19 below, *E. coli* levels downstream of RAM were very high. Also refer to Figure 20 which indicates only upstream levels. These levels also exceeded the limits throughout the sampling period.

Total coliform bacteria:

According to Figure 21 below, Total coliform levels downstream and upstream of RAM were very high.

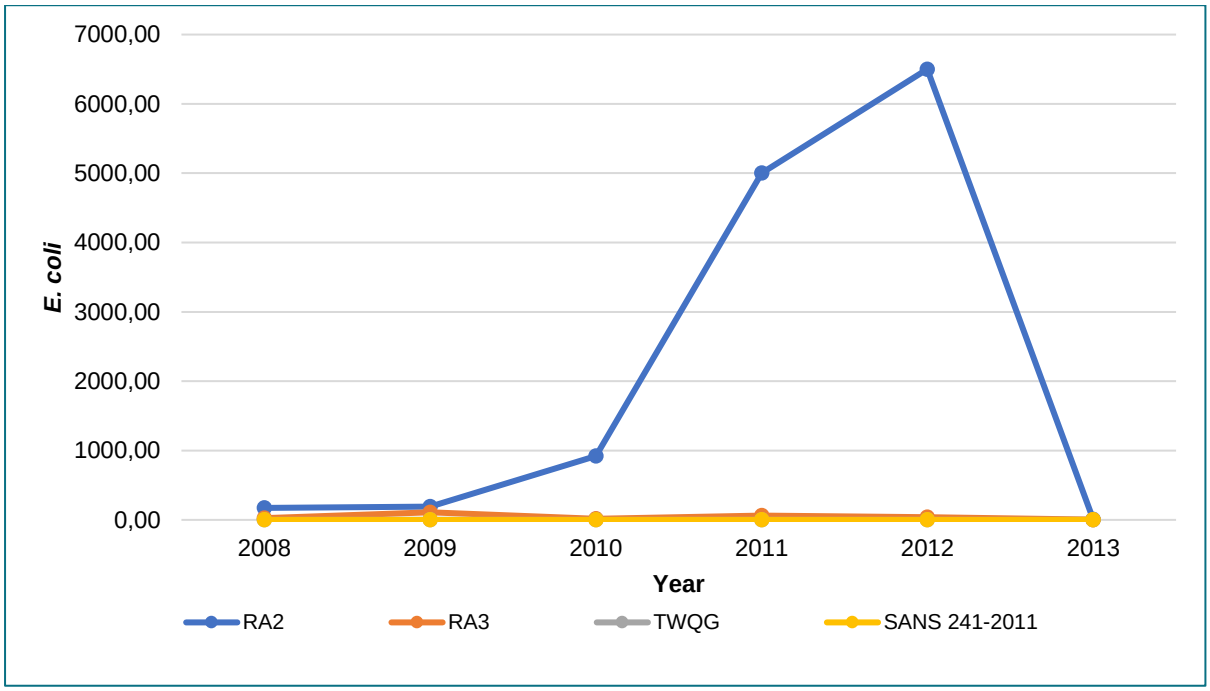


Figure 19: *E. coli* results of surface water for the years 2008 to 2013

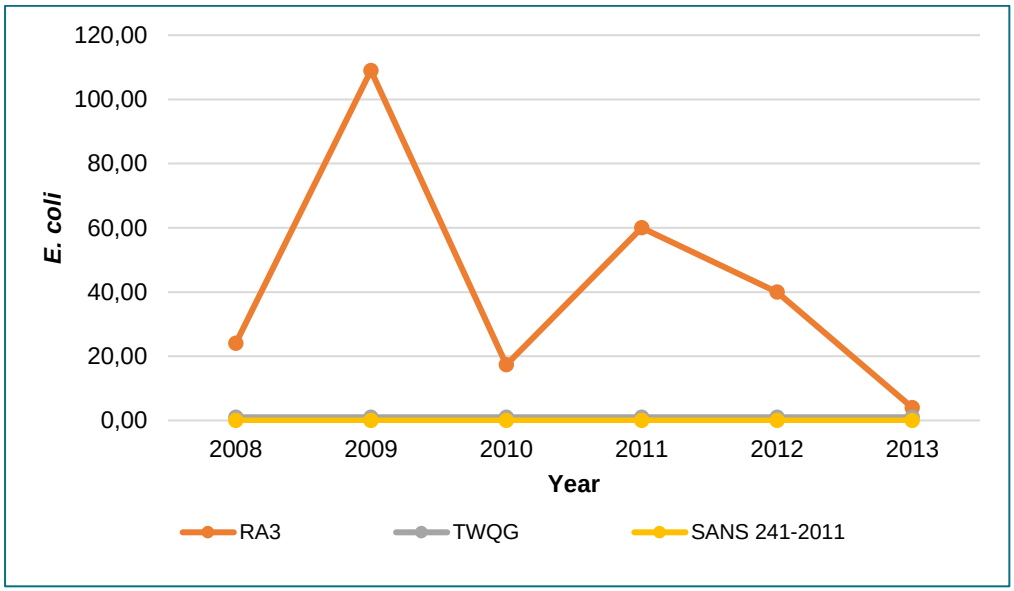


Figure 20: *E. coli* results of upstream surface water for the years 2008 to 2013

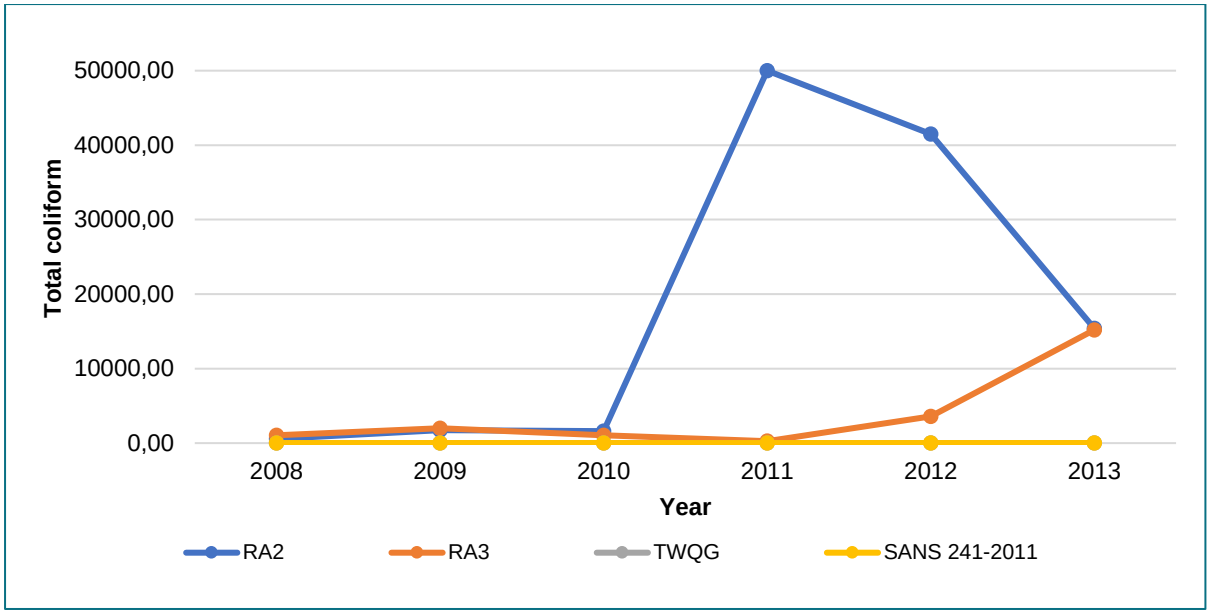


Figure 21: Total coliform results of surface water for the years 2008 to 2013

1.8.5 Water authority

The relevant water authority in this instance is the DWS – Lower Crocodile (West) and Marico (Hartbeespoort) regional office.

1.8.6 Wetlands

According to both the Ecological study (Pachnoda Consulting cc, 2015) and the Soil, Land Use and Land Capability study (Gudani Consulting, 2015) there are no wetlands on the proposed site.

1.8.7 Water use

Surface water use in the area is mainly for agricultural purposes, with little domestic use. Agricultural water uses include both irrigation and livestock watering.

1.9 Groundwater

Information for this section was obtained from the 'Report on geohydrological investigation as part of the EIA, EMP and IWULA (Groundwater Complete, 2015).

1.9.1 Hydrocensus/user survey

A hydrocensus and groundwater user survey was conducted by Aquatico Scientific within radius of up to 10km around the project area. A total of 32 boreholes were located during the hydrocensus/user survey and their positions are indicated in Figure 7 (Groundwater Complete, 2015). Summaries of the findings are provided in Figure 8 (Groundwater Complete, 2015) and Table 29, while the complete hydrocensus report is provided in Appendix A (Groundwater Complete, 2015). Nearly half of all boreholes located are used for domestic purposes, game and livestock watering and irrigation.

Table 29: Results of hydrocensus/user surveys

Locality	Farmer/Owner	Farm	Coordinates		Static water level (m)	Depth (m)	Sampled	Use
			South	East				
Aquatico Hydrocensus								
BH1	Rhino Mine	-	-24.70767	27.26000	31.5	80	Yes	Dust suppression
BH2	Rhino Mine	-	-24.70749	27.25978	34.3	51	Yes	Dust suppression
BH3	Rhino Mine	-	-24.70773	27.25939	31.9	50	No	Dust suppression
BH4	Rhino Mine	-	-24.70868	27.25988	-	-	Yes	Dust suppression
BH5	Rhino Mine	-	-24.70900	27.25993	25.0	87	Yes	Dust suppression
BH6	Rhino Mine	-	-24.69452	27.30581	29.0	100	Yes	Plant process water
BH7	Rhino Mine	-	-24.66944	27.30597	30.0	80	Yes	Plant process water
BH8	Rhino Mine	-	-24.67261	27.31564	10.1	43	Yes	Plant process water
BH9	Rhino Mine	-	-24.67328	27.31632	10.1	15	Yes	Plant process water
BH10	Rhino Mine	-	-24.67355	27.31666	15.6	25	Yes	Plant process water
BH11	Rhino Mine	-	-24.67355	27.31666	9.4	15	Yes	Plant process water
BH12	Rhino Mine	-	-24.67495	27.31642	-	-	Yes	Plant process water
BH13	Rhino Mine	-	-24.67495	27.31642	9.1	10	Yes	Plant process water
Bokkie1	Bokkie Bronkhorst	Roodedam	-24.71127	27.32606	17.0	44	Yes	None
FerdieBotha1	Ferdie Botha	Tygerkloof 1	-24.72327	27.23783	37.8	40	Yes	None
FerdieBotha2	Ferdie Botha	Tygerkloof 1	-24.73134	27.22120	19.2	45	Yes	None
JohanVenter1	Johan Venter	Roodedam 4	-24.70894	27.29749	50.3	80	Yes	Domestic/livestock/irrigation
KobusMuller1	Kobus Muller	Roodedam 12 & 14	-24.71369	27.31340	-	100	Yes	Domestic/livestock/irrigation
KobusMuller2	Kobus Muller	Roodedam 12 & 14	-24.71369	27.31340	-	96	Yes	Domestic/livestock/irrigation
KobusMuller3	Kobus Muller	Roodedam 12 & 14	-24.71369	27.31340	70.0	80	Yes	Domestic/livestock/irrigation
Leadwood1	Victor Selvadi	Leadwood	-24.75627	27.21675	-	-	Yes	Domestic/livestock
Leadwood2	Victor Selvadi	Leadwood	-24.75848	27.20250	36.8	100	Yes	None
Leadwood3	Victor Selvadi	Leadwood	-24.76588	27.24796	27.2	65	Yes	Game water
Leadwood4	Victor Selvadi	Leadwood	-24.71642	27.23171	-	-	Yes	Game water

Locality	Farmer/Owner	Farm	Coordinates		Static water level (m)	Depth (m)	Sampled	Use
			South	East				
Leadwood5	Victor Selvadi	Leadwood	-24.72755	27.19343	-	-	Yes	Game water
RheederRanch1	Jan Rheeder	Grootfontein	-24.66656	27.31263	20.1	44	Yes	Game water
RheederRanch2	Jan Rheeder	Grootfontein	-24.66978	27.30704	39.4	100	Yes	None
RheederRanch3	Jan Rheeder	Grootfontein	-24.66928	27.29041	59.5	75	Yes	Game water
RheederRanch4	Jan Rheeder	Grootfontein	-24.68159	27.27847	-	-	Yes	Game water
ScottDenton1	Scott Denton	Hartbeeskopje	-24.75275	27.22900	-	-	Yes	Domestic
ScottDenton2	Scott Denton	Hartbeeskopje	-24.74992	27.24731	-	-	Yes	Livestock
StephanSchoeman1	Stephan Schoeman	Maroelasfontein	-24.76277	27.20533	31.0	60	Yes	None

Note: Coordinates – WGS84

1.9.2 Aquifer delineation

Because the main aquifer is a fractured rock type and fractures could assume any geometry and orientation, the physical boundary or 'end' of the aquifer is very difficult to specify or quantify. Aquifer boundary conditions that are generally considered during the delineation process are described below:

- No-flow boundaries are groundwater divides (topographically high or low areas/lines) across which no groundwater flow is possible.
- Constant head boundaries are positions or areas where the groundwater level is fixed at a certain elevation and does not change (perennial rivers/streams or dams/pans).

Topographic highs (no-flow boundary) and the perennial Bierspruit (constant head boundary) were used to roughly delineate the aquifer system underlying the project area (Figure 22). The aquifer was estimated to cover an area of approximately 420km².

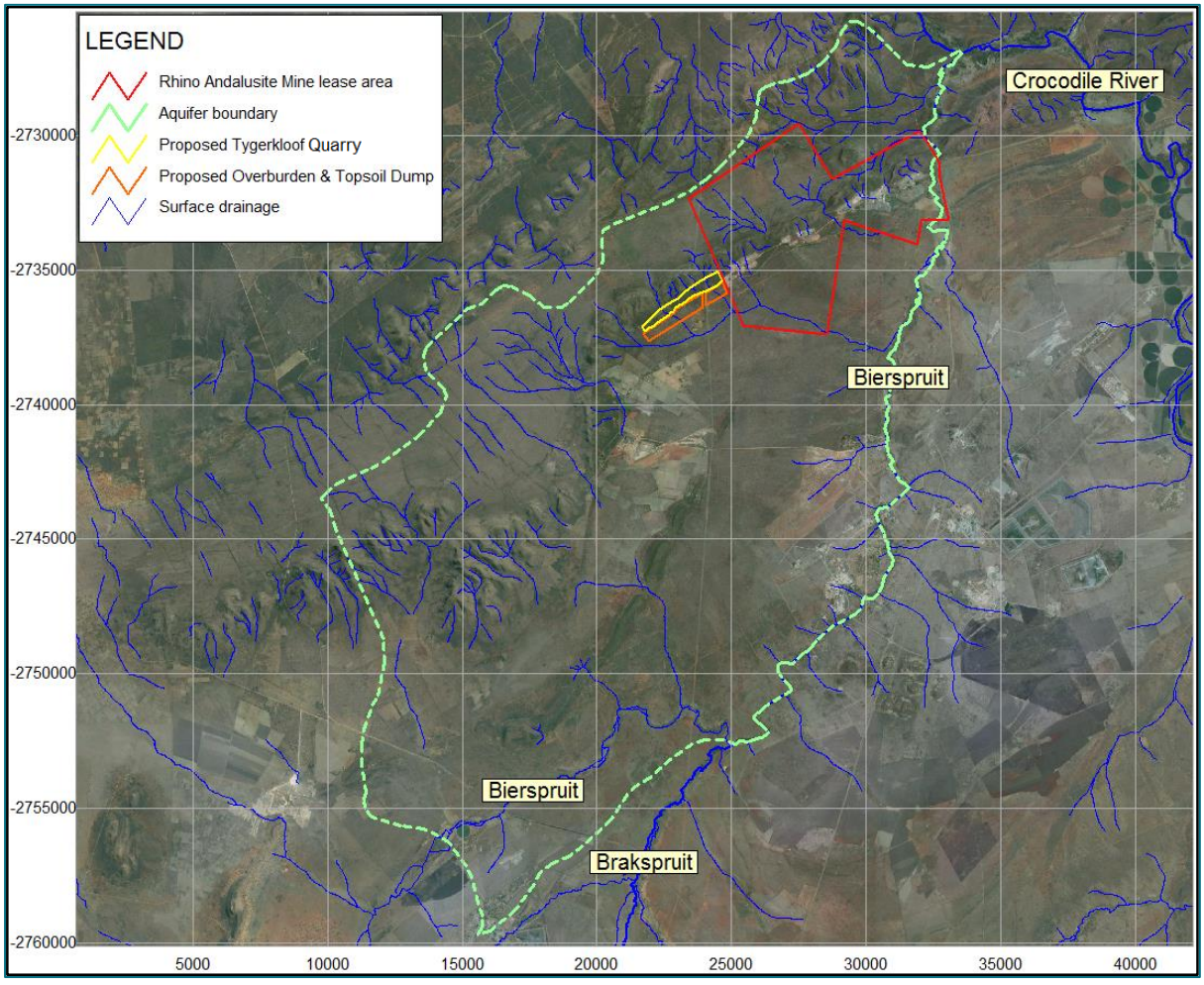


Figure 22: Aquifer delineation for project area

1.9.3 Groundwater level depth

Groundwater levels in the project area are available from monitoring boreholes and surrounding groundwater user boreholes that were located during the hydrocensus survey. A thematic groundwater

level map of the entire project area is provided in Figure 25. These water levels are essential as they were used in the generation of static groundwater level elevations with the use of the Bayesian interpolation method (Figure 26).

Regional static groundwater levels around the project area generally vary between ±9m and 70m below surface. Some of the deeper groundwater levels measured during the hydrocensus surveys are the result of groundwater abstraction. Due to the generally low aquifer transmissivities the pumping causes deep drawdown of the groundwater levels/piezometric heads and depression cones form that are deep, but very limited in lateral extent.

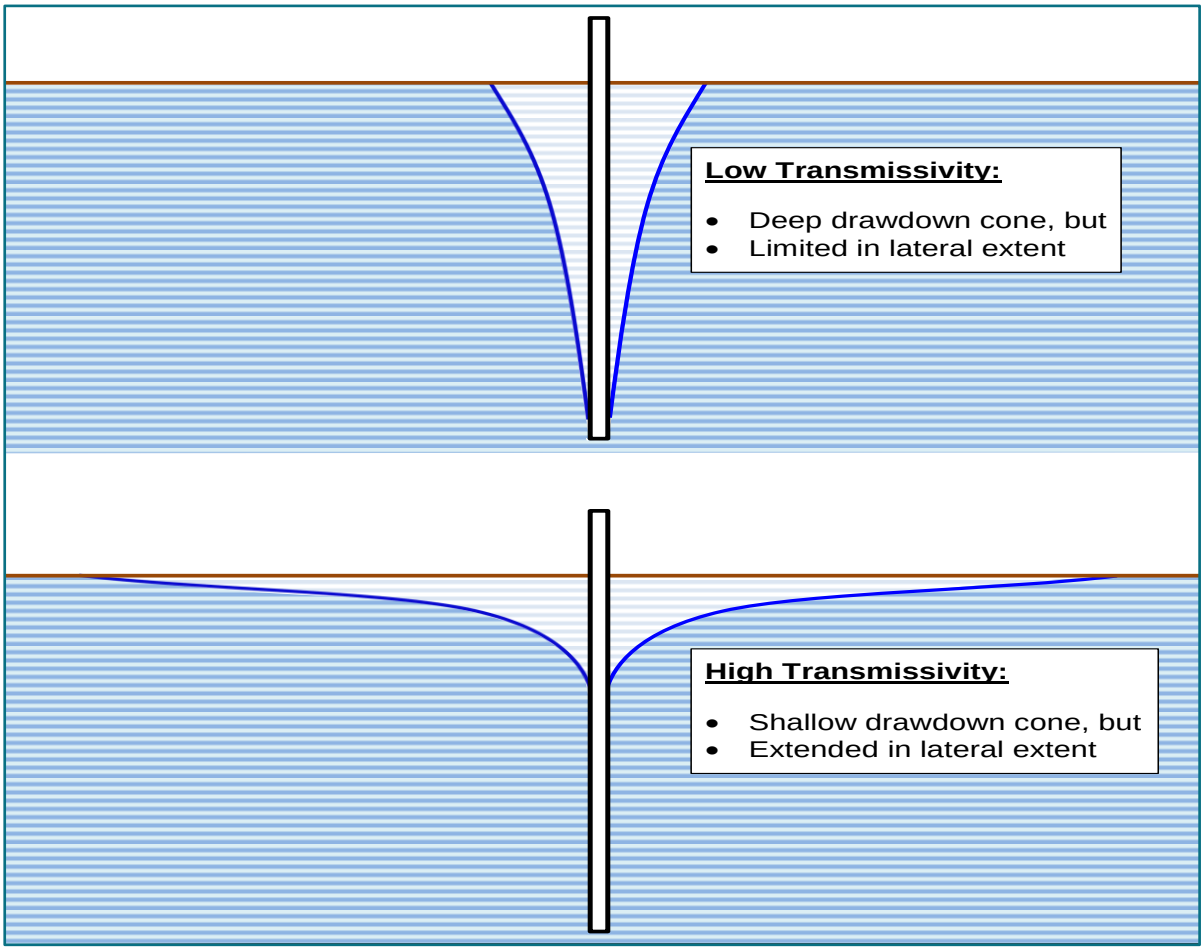


Figure 23: Effect of aquifer transmissivity on depression cone

The static groundwater elevation contour map provided in Figure 23 was constructed through the utilisation of the Bayesian interpolation technique. The Bayesian interpolation technique utilises the natural relationship that exists between the surface topography and the depth-to-groundwater level to estimate groundwater levels in areas where borehole data is scarce.

Because impacts on the natural groundwater level already exist due to groundwater abstraction for domestic and irrigation purposes, only boreholes where the linear correlation between borehole collar

elevation and groundwater level elevation exists were used in the interpolation. The pre-mining static groundwater contours presented in Figure 23 therefore represent conditions without impacts from sources or actions other than natural conditions.

A graph of borehole collar elevation versus groundwater level elevation is presented in Figure 21 where the linear correlation of approximately 99% can be seen. It should be noted that groundwater levels from some boreholes were discarded because impacts from groundwater abstraction destroys the natural groundwater-topography relationship.

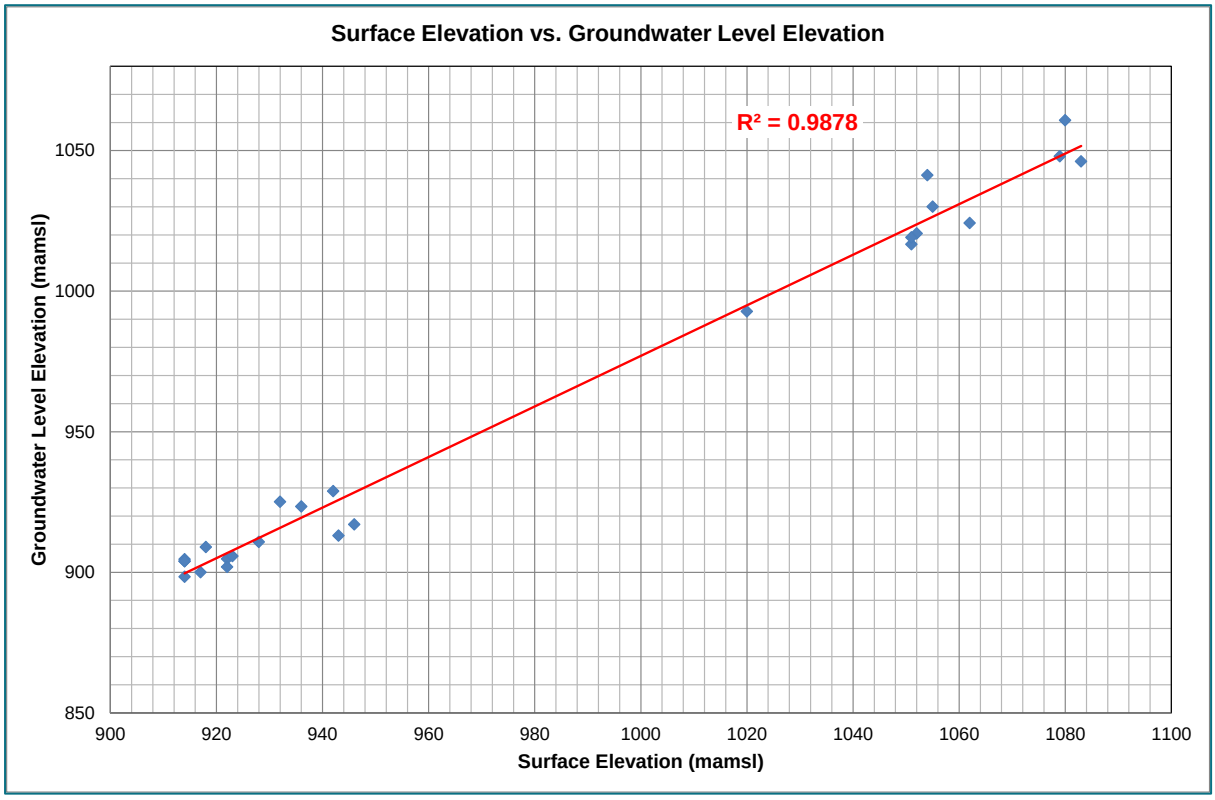


Figure 24: Relationship between surface and groundwater level elevation

The highest static water level elevation within the immediate vicinity of the project area is approximately 1,360mamsl and occurs in the topographically higher region of the Witfonteinrand Mountain range. The lowest static water level elevation where no impact from abstraction occurs is at approximately 880mamsl in the northern down gradient direction. Groundwater flow directions within the project area are also indicated in Figure 23 with the use of blue arrows.

Seen in the light of water level differences because of mining, pumping and recharge effects, filtering and processing of water levels is required to remove water levels considered anomalous high or low. **The final interpolated potentiometric surface of the water levels is thus bound to contain local over- or under estimations of the actual water levels, but it will be representative of the general regional trend of the static groundwater level.**

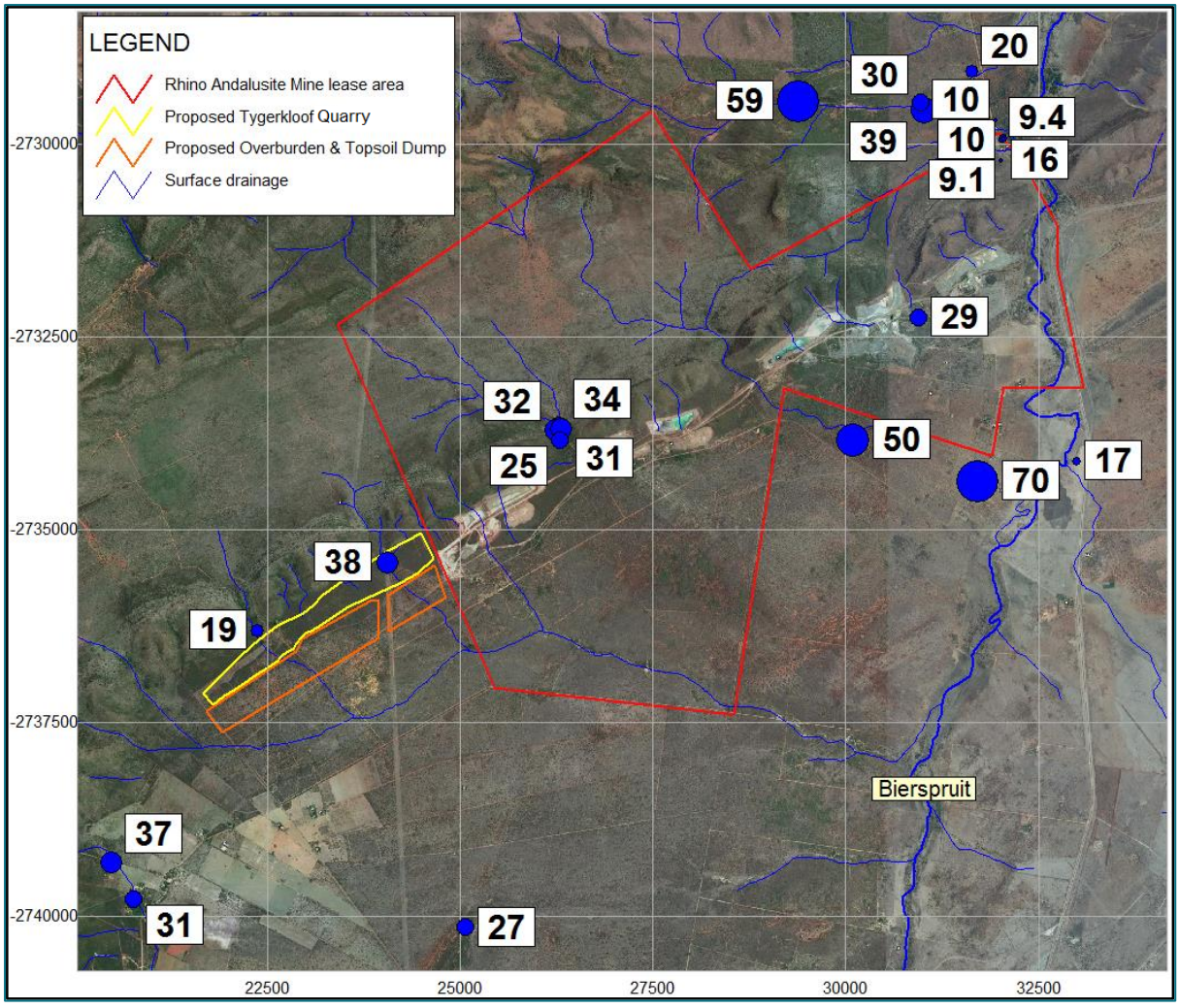


Figure 25: Thematic map of groundwater level depths (mbs)

Notes: - The numbers in the above figure indicate the groundwater level depth below surface in meters,

- The blue circles represent the positions of the user/monitoring boreholes,

- The size of the blue circles is directly proportional to the groundwater level depth; hence the largest circle represents the deepest water level.

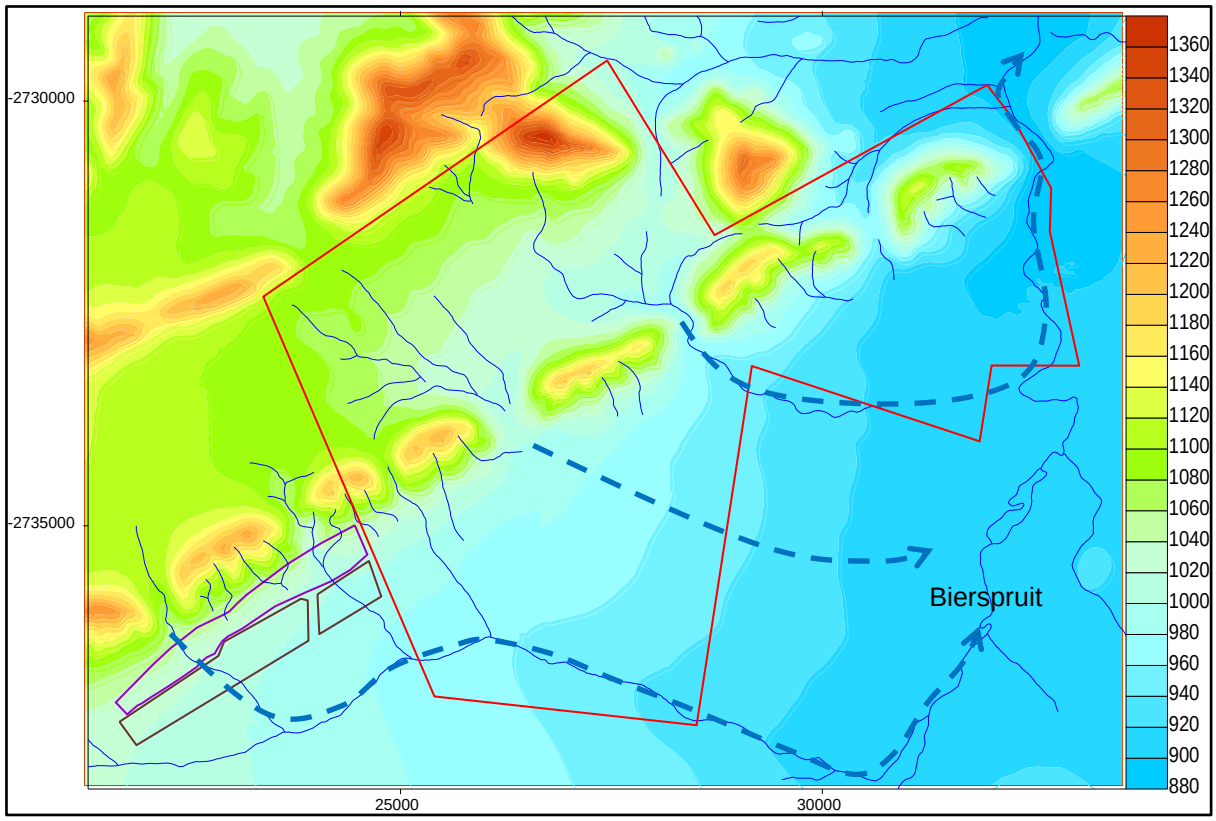


Figure 26: Bayesian interpolated groundwater elevation contour map of the project area (mamsl)

1.9.4 Groundwater flow directions, gradients and velocities

Contours of the static water levels or piezometric heads in and around the project area are indicated in Figure 26. Path lines or flow lines of groundwater particles are lines perpendicular to the contours, as indicated with arrows. Flow occurs faster where contours are closer together and gradient are thus steeper.

On the relatively steeper sloping hillocks where groundwater gradients are higher, groundwater seepage rates are correspondingly higher. Seepage rates on the other hand are much lower in the flat plateaus and valley bottoms.

Average groundwater gradients were calculated with the above formula from the water level elevation data by substituting the hydraulic head difference over lateral distance a hydraulic gradient of approximately 2% east/south-eastwards was calculated for the proposed Tygerkloof Quarry mining area.

The pre-mining static groundwater contours represent conditions without impacts from sources or actions other than natural conditions. Groundwater flow gradients were used to calculate the rate of groundwater movement (the so-called 'Darcy flux') within the potentially impacted areas and the results are provided below in Table 30.

Table 30: Direction and rate of groundwater movement in the project area

Groundwater flow direction	Groundwater flow gradient	Groundwater flow velocity (m/d)	Groundwater flow velocity (m/y)
East/South-East	3%	0.01	3.65

Notes: Flow velocity (Darcy Flux) calculations were done by assuming an average aquifer porosity of 6% and hydraulic conductivity of 0.02m/d.

1.9.5 Aquifer types

For the purpose of this study an aquifer is defined as a geological formation or group of formations that can yield groundwater in economically useable quantities. Aquifer classification according to the Parsons Classification (Groundwater Complete, 2015).

The **first aquifer** is a shallow, **semi-confined or unconfined aquifer** that occurs in the transitional soil and **weathered bedrock zone** or sub-outcrop horizon. Drilling in the project area indicated the presence of significant scree deposits, which are restricted to the lower lying areas. Yields in this aquifer are generally low (less than 0.5l/s) and the aquifer is usually not fit for supplying groundwater on a sustainable basis. Consideration of the shallow aquifer system becomes important during seepage estimations from pollution sources to receiving groundwater and surface water systems. The shallow weathered zone aquifer plays the most important role in mass transport simulations from process and mine induced contamination sources because the lateral seepage component in the shallow weathered aquifer often dominates the flow. **According to the Parsons Classification system, this aquifer is usually regarded as a minor- and in some cases a non-aquifer system.**

Due to the mainly lateral flow and sometimes phreatic nature of the weathered zone aquifer, it is usually only affected by opencast mining or by high extraction or shallow underground mining where subsidence occurs and the entire roof strata above the mined area is destroyed. Where mining becomes deeper the weathered zone aquifer is usually affected to a very limited extent. The shallow aquifer system is not developed in the mountainous areas where the proposed opencast mining is planned to take place.

The **second, main aquifer system** is the deeper **secondary fractured rock aquifer** that is hosted within the sedimentary rocks of the Transvaal Supergroup. Groundwater yields, although more heterogeneous, can be higher. This aquifer system usually displays semi-confined or confined characteristics with piezometric heads often significantly higher than the water-bearing fracture position. Fractures may occur in any of the co-existing host rocks due to different tectonic, structural and genetic processes. Drilling results indicated an absence of significant water yielding fractures within the secondary fractured rock aquifer. **According to the Parsons Classification system, the aquifer could be regarded as a minor aquifer system, but also a sole aquifer system in some cases where groundwater is the only source of domestic water.**

Notable is the fact that **no significant blow yields** were recorded in the secondary fractured rock aquifer.

If the dip of the strata is considered, the Malmani Sub-group dolomite of the Chuniespoort Group outcrops to the north of the project area. Dolomite is capable of forming major aquifers, especially where widespread karst formation occurred. However, groundwater studies conducted for the adjacent RAM found no signs of significant karst development within the immediate vicinity of the project area – the dolomite is estimated to underlie the proposed Tygerkloof Quarry at a depth of approximately 4,500 meters below surface.

In spite of relatively low blow-out yields, pump tests were performed on 2 boreholes in the immediate vicinity of the proposed quarry in order to obtain representative aquifer parameters for the project area. These pump tests were performed using a low yield (± 0.3 l/s) pump with the main aim of determining the transmissivity and storage characteristics of the solid geological formation – the so-called aquifer matrix. These low rate pump tests are performed instead of the more commonly used slug tests because of the much-improved accuracy obtained with the pump tests, resulting in much more reliable aquifer parameters calculated from the tests. The tests results are provided in Table 27.

1.9.6 Aquifer transmissivity and storativity

Constant rate pump tests were performed on two boreholes and their positions are indicated in Figure 28 (Groundwater Complete, 2015). A short summary of the pump tests is also provided in Table 31.

Data collected from the pump tests were used to determine aquifer parameters such as transmissivity and storativity for both the matrix- and fracture flow stages.

Table 31: Summary of pump tests

BH	**BH depth**	**Static WL**	**Pump duration**	**Pump rate**	**Drawdown**	**Recovery**
Unit	***m***	***mamsl***	***min***	***l/s***	***m***	***%***
FerdieBotha2	97	19.1	48	0.30	25.0	28% @ 50 min
TKBH02	47	33.6	19	0.35	10.3	66% @ 35 min

Aquifer transmissivity is defined as a measure of the amount of water that could be transmitted horizontally through a unit width of aquifer by the full-saturated thickness of the aquifer under a hydraulic gradient of 1. Transmissivity is the product of the aquifer thickness and the hydraulic conductivity of the aquifer, usually expressed as m^2/day ($Length^2$/Time).

Storativity (or the storage coefficient) is the volume of water that a permeable unit will absorb or expel from storage per unit surface area per unit change in piezometric head. Storativity (a dimensionless quantity) cannot be measured with a high degree of accuracy in slug tests or even in conventional pumping tests. It has been calculated by numerous different methods with the results published widely

and a value of 0.002 to 0.01 is taken as representative for the proposed mining area. The storage coefficient values calculated from the pump tests proved to be in this order of magnitude.

The pump test data was analysed with the AQTESOLV Professional software package, which offers a wide range of mathematical equations/solutions for the calculation of aquifer parameters. The time-water level data collected during the constant rate pump test is plotted on a log-linear graph. A straight line can then be fitted to the different flow stages on the graph (process known as curve matching) and the aquifer transmissivity and storativity is calculated in accordance with the preselected analytical equation. All aquifer parameters provided in this report were calculated with the *Cooper-Jacob (1946)* equation.

Examples of curve matching are provided in Figures 16 and 17 (Groundwater Complete, 2015), which illustrate aquifer parameters calculated for both the matrix- and fracture flow stages. It is important to note that the Cooper-Jacob approximation algorithm for pump test analysis was designed for pump tests interpretation in a primary porosity aquifer environment with the following assumptions:

- The aquifer is a homogeneous medium,
- Of infinite extent,
- No recharge is considered, and
- An observation borehole is used for water level recording at a distance from the pumped borehole.

Although few of these assumptions apply at the project area, the method could still be used as long as the assumptions and 'shortcomings' are recognized and taken into account. It is for this reason that not one straight line is fitted but two different lines are fitted for the fracture and matrix flow periods respectively.

Because aquifer hydraulic parameters (like most geological parameters) usually display a log-normal distribution it is an accepted approach to calculate the harmonic or geometric mean in preference to the arithmetic mean. A generally accepted approach for calculating a representative hydraulic conductivity for an aquifer is to take the average of the harmonic and geometric means. This methodology could however not be followed due to an insufficient amount of data and only averages have been calculated and are provided in Table 32.

It follows that the average transmissivity of the **aquifer matrix** (between fracture zones) in the project area is approximately **0.4m^2/d**, which translates to an average **hydraulic conductivity** of ± **0.02m/d**. The average transmissivity of **fractures** in the area is ± **2.9m^2/d**, translating to an average **hydraulic conductivity of 0.15m/d**.

The extremely heterogeneous nature of the fractured rock aquifer regime may however cause significant variations in aquifer transmissivity/storativity within relatively short distances, which makes it

difficult to determine representative values over large areas. The data distribution of only two boreholes over the project area is far from ideal and aquifer parameters provided in Table 32 below cannot be considered representative of the wider project area. The values obtained, however, are precisely in line with literature values and what we know from experience in the aquifer(s) developed in this shale rock environment.

Table 32: Aquifer parameters calculated from pump tests

BH	Tf	Tm	Sf	Sm
FerdieBotha2	2.7	0.2	0.04	0.18
TKBH02	3.0	0.6	0.05	0.16
Average:	2.85	0.40	0.045	0.170

Note: Tf: - Fracture transmissivity (m^2/d); Tm – Matrix transmissivity (m^2/d); Sf – Fracture storativity/storage coefficient (dimensionless quantity); Sm – Matrix storativity/storage coefficient (dimensionless quantity).

1.9.7 Aquifer recharge and discharge rates

According to Figure 18 (Groundwater Complete, 2015) the mean annual recharge to the aquifer underlying the project area varies between approximately 8mm to 20mm, which based on an average rainfall of approximately 650mm/a (Figure 3 (Groundwater Complete, 2015)) translates to a recharge percentage varying between 1% and 3%.

Where outcrop occurs, the effective recharge percentage can be slightly higher while in low-lying topographies where discharge generally occurs and thicker sediment deposition, the effective recharge will be lower or even zero. Based on this estimate, the mean annual recharge to the aquifer regime as defined in Figure 9 (Groundwater Complete, 2015) should vary between ±3.3Mm^3 & 8.3Mm^3.

1.9.8 Groundwater quality conditions

Groundwater quality data is available for two groups of boreholes, namely user boreholes and purposed drilled monitoring boreholes for the adjacent RAM. Refer to the specialist report for methodology used to assess groundwater quality.

1.9.8.1 Groundwater quality evaluation for user boreholes

Water quality information is available for a total of 17 user boreholes and their positions are indicated below in Figure 27. The results of the chemical analyses are provided in Table 33.

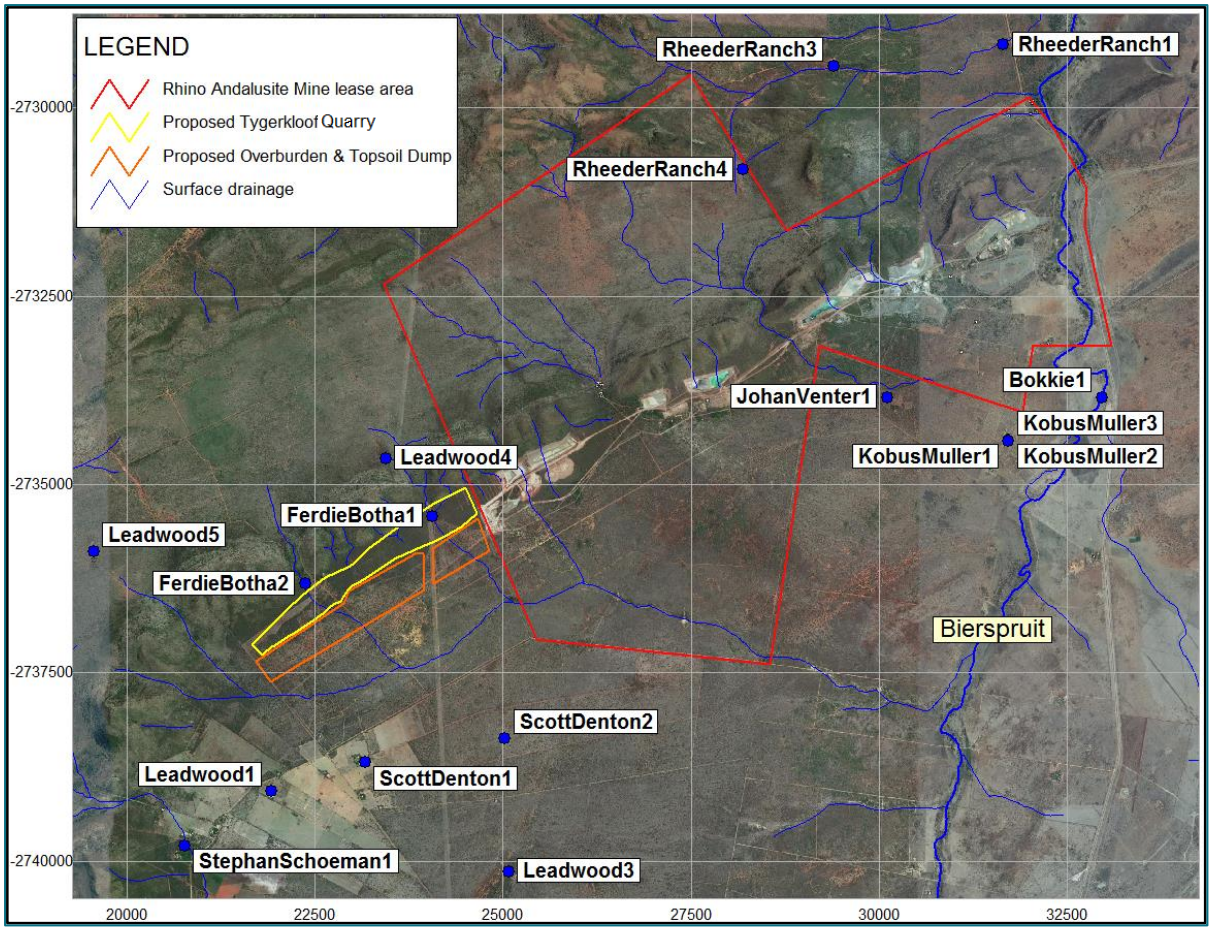


Figure 27: Positions of user boreholes used in groundwater quality assessment

Five chemical parameters (TDS, SO_4, NO_3, Chlorine (Cl) and pH) were chosen from the full list of analytes as indicators of the specific type of contamination expected to occur at the proposed mining operations. Although only the five parameters will be discussed, all inorganic parameters will be assessed, and anomalies will be discussed.

The **TDS** content of groundwater is a good indicator of the overall quality conditions, as it provides a measurement of the total amount/weight of salts that are present in solution. An increase in TDS will therefore also indicate an increase in the total inorganic content of the groundwater. Groundwater TDS concentrations measured in user boreholes vary between ±80mg/l & 850mg/l, which are well below the permissible SANS value of 1,200mg/l (Table 3 (Groundwater Complete, 2015)). A positive linear correlation generally exists between groundwater salinity and aquifer residence time and because gravity dictates that groundwater moves from higher to lower hydraulic gradients, overall higher salinities are generally measured in the lower lying areas and valley bottoms.

This phenomenon may explain the overall higher salinities measured in user boreholes Bokkie1, KobusMuller1 and KobusMuller2, which are located at lower surface elevations close to the Bierspruit.

The SO_4 content of groundwater measured within the user boreholes vary from below the detection limit of 0.04mg/l to approximately 50mg/l, which are well below the permissible SANS value of 500mg/l and representative of ambient conditions. SO_4 contamination is more often than not associated with the oxidation of sulphide bearing minerals (in particular pyrite).

No Acid Base Accounting (ABA) tests were conducted for the purpose of this study. However, ABA test results were obtained for the adjacent RAM, which shows that the rock material contains very low concentrations of sulphur and is non-acid forming (Geohydrological Study for Rhino Minerals – Rhino Andalusite Mine, 2010). Since the RAM and proposed Tygerkloof Quarry are located within the exact same geological environment, similarly low concentrations of sulphur are expected for the project area and no significant acid formation should occur.

The groundwater pH conditions are more or less neutral with values ranging between 7.1 and 8.5. The neutral pH conditions restrict the mobilisation of metals, which are also sensitive to groundwater redox conditions.

Groundwater NO_3 concentrations measured in the majority of boreholes are below the permissible SANS value of 11mg/l (Table 3. Exceptions do however occur as a NO_3 concentration of 16mg/l was measured in user borehole ScottDenton1, which exceeds the permissible SANS value for drinking water (Table 3 (Groundwater Complete, 2015)). Borehole LeadWood1 displayed a concentration of approximately 7mg/l, which despite being below the SANS guideline value, exceeds the ambient concentration of ±1.0mg/l. The once-off analyses do not allow for accurate source identification, however the NO_3 contamination affecting the abovementioned two boreholes is likely to originate from quarry latrines and/or feedlots.

User boreholes displayed groundwater chloride concentrations varying from less than 10mg/l to approximately 230mg/l, which are below the permissible SANS value of 300mg/l. Similar to the groundwater TDS content, overall higher chloride concentrations were measured in user boreholes Bokkie1, KobusMuller1 and KobusMuller2, which are likely to be caused by natural occurring ion exchange reactions as the groundwater moves through the aquifer host rock.

According to the Expanded Durov diagram (EDD) (Figures 18 (Groundwater Complete, 2015)) the user boreholes are dominated by fresh, clean, relatively young groundwater that has started to undergo mineralisation with especially Mg ion exchange. The groundwater is therefore dominated by Mg cations, while bicarbonate (HCO_3) alkalinity dominates the anion content.

Table 33: Concentrations in indicator chemical parameters for user boreholes

Locality	pH	EC mS/m	TDS mg/l	Alk mg/l	Cl mg/l	SO_4 mg/l	NO_3 mg/l	NH_4 mg/l	PO_4 mg/l
Rheeder Ranch1	7.6	72.7	380.0	348.0	25.5	2.8	0.7	0.04	0.06
Rheeder Ranch3	7.1	13.6	76.0	71.3	4.6	1.2	0.4	0.03	0.07
Rheeder Ranch4	8.2	73.3	384.0	379.0	21.8	2.1	0.3	0.28	0.05
Kobus Muller1	8.0	139.0	770.0	529.0	136.0	51.5	0.2	0.02	0.04
Kobus Muller2	7.8	137.0	750.0	504.0	134.0	52.7	0.3	0.03	0.04
Kobus Muller3	7.9	98.8	551.0	486.0	40.8	12.2	0.6	0.01	0.04
Johan Venter1	8.5	88.8	490.0	487.0	20.0	7.2	0.5	0.07	0.04
Bokkie1	7.6	165.0	847.0	481.0	234.0	27.4	4.1	0.03	0.13
Ferdie Botha1	7.4	61.7	324.0	273.0	30.7	13.0	0.2	0.46	0.04
Ferdie Botha2	7.4	78.2	427.0	428.0	9.1	4.4	0.5	0.36	0.04
Leadwood1	8.0	87.2	497.0	475.0	12.5	<0.04	6.9	0.03	0.04
Leadwood3	8.3	62.5	329.0	324.0	10.1	0.3	3.4	0.02	0.04
Leadwood4	7.8	71.5	395.0	403.0	6.9	1.2	0.4	0.02	0.04
Leadwood5	8.0	77.4	407.0	372.0	13.5	18.0	2.1	0.01	0.04
Scott Denton1	8.0	111.0	637.0	528.0	28.4	12.3	15.9	0.02	0.04
Scott Denton2	8.4	74.2	427.0	450.0	7.2	<0.04	0.2	0.14	0.04
Stephan Schoeman1	7.9	91.4	521.0	534.0	10.5	5.1	0.5	0.01	0.04

Locality	F mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	Al mg/l	Fe mg/l	Mn mg/l	Thard mg/l
Rheeder Ranch1	0.3	61.8	54.0	18.3	1.7	<0.003	<0.003	<0.001	376.0
Rheeder Ranch3	0.1	8.6	8.8	7.2	0.3	<0.003	<0.003	<0.001	58.0
Rheeder Ranch4	0.2	42.3	70.6	11.4	3.0	<0.003	<0.003	<0.001	397.0
Kobus Muller1	0.2	88.0	80.4	85.6	4.8	<0.003	<0.003	<0.001	551.0
Kobus Muller2	0.3	91.6	84.3	75.5	3.4	<0.003	<0.003	<0.001	576.0
Kobus Muller3	0.4	60.4	54.9	80.1	3.2	<0.003	<0.003	<0.001	377.0
Johan Venter1	0.3	57.6	86.6	17.5	0.7	<0.003	<0.003	<0.001	500.0
Bokkie1	0.5	66.3	143.0	61.5	2.7	<0.003	<0.003	0.0	754.0
Ferdie Botha1	0.4	55.2	39.5	14.4	3.4	<0.003	<0.003	0.2	300.0

Locality	F mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	Al mg/l	Fe mg/l	Mn mg/l	Thard mg/l
Ferdie Botha2	0.2	84.1	58.7	5.6	1.1	<0.003	<0.003	0.8	452.0
Leadwood1	0.2	74.6	79.6	7.8	1.3	<0.003	<0.003	<0.001	514.0
Leadwood3	0.2	33.1	67.0	5.8	0.3	<0.003	<0.003	<0.001	358.0
Leadwood4	0.2	81.3	54.0	2.6	0.8	<0.003	<0.003	<0.001	425.0
Leadwood5	0.2	60.0	71.6	5.6	1.7	<0.003	<0.003	<0.001	445.0
Scott Denton1	0.3	92.5	89.2	20.8	1.0	<0.003	<0.003	<0.001	598.0
Scott Denton2	0.2	56.7	62.3	23.2	2.0	<0.003	<0.003	<0.001	398.0
Stephan Schoeman1	0.3	103.0	69.6	4.1	0.5	<0.003	<0.003	<0.001	544.0

Note: Values shaded with red are those that exceed the SANS guideline values for drinking water

1.9.8.2 Groundwater quality evaluation for mine monitoring boreholes

Groundwater quality information is available for a total of 12 monitoring boreholes from the adjacent RAM and their positions are indicated below in Figure 28. The results of the chemical analyses are provided in Table 33.

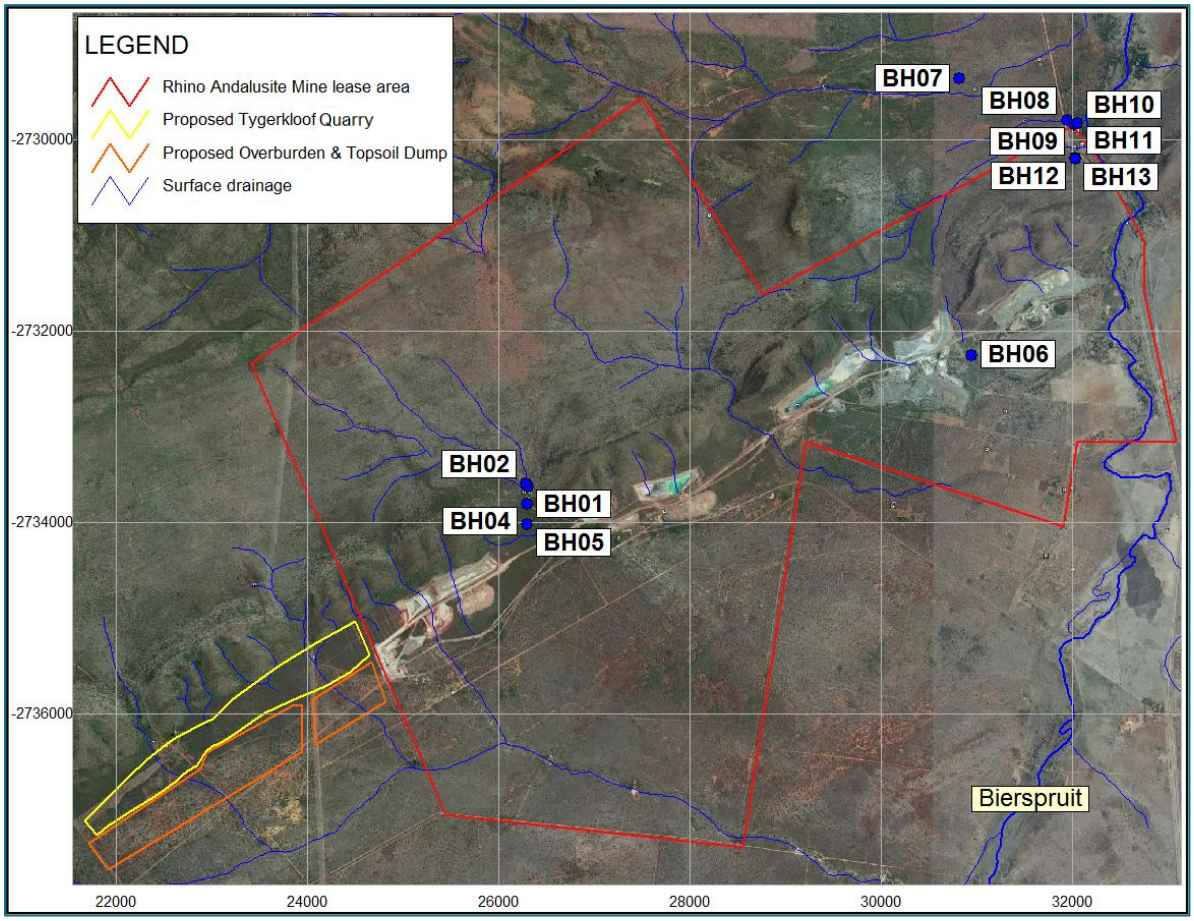


Figure 28: Positions of mine monitoring boreholes used in groundwater quality assessment

Groundwater TDS concentrations measured in mine monitoring boreholes vary between approximately 430mg/l and 1,130mg/l, which are below the permissible SANS value of 1,200mg/l. Overall higher concentrations were measured in monitoring boreholes BH06 and BH07, however no reasonable explanation can be provided given the limited amount of data available.

Groundwater SO_4 concentrations of less than 10mg/l were measured in the majority of monitoring boreholes, therefore representing natural, unaffected groundwater quality conditions. However, overall higher concentrations were again measured in monitoring boreholes BH06 and BH07, which displayed concentrations of approximately 160mg/l and 150mg/l respectively. These concentrations are still well below the permissible SANS level of 500mg/l, however they do exceed the ambient concentration of approximately 6mg/l.

The groundwater pH conditions are more or less neutral with values ranging between 7.3 and 8.2, which are well within recommended SANS ranges for drinking water purposes.

The mine monitoring boreholes displayed groundwater NO_3 concentrations varying between approximately 0.5mg/l and 0.8mg/l, which are well below the permissible SANS value of 11mg/l. A slightly higher concentration of ± 2.1mg/l was measured in BH04, however no reasonable explanation can be provided for this anomaly at this point in time.

Groundwater chloride concentrations measured in the majority of monitoring boreholes vary from less than 10mg/l to approximately 140mg/l, which are below the permissible SANS value of 300mg/l. However, boreholes BH06 and BH07 displayed concentrations of ± 33mg/l and 360mg/l respectively, therefore exceeding the permissible SANS value for drinking water purposes (Table 5 (Groundwater Complete, 2015)). The once-off sampling data is insufficient and does not provide any reasonable explanation for this phenomenon.

According to the EDD(Figure 20 (Groundwater Complete, 2015)) the mine monitoring boreholes are dominated by two main types of groundwater:

- Fresh, clean, relatively young groundwater that has started to undergo mineralisation with especially Mg ion exchange. The groundwater is therefore dominated by Mg cations, while HCO_3 alkalinity dominates the anion content.
- Groundwater that is usually a mix of different types – either clean water from fields 1 and 2 that has undergone SO_4 and NaCl mixing/contamination or old stagnant NaCl dominated water that has mixed with clean water. The groundwater is consequently dominated by Mg cations and SO_4 anions.

The plot position of boreholes BH06 and BH07 in field 5 of the EDD represents groundwater that is affected by an unknown source of SO_4 contamination. Both boreholes also displayed elevated salinities in comparison to the other boreholes, which also suggest localised impacts on groundwater quality.

Table 34: Concentrations in indicator chemical parameters for mine monitoring boreholes

Locality	pH	EC mS/m	TDS mg/l	Alk mg/l	Cl mg/l	SO_4 mg/l	NO_3 mg/l	NH_4 mg/l	PO_4 mg/l
BH01	7.5	79.8	442.0	448.0	7.0	2.8	0.6	0.027	0.041
BH02	7.6	79.8	439.0	443.0	7.2	2.8	0.8	0.034	0.038
BH04	7.5	84.3	452.0	424.0	16.3	4.1	2.1	0.026	0.038
BH05	8.2	77.9	427.0	410.0	15.9	3.7	0.7	0.025	0.038
BH06	7.6	197.0	1116.0	439.0	333.0	162.0	0.6	0.028	0.040
BH07	7.5	199.0	1126.0	449.0	357.0	149.0	0.7	0.019	0.040
BH08	7.5	121.0	642.0	472.0	110.0	6.3	0.6	0.021	0.038
BH09	7.5	120.0	621.0	426.0	119.0	5.5	0.6	0.018	0.037
BH10	7.5	125.0	638.0	398.0	141.0	6.0	0.6	0.021	0.038

Locality	pH	EC mS/m	TDS mg/l	Alk mg/l	Cl mg/l	SO_4 mg/l	NO_3 mg/l	NH_4 mg/l	PO_4 mg/l
BH11	7.5	94.0	505.0	467.0	30.4	2.6	0.6	0.065	0.038
BH12	7.5	104.0	569.0	473.0	67.4	4.3	0.5	0.024	0.038
BH13	7.6	109.0	578.0	449.0	86.3	5.0	0.5	0.128	0.039
TKBH01*	7.3	81.5	440.0	440.0	9.3	8.3	<0.392	0.08	0.01
TKBH02*	7.4	77.2	400.0	423.0	2.2	<0.957	<0.392	0.70	0.01

Locality	F mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	Al mg/l	Fe mg/l	Mn mg/l	Thard mg/l
BH01	0.3	91.8	58.2	4.4	1.5	<0.003	<0.003	<0.001	469.0
BH02	0.3	90.9	58.5	4.4	1.5	<0.003	<0.003	<0.001	468.0
BH04	0.3	92.3	60.8	8.1	2.2	<0.003	<0.003	<0.001	481.0
BH05	0.4	83.7	55.1	11.8	3.0	<0.003	<0.003	<0.001	436.0
BH06	0.2	148.0	138.0	61.5	2.9	<0.003	<0.003	<0.001	939.0
BH07	0.3	163.0	146.0	31.7	2.3	<0.003	<0.003	<0.001	1009.0
BH08	0.4	99.3	66.2	65.6	4.4	<0.003	<0.003	<0.001	521.0
BH09	0.4	97.1	59.9	70.3	5.6	<0.003	<0.003	<0.001	489.0
BH10	0.4	95.9	56.3	86.9	6.3	<0.003	<0.003	<0.001	471.0
BH11	0.3	99.6	64.4	17.9	2.6	<0.003	<0.003	<0.001	514.0
BH12	0.3	99.1	62.7	40.8	3.6	<0.003	<0.003	<0.001	506.0
BH13	0.3	95.4	59.5	50.6	4.4	<0.003	<0.003	<0.001	483.0
TKBH01*	<0.496	83.1	54.2	13.0	2.9	<0.003	<0.003	<0.001	431.0
TKBH02*	<0.496	82.4	45.2	6.9	3.3	<0.003	<0.003	0.5	392.0

Note: Values shaded with red are those that exceed the SANS guideline values for drinking water.

* Purpose drilled source monitoring borehole.

1.10 Air quality

Information for this section was obtained from 'Air Quality Specialist Report for the Proposed Tygerkloof Mine, Thabazimbi, Limpopo Province' (Airshed Planning Professionals, 2015).

1.10.1 Sources of air pollution within the region

Neighbouring land-use in the surrounding of the proposed project comprises predominantly of farming and mining activities. These land-uses contribute to baseline pollutant concentrations via fugitive and process emissions, vehicle tailpipe emissions, household fuel combustion, biomass burning etc.

1.10.1.1 Mining sources

Existing mines located in this region include the TIOM, the Amandelbult Platinum Mine and the Cronimet Chrome Mine. Particulates represent the main pollutant of concern at mining operations, be it underground or opencast mining. The amount of dust emitted by these activities depends on the physical characteristics of the material, the way in which the material is handled and the weather conditions (e.g. high wind speeds, rainfall, etc.).

1.10.1.2 Unpaved and paved roads

Emissions from unpaved roads constitute a major source of emissions to the atmosphere in the South African context. When a vehicle travels on an unpaved road the force of the wheels on the road surface causes pulverization of surface material. Particles are lifted and dropped from the rolling wheels, and the road surface is exposed to strong turbulent air shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed. Dust emissions from unpaved roads vary in relation to the vehicle traffic and the silt loading on the roads.

Emission from paved roads are significantly less than those originating from unpaved roads, however they do contribute to the particulate load of the atmosphere. Particulate emissions occur whenever vehicles travel over a paved surface. The fugitive dust emissions are due to the re-suspension of loose material on the road surface.

1.10.1.3 Wind erosion of open areas

Windblown dust emanates from natural and anthropogenic sources. For wind erosion to occur, the wind speed needs to exceed a certain threshold, called the threshold velocity. This relates to gravity and the inter-particle cohesion that resists removal. Surface properties such as soil texture, soil moisture and vegetation cover influence the removal potential. Conversely, the friction velocity or wind shear at the surface is related to atmospheric flow conditions and surface aerodynamic properties. Thus, for particles to become airborne, its erosion potential has to be restored; that is, the wind shear at the surface must exceed the gravitational and cohesive forces acting upon them, called the threshold friction velocity. Every time a surface is disturbed, its erosion potential is restored (US EPA, 2004). Erodible surfaces may occur as a result of agriculture and/or grazing activities.

1.10.1.4 Vehicle Tailpipe Emissions

Emissions resulting from motor vehicles can be grouped into primary and secondary pollutants. While primary pollutants are emitted directly into the atmosphere, secondary pollutants form in the atmosphere as a result of chemical reactions. Significant primary pollutants emitted combustion engines include carbon dioxide (CO_2), carbon (C), sulphur dioxide (SO_2), oxides of nitrogen (mainly NO), particulates and lead. Secondary pollutants include Nitrogen dioxide (NO_2), photochemical oxidants such as ozone, sulphur acid, sulphates, nitric acid, and nitrate aerosols (particulate matter). Vehicle type (i.e. model-year, fuel delivery system), fuel (i.e. oxygen content), operating (i.e. vehicle speed, load) and environmental parameters (i.e. altitude, humidity) influence vehicle emission rates. Transport in the vicinity of the mine site is via trucks and private vehicles along the R510 and R511 provincial road, which are the main sources of vehicle tailpipe emissions.

1.10.1.5 Agriculture

Agriculture is a major land-use activity within the area surrounding the site. Particulate matter is the main pollutant of concern from agricultural activities as particulate emissions are derived from windblown dust, burning crop residue, and dust entrainment as a result of vehicles travelling along dirt

roads. In addition, pollen grains, mould spores and plant and insect parts from agricultural activities all contribute to the particulate load. Should chemicals be used for crop spraying, they would typically result in odiferous emissions. Crop residue burning is an additional source of particulate emissions and other toxins. Due to the small scale of farming activities these are regarded to have an insignificant cumulative impact.

1.10.1.6 Biomass and residential fuel burning

Aerosols, black C and hydrocarbons are associated with biomass burning. Burning crop residue may be a significant source of atmospheric emissions within the area. Also, domestic households are potentially one of the most important sources contributing to poor air quality within residential areas. Individual households are low volume emitters, but their cumulative impact is significant. It is likely that households within the local communities/settlements utilise coal, paraffin and /or wood for cooking and/or space heating purposes (mainly during winter). Pollutants arising from the combustion of wood include respirable particulates.

1.10.2 Measured ambient air quality

The site is located in a rural area currently affected by air pollution sources as described in the preceding section. Pollutants released include but are not limited to, fugitive $PM_{2.5}$, PM_{10} and Total Suspended Particulates (TSP) and gaseous pollutants as products of the combustion of petrol and diesel. Ambient monitoring data was obtained from the TIOM monitoring network as well as the Department of Environmental Affairs (DEA's) Thabazimbi monitoring station (Waterberg/Bojanala Priority Area network (WBPA)). The locations of these ambient monitoring locations are illustrated in Figure 29.

1.10.2.1 Thabazimbi Iron Ore Mine monitoring network

The TIOM monitoring network comprise 21 dustfall sampling buckets and a gravimetric PM_{10} and $PM_{2.5}$ sampler. Dustfall deposition results for the period July 2013 to August 2014 are presented in Figure 30. Monthly averages of daily PM_{10} and $PM_{2.5}$ concentrations for the period September 2011 to July 2013 and November 2012 to July 2013 respectively, are presented in Figure 31. Dustfall rates are generally low and below the residential and non-residential National Dust Control Regulations limits, except for D15 in September 2013 and D9 in November 2013. Daily PM_{10} and $PM_{2.5}$ concentrations do not exceed their respective standard over the monitoring period. Concentrations are generally low, exhibiting slight spatial or temporal variation throughout the monitoring period.

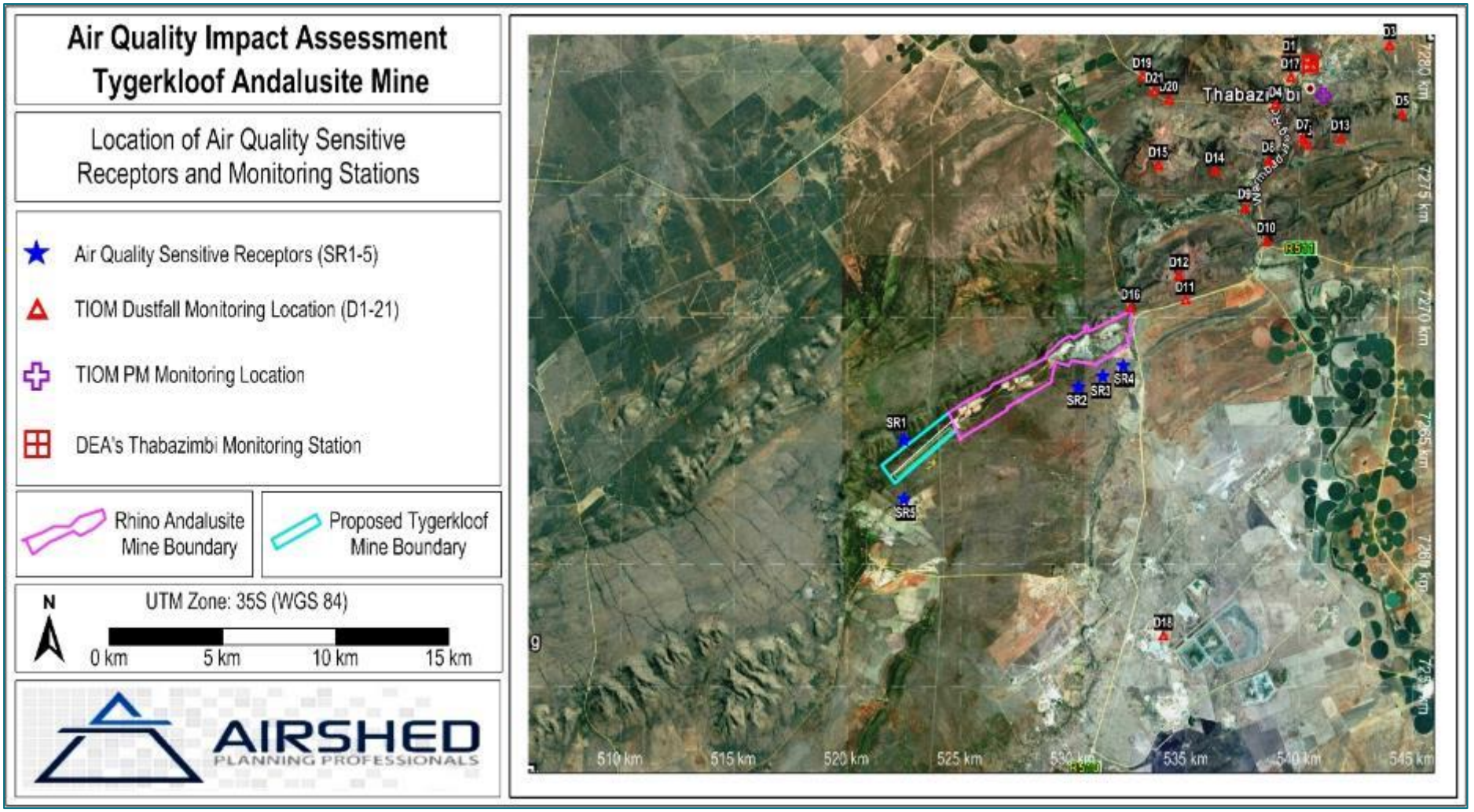


Figure 29: Location of air quality sensitive receptors and ambient monitoring stations in the vicinity of the project

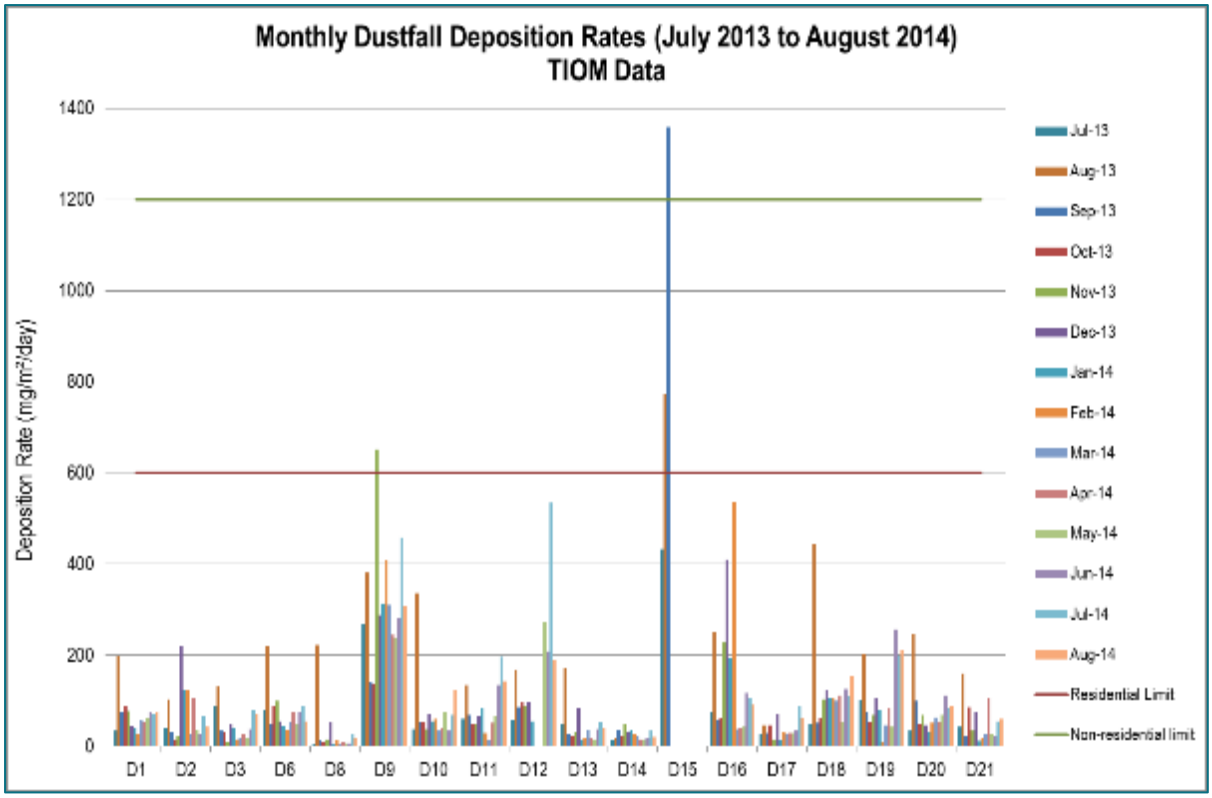


Figure 30: Monthly dustfall deposition rates (July 2013 to August 2014) TIOM monitoring station

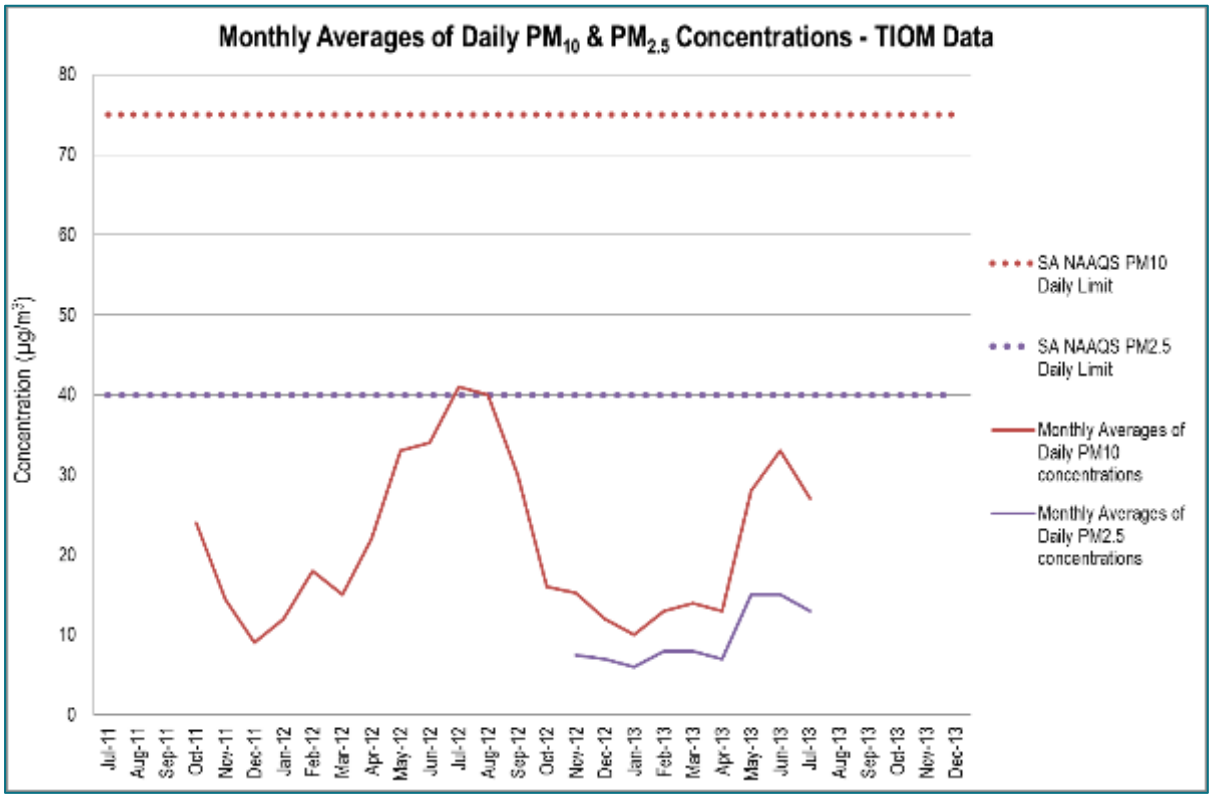


Figure 31: Monthly averages of daily PM_{10} & $PM_{2.5}$ concentrations - TIOM monitoring station

1.0.2.2 Thabazimbi monitoring station (DEA)

The DEA operates an ambient monitoring station in Thabazimbi as part of the WBPA. The station was commissioned in February 2013 and is located at the Regorogile Gateway Clinic, Shai drive (27.391605 E; -24.591058 S). The station was set up with the purpose of measuring residential emissions and emissions from mines located about 15-20km south of the station. The station measures most of the criteria pollutants including PM_{10} and $PM_{2.5}$ at varying intervals.

Analyses of data for the period 1st October 2012 to 20th April 2015 are presented in Figure 29, Figure 30, Figure 31 (Airshed, 2015) for $PM_{2.5}$, PM_{10}, CO and NO_2 respectively. From these figures, it can be deduced that ambient concentration for CO does not exceed it standard at the Thabazimbi monitoring station.

Daily PM_{10} and $PM_{2.5}$ as well as hourly NO_2 concentrations exceed the National Ambient Air Quality Standards (South Africa) standard at varying frequencies across the period with irregular spikes in concentrations recorded mostly in the winter/spring months.

1.10.3 Air quality sensitive receptors

Sensitive receptors around the project site are shown in Figure 29. Thabazimbi town is located about 15km to the northeast of the project boundary. Nearby air quality sensitive receptors include informal settlements and residential houses situated within 100m to 1,000m of the project boundary.

1.11 Environmental noise

Information for this section was obtained from the 'Environmental Noise Impact Assessment Report' (Varicon cc, 2015).

The sound pressure levels were evaluated against the standards as specified in the SABS Code of Practice 0103 of 2008 (The measurement and rating of environmental noise with respect to land use, health, annoyance and to speech communication) with reference to Code SABS 0328 of 2003 (Environmental Noise Impact Assessments). Refer to Table 35 below for the typical rating levels for ambient noise in districts.

Table 35: Typical rating levels for ambient noise in districts

Type of district	**Equivalent continuous rating level (LReq.T) for ambient noise**					
	Outdoors			**Indoors, with open windows**		
	Day-night	**Daytime**	**Night-time**	**Day-night**	**Daytime**	**Night-time**
(a) Rural districts	45	45	35	35	35	25
(b) Suburban with little road traffic	50	50	40	40	40	30
(c) Urban districts	55	55	45	45	45	35

Type of district	Equivalent continuous rating level (LReq.T) for ambient noise					
	Outdoors			Indoors, with open windows		
	Day-night	Daytime	Night-time	Day-night	Daytime	Night-time
(d) Urban districts with some workshops, business premises and with main roads.	60	60	50	50	50	40
(e) Central business districts	65	65	55	55	55	45
(f) Industrial districts	70	70	60	60	60	50

Note: The values given are A-weighted sound pressure levels and include corrections for tonal character and impulsiveness of the noise

The day-time weather conditions were dry and sunny and very hot temperatures with a slight breeze blowing. The night time weather conditions presented warm weather with clear skies and a light breeze blowing. Refer to Table 36 below for the environmental conditions present during the survey periods.

Table 36: Environmental conditions during the survey periods

Time	Wind speed	Wind direction	Humidity	Air temperature
10:00 – 14:00 (Day-time)	Mild breeze blowing	North-Westerly Direction	20%	29,5 0C – 40,0 0C
20:00 – 23:00 (Night-time)	Mild breeze blowing	North-Westerly Direction	15%	27,5 0C – 34,0 0C

In general, daytime results indicated normal background noise, caused by slight wind through the grass, wild animals, and birds. Night-time results indicated sounds of crickets, frogs and other night-time animals such as jackals with slight wind blowing through the grass. Noise results closer to the existing plant indicated a slight rise in results, however; these results were still below the typical rating for SABS 0103, Category D limitations (urban districts with some workshops, business premises and with main roads). Refer to Table 37 below for the results from the survey.

Table 37: Noise levels at various sampling locations

Measuring positions	Approximate co-ordinates	Ambient noise (dB(A))						Remarks
		Day-time Levels (outdoors)			Night-time Levels (outdoors)			
		Average Results	Typical Rating (SABS 0103) (Category D)	Excess ΔLReq,T (dBA)	Average Results	Typical Rating (SABS 0103) (Category D)	Excess ΔLReq,T (dBA)	
Position A: Middle section of the proposed new mine area. West of the existing quarry area.	24º44'12.94"S 27º13'23.46"E	32.8	60	+27.2	28.0	50	+22.0	Daytime: - Normal background noise, caused by slight wind through the grass, wild animals, birds. Night-time: –Night-time sounds of crickets, frogs and other night time animals such as jackals. Slight wind blowing through the grass.
Position B: Southern corner of the proposed new mining area. South-West of the existing quarry area.	24º44'41.60"S 27º13'06.10"E	27.4	60	+32.6	26.8	50	+23.2	Daytime: - Normal background noise, caused by slight wind through the grass, wild animals, birds. Night-time: –Night-time sounds of crickets, frogs and other night time animals such as jackals. Slight wind blowing through the grass.
Position C: Western corner of the proposed new mining area. West of the existing quarry area.	24º44'20.10"S 27º12'47.12"E	27.2	60	+32.8	26.4	50	+23.6	Daytime: - Normal background noise, caused by slight wind through the grass, wild animals, birds. Night-time: –Night-time sounds of crickets, frogs and other night time animals such as jackals. Slight wind blowing through the grass.
Position D: Moving quarter way upwards on the Northern side of the proposed new mining area. Close to the farmer's residence.	24º43'57.30"S 27º13'21.81"E	29.2	60	+30.8	28.7	50	+21.3	Daytime: - Normal background noise, caused by slight wind through the grass, wild animals, birds. Night-time: –Night-time sounds of crickets, frogs and other night time animals such as jackals. Slight wind blowing through the grass.
Position E:	24º43'42.65"S 27º13'47.92"E	33.4	60	+27.2	30.0	50	+22.0	Daytime: - Normal background noise, caused by slight wind through the grass, wild animals, birds.

Measuring positions	Approximate co-ordinates	Ambient noise (dB(A))						Remarks
		Day-time Levels (outdoors)			Night-time Levels (outdoors)			
		Average Results	Typical Rating (SABS 0103) (Category D)	Excess ΔLReq,T (dBA)	Average Results	Typical Rating (SABS 0103) (Category D)	Excess ΔLReq,T (dBA)	
Moving upwards on the northern side towards the existing quarry area.								Night-time: –Night-time sounds of crickets, frogs and other night time animals such as jackals. Slight wind blowing through the grass.
Position F: Entrance gate into the proposed new mining area towards the eastern corner. Closer to the existing quarry.	24º43'50.86"S 27º14'15.36"E	33.9	60	+26.1	27.8	50	+22.2	Daytime: - Normal background noise, caused by slight wind through the grass, wild animals, birds. Night-time: –Night-time sounds of crickets, frogs and other night time animals such as jackals. Slight wind blowing through the grass.
Position G: Moving up in the dirt road against the main fence towards the northern corner of the proposed new area.	24º43'26.45"S 27º14'17.29"E	34.4	60	+25.6	28.4	50	+21.6	Daytime: - Normal background noise, caused by slight wind through the grass, wild animals, birds. Night-time: –Night-time sounds of crickets, frogs and other night time animals such as jackals. Slight wind blowing through the grass.
Position H: The top north corner of the proposed mine, adjacent of Plant 5 of the existing quarry.	24º43'15.78"S 27º13'21.81"E	38.2	60	+21.8	29.7	50	+20.3	Daytime: - Normal background noise, caused by slight wind through the grass, wild animals, birds. Closer to the production plant Night-time: –Night-time sounds of crickets, frogs and other night time animals such as jackals. Slight wind blowing through the grass. Closer to the production plant.
Position I: The bottom south-eastern corner of the proposed mine,	24º43'31.94"S 27º14'42.29"E	40.2	60	+19.8	31.7	50	+18.3	Daytime: - Normal background noise, caused by slight wind through the grass, wild animals, birds. Closer to the production plant

Measuring positions	Approximate co-ordinates	Ambient noise (dB(A))						Remarks
		Day-time Levels (outdoors)			Night-time Levels (outdoors)			
		Average Results	Typical Rating (SABS 0103) (Category D)	Excess ΔLReq,T (dBA)	Average Results	Typical Rating (SABS 0103) (Category D)	Excess ΔLReq,T (dBA)	
adjacent of Plant 5 of the existing quarry.								Night-time: –Night-time sounds of crickets, frogs and other night time animals such as jackals. Slight wind blowing through the grass. Closer to the production plant.

1.12 Visual aspects

The site is directly adjacent the R510 Road from Rustenburg to Ellisras (Lephalale). Mining activities of the current mine (RAM) are visible from the R510. There are also other mines in the area which impact on the visual aspect of the area.

1.13 Sensitive landscapes

Refer to Figure 32 for a sensitive landscape map. Sensitive landscapes include ecological sensitive areas, the Bushveld saffron, as well as heritage & cultural resources on and surrounding the site. The Tygerkloof Mining layout plan was adjusted to prevent damage to any of these sensitive features. A 50m buffer was included to remain outside of the high ecological sensitivity area, and 100m buffers around the Blue saffron identified on site as well as the drainage line. Tygerkloof Mining is allowed to mine under the Eskom power lines, but no overburden may be placed under these lines.

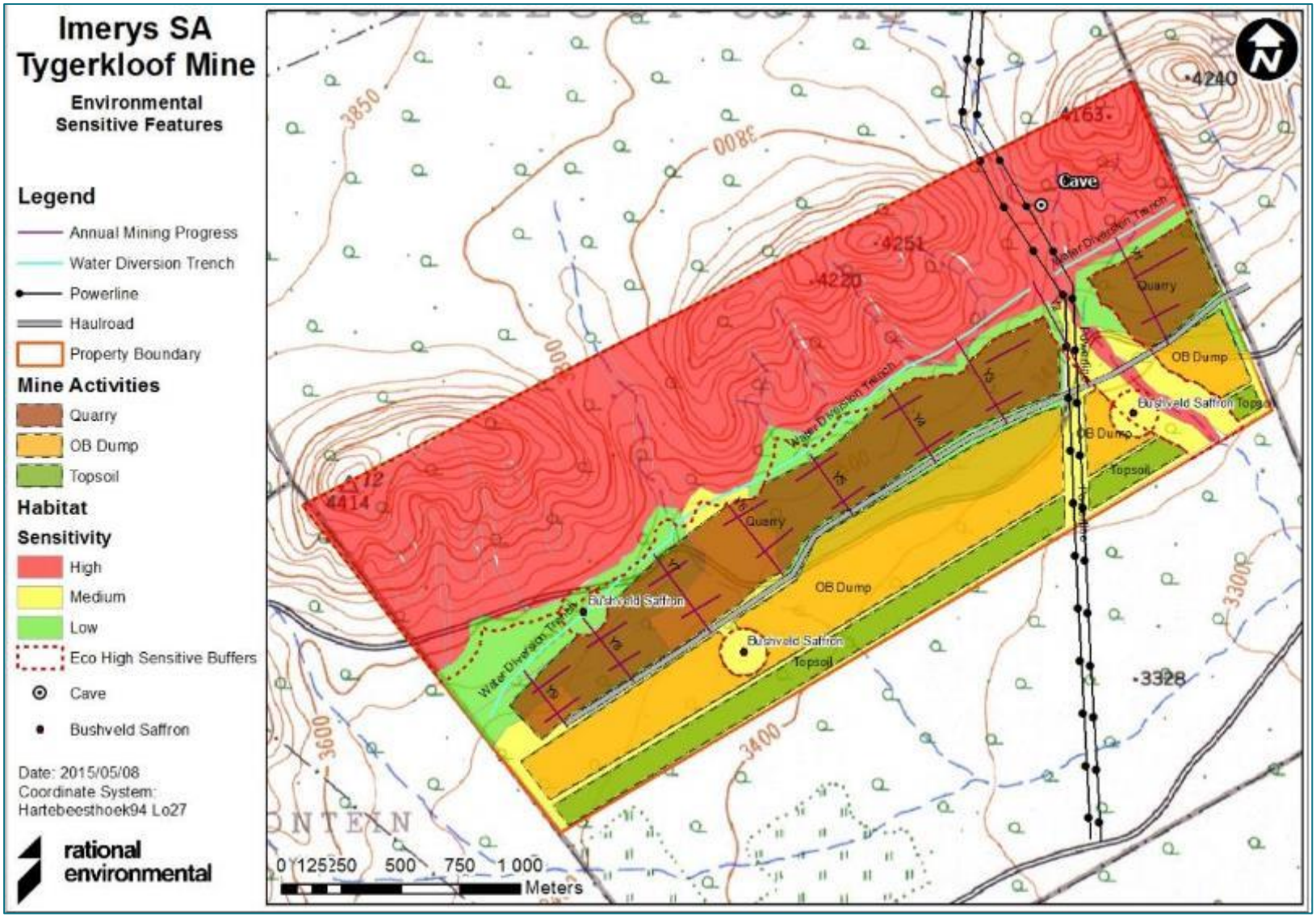


Figure 32: Map indicating environmental sensitive features

1.14 Land use and existing infrastructure

Information for this section was obtained from the 'Soil Study Report' (Gudani Consulting, 2015).

The localities and extents of pre-mining land uses within the proposed quarry and overburden dump footprints are shown in Figure 32 (Gudani Consulting, 2015) and are summarised in Table 38.

Table 38: Pre-mining land uses – proposed open pit and overburden dump areas

Land Use Code	Pre-mining Land Use	Unit Count	Area (ha)	Area (%)
G	Grazing - formerly used for cattle, currently used for game farming	1	310.38	99.71
F	Farmstead	1	0.91	0.29
TOTAL		2	311.29	100.0

1.15 Cultural and heritage resources

Information for this section was obtained from the 'Phase I Cultural heritage resources impact assessment (African Heritage Consultants CC, 2015).

1.15.1 Background to the archaeological and history of the area

Resources, and in particular the mineral resources (Küsel 1998), in what is now known as the Thabazimbi region have been extensively utilised by prehistoric and historic groups. The greater region has several important Stone Age localities with deep occupation deposits and importantly, a widespread occurrence of open-air sites.

The shelter site of Olieboomspoort near Lephalale show a succession from the Earlier, Middle and Later Stone Ages (ESA, MSA and LSA) and up to historic times (van der Ryst 2006). Early Iron Age (EIA) localities such as Diamant are particular important. At this locality in the western Waterberg the EIA facies of Diamant was first identified at the eponymous locality (Huffman 1990). This site has also delivered the earliest evidence for glass trade beads and domesticated dogs in the Limpopo Province (van der Ryst 2006).

The movement of African farmers into this region is documented by their ceramics and settlements (Huffman 2007b). The later occupations of agropastoralists groups are complex (Schapera 1942, 1965; Breutz 1953, 1989; Bergh 1998). The accounts of early travellers provide important data on the fauna, flora and inhabitants of the Waterberg. The observations of travellers, missionaries and hunters who traversed the region throughout the 18th and the 19th centuries constitute a source of implicit ethnography on the late presence of hunting and gathering groups, the African farmers and inmoving colonists (Baines 1872, 1877; Smith 1836; Schlömann 1896; Wallis [Baines] 1946; Burke [Mauch's journals] 1969). The region is also rich in rock art (Eastwood and Eastwood 2006).

Heritage resources

Huffman (2004, 2006a, 2007a, 2009a) in surveys for Rhino Minerals Andalusite Mine on the Farm Buffelsfontein 353 KQ recorded an Early Iron Age village on red colluvial/alluvial deposits and several grainbins. The LIA homesteads contained several burnt houses. He ascribed the burning to a severe drought (Huffman 2009b). He also noted MSA lithics but not of any significance. In a subsequent archaeological impact assessment (AIA) no settlements were recorded but isolated fragments of pottery and slag suggest a buried occupation (Huffman 2009a).

Van Schalkwyk (2007) in an assessment for cultural heritage resources on sections of the farms Amandelbult 383KQ and Elandsfontein 386KQ in the Thabazimbi District recorded surface MSA and LSA lithics. He also noted two possible EIA sites whereas most of the others that were identified are from the Late Iron Age/early Historical period, the latter features assigned Medium significance. A buffer zone is already in place following on previous recommendations on Iron Age remains within this general area (Van Schalkwyk 1994, 2001, 2003, 2004; Van Schalkwyk *et al*. 2004).

Coetzee (2008) in a report for the PPC expansion project recorded only a small Stone Age lithic scatter from the prehistoric period. However, 10 historical houses from the 1930s to 1940s have been documented as well as several graves. He provides a synthesis of the Stone Age and Iron Age (IA) sequences. In the latter the different settlement phases of the Early Iron Age are defined, namely Happy Rest, Diamant and Eiland. The Late Iron Age (LIA) sequence is much more complex, with numerous groups moving into the region. The mainly stone-walled settlements are also more visible. Based on ethnographic accounts (Schapera 1942, 1965; Breutz 1953, 1989; Bergh 1998) he provides an overview of the ethnographic sequence of groups who occupied the region, such as the Bakgatla baga Kgafela, and the Batlokwa ba Kgosi and provides detail on the trust farms occupied. In the greater region Dreyer (2011) in an assessment for proposed chrome mining developments found no heritage remains at Hartbeestkopje 367KQ, Schilpadnest 385KQ and Moddergat 389KQ, in the Northam District but recorded historical material at Zwartkop 369KQ.

At Boikarabelo excavations of an extensive grainbin-site and surface collections of around 12 IA settlements demonstrated Tswana settlement sequences that include a probable early Moloko (probably Icon) facies and at least one site had been identified to the Letsibogo facies. The relative age of the sites were therefore inferred to range from the late 17th to late 18th centuries (Digby Wells Environmental 2011).

A heritage impact assessment (HIA) for the proposed development of the Kambaku Private School on the farm Vlakplaats 137 KQ yielded no evidence for heritage resources (Hutten 2012). Hutten (2013a, 2013b, 2013c) in several assessments for solar developments noted that there was an absence of heritage resources on the farms Liverpool and Aapiesdraai near Koedoeskop, whereas a historic structure, outside the developments, was recorded at Grootkuil. Coetzee (2014) in an assessment for the Marakele Park on the northern edge of the Waterberg Plateau similarly found no heritage resources.

The area is some distance from Thabazimbi. However the Waterberg region abounds in heritage and archaeological resources and forms part of the broader study region.

Van Vollenhoven in an HIA for the proposed development of a limestone mine on Portion 1 of the farm Nooitgedacht 136 JQ, Portion 1 of the farm Buffelskraal 545 KQ and Portions 3, 4, 5, 6 and the Remainder of Krokodilkraal 545 KQ in the Thabazimbi District reported that no heritage resources have been identified and that the surveyed properties have been used for cattle farming and extensive agriculture. In a draft ESR for the proposed township on Portion 20 and 22 of the farm Theunispan 293 LQ, Portion 1-4 and a portion of the remainder of the Farm Grootdoorn 292 LQ, portion 3 of the Farm Steenbokpan 295 seven heritage sites of significance or value were identified within the area proposed for the development of the Steenbokpan Extension 3 Township. These comprise five informal cemeteries, all on portions of Grootdoorn and two historic structures of the Harmse family homestead (Ila 2014; PGS 2014).

In an extension of a mining licence for clay extraction on the farm Nooitgedacht 436 JR Portion 25 an informal cemetery with 15 graves was identified (African Heritage Consultants 2013). African Heritage Consultants (2011, 2014) in a Phase 1 AIA identified numerous stone-walled enclosures, a pre-colonial mine, graves, and historic structures that include a weir and bridge at the Sondagsriver. A Phase 2 mitigation was recommended.

The ESR on heritage for Project Infinity Sishen Iron Ore Thabazimbi Mine (Shangoni Management Services 2013) noted that MSA lithics were present in an area with sheet erosion. The Mine has in the past encouraged research on the IA stone-walled enclosures on their property, and further research is supported. Mitigation of historical buildings, including the Du Randt Homestead, was also addressed. The proposed mining on Wachsteenbietjesdraai 350 KQ and Kwaggashoek 345 KQ is in close proximity from the Mostert Tunnel Cave south of Thabazimbi that has significant geological formations. Appropriate mitigation measures will be recommended (PGS 2012).

Gatkop Cave on the farm Randstephane 455 KQ ESE of Thabazimbi was also investigated. The locality lies within an area with rich iron ore deposits that are currently being explored by Aquila Resources in view of future extraction. It is an important heritage resource of high cultural significance that is still being used for ritual ceremonies and constitutes a contentious issue in view of the developments. This locality also has potentially high palaeontological heritage significance (Almond 2013). Madimatle Mountain at Donkerpoort 448 KQ and Gatkop Cave on Randstephane 455 KQ hold significant spiritual, ancestral and cultural heritage importance to the local community, local traditional healers, local traditional leaders, persons that practice and belong to certain African Christian denominations (van Vuuren 2014; SAHRA Statement of Significance, accessed SAHRIS 11 February 2015). Acting on the recommendations SAHRA has appointed an anthropologist who compiled a report on the significance of this locality (van Vuuren 2014). Mademattle/Mletse Mountain and the Gatkop caves described as the Remainder of the Farm Randstephne 455 KQ and the Remainder of the Farm Donkerpoort 448 KQ

have now been nominated as a Provincial Heritage Site (SAHRA 2014; SAHRIS database accessed February 2015).

1.15.2 Description of the site

North western section

The north western section is thick sickle bush (*Dichrostachys cinerea*). The dense growth of sickle bush is an indication of over grazing and utilisation. In this area archaeological sites should be present but will only be found if the area is cleared of sickle bush. When the mine cleans the area for mining an archaeologist should be present to identify possible archaeological sites.

Eastern section

According to the farmer who uses the area for game farming, there is no heritage resource on the eastern part of the site. No heritage resource were observed.

West of the northern section – not on proposed footprint

Just west of the northern section of the development area is a large rock shelter. The floor of this shelter has a good archaeological deposit with Late Stone Age and Iron Age material present (Madikwe Facies). At the roof of the shelter small stalactites' are forming. On the floor is a single very large stalagmite. See photographs and map on pages 22 & 25 (African Heritage Consultants CC, 2015).

North of the site – not on the proposed footprint

To the north of the development site on the farm Buffelsfontein 353 KQ is an ancient mine recorded by Küsel US (2003) at S24° 42' 40.5" & E27° 16' 00.9". At that stage Küsel informed SAHRA that the proposed mining activities would possibly damage the ancient mine. The mining company undertook to fence the area in and to install instruments to monitor shock waves from blasting. The entrance to the mine has collapsed probable because of blasting. Rainwater also now runs into the underground section of the ancient mine - see photographs below and maps on pages 22, 23 & 24 (African Heritage Consultants CC, 2015).

Roger Summons who has made a detail study of the ancient mining in Zimbabwe could find not a single complete mine as all the mines were destroyed by modern mining.

The ancient mine and surroundings were investigated by Prof Tom Huffman (2006) when the mine requested a second opinion after the author's original report. Huffman found a number of Early Sotho (Tswana) settlements at the foot of the mountain on Buffelsfontein and Tygerkloof as well as two iron smelting sites. He identified the pottery as Madikwe facies of the Moloko cluster. He had the sites dated which gave a date of 1485 -1615.

As far as the ancient mine is concerned he came to the conclusion that red ochre was mined. Unfortunately he did not investigate the mine itself. The author and his team entered the mine during our current visit and found no red ochre inside.

Huffman (2006) came to the conclusion that the settlements and the mine are interrelated. Huffman also suggested that the mine should be investigated. This is strongly supported as this mine is probably the most complete ancient mine in Southern Africa found up to date.

1.16 Regional socio-economic aspects

Information for this section was obtained from the 'Integrated Development Plan' (Thabazimbi Local Municipality, 2013), and 'Integrated Development Plan' (Waterberg District Municipality, 2013)

1.16.1 Demographics

Limpopo is the fifth most populated province at 5.4 million. Population increased in WDM from 604,936 in 2001 to 679,336 in 2011. Population increased in TLM from 65,533 in 2001 to 85,234 in 2011. Refer to Table 39 below for population, age and gender structure. The majority of population is aged below 35 years. TLM experienced fast population growth for the period between 2001 and 2011. Majority of population is age between 15 and 64 with males in the majority.

Table 39: Population, age and gender structure

Age structure						**Gender ration**		**Population growth (% p.a.)**	
<15		**15-65**		**>65**		**Males per 100 females**			
2001	2011	2001	2011	2001	2011	2001	2011	1996-2001	2001-2011
26.0	21.1	71.5	76.4	2.5	2.4	114.0	141.1	1.71	2.63

Source: Statssa, Census 2011

Refer to Table 40 below for population group and sex structure. According to these results, Blacks are in the majority, followed by whites. There are more male blacks than female blacks.

Table 40: Population group and sex structure

Population group	**1996**			**2001**			**2011**		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
Blacks	29,984	17,15	46,999	28,935	24,940	53,875	42,773	29,072	71,845
Whites	6,415	5,886	12,281	5,810	5,540	11,350	6,420	5,889	12,309
Coloured	136	115	251	151	122	274	310	217	527
Indians/Asian	19	8	26	19	15	34	130	75	205
TOTAL	36,554	23,024	59,578	34,915	30,617	65,532	49,633	35,253	84,886

Source: Statssa, Census 2011

Refer to Table 41 below for the dependency ratio for 1996, 2001 and 2011. Dependency ratios provide insights in to the burden born by those who are in working age group (15 -64) years to support those aged 0 -14 and 65+ years. Dependency ratio has been declining over time.

Table 41: Dependency ratio for 1996, 2001 and 2011

	1996	**2001**	**2011**
0 - 14	14,451	17,062	18,014
15 - 64	42,225	46,835	65,153
65+	1,894	1,637	2,067
Dependency Ratio	38.7	39.9	30.8

Source: Statssa, Census 2011

Refer to Table 42 below for the distribution of the population aged between 5 and 24 years by school attendance, and sex for 1996, 2001 and 2011

Table 42: Distribution of the population aged between 5 and 24 years by school attendance, and sex for 1996, 2001and 2011

	1996			**2001**			**2011**		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
Attending	4,901	4,567	9,468	5,425	5,139	10,563	6,462	6,091	12,554
Not Attending	3,933	3,505	7,438	5,109	5,399	10,507	5,570	4,465	10,035
TOTAL	8,834	8,072	16,906	10,533	10,537	21,070	12,032	10,556	22,589

Source: Statssa, Census 2011

Refer to Table 43 below for the household demographics.

Table 43: Household demographics

Household		**Household dynamics**			
2001	2011	2001	2011	2001	2011
20,734	25,080	2.9	3.4	29.4	24.7

Source: Statssa, Census 2011

1.16.2 Basic services

Refer to Table 44 below for distribution of households using electricity for lighting, heating, cooking, Table 45 for distribution of households by access to piped water, Table 46 for distribution of households by type of refuse removal, and Table 47 for distribution of households by type of toilet facility

Table 44: Distribution of households using electricity for lighting, heating, cooking

Lighting			Cooking			Heating		
1996	2001	2011	1996	2001	2011	1996	2001	2011
7,819	10,039	19,269	6,664	7,985	18,332	6,668	8,010	17,062

Source: Statssa, Census 2011

Table 45: Distribution of households by access to piped water

Piped (tap) water inside dwelling yard			Piped (tap) water on communal stand			No access to piped (tap) water		
1996	2001	2011	1996	2001	2011	1996	2001	2011
9,521	11,782	17,863	1,686	8,705	5,668	3,603	247	1,550

Source: Statssa, Census 2011

Table 46: Distribution of households by type of refuse removal

Removed by local authority/ Private company			Communal Refuse dump			No rubbish disposal		
1996	2001	2011	1996	2001	2011	1996	2001	2011
5,788	7,727	15,609	8,189	10,844	7,756	627	2,164	1,381

Source: Statssa, Census 2011

Table 47: Distribution of households by type of toilet facility

Flush/ Chemical toilet			Pit toilet			Bucket latrine			No toilets		
1996	2001	2011	1996	2001	2011	1996	2001	2011	1996	2001	2011
7,563	9,796	17,211	5,307	5,630	5,51	67	88	189	1,877	5,220	1,585

Source: Statssa, Census 2011

TLM is designated as Water Services Authority (WSA) and Water Service Development Plan (WSDP). TLM has appointed Water lab for a period of 1 year for sampling on clear water quality monitoring. The challenge is that the Service provider withheld the test result due to Municipality cash flow problem. Water Services Development Plan and Draft Water and Sanitation Bulk Infrastructure are in place.

Thabazimbi, Regorogile and Northam currently have a quota of 9Ml per day from Magalies board. Regorogile and Thabazimbi have additional supply from seven boreholes. The boreholes are located at Group 5, 12 and TIOM. Rooiberg and Leeupoort/Raphuti currently source their water from local boreholes. Schilpadnest water is also supplied from three working boreholes without any chlorination facilities.

Thabazimbi and Regorogile are using water borne sewer system. The existing water treatment plant caters for Thabazimbi town including Regorogile and Ipelegeng. The current capacity of the plant is 28 litres per second but the average daily flow is about 60 litres per second. The current sanitation system in Northam is 60% water borne and 40% septic tank. Leeupoort is septic tank. The Municipality empties

the septic tanks for all the residents regularly and discharges the sewerage into the existing oxidation pounds. The outfall sewer has been partially constructed in Northam and the project is still outstanding. The municipality does not provide bulk water to the mines within its area of jurisdiction

1.16.3 Employment and income

Refer to Table 48 for the labour market demographics, Table 49 for the distribution of the population aged between 15 and 64 years by employment status for 1996, 2001 and 2011, and Table 50 for households by monthly income category. Majority of household earn between R3,201 – R6,400.

Table 48: Labour market demographics

Unemployment rate		**Labour market**		**Education age 20+**				**Matric**	
		Youth Unemployment Rate 15 – 24 years		**No Schooling**		**Higher Education**			
2001	2011	2001	2011	2001	2011	2001	2011	2001	2011
21.0	20.6	31.0	26.9	17.5	8.8	16.0	26.6	4.3	7.6

Source: Statssa, Census 2011

Table 49: Distribution of the population aged between 15 and 64 years by employment status for 1996, 2001 and 2011

Employed			**Unemployed**			**Unemployed Rate**		
1996	2001	2011	1996	2001	2011	1996	2001	2011
28,712	26,903	29,605	2,540	7,143	7,304	8.1	21.0	19.8

Source: Statssa, Census 2011

Table 50: Households by monthly income category

Income category	**Household**
No income	3,518
R1 – R400	686
R401 – R800	1,027
R801 – R1,600	3,165
R1,601 – R3,200	4,048
R3,201 – R6,400	5,021
R6,401 – R12,800	3,517
R12,801 – R25,600	2,474
R25,601 – R51,200	1,160
R51,201 – R102,400	313
R102,401 – R204,800	105
R204,801 or more	45

Source: Statssa, Census 2011

1.16.4 Settlement patterns

There are four urban settlements in TLM area:

- Thabazimbi/ Regorogile: Main hub of the Municipal area. It has a well-established business and industrial area with sizable residential developments. It provides the majority of services to the rest of the municipal area.
- Northam: The second largest town in the Thabazimbi Municipal area. It has a well-established business sector (albeit smaller than Thabazimbi) and caters for the residents of the Northam town, as well as for the wider faming and mining areas.
- Rooiberg: A small rural town that originated as a mining town. Today no more mining activities take place and the town is mostly inhabited by residents involved in local businesses, which is primarily tourist and property related, as well as by retired citizens. A Low Cost Housing project has been approved by the former Department of Housing and provision was made for ± 200 new houses. The farms that are located in and around Rooiberg also accommodate farm workers.
- Dwaalboom: A small town also referred to a mining town with the focal point being the PPC mine. Dwaalboom residents reside in the surrounding farm areas or in PPC houses. It has a various supporting social and business amenities. Thabazimbi provides key specialised services. The farms that are located in and around Dwaalboom also accommodate farm workers.

Other predominantly rural settlements in the Thabazimbi Municipal area are; Leeupoort, Kromdraai, Koedoeskop, Makoppa and Sentrum. These smaller settlements are mostly rural residential in character with ancillary small-scale businesses. (Rural areas are defined as: the sparsely populated areas in which people farm or depend on natural resources, including the villages and small towns that are dispersed through these areas. (Rural Development Framework, 1997)):

- Leeupoort (including Raphuti Stad): so-called “Holiday Township”, but proclaimed as a formal public township. It has specific eco-life style natural living areas. The township is characterised by gravel roads, borehole water, septic tanks with limited boundary fences around dwelling houses and game is roaming freely within the confines of Leeupoort. In respect of Raphuti (a.k.a. Leeupoort Vakansiedorp Extension 7) 100 government subsidies have been approved by the Department of Health but no houses have yet been built.
- Kromdraai: A grouping of “agricultural holdings” and has a distinct rural character. Some businesses, guest houses and lodges are found in this settlement but residents are dependent on Thabazimbi or Bela-Bela for primary services. There are a number of farm workers working and staying in this area.
- Koedoeskop: A small rural settlement with a small number of residents. It provides a low level commercial service to the farming community in the area. The surrounding area is mostly agricultural and utilised for irrigation farming. There are a number of farm workers working and staying in this area.
- Makoppa: This settlement is characterised as a typical farming community with predominant agricultural land uses including a large number of game farms. It provides a low level commercial service to the farming community in the area. There are a number of farm workers working and staying in this area.

- Sentrum: This settlement is a small-scale rural settlement with a small number of residents. It is totally dependent on Thabazimbi for basic and primary services. The area is mostly known for game and cattle farming. There are a number of farm workers working and staying in this area.

Thabazimbi is characterised by a number of informal settlements. The following describes the various informal settlements:

- Schilpadnest “Smash block”: Located close to Amandelbult (mine area). Settlement is reaching alarming proportions as no formal infrastructure service are in place. Many efforts have been made by in the past by different authorities to resettle the people or to formalise the area for residential purposes but without success.
- Jabulani: Located close to Northam Platinum Mines on the farm Elandskuil. No infrastructure services. Municipality supply’s water by truck. The settlement is growing on a constant basis. Inhabitants are most likely local mine workers and farm workers from the nearby farms.
- Rooiberg: Located south-east of Rooiberg Town. Land is affected by undermining and the Municipality should as a matter of urgency relocate the people staying here. The DMR has already notified the Municipality in writing that it is not safe for people to stay on this property.
- Raphuti village: Located at Leeupoort Township. A formal township application has already been launched, i.e. Leeupoort Vakansiedorp Extension 7 to formalise this area, but proclamation has been drawn out for a number of years. The Provincial Government granted 100 subsidies in favour of this project but no houses have yet been built.
- Donkerpoort Informal: Thabazimbi: Located in Thabazimbi on a part of the Remainder of the farm Donkerpoort 344 KQ, on entering Thabazimbi Town. This settlement is close to a stormwater channel running from Regorogile which could pose danger during high floods and rainy seasons.
- Regorogile Informal: Located in Regorogile Extension 3 & on parts of the farm Rosseauspoort 319-KQ and Apiesdoorn, 316-KQ. This settlement is partly located within an ESKOM servitude area and should be relocated. The remaining area could be formalised into a proper residential township.
- Dwaalboom Informal: Located in the Dwaalboom area on Portion 7 of the farm Dwaalboom, 217-KP. Approx. 10 new units have also been built on Portion 3, Dwaalboom, 217-KQ, and all southwest of the Road D2707.
- Skierlik: Located on the farm Groenvley, 87-KQ in Sentrum next to a school property owned by the Department of Public Works. No infrastructure services. The settlement is growing on a constant basis. Inhabitants are most likely people that were retrenched from nearby farms and other homeless people in the area.
- Northam Illegal Occupants: In Northam Extension 7 people are illegally occupying the houses in this township area.

Another informal settlement affecting Thabazimbi, although it is not situated within the Thabazimbi borders is Thulamashwana. This settlement is on the border between Limpopo and North-West Province on the Anglo mining land. Anglo wishes to relocate these people into Thabazimbi Municipality to a location that is more suitable. For this reason Thulamashwana will be highlighted in the Thabazimbi

Housing Strategy. Various formal Mining settlements are also found within the municipal area, i.e. Setaria, Swartklip and Amandelbult.

1.16.5 Local economic development

The WDM is one of the major mining regions within South Africa of which platinum, iron ore, coal and diamonds are mined. The District is also home to a world renowned Biosphere Reserve. The Waterberg Biosphere reserve is an area of 414,000ha and includes various ingenious fauna and flora. The fertile soil has also lead to a competitive advantage in the agricultural sector and opportunities within this sector still needs to be used to its full potential. The area has variety of natural resources has the potential to create countless opportunities for the local population to encourage entrepreneurship and economic development.

The Limpopo Employment Growth and Development Strategy identifies the Waterberg District within the meat production, coal, energy and petrochemicals, platinum, tourism cluster. Depicting the local economy of the municipal area based on the local economic development (LED) Strategy of the municipality, the Waterberg has both comparative and competitive advantages in agriculture, mining and tourism. The tourism comparative advantage is almost evenly distributed in all the six local municipalities.

Mining:

The mining industry in the municipal area contributes to the economic development of the District and Province. Waterberg area is the largest production area of platinum in the Province. Mining of coal and petroleum development in Lephalale has increased demand for the commodity for electricity generation. The coal resource in the Waterberg field is estimated at 76 billion tons, which is more than 40% of the national coal reserve. There is also mining of cement and iron in the municipal area.

The Waterberg area host 70% platinum reserves in Limpopo Province followed by the Sekhukhune District. The platinum mining activity is found in Mokgalakwena and Thabazimbi.

Amandabult and Union section in Thabazimbi have 130 million tons of proven ore reserves between them and the current mining rate is approximately 6 million tons per year between them. Potgieterus Platinum has proven reserves of 280 million tons and its current extraction rate is 57 million tons per year. The municipal area still has the potential of expanding mining activities; currently PPRust Mine is to further expand production to an additional 230,000 ounce of platinum. The TIOM in Thabazimbi is reaching its lifespan while the existence of the town is dominated by mining activities and government services.

The construction of Medupi Power station, the expansion of Grootegeluk and petrochemical production facility will require expansion of accommodation both the mix of single and family units in Lephalale and

adjacent municipalities. The development has an impact also on municipal services; including infrastructure and social services.

Agriculture:

Waterberg District contributes almost 30% of the Limpopo Province agricultural activity, agriculture contributes over 4% of the District GGP and it employs around 21% of the labour force of the District. Although named the Waterberg the district is actually classified as a semi-arid area with poor water resources. For crop farmers there have been dramatic changes in many commodity prices leading to changes in cropping patterns. Crops such as cotton, tobacco, maize and sorghum have been badly affected by low international prices and over production and plantings have been reduced significantly, often with negative financial and employment implications. Alternative crops like sunflower, wheat, soya beans, groundnuts and paprika are all internationally traded commodities and thus sensitive to the rand/dollar exchange rate.

These crops therefore are limited substitutes. Lucerne appears to have some potential, especially with the movement towards game ranching, although demand is sensitive to seasonal conditions. Potato production also has some potential although entry is constrained by high input costs. In general there is little cropping that takes place without some form of irrigation. With demand on water resources increasing consistently crop farmers are going to have to examine their returns on the use of water in future.

The cattle and game industry is undergoing significant transformation. Lead by water constraints, areas previously under dry land and irrigation are being consolidated and converted for extensive livestock production. Similarly other former cultivated land and livestock grazing is being converted to game ranching and eco-tourism. Even within the game ranching industry owners are diversifying into lodges and eco-tourism. This general trend has been encouraged by the establishment and development of the Waterberg Biosphere. This trend is expected to continue.

Tourism:

The Waterberg District host internationally renowned tourist attractions that can be used as draw cards to attract more tourists in the area:

- Waterberg Biosphere Reserve- received its international status in March 2001 and now forms part of the World Network of biosphere reserves, registered with UNESCO. The Waterberg Biosphere Reserve is the first " savannah" biosphere reserve registered in Southern Africa;
- The Makapan Valley World Heritage Site - is a site for one of the most dramatic incidents in the long and fascinating local history near Mokopane town in the Mogalakwena Local municipality. This cooking pot reached a boiling point between the Voortrekkers and the local Ndebeles. The Voortrekkers, which by the 1850s were already well established as far as Schoemansdal near Soutpansberg, used the local area as a thoroughfare. The Makapan Valley was declared as one of the first National Heritage Sites of the new united nation-an act supported by all local communities.

In fact, current Chief Mokopane made contributions towards the development of the site as a cultural shrine and tourism icon. The application for the World Heritage Status has been approved by UNESCO.

- Nylsvley Wetland- is a registered Ramsar site (Ramsar is the international convention for the protection of wetlands). More than 400 bird species have been recorded on the 16 000ha wetland extending some 70km between the towns of Modimolle and Mokopane. The heart of the Nylsvley wetland is in the Nylsvley Nature Reserve with five modern bird hides providing perfect view and photo opportunities.
- Marakele National Park – located in the northeast of Thabazimbi, this park is undoubtedly one of the greatest wilderness areas of South Africa. The park has become a „place of sanctuary" for an impressive variety of wildlife due to its location in the transitional zone between the dry wester and moister eastern regions of South Africa.
- Hot Spring Water- the strong mineral springs with a flow of 220,000l of water per hour with a temperature of 52 degrees Celsius gave rise to the establishment of Bela-Bela (Warmbaths). The town`s progress was to a large extent due to the hot water and their healing qualities. The water from the springs is rich with NaCl, calcium-carbonate and other salts are, amongst others, beneficial to persons suffering from rheumatic ailments. About 400 000 people visit the beautiful swimming baths of the springs annually, mainly during winter months when the climate is pleasant.

v) Impacts and risks identified including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts

The preferred option is the only option that was approved by DMR and LEDET in the original application, therefore, it is not necessary to include an alternative option to this project.

Please note that all training and environmental awareness management is moved to Part B (1)(j).

Financial provision costs are not included because it changes annually.

1. Geology and the mineral resource

1.1 Loss of geology and mineral resource

Activity: Mining activities- making of open quarry

Aspect and impact description: Removal of ore will lead to the loss of geology.

Method for assessing risks: Information for this risk was extracted from the Approved EMP (BECS Environmental, 2014).

Changes to previous EMP: The impact and risk methodology have been updated to a new format. The impact on geology will remain the same.

CONSEQUENCE							
Nature / Intensity / Severity of Impact				**Before management**		**With management**	
The loss of geology will not impact any other environmental component.				1		1	
Spatial extent of Impact				**Before management**		**With management**	
The impact will be specific to the site of the activity if management measures are implemented.				2		2	
Duration of Impact				**Before management**		**With management**	
The loss of geology is permanent.				4		4	
LIKELIHOOD							
Probability of potential occurrence of the Impact				**Before management**		**With management**	
The likelihood of the impact is definite as mining activities are unavoidable.				4		4	
Frequency of potential occurrence of the Impact				**Before management**		**With management**	
The impact occurs at least once a week.				4		4	
SIGNIFICANCE				**Before management**		**With management**	
Medium pre and post mitigation.				15		15	
Cumulative impacts There are various mines in the area which are removing geology.							
Environmental objective To prevent unnecessary removal of ore.							
Management measures to be applied	**Phase applicable to**	**Management tools**	**Management timeframe**	**Monitoring programmes**	**Responsibilities for**	**Financial provision for**	**Mitigation hierarchy**

	management measure		**and schedule**		**implementation and long-term maintenance**	**long-term maintenance and/or environmental costs**	
Mining will take place according to the layout plan as approved by DMR. The geologists do the quarry design according to the layout plan. Once this is done, the surveyor marks out the area, which is then further marked by and excavator.	Operational	Layout plan and designs	Continuous	Comparing layout plans to mining activity.	Geologist and surveyor.	No additional costs.	Minimisation
Stakeholder expectations and / or comments None received.							
Legal compliance and standards Regulations 3 & 9(1)(a&g) & 12 of GN 632 of 2015 (Regulations Regarding the Planning and Management of Mine Residue) under NEMWA, regulation 8 of GN 634 of 2013 (Waste Classification and Management Regulations) under NEMWA, GN 632 of 2015 has replaced regulation 73 of GN 527 of 2004 under MPRDA. Refer to transitional period							
Residual and latent risks The removed geology will be a residual risk. No latent impacts identified at this stage.							

2. Soils, land capability, surrounding land use and landscape character

2.1 Removal of topsoil

Activity: Removal of all topsoil at the quarry footprint in order to mine the underlying geological strata

Aspect and impact description: Removal of all topsoil will cause all productive soil functions at the quarry footprint in terms of a growth medium for plants and subsequent food and habitat for fauna and flora to cease completely. The mixing of soil horizons will cause a reduction in soil quality. Removal of the topsoil at the quarry footprint will cause the all existing land capability and land use in terms arable, grazing and wilderness potential to cease completely.

Method for assessing risks: Information for this section was extracted from Soil Study Report (Gudani consulting, 2015). The table has been updated to the most recent impact methodology.

Changes to previous EMP: Updated procedures and plans. The proposed amendment of the mining method is to store all overburden adjacent to the quarry, in the already approved overburden footprint. Coarse and fine tailings will be backfilled into the quarry. The approved footprints for overburden and topsoil stockpile will still be used. The impact and risk methodology have been updated to a new format.

CONSEQUENCE		
Nature / Intensity / Severity of Impact	**Before management**	**With management**
All topsoil will be removed and all productive soil functioning and subsequent land capability and land use in terms of arable, grazing or wilderness at the quarry footprint will cease completely. Soil horizons sequences and habitats which developed over many of years will be destroyed	5	4
Spatial extent of Impact	**Before management**	**With management**
The impact will occur only at the quarry footprint where all topsoil will be removed.	1	1
Duration of Impact	**Before management**	**With management**
The impact will remain throughout the life of the activity (construction to operational phase) and will be permanent if the quarry is not backfilled and the topsoil not replaced.	4	4
LIKELIHOOD		
Probability of potential occurrence of the Impact	**Before management**	**With management**
The mine has already removed all the economic viable material making the probability definite pre and post management.	4	4
Frequency of potential occurrence of the Impact	**Before management**	**With management**
This is a once-off impact.	1	1
SIGNIFICANCE	**Before management**	**With management**
Significance will be negative medium pre and low post mitigation.	15	14
Cumulative impacts The proposed mine is surrounded by various other mines in the area as well as other land uses in the area, which could lead to cumulative impacts on the soil, land capability and land uses of the area		
Environmental objective To implement all soil management measures in order to conserve soil.		

Management measures to be applied	Phase applicable to management measure	Management tools	Management timeframe and schedule	Monitoring programmes	Responsibilities for implementation and long-term maintenance	Financial provision for long-term maintenance and/or environmental costs	Mitigation hierarchy
Management of the impact on soil lies in ensuring that the soil resource is removed and conserved in high quality status during the mining period until rehabilitation can be done.	Operational until rehabilitation.	Rehabilitation plan	Continuous	Monitor soil stripping	Mine manager / site geologist and surveyor	Stripping and stockpiling of soil - R357,000/year	Minimise & rehabilitation
The topsoil should be stripped at different depths per soil type and stored separate from underlying overburden material as shown in Figure 6 and Section 7 of the soil report. This will ensure that sufficient high-quality soil is available during the decommissioning phase.	Operational until decommissioning.	Soil Study Report	Continuous	Monitor soil stripping	Mine manager / site geologist and surveyor	Stripping and stockpiling of soil - R357,000/year	Minimise & rehabilitation
The topography should be reconstructed to such an extent that it is free-draining, and topsoil should then be replaced at depths indicated in Figure 6 of the specialist report.	Decommissioning and rehabilitation	Rehabilitation plan	Rehabilitation.	Compare rehabilitation to rehabilitation plan	Mine manager / site geologist	Reconstruction of topography - Part of financial provision	Minimise & rehabilitation
Proper rehabilitation of the soils at the quarry footprint will directly influences post-mining land capability and increase the tempo at which habitats can re-establish.	Decommissioning and rehabilitation	Rehabilitation plan	Continuous throughout rehabilitation	Compare rehabilitation to rehabilitation plan	Mine manager / site geologist	Rehabilitation of topsoil - Part of financial provision	Minimise & rehabilitation
Stakeholder expectations and / or comments None received.							
Legal compliance and standards							

Environmental Impact Assessment (EIA) as required in terms of the Mineral and Petroleum Resources Development Act (MPRDA), Act 28 of 2002 and the National Environmental Management Act (NEMA), Act 107 of 1998. The Acts require that pollution and/or degradation of the environment is to be avoided, or where either aspect cannot be avoided, is to be minimised and remedied.
Residual and latent risks With adequate management, no residual impacts are envisaged. Without adequate management, there will be a loss of soil fertility. No latent impacts identified at this stage.

2.2 Soil disturbance

Activity: Placement of overburden dumps and topsoil stockpiles on top of natural undisturbed soils, road building material will be placed and compacted on top of productive undisturbed soils.

Aspect and impact description: The overburden dumps and topsoil stockpiles will cause all productive soil functions, and all land capability and land use in terms of arable land or grazing, to cease completely. The road material will cause all productive soil functions at the road footprint in terms of a growth medium for plants and subsequent food and habitat for fauna and flora to cease completely. The haul road will cause all land capability at the road footprint in terms of arable land or grazing to cease completely. Oil leaks from machinery may occur. If the overburden dumps remain after the decommissioning phase it will result in an altered topography with much lower quality growth medium.

Method for assessing risks: Information for this section was extracted from Soil Study Report (Gudani consulting, 2015). The table has been updated to the most recent impact methodology.

Changes to previous EMP: The significance rating has been changed to the new format. The proposed amendment of the mining method is to store all overburden adjacent to the quarry, in the already approved overburden footprint. The approved footprints for overburden and topsoil stockpile will still be used. The sequence of storing as per the layout plan has changed somewhat.

CONSEQUENCE		
Nature / Intensity / Severity of Impact	**Before management**	**With management**
All productive soil functioning, land capability and land use underneath the overburden dumps and topsoil stockpiles will cease completely having a high severity.	3	2
Productive soil functions will cease at the haul road footprint which covers 3.320km in distance and approximately 10-20m wide causing medium severity.	3	2

Spatial extent of Impact	**Before management**	**With management**
Impact will be localised.	1	1
Duration of Impact	**Before management**	**With management**
The impact will occur during the construction and operational phase until the overburden dumps and topsoil stockpiles are removed.	3	3
The impact will occur during the construction and operational phase until the haul road is removed and the footprint rehabilitated	3	3
LIKELIHOOD		
Probability of potential occurrence of the Impact	**Before management**	**With management**
Productive soil functioning, land capability, and land use will definitely cease underneath all overburden dumps and topsoil stockpiles.	4	4
Productive soil functions, land capability and current land use will definitely cease at the haul road footprint	4	4
Frequency of potential occurrence of the Impact	**Before management**	**With management**
Removal of soil for mining occurs daily	5	5
Construction of the haul road is once off	1	1
SIGNIFICANCE	**Before management**	**With management**
Significance for overburden dumps and topsoil stockpiles is negative medium pre and post mitigation.	16	15
Significance for haul road before management is medium and low post mitigation.	12	11
Cumulative impacts The proposed mine is surrounded by various other mines in the area as well as other land uses in the area, which could lead to cumulative impacts on the soil, land capability and land uses of the area.		
Environmental objective To implement all soil management measures in order to conserve soil.		

Management measures to be applied	**Phase applicable to management measure**	**Management tools**	**Management timeframe and schedule**	**Monitoring programmes**	**Responsibilities for implementation and long-term maintenance**	**Financial provision for long-term maintenance and/or environmental costs**	**Mitigation hierarchy**

Overburden will be sloped sloped. This must be adequately described in the annual and final rehabilitation plans.	Closure and rehabilitation	Rehabilitation plan	Continuously through closure	Compare rehabilitation to rehabilitation plan	Mine manager / site geologist	Sloping of overburden - Part of financial provision	Rehabilitation
Management of the impact by the haul road lies in containing the size of the haul road as far as possible and by removing the haul road as soon as possible.	Construction until closure.	Rehabilitation plan	Continuously through closure and decommissioning	Compare rehabilitation to rehabilitation plan	Mine manager / site geologist	Rehabilitation of topsoil - Part of financial provision	Minimise
Stakeholder expectations and / or comments None received.							
Legal compliance and standards Contaminated land: GN 527 of 2004 i.t.o. MPRDA, and sections 35-41 of NEMWA							
With adequate management, no residual impacts are envisaged. Without adequate management, there will be a loss of soil fertility. No latent impacts identified at this stage.							

2.3 Loss of topsoil and land capability

Activity: Excavation of a water diversion trench

Aspect and impact description: Excavation of a water diversion trench implies removal of the topsoil and subsoil horizons and placing it adjacent to the trench. The natural soil horizon sequence will be disturbed, and the A, B and C-horizons will be mixed which will result in a reduction in soil quality. All vegetation will also be removed and the current land use in terms of grazing for livestock or wildlife will cease.

Method for assessing risks: Information for this section was extracted from Soil Study Report (Gudani consulting, 2015). The table has been updated to the most recent impact methodology.

Changes to previous EMP: The significance rating has been changed to the new format.

CONSEQUENCE		
Nature / Intensity / Severity of Impact	**Before management**	**With management**

The topsoil will be excavated and all productive soil functioning at the trench footprint will cease completely. Land capability at the trench footprint will cease completely. The vegetation will be removed, and existing land uses at the trench footprint will cease completely resulting in medium severity.	3	2
Spatial extent of Impact	**Before management**	**With management**
The impact will occur only at the trench footprint	1	1
Duration of Impact	**Before management**	**With management**
The impact is long-term and will occur during the construction and operational phase and until the trench is backfilled.	3	3
LIKELIHOOD		
Probability of potential occurrence of the Impact	**Before management**	**With management**
Productive soil functions, land capability, and current land uses, will definitely cease at the trench footprint.	4	4
Frequency of potential occurrence of the Impact	**Before management**	**With management**
Mining activity will be daily	5	5
SIGNIFICANCE	**Before management**	**With management**
Significance will be negative medium pre and post mitigation.	16	15
Cumulative impacts The proposed mine is surrounded by various other mines in the area as well as other land uses in the area, which could lead to cumulative impacts on the soil, land capability and land uses of the area		
Environmental objective To implement all soil management measures in order to conserve soil.		

Management measures to be applied	**Phase applicable to management measure**	**Management tools**	**Management timeframe and schedule**	**Monitoring programmes**	**Responsibilities for implementation and long-term maintenance**	**Financial provision for long-term maintenance and/or environmental costs**	**Mitigation hierarchy**
Management of the impact on soil lies in ensuring that the soil resource is conserved during the mining period until rehabilitation can be done.	Operation until rehabilitation.	Rehabilitation Plan and Soil Study Report	Continuously during rehabilitation.	Monitoring of rehabilitation plan.	Mine manager / site geologist and surveyor	Rehabilitation of topsoil - Part of financial provision	Minimise & rehabilitation

Backfilling of the trenches will re-establish the soil functions over time.	Rehabilitation.	Rehabilitation plan	Continuously during rehabilitation.	Monitoring of rehabilitation plan.	Mine manager / site geologist and surveyor	Rehabilitation of topsoil - Part of financial provision	Minimise & rehabilitation
Stakeholder expectations and / or comments None received.							
Legal compliance and standards Section 21 (c) and (i) of NWA							
Residual and latent risks With adequate management, no residual impacts are envisaged. Without adequate management, there will be a loss of soil fertility. No latent impacts identified at this stage.							

3. Vegetation

3.1 Loss of floristic communities (affecting floristic richness, floristic structure, and ecological condition) and loss of declining, protected and near threatened plant taxa

Activity: Construction and operation of the quarry; and construction and operation of discard dumps

Aspect and impact description: Loss of floristic communities (affecting floristic richness, floristic structure, and ecological condition) and loss of declining, protected and near threatened plant taxa. Invasive plants may establish due to surface area disturbance and also through future rehabilitation activities (e.g. seeding practices). This may lead to:

- Displacement of indigenous vegetation;
- Change in plant species composition;
- Change in vegetation composition and structure;
- Competition for sunlight will increase between indigenous and alien species;
- Loss of habitat and a change in biodiversity.

Method for assessing risks: Information for this section was extracted from An Ecological Evaluation for The Tygerkloof Mine (Pachnoda Consulting CC, 2015). The table has been updated to the most recent impact methodology.

Changes to previous EMP: The significance rating has been changed to the new format. The proposed amendment of the mining method is to store all overburden adjacent to the quarry, in the already approved overburden footprint. The impact on the animal and vegetation life will remain the same. Erosion management moved to Surface water section.

CONSEQUENCE		
Nature / Intensity / Severity of Impact	**Before management**	**With management**
Loss of vegetation pertaining to areas with low ecological sensitivity which is of medium severity.	3	2
The region is not characterised by aggressive alien vegetation, thereby the impact is not expected to be highly severe.	3	2
Spatial extent of Impact	**Before management**	**With management**
The impact will occur only at the haul road footprint	1	1
The impact of alien species could spread beyond area of disturbance	2	1
Duration of Impact	**Before management**	**With management**
The loss of vegetation is permanent.	4	4
The impact of alien species is likely to persist during rehabilitation.	3	2
LIKELIHOOD		
Probability of potential occurrence of the Impact	**Before management**	**With management**
The construction and mining activities is unavoidable - low ecological sensitivity	4	4
It is expected that ruderal and annual weed will colonise the area along with opportunistic floristic taxa (resulting in a species poor community)	4	3
Frequency of potential occurrence of the Impact	**Before management**	**With management**
Monthly- Removal of vegetation as it grows	3	3
SIGNIFICANCE	**Before management**	**With management**
Significance for the loss of floristic communities will be medium negative before and after management	15	14
Significance of alien invasive species will be medium negative before management and low after management.	15	11
Cumulative impacts The proposed mine is surrounded by various other mines in the area as well as other land uses in the area, which could lead to cumulative impacts on the ecological aspects of the area. Land use in this area is mostly wilderness due to the slope of the area.		

Environmental objective To implement all ecological management measures in order to prevent and/or management the loss of vegetation communities.							
Management measures to be applied	**Phase applicable to management measure**	**Management tools**	**Management timeframe and schedule**	**Monitoring programmes**	**Responsibilities for implementation and long-term maintenance**	**Financial provision for long-term maintenance and/or environmental costs**	**Mitigation hierarchy**
The attached sensitivity map must be used as a decision tool to guide the layout design. Mining and construction activities should preferably be restricted to areas identified with low conservation importance. Open cast mining on areas of high conservation importance should be avoided.	Planning and operational	Sensitivity map	Continuously	Consult the sensitivity map to avoid areas of high conservation importance	Mine manager / site geologist and specialist	Walk-through of site prior to construction for protected and near threatened tree species – R12,000-00 once-off	Avoid / prevent & rehabilitation
Footprint areas must be scanned for protected and near threatened tree species during a walk-through of the affected area prior to the construction/mining phase. It is recommended that these plants be identified and marked prior to the development in order to obtain the necessary permits from the relevant authority.		Ecological Evaluation for The Tygerkloof Mine	Once-off	Site inspections to find protected and near threatened tree species	Specialist		
Where possible, large and aged specimens of protected trees (e.g. *Vachellia erioloba)* and *Elaeodendron transvaalensis* should be retained and buffered and the sensitivity map to follow this report). All buffered areas should form part of an open space network to promote movement of fauna when a high rate of natural disruption is expected and to conserve part of the seed bank diversity (essential for restoration).							

It is recommended that the protected species identified also be demarcated to prevent accidental encroachment into the 100m buffer recommended by the ecologist.					Mine manager / site geologist and specialist		
Rehabilitation/restoration should make use of indigenous species, and preferably of species native to the study site and immediate surroundings. The species selected should strive to represent habitat types typical of the ecological landscape prior to construction.	Planning until rehabilitation	Rehabilitation and site layout plan	Continuous	Monitoring of rehabilitation plan.	Mine manager	Re-vegetation - Part of financial provision	Avoid / prevent & rehabilitation
Reinstate/rehabilitate as a continual process – this will maximise the viability of the natural seed bank and prevent the unnecessary loss of topsoil during storage.							
An alien and invasive plant eradication and control programme must be implemented along with a follow-up programme. The programme must be compiled by a qualified botanist/ecologist and the implementation thereof should be supervised by a qualified botanist/ecologist.	Planning until rehabilitation.	Alien and invasive plant eradication and control programme	Ongoing	Site inspections to find alien and invasive plants	Qualified botanist/ecologist.	Alien and invasive plant eradication and control programme - R30,000-00 and once off for the plan	Avoid / prevent & rehabilitation
Priority should be given to eradicate aggressive species.			As necessary	Site inspections to find alien and invasive plants	Mine manager		
Method of removal, that will depend on category of identified species and seasonal period when recorded.			As necessary	Site inspections to find alien and invasive plants	Mine manager		
Any action taken to control and eradicate a listed invasive species shall be executed with caution and in a manner that may cause the least possible harm to biodiversity and damage to the environment.			As necessary	Site inspections to find alien and invasive plants	Mine manager		

Future rehabilitation strategies must consider sensitivity of the flora/fauna within the area and prevent the introduction of species that may compromise the existing habitat and/or promote.	Rehabilitation	Rehabilitation plan	Continuous for operation and rehabilitation	Monitoring of rehabilitation plan.	Mine manager	Re-vegetation - Part of financial provision	Rehabilitation
Stakeholder expectations and / or comments None received.							
Legal compliance and standards Protection of threatened or protected species and permits: Sections 56-58 & 87-93 of National Environmental Management Biodiversity Act No 10 of 2004 (as amended) (NEMBA), section 12 of NFA GN864 of 2016 (Alien and Invasive Species List) & GN255 of 2015 (Threatened or Protected Species Regulations) under NEMBA							
Residual and latent risks With adequate management, no residual impacts are envisaged. Without adequate management, there will be a loss of soil fertility. Loss of soil fertility will hinder vegetation growth. No latent impacts identified at this stage.							

4. Fauna

4.1 Loss of fauna richness during clearing of vegetation and loss of fossorial and stenotopic taxa with restricted dispersal abilities

Activity: Construction and operation of the quarry; and construction and operation of discard dumps

Aspect and impact description: The proposed construction (site clearing and earthworks) and operational (mining operations) activities go hand in hand with high ambient noise levels and the eventual displacement of animal taxa. Many of the larger terrestrial mammal and bird species will vacate these areas (including taxa of conservation concern). Outside lighting attracts nocturnal migrating birds and nocturnal invertebrates and many of these nocturnal invertebrates and certain migratory bird species could be attracted to outside lighting, thereby disrupting natural dispersal and possible collision with infrastructure.

Method for assessing risks: Information for this section was extracted from An Ecological Evaluation for The Tygerkloof Mine (Pachnoda Consulting CC, 2015). The table has been updated to the most recent impact methodology.

Changes to previous EMP: The significance rating has been changed to the new format. Mining activities will take place at night and will continue after 22:00. No lights are placed on site. During night-time, only the lights form the machinery will be used. The lights are for night-working. The management measures for lighting are therefore removed. Waste management moved to section 12.1

CONSEQUENCE		
Nature / Intensity / Severity of Impact	**Before management**	**With management**
Medium-Nocturnal invertebrates and certain migratory birds could become disoriented, displaced and could collide with mining infrastructure	3	3
Loss of fauna pertaining to areas with low ecological sensitivity	3	3
Spatial extent of Impact	**Before management**	**With management**
The effect will depend on the light intensity but is expected to extend beyond site boundary (hundreds of metres) which is considered local.	2	1
The impact will be specific to the site and the surrounding habitat.	2	1
Duration of Impact	**Before management**	**With management**
Long-term and impact will last the life of the project.	3	3
The anticipated loss of habitat (vegetation) will result in the displacement of fauna.	3	2
LIKELIHOOD		
Probability of potential occurrence of the Impact	**Before management**	**With management**
The impact is likely to occur, especially considering the proximity of natural habitat.	4	3
The construction and mining activities is unavoidable and definite - low ecological sensitivity	4	3
Frequency of potential occurrence of the Impact	**Before management**	**With management**
Monthly-Not all animals are nocturnal	3	3
Monthly- Removal of fauna as mining operations continue	3	3
SIGNIFICANCE	**Before management**	**With management**
Significance for nocturnal lighting will be medium negative before and after management.	15	13
Significance for removal of fauna will be medium negative before and after management.	15	12
Cumulative impacts		

The proposed mine is surrounded by various other mines in the area as well as other land uses in the area, which could lead to cumulative impacts on the ecological aspects of the area. Land use in this area is mostly wilderness due to the slope of the area.

Environmental objective

To implement all ecological management measures in order to prevent and/or management the loss of vegetation communities and to manage lighting on the mine.

Management measures to be applied	Phase applicable to management measure	Management tools	Management timeframe and schedule	Monitoring programmes	Responsibilities for implementation and long-term maintenance	Financial provision for long-term maintenance and/or environmental costs	Mitigation hierarchy
Intentional killing of any faunal species (in particular invertebrates and snakes) should be avoided. Any person found deliberately harassing any animal in any way should face disciplinary measures, following the possible dismissal from the site.	Operational	Awareness material.	As necessary.	Inspections	Mine manager / site geologist	No additional costs.	Prevent
If any species of conservation concern is exposed or seen during the Operational Phase at the Overburden, all activities in the direct vicinity of the occurrence of the species should be halted. The Environmental Department shall be informed, who shall then issue instructions for the relocation / translocation / safe release of species (with the necessary permits and permission from the local authorities); Large trees (including dead tree) should be retained on site since these provide potential breeding and roosting habitat for Red-billed Oxpeckers.	Operational	Layout plan	As necessary.	Inspections of overburden.	Mine manager / site geologist	No additional costs.	Minimise

Stakeholder expectations and / or comments

None received.

Legal compliance and standards Protection of threatened or protected species and permits: Sections 56-58 & 87-93 of National Environmental Management Biodiversity Act No 10 of 2004 (as amended) (NEMBA), section 12 of NFA
Residual and latent risks The risk of animals grazing in the open pit area could fall into the pit exists. Alien invasive vegetation could establish on the disturbed areas. Proper rehabilitation will reduce, the probability of the establishment of alien invasive vegetation occurring.

4.2 Deterring animals from utilising nearby resources

Activity: Operation of haul road

Aspect and impact description: Haul traffic will lead to increased noise generation which will deter animals from utilising nearby resources. However, displacement of large-bodied animals which require large home ranges will lead to excessive competition between conspesific species, resulting in potential conflict with neighbouring species. Increased haul traffic noise and vibration will interfere with ability of ground-dwelling animals to detect potential predators or to escape predation. Haul traffic will lead to increased incidents of animal and vehicle encounters. If speed limits are not adhered to then the risk of road kill increases. The death of an individual from a species has the potential to effect local habitual behaviour.

Method for assessing risks: Information for this section was extracted from An Ecological Evaluation for The Tygerkloof Mine (Pachnoda Consulting CC, 2015). The table has been updated to the most recent impact methodology.

Changes to previous EMP: The significance rating has been changed to the new format. Mining activities will take place at night and will continue after 22:00. This will disturb nocturnal animals. The following management measure is removed: ‘Allow movement of animals during operation and increase the permeability of the road network.’

CONSEQUENCE		
Nature / Intensity / Severity of Impact	**Before management**	**With management**
Medium- The road is of linear configuration, thereby the impact is largely confined to the road reserve and immediate surroundings	2	2
Spatial extent of Impact	**Before management**	**With management**
The effect will impact on the area at the road and the area beyond road reserve.	2	2
Duration of Impact	**Before management**	**With management**

Long-term and impact will last the life of the project.	3	3
LIKELIHOOD		
Probability of potential occurrence of the Impact	**Before management**	**With management**
The impact is likely to occur, especially considering the proximity of natural habitat.	4	3
Frequency of potential occurrence of the Impact	**Before management**	**With management**
Haul road will be used daily	5	5
SIGNIFICANCE	**Before management**	**With management**
Significance will be medium negative before and after management.	16	15
Cumulative impacts The proposed mine is surrounded by various other mines in the area as well as other land uses in the area, which could lead to cumulative impacts on the ecological aspects of the area. Land use in this area is mostly wilderness due to the slope of the area.		
Environmental objective To manage any displacement of fauna and manage and minimise any road killings		

Management measures to be applied	Phase applicable to management measure	Management tools	Management timeframe and schedule	Monitoring programmes	Responsibilities for implementation and long-term maintenance	Financial provision for long-term maintenance and/or environmental costs	Mitigation hierarchy
Limit the road network to areas with low ecological sensitivity and plan roads to cross the least number of different habitat types - this will limit the richness of taxa that could be affected by the impact.	Construction until rehabilitation	Sensitivity map	As necessary.	Consult the sensitivity map to avoid areas of high conservation importance	Mine manager / site geologist	No additional costs.	Prevent
Road kills must be monitored, and a database created of species killed to identify areas with a high frequency of mortalities.	Operational until closure.	Road kill database	Ongoing	Monitor road-kill database	Mine personnel and mine manager / site geologist	No additional costs.	Prevent

Introduce road calming structures (e.g. humps) and enforce the speed limit.	Operational until closure.	Road designs and signage	Ongoing	Inspection of roads and signage	Mine manager / site geologist	No additional costs.	Prevent road kill
Allow movement of animals during operation and increase the permeability of the road network.	Operational until closure.	Road designs	Ongoing	Compare road to designs	Mine manager / site geologist	No additional costs.	Prevent road kill
Stakeholder expectations and / or comments None received.							
Legal compliance and standards GN255 of 2015 (Threatened or Protected Species Regulations) under NEMBA							
Residual and latent risks No residual impacts after closure. No latent impacts identified at this stage.							

5. Air quality

5.1 Impact on air quality

Activity: Mining activities and placement of overburden

Quantitative assessment of the significance of operational phase air quality impacts associated with PM and gaseous emissions

Method for assessing risks: Information for this section was extracted from the Air Quality Specialist Report for the Proposed Tygerkloof Mine, Thabazimbi, Limpopo Province (Airshed Planning Professionals, 2015). The table has been updated to the most recent impact methodology.

Amendment from approved EMP: Significance rating as per the original EMP is used. The following management is changed: '*For the control of vehicle entrained dust it is recommended that water (at an application rate of 1litre/m2-hour), be applied in combination with addition of chemicals. Literature reports an emissions reduction efficiency of 80%.'*

Activity	Impact	Quantity or size of disturbance	Severity or destruction effect	Extent	Duration	Probability	Reversibility	Irreplaceability of resources	Degree to which can be avoided	Significance
	$PM_{2.5}$	1	1	2	2	2	2	2	1	13 (Low) [(a)]

Operational phase – Scenario A and B	PM_{10}	2	2	2	2	2	2	2	2	16 (Medium) [b]
	NO_2	1	1	2	2	2	2	2	2	14 (Medium) [c]
	VOCs	1	1	1	2	2	2	2	1	12 (Low) [d]
	CO	1	1	1	2	2	2	2	1	12 (Low) [d]
	SO_2	1	1	1	2	2	2	2	1	12 (Low) [d]
	Dustfall (Nuisance effect)	1	1	1	2	2	2	2	1	12 (Low) [d]

Notes: Description of Significance Rating

[a] The proposed activities will contribute minimally to the pollutant baseline footprint in the area (low). Impacts will recede with recommended mitigations or when the activities cease.

[b] The proposed activities will contribute slightly significantly to the pollutant baseline footprint in the area (medium). Impacts will recede with recommended mitigations or when the activities cease.

[c] The proposed activities will contribute slightly significantly to the pollutant baseline footprint in the area (medium). Impacts will recede with recommended mitigations or when the activities cease.

[d] The proposed activities will contribute minimally to the pollutant baseline footprint in the area (low). Impacts will recede with recommended mitigations or when the activities cease.

Unpaved roads and crushing and screening were identified as the major contributor to PM emissions. The main dust generating factors on unpaved road surfaces include: Vehicle speeds; Number of wheels per vehicle; Traffic volumes; Particle size distribution of the aggregate; Compaction of the surface material; Surface moisture; and Climate.

Cumulative impacts

Due to the small scale of farming activities these are regarded to have an insignificant cumulative impact. Domestic households are potentially one of the most important sources contributing to poor air quality within residential areas. Individual households are low volume emitters, but their cumulative impact is significant. Cumulative pollutant concentrations and dustfall rates as a result of the project in addition to pre-development air pollution levels could not be determined at this stage.

Environmental objective

The main objective of the proposed air quality management measures for the project is to ensure that operations result in ambient air concentrations (specifically PM2.5, PM10 and NO2) and dustfall rates that are within the relevant ambient air quality standards at Hotazel, Santoy and other off-site areas. In order to define site specific management objectives, the main sources of pollution need to be identified. Once the main sources have been identified, target control efficiencies for each source can be defined to ensure acceptable cumulative ground level concentrations.

Management measures to be applied	Phase applicable to management measure	Management tools	Management timeframe and schedule	Monitoring programmes	Responsibilities for implementation	Financial provision for long-term maintenance and/or environmental costs	Mitigation hierarchy

					and long-term maintenance		
The mine must commit itself to adequate air quality management planning throughout the life of the proposed project. The air quality management plan (AQMP) provides options on the control of dust particles and gases at the main sources, while the monitoring network is designed to track the effectiveness of the mitigation measures.	Operational until closure	Air quality management plan	Ongoing.	Monitor as per air quality impact assessment	Air quality consultant	Air quality monitoring – This will depend on costs of consultant to monitor air quality.	Minimise
Use water carts to water down roads.	Operational until closure.	Air quality impact assessment	Ongoing.		Mine manager / site geologist	Water down roads - R55,000/month	Minimise
Once a portion of the area has reached the end of its active life i.e. sides and certain surface areas, it should be rehabilitated. If this is done continually, a 75% or more reduction in emissions is anticipated.	Operational until closure.	Rehabilitation plan	Ongoing		Mine manager / site geologist	Re-vegetation - Part of financial provision	Rehabilitate
To ensure lower diesel exhaust emissions, equipment suppliers or contractors should be required to ensure compliance with appropriate emission standards for mining fleets.	Operational until closure.	Contractor's agreement, maintenance records.	Ongoing	Inspect maintenance records.	Mine manager / site geologist	No additional costs – maintenance costs for contractors.	Minimise
Stakeholder expectations and / or comments None received.							
Legal compliance and standards Ambient air quality management							

GN 351 of 2014 (Regulations Regarding the Phasing-out and Management of Ozone- Depleting Substances) under NEMAQA. Regulations 9(f) & 11 of GN 632 of 2015 (Regulations Regarding the Planning and Management of Residue Stockpiles and Residue Deposits) under NEMWA
Residual and latent risks No residual impacts identified. No latent impacts identified at this stage.

6. Groundwater

6.1 Impact on groundwater quality and levels

Activity: development and utilisation of the topsoil and overburden dumps in tandem with the development and progression of the proposed quarry and opencast mining cuts

Aspect and impact description: Topsoil and overburden material are mostly inert, therefore no significant impacts on groundwater quality conditions are envisaged. Local groundwater levels are expected to remain unaffected by the planned opencast mining activities since the quarry floor is planned to remain largely above the local groundwater level.

Method for assessing risks: Information for this section was extracted from the Report on Geohydrological Investigation as part of the EIA, EMP AND IWULA (Groundwater Complete, 2015). The table has been updated to the most recent impact methodology.

Amendment from approved EMP: The significance rating has been changed to the new format. The proposed amendment of the mining method is to store all overburden adjacent to the quarry, in the already approved overburden footprint. The approved footprints for overburden and topsoil stockpile will still be used, therefore, the impact on groundwater will remain the same.

CONSEQUENCE		
Nature / Intensity / Severity of Impact	**Before management**	**With management**
Low- No significant quarry dewatering is expected. The topsoil and overburden material are mostly inert and ± 116 ha disturbed by proposed quarry	1	1
Spatial extent of Impact	**Before management**	**With management**
On-site- no significant impact is envisaged	1	1
Duration of Impact	**Before management**	**With management**

Medium- No significant impact envisaged	2	2
LIKELIHOOD		
Probability of potential occurrence of the Impact	**Before management**	**With management**
Improbable- No significant impact envisaged	3	2
Frequency of potential occurrence of the Impact	**Before management**	**With management**
Impact occurs at least once in a year or less frequently	1	1
SIGNIFICANCE	**Before management**	**With management**
Significance is low before management and after management.	8	7

Cumulative impacts

Pollution from the proposed mine and the existing RAM could lead to a cumulative impact on the groundwater resource. These two mines will be managed as a unit.

Environmental objective

To monitor groundwater quantity and prevent spillages from machinery and vehicles.

Management measures to be applied	Phase applicable to management measure	Management tools	Management timeframe and schedule	Monitoring programmes	Responsibilities for implementation and long-term maintenance	Financial provision for long-term maintenance and/or environmental costs	Mitigation hierarchy
If the monitoring program indicates that nearby groundwater users are affected negatively by dewatering, the users need to be compensated for the loss.	Operational until closure	Groundwater monitoring programme	As necessary	Monitor groundwater levels.	Mine manager / site geologist	Quarterly monitoring of groundwater levels - R75,000/year. Unknown costs if groundwater users impacted.	Monitor & minimise
Clean surface water should not come into contact with dirty water.	Operational until closure	Stormwater management plan and Groundwater monitoring programme	Continuous	Site inspections to the diversion berm & Monitor	Mine manager / site geologist	Quarterly monitoring of groundwater levels - R75,000/year. No additional costs for inspections.	Monitor & prevent

				groundwater qualities.			
Stakeholder expectations and / or comments None received.							
Legal compliance and standards Regulation 4 of GN 632 of 2015 under NEMWA (Regulations Regarding the Planning and Management of Mine Residue) under NEMWA' Section 21 of the National Water Act sets out the water uses for which an IWUL is required.							
Residual and latent risks Depending on the results of further monitoring, the risk of potential pollution (excluding acid mine drainage) might be a residual risk. A groundwater pollution plume was conducted for the adjacent Rhino Andalusite Mine. According to this study; the tailings material is expected to be free of any mineral or contaminant/pollutant that may potentially pose a risk to groundwater quality. The potential for acid mine drainage becoming a latent impact is not probable							

6.2 Reduction in groundwater recharge

Activity: The extension of the haul road will cause a very small reduction in recharge to the underlying aquifer system due to the compaction of the surface of the road.

Aspect and impact description: Groundwater pollution and lowering of local groundwater recharge.

Method for assessing risks: Information for this section was extracted from the Report on Geohydrological Investigation as part of the EIA, EMP AND IWULA (Groundwater Complete, 2015). The table has been updated to the most recent impact methodology.

Amendment from approved EMP: The significance rating has been changed to the new format.

CONSEQUENCE		
Nature / Intensity / Severity of Impact	**Before management**	**With management**
Material used in the construction is inert, therefore severity will be low.	1	1
Spatial extent of Impact	**Before management**	**With management**
Impact will be local.	1	1
Duration of Impact	**Before management**	**With management**
Medium-term as no significant impact is envisaged.	2	2

LIKELIHOOD		
Probability of potential occurrence of the Impact	**Before management**	**With management**
Improbable- No significant impact envisaged	1	1
Frequency of potential occurrence of the Impact	**Before management**	**With management**
Impact occurs at least once in a year or less frequently	1	1
SIGNIFICANCE	**Before management**	**With management**
Low pre and post mitigation.	6	6

Cumulative impacts

Pollution from the proposed mine and the existing RAM could lead to a cumulative impact on the groundwater resource. These two mines will be managed as a unit.

Environmental objective

To prevent spillages from vehicles and machinery.

Management measures to be applied	**Phase applicable to management measure**	**Management tools**	**Management timeframe and schedule**	**Monitoring programmes**	**Responsibilities for implementation and long-term maintenance**	**Financial provision for long-term maintenance and/or environmental costs**	**Mitigation hierarchy**
Haul road should be kept free of potentially hazardous material by cleaning spillages, thereby reducing infiltration of contaminated water.	Operational.	Spill handling procedure & spill kits	Ongoing and cleaning if necessary	Inspection of haul roads.	Mine manager / site geologist	Spill handling kits - R5,000 once off	Minimise & prevent

Stakeholder expectations and / or comments

None received.

Legal compliance and standards

Regulation 4 of GN 632 of 2015 under NEMWA (Regulations Regarding the Planning and Management of Mine Residue) under NEMWA'

Residual and latent risks

None. This is an insignificant impact.

No latent impacts identified at this stage.

7. Surface water

7.1 Potential of flooding

Activity: Development of quarry within drainage lines with the potential of flooding

Aspect and impact description: Damage to infrastructure and/or excessive inflow into open quarry causing financial/production loss and/or surface water contamination

Method for assessing risks: Information for this section was extracted from the Report on Geohydrological Investigation as part of the EIA, EMP AND IWULA (Groundwater Complete, 2015). The table has been updated to the most recent impact methodology.

Amendment from approved EMP: The significance rating has been changed to the new format. The impact will remain the same.

CONSEQUENCE		
Nature / Intensity / Severity of Impact	**Before management**	**With management**
Medium as flooding has the potential to cause severe damage to high walls, roads and other infrastructure that may be placed on site.	3	3
Spatial extent of Impact	**Before management**	**With management**
Flooding of quarry and damage to infrastructure is limited to the direct site	1	1
Duration of Impact	**Before management**	**With management**
Impact is a temporary impact	1	1
LIKELIHOOD		
Probability of potential occurrence of the Impact	**Before management**	**With management**
The upstream catchment area will probably produce surface runoff with the potential to flood.	2	1
Frequency of potential occurrence of the Impact	**Before management**	**With management**
Impact occurs at least once in a year or less frequently	1	1
SIGNIFICANCE	**Before management**	**With management**
Significance is low pre and post management.	8	7
Cumulative impacts Surface water run-off from the adjacent mine is also decreased to prevent dirty water from leaving the area. The new proposed mine will increase the amount of water lost to the surface water catchment.		

Environmental objective To prevent excessive inflow into the open quarry.							
Management measures to be applied	**Phase applicable to management measure**	**Management tools**	**Management timeframe and schedule**	**Monitoring programmes**	**Responsibilities for implementation and long-term maintenance**	**Financial provision for long-term maintenance and/or environmental costs**	**Mitigation hierarchy**
Trench (berm): Clean runoff water from the mountain area should be diverted around the quarry with a trench along the north to prevent clean inflow into the quarry. Natural drainage line to the east coincides with a servitude from Eskom that provides a proposed 200m wide drainage area through the quarry footprint. The size of the trench is recommended at 1.5m (width of an average excavator bucket) by 1m deep and vegetation growth should be encouraged but limited to grass as trees and scrubs may create a blockage. A portion of the runoff should be diverted around the western side of the quarry. As the topography flattens below the quarry the drainage is mainly in an eastern direction where runoff will join with the eastern drainage line of the quarry before forming part of the Bierspruit. Storm water runoff diverted to west will have no impact on the property west of the mine as it can be considered upstream of the proposed diversion outfall.	Operational.	Stormwater management plan	Continuous throughout operation	Inspection of all surface water infrastructure.	Mine manager / site geologist	No additional costs.	Avoid & prevent
Culvert A culvert will be required where the haul road has to cross the drainage line. Based on the estimated 1:50 year flood peaks along the drainage line it is anticipated that at least a 3m*2m high box culvert is required to sufficiently	Operational.	Stormwater management plan	Once-off	Inspection of all surface water infrastructure.	Mine manager / site geologist	Costs not yet known.	Avoid & prevent

allow drainage past the proposed haul road. This can only be used as a reference as it is not based on detailed surveyed data. Refer to Table 7 of the SWMP for the slope and sizing parameters used. Runoff is expected to be at a high velocity and decent erosion control measures are necessary.							
General storm water management measures Storm water control infrastructure within this document is designed to withstand a 1:50 year flood event. In the event of runoff breaching infrastructure, it is important to first ensure the safety of the people on site. No affected water from the mine is allowed to spill into the clean water environment. This should be ensured through design as well as operational control measures.	Operational.	Stormwater management plan.	Continuous throughout operation	Inspection of all surface water infrastructure	Mine manager / site geologist	In-house – no additional budget necessary.	Avoid & prevent
Stakeholder expectations and / or comments A question was raised regarding the storm water being channelled around the quarry. An enquiry was also made regarding the layout. Rainfall / stormwater falling on the upstream of Tygerkloof Mine to ensure that the water does not result in a negative impact on the Andalusite Resources mining right area. He also enquired whether the mine considered the impact of MHSA Regulation 17.7 and 17.8 as well as 17.10							
Legal compliance and standards Section 21 of the NWA sets out the water uses for which an IWUL is required.							
Residual and latent risks Depending on the results of further monitoring, the risk of potential pollution and sedimentation might be a residual risk. No latent impacts identified at this stage.							

7.2 Erosion and siltation

Activity: Concentration of accelerated runoff

Aspect and impact description: Erosion of steep slopes accompanied by siltation of downstream receiving environment which also causes a loss of soil with reduced capacity downstream.

Method for assessing risks: Information for this section was extracted from the Report on Geohydrological Investigation as part of the EIA, EMP AND IWULA (Groundwater Complete, 2015). The table has been updated to the most recent impact methodology.

Amendment from approved EMP: The significance rating has been changed to the new format.

CONSEQUENCE		
Nature / Intensity / Severity of Impact	**Before management**	**With management**
Erosion will be directly at drainage lines and exposed slopes, whereas the settling may impact a wider downstream area. Erosion usually has an escalating effect while the siltation downstream is often uncontrollable, therefore, medium impact.	3	3
Spatial extent of Impact	**Before management**	**With management**
The impact of erosion and siltation may extend far downstream which makes the impact regional.	3	3
Duration of Impact	**Before management**	**With management**
If not prevented or rehabilitated, erosion and siltation may remain after closure causing the impact to be permanent.	4	3
LIKELIHOOD		
Probability of potential occurrence of the Impact	**Before management**	**With management**
If not managed there is a probability that erosion and subsequent siltation will take place.	2	1
Frequency of potential occurrence of the Impact	**Before management**	**With management**
Impact occurs at least once a week.	4	4
SIGNIFICANCE	**Before management**	**With management**
Significance is negative high pre and medium post management.	16	14
Cumulative impacts Surface water run-off from the adjacent mine is also decreased to prevent dirty water from leaving the area. The new proposed mine will increase the amount of water lost to the surface water catchment.		
Environmental objective To prevent sedimentation of water resources		

Management measures to be applied	Phase applicable to management measure	Management tools	Management timeframe and schedule	Monitoring programmes	Responsibilities for implementation and long-term maintenance	Financial provision for long-term maintenance and/or environmental costs	Mitigation hierarchy
Active overburden and topsoil dumps should be defined with berms to prevent erosion runoff extending beyond the property boundaries.	Operational until rehabilitation.	Stormwater management plan and erosion inspection checklists.	Continuously throughout operation.	Inspections of infrastructure and signs of erosion.	Mine manager / site geologist	Checks on erosion and infrastructure are in-house – no additional budget necessary.	Prevent & minimise
Dumps should be free draining and minimise runoff directly over the sides where erosion may be a high risk.							
Prevent erosion at high risk erosion areas. This include all road and berms where surface water is concentrated into sheet flow. Erosion prevention measures (e.g. grass, cement or rock) should be in place at all concentration points on the mine. These areas specifically include high velocity trenches and drains diverting clean runoff around the quarries.							
Appropriate remedial action, including the rehabilitation of the eroded areas, and where erosion is occurring, appropriate remedial actions taken.							
Ensure function and capacity of infrastructure is maintained.	Operational until rehabilitation.	Stormwater management plan	Continuously throughout operation.	Monitor surface water qualities.	Mine manager / site geologist	Quarterly monitoring of groundwater levels - R75,000/year. No additional costs for inspections.	Monitor & prevent
Stakeholder expectations and / or comments None received.							
Legal compliance and standards Section 21 of the NWA sets out the water uses for which an IWUL is required.							

Residual and latent risks
Depending on the results of further monitoring, the risk of potential pollution and sedimentation might be a residual risk.
No latent impacts identified at this stage.

8. Environmental noise

8.1 Environmental noise generation

Activity: Mining activities and placement of overburden

Aspect and impact description: Noise generation through mining activities and placement of overburden resulting in noise nuisance on environment and community.

Method for assessing risks: Information for this section was extracted from the Environmental Noise Impact Assessment Report (Varicon CC, 2015) The table has been updated to the most recent impact methodology.

Amendment from approved EMP: The significance rating has been changed to the new format. Management measures have been amended to indicate working hours 24 hours a day.

CONSEQUENCE		
Nature / Intensity / Severity of Impact	**Before management**	**With management**
Noise generation is small and will be limited to vehicle noise and mining activities. The reef is removed through pick and shovel and blasting is only done when hard rock needs to be removed to gain access to the ore body. Noise levels could be accumulative between the existing quarry and the new quarry when in operation, but the levels should remain below the statutory requirements.	1	1
Spatial extent of Impact	**Before management**	**With management**
The noise generation will mainly be limited to the mining site but will extent past the boundaries of the quarry area through the vehicles that travel in and out of the quarry.	1	1
Duration of Impact	**Before management**	**With management**
Noise generation will continue for the duration of the mining activities and is therefore medium-term.	2	2
LIKELIHOOD		
Probability of potential occurrence of the Impact	**Before management**	**With management**
All vehicles and mining processes are noise generation activities.	4	4

Frequency of potential occurrence of the Impact	**Before management**	**With management**
This will take place daily.	5	5
SIGNIFICANCE	**Before management**	**With management**
Significance is medium negative before management and after management.	13	13
Cumulative impacts Noise levels could be accumulative between the existing quarry and the new quarry when in operation, but the levels should remain below the statutory requirements.		
Environmental objective To manage noise nuisance on and around the mine.		

Management measures to be applied	**Phase applicable to management measure**	**Management tools**	**Management timeframe and schedule**	**Monitoring programmes**	**Responsibilities for implementation and long-term maintenance**	**Financial provision for long-term maintenance and/or environmental costs**	**Mitigation hierarchy**
All maintenance and operating of equipment should be done as per specifications of the OEM's. Effective maintenance of the vehicle engines and exhaust systems.	Operational.	Maintenance registers	As necessary.	Inspection of maintenance registers.	Mine manager / site geologist.	No additional costs – maintenance costs for contractors.	Minimise
Hearing conservation programme as per DMR guidelines on Noise Control, including zoning of high noise areas, such as vehicles for people working in close proximity of the vehicle engines while operating	Operational.	DMR guidelines on Noise Control and awareness. Health and safety procedures (Noise Procedure (COP- 008))	Management throughout operation	Inspections by health and safety	Health and safety manager	PPE provided to all workers in-house – no additional budget necessary	Minimise & prevent
The use of approved hearing protection devices for the personnel involved with the mining process.							
From an occupational perspective the mining workers should be protected through standards and procedures and							

monitored as requires through Section 12 of the MHSA							
Stakeholder expectations and / or comments None received.							
Legal compliance and standards From an occupational perspective the mining workers should be protected through standards and procedures and monitored as requires through Section 12 of the MHSA.							
Residual and latent risks No residual impacts identified. No latent impacts identified at this stage.							

9. Archaeological, historical and cultural aspects

9.1 Destruction of heritage or archaeological resources

Activity: Any potential impacts including uncontrolled access to heritage resources or mining activities creeping into in buffer zones

Aspect and impact description: Permanent and site specific including uncontrolled access to or disturbance of the identified buffer zones, spillage of material, stockpiling, traversing by services, spillage of silt from slimes dams (please note, not this is not part of the proposed Tygerkloof project, but a potential impact for the existing RAM), and flooding.

Method for assessing risks: Information for this section was extracted from the Phase I Cultural Heritage Resources Impact Assessment (African Heritage Consultants CC, 2015) The table has been updated to the most recent impact methodology.

Amendment from approved EMP: The significance rating has been changed to the new format. No suitably qualified professional inspects the area for any potential archaeological or heritage resources; however, a heritage specialist did indeed conduct an impact assessment as part of the EIA, therefore, the following is removed: '*During the stripping of topsoil from the mining area, a suitably qualified professional must inspect the area for any potential archaeological or heritage resources'.*

CONSEQUENCE		
Nature / Intensity / Severity of Impact	**Before management**	**With management**
No heritage resources found on the mining area itself.	0	0
Heritage Resources outside mining area are protected as indicated above.	5	5

Spatial extent of Impact	**Before management**	**With management**
Site and locality specific	1	1
Duration of Impact	**Before management**	**With management**
Heritage resources are non-renewable, and all impacts are permanent	4	4
LIKELIHOOD		
Probability of potential occurrence of the Impact	**Before management**	**With management**
Highly likely, once people know of the resource they tend to want to visit it. Mining activities will likely impact on the resources without constant management.	2	2
Frequency of potential occurrence of the Impact	**Before management**	**With management**
Impact occurs at least once a month.	3	3
SIGNIFICANCE	**Before management**	**With management**
Significance before management for site itself:	0	0
Significance before management for resources outside the site	15	15

Cumulative impacts

There are various heritage resources in the area. These heritage resources were identified as part of EIA studies and are therefore managed in accordance to these HIAs. The cumulative impact on heritage resources are therefore not severe.

Environmental objective

To prevent damage or destruction of any heritage resources.

Management measures to be applied	**Phase applicable to management measure**	**Management tools**	**Management timeframe and schedule**	**Monitoring programmes**	**Responsibilities for implementation and long-term maintenance**	**Financial provision for long-term maintenance and/or environmental costs**	**Mitigation hierarchy**
Archaeological deposits can occur below ground level. Should any archaeological artefacts or skeletal material be revealed in the area during construction activities, such	Operational	General awareness & Phase I Cultural Heritage Resources Impact Assessment	As necessary	Inspections during mining progression	Mine manager / site geologist	Only necessary if any resource is found.	Prevent

activities should be halted, and a university or museum notified in order for an investigation and evaluation of the find(s) to take place (cf. HRA). Prior to the commencement of any work or action that will impact or effect a heritage resource, the relevant authorisation must be obtained from the SAHRA. Where there is uncertainty with regard to the status of a heritage resource, object, place or artefact, or any legislative or other policy issue the SAHRA can be contacted for clarity: SAHRA, P.O. Box 2771, CAPE TOWN, 8000, Tel: (021) 465 2198, Fax: (021) 465 5789, Email: info@sahra.org.za		(African Heritage Consultants CC, 2015					
To protect the integrity of the heritage resources it is recommended that the works / mining area be demarcated to limit the footprint of the mining activities and limit creep of activities outside the impact area Should any archaeological or heritage resources be exposed during the mining activities all activities must be suspended to allow for an investigation by a suitably qualified professional.							
Stakeholder expectations and / or comments None received.							
Legal compliance and standards National Heritage Resources Act no 25 of 1999 (NHRA), section 34, 35 & 36.							
Residual and latent risks							

No residual impacts identified. No latent impacts identified at this stage.

10. Visual aspect

10.1 Change in topography

Activity: Mining activities- making of open quarry and placement of overburden

Aspect and impact description: Removal of ore will lead to a change in topography, which will lead to a visual impact on the area. There are already visual impacts from the existing RAM and other mining activities in the area. This visual impact will only be visible from the R510 as well as adjacent forms to the south of the mine.

Method for assessing risks: Information for this risk was extracted from the Approved EMP (BECS Environmental, 2014).

Amendment from approved EMP: The significance rating has been changed to the new format. The proposed amendment of the mining method is to store all overburden adjacent to the quarry, in the already approved overburden footprint.

CONSEQUENCE		
Nature / Intensity / Severity of Impact	**Before management**	**With management**
The mining activities will be mostly visible to the R510. Due to the already existing mines in the area, this impact will not be severe.	1	1
Spatial extent of Impact	**Before management**	**With management**
The quarry will be visible adjacent to the site.	2	2
Duration of Impact	**Before management**	**With management**
The impact will be permanent without management measures, but only throughout life of mine if management (rehabilitation) takes place.	4	4
LIKELIHOOD		
Probability of potential occurrence of the Impact	**Before management**	**With management**
The mining activities is unavoidable.	4	4
Frequency of potential occurrence of the Impact	**Before management**	**With management**
This will take place at least once a week.	4	4
SIGNIFICANCE	**Before management**	**With management**

Significance is medium negative before management and after management.	15	15

Cumulative impacts

The proposed mine is an extension of the already existing quarry, and therefore and extension of the already existing visual impact on the area.

Environmental objective

To minimise the visual aspect as soon as possible.

Management measures to be applied	Phase applicable to management measure	Management tools	Management timeframe and schedule	Monitoring programmes	Responsibilities for implementation and long-term maintenance	Financial provision for long-term maintenance and/or environmental costs	Mitigation hierarchy
Mining will take place according to the layout plan as approved by DMR. The geologists do the quarry design according to the layout plan. Once this is done, the surveyor marks out the area, which is then further marked by and excavator.	Operational	Layout plan and designs	Continuous	Comparing layout plans to mining activity.	Geologist and surveyor.	No additional costs.	Minimisation

Stakeholder expectations and / or comments

None received.

Legal compliance and standards

None are applicable

Residual and latent risks

No residual impacts identified.

No latent impacts identified at this stage.

11. Socio-economic

11.1 Job creation

Consequence: The mine has a social and labour plan (SLP) as part of the mining right process. This plan indicates how the mine must implement human resources development plans, and social economic development plans. This SLP also indicates how the mine will manage down-scaling and retrenchment once mining cease.

Impact phase: Impact will take place during construction and operation and will be cease after rehabilitation. This impact is of a positive. No impact rating is therefore done. This will be an extension of the existing process operation at RAM, so no additional job will be created.

Management: The mine must ensure that the SLP is implemented

Roles and responsibility: Human resources

Monitoring: A senior manager will be accountable for the on-going monitoring and evaluation of the SLP and for the annual report.

Environmental budget: Not applicable, part of human resources budget. A request was made which included information regarding land claims. No new jobs will be created; however, the extension of the quarry into the new mine will ensure ongoing employment of the already employed personnel in the area.

12. General

12.1 Soil and surface water pollution

Activity: Waste management and management of spillages

Aspect and impact description: Hydrocarbon spillages from vehicles and machinery, waste generation leading to both soil and surface water pollution.

Method for assessing risks: Information for this risk was extracted from the Approved EMP (BECS Environmental, 2014).

Amendment from approved EMP: The significance rating has been changed to the new format. Mining method amended from roll-over mining to placement of overburden and sloping at closure.

CONSEQUENCE		
Nature / Intensity / Severity of Impact	**Before management**	**With management**
The amount of hydrocarbon spillages from a vehicle or machinery, as well as waste generation will not be severe.	1	1
Spatial extent of Impact	**Before management**	**With management**
Water run-off from the area will impact the adjacent drainage lines.	2	2
Duration of Impact	**Before management**	**With management**

Water run-off will cease once the area is rehabilitated.	3	3
LIKELIHOOD		
Probability of potential occurrence of the Impact	**Before management**	**With management**
Without management measures, the probability of pollution exists.	2	1
Frequency of potential occurrence of the Impact	**Before management**	**With management**
Impact occurs at least once in a year or less frequently.	1	1
SIGNIFICANCE	**Before management**	**With management**
Significance for waste management is low before management after management.	9	8

Cumulative impacts

Pollution from the proposed mine and the existing RAM could lead to a cumulative impact on the groundwater resource. These two mines will be managed as a unit.

Environmental objective

To prevent spillages from vehicles and machinery.

Management measures to be applied	Phase applicable to management measure	Management tools	Management timeframe and schedule	Monitoring programmes	Responsibilities for implementation and long-term maintenance	Financial provision for long-term maintenance and/or environmental costs	Mitigation hierarchy
Contain any spillages from vehicles and machinery.	Operational	Procedures for Waste Disposal and spill handling	Continuous	Monitor of procedures	Mine manager / site geologist & mine personnel	Spill handling and waste management procedure - R5,000 once off	Avoid / prevent & minimise
Ensure correct disposal of waste. All waste (if present) should be removed from the study site as soon as possible and should be appropriately covered to reduce the risk of colonisation by feral mammals or competitively superior bird species (e.g. Pied Crows *Corvus albus).*							
The mine will adhere to the Water and Waste management as set out in the IWWMP	Operational	IWWMP	Continuous	As per the IWWMP			

Stakeholder expectations and / or comments

None received
Legal compliance and standards Section 21 of the NWA sets out the water uses for which an IWUL is required. Sections 35-41 of NEMWA
Residual and latent risks No residual impacts identified. No latent impacts identified at this stage.

12.2 Inadequate planning and design, not taking specialist studies and sensitive area into consideration

Impact	Objectives	Management measures	Responsible person
Impacts on various environmental components that could potentially have been avoided	To plan and design the proposed mine extension to such as degree that impacts are prevented and/or minimised and that the mine works towards rehabilitation after the life of mine has ceased.	Site selection must consider: • the recommendations of the specialist reports; • the environmental map which indicates sensitive areas	Mine manager / site geologist and surveyor
Monitoring compliance and reporting: The site layout has been adjusted to include all buffer zones and 'no-go' areas as stipulated by the specialists. The mine must ensure compliance to these buffer zones and areas.			
Timeframe: Completed prior to construction phase			

vi) Methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks

Impact assessment

The methodology used to assess the significance of an impact is based on the requirements as set out in EIA Regulations, (GN 982) of 2014 i.t.o. the NEMA as well as the Proposed National Guideline on Minimum Information Requirements for Preparing EIA for Mining Activities that Require EA, of 2018, GN 86 in terms of NEMA. The impact significance methodology described below also complies to Appendix B of the Operational Guideline to Integrated Water and Waste Management of 2010 in terms of the NWA. In the event of any Section 21c&I water uses in terms of the NWA being assessed, Appendix A of the General Authorisations of 2016, GN 509 in terms of the NWA will be used to construct a risk matrix. Regulation 3(b) of the General Authorisations of 2016, GN 509 in terms of the NWA states that a suitably qualified SACNASP professional member must determine risks associated with this risk matrix.

Impact identification and prediction means forecasting the change of environmental parameters due to developmental patterns. These parameters may also be changing due to climate change and should be included.

Method of assessment: Impact identification and prediction is a stepwise procedure to identify the direct, indirect and cumulative impacts (relating to both positive and negative impacts) for which a proposed activity and its alternatives will have on the environment as well as the community. This should be undertaken by determining the geographical, physical, biological, social, economic, heritage and cultural sensitivity aspects of sites and locations as well as the risk of impact of the proposed activity. Refer to part A(h)(iv) for a complete description of these environmental attributes. Sources of data to be used for gathering data on the environmental attributes as well as the impacts include; monitoring / sampling data collected and stored, assumptions and actual measurements, published data available from the departments or other stakeholders in the area as well as specialist studies. Likely impacts should be described qualitatively and then studied separately in detail. This provides consistent and systematic basis for the comparison and application of judgements.

Significance rating: Ratings should then be assigned to each criterion. Significance of impacts should be determined for each phase of the mining lifecycle this includes; preconstruction, construction, operational, closure (including decommissioning) and post closure phases. The significance of impacts should further be assessed both with and without mitigation action. The description of significance is largely judgemental, subjective and variable. However, generic criteria can be used systematically to identify, predict, evaluate and determine the significance of impacts resulting from project construction, operation and decommissioning. The process of determining impact magnitude and significance should never become mechanistic. Impact magnitude is determined by empirical prediction, while impact significance should ideally involve a process of determining the acceptability of a predicted impact to

society. Making the process of determining the significance of impacts more explicit, open to comment and public input would be an improvement of environmental assessment practice. Impact magnitude and significance should as far as possible be determined by reference to either legal requirements (accepted scientific standards) or social acceptability. If no legislation or scientific standards are available, the EAP can evaluate impact magnitude based on clearly described criteria. A matrix selection process is the most common methodology used in determining and ranking the site sensitivities:

- The consequence: includes the nature / intensity / severity of the impact, spatial extent of the impact, and duration of the impact.
    - The nature / intensity / severity of the impact: An evaluation of the effect of the impact related to the proposed development on the receiving environment. The impact can be either positive or negative. A description should be provided as to whether the intensity of the impact is high, medium or low or has no impact in terms of its potential for causing negative or positive effects. Cognisance should be given to climate change which may intensify impacts.
    - The spatial extent of the impact: Indication of the zone of influence of the impact: A description should be provided as to whether impacts are either limited in extent or affect a wide area or group of people. Cumulative impacts must also be considered as the extent of the impact as may increase over time.
    - The duration of the impact: It should be determined whether the duration of an impact will be short-term, medium term, long term or permanent. Cumulative impacts must also be considered as the duration of the impact as it may increase over time.
- The likelihood: includes the probability of the potential occurrence of the impact, and frequency of the potential occurrence of the impact
    - The probability of the impact: The probability is the quality or condition of being probable or likely. The probability must include the degree to which these impacts can be reversed; may cause irreplaceable loss of resources; and can be avoided, managed or mitigated
    - The frequency of the potential occurrence of the impact.
- The significance: This is worst case scenario without any management measures. See below how significance is determined: Impact that may have a notable effect on one or more aspects of the environment or may result in noncompliance with accepted environmental quality standards, thresholds or targets and is determined through rating the positive and negative effects of an impact on the environment based on criteria such as duration, magnitude, intensity and probability of occurrence. Mitigation measures should be provided with evidence or motivation of its effectiveness

Example of significance rating:

	Before management	**With management**

CONSEQUENCE	**Nature / Intensity / Severity of Impact**			
	Low	Impacts affect the environmental in such a way that natural, cultural and/or social functions and processes are not affected.	1	
	Medium	Impacts affect the environment in such a way that natural, cultural and/or social functions and processes are altered	3	
	High	Impacts affect the environment in such a way that natural, cultural and/or social functions and processes will temporarily or permanently cease.	5	
	Spatial extent of Impact			
	On-site	Impact occurs on-site	1	
	Local	Impact occurs within 5km radius of the site	2	
	Regional	Regional Impact occurs within a 100km radius of the site	3	
	National	National Impact occurs within South Africa	4	
	International	Impact occurs internationally	5	
	Duration of Impact			
	Short-term	Through dilution and dispersion, the impact reduces to insignificant within 1 week.	1	
	Medium-term	Through dilution and dispersion, the impact reduces to insignificant within the life of the mine.	2	
	Long-term	The impact will cease after the operational life of the mine either because of natural process or by human intervention	3	
	Permanent	Where mitigation either by natural process or by human intervention will not occur in such a way or in such a time span that the impact can be considered transient.	4	
LIKELIHOOD	**Probability of potential occurrence of the Impact**			
	Improbable	The possibility of the impact materializing is very low either because of design or historic experience	1	
	Probable	There is a distinct possibility that the impact will occur	2	
	Highly probable	It is most likely that the impact will occur	3	
	Definite	The impact will occur regardless of any prevention measures	4	
	Frequency of potential occurrence of the Impact			
	Annually or less	Impact occurs at least once in a year or less frequently	1	
	6 months	Impact occurs at least once in 6 months	2	
	Monthly	Impact occurs at least once a month	3	
	Weekly	Impact occurs at least once a week.	4	
	Daily	Impact occurs daily	5	

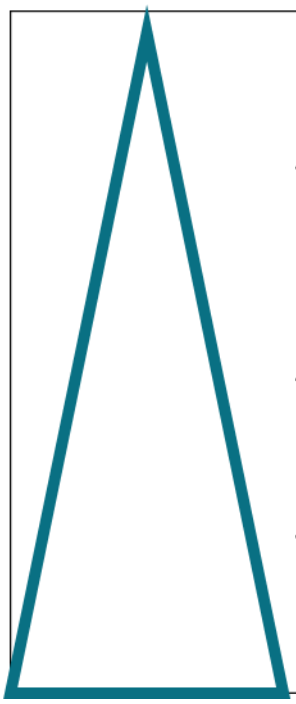
CONSEQUENCE													
LIKELIHOOD		3	4	5	6	7	8	9	10	11	12	13	14
	2	5	6	7	8	9	10	11	12	13	14	15	16
	3	6	7	8	9	10	11	12	13	14	15	16	17
	4	7	8	9	10	11	12	13	14	15	16	17	18
	5	8	9	10	11	12	13	14	15	16	17	18	19
	6	9	10	11	12	13	14	15	16	17	18	19	20
	7	10	11	12	13	14	15	16	17	18	19	20	21
	8	11	12	13	14	15	16	17	18	19	20	21	22
	9	12	13	14	15	16	17	18	19	20	21	22	23

Low	Where it will not have a significant influence on the environment. Management measures can be proposed to ensure that significance does not increase	5- 11
Medium	Where it could have a significant influence on the environment unless it is mitigated or managed	12- 17
High	Where it would have a significant influence on the environment regardless of any possible mitigation and hence must be either avoided or managed	18- 23
Medium positive	In the case of an impact having a positive outcome.	High positive

Mitigation and management

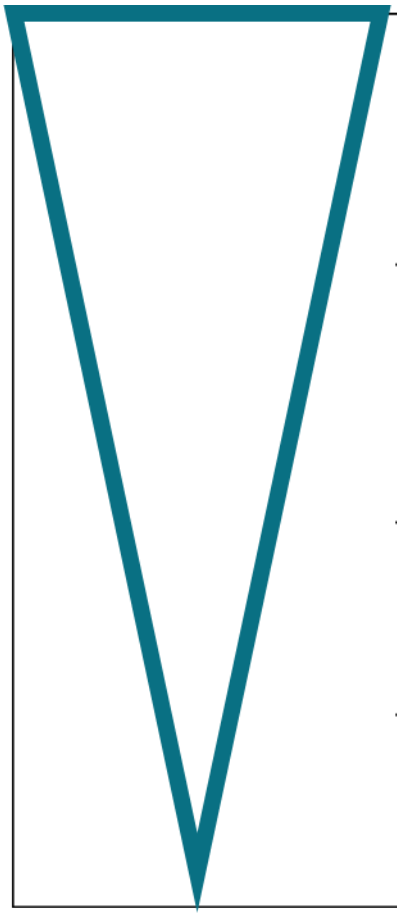
Management methodology is based on the requirements as set out in EIA Regulations, (GN 982) of 2014 i.t.o. the NEMA as well as the Proposed National Guideline on Minimum Information Requirements for Preparing EIA for Mining Activities that Require EA, of 2018, GN 86 in terms of NEMA; and the Mining and Biodiversity Guideline (Mainstreaming Biodiversity into the Mining Sector) IDB of 2013 in terms of the MPRDA.

Management statements detail the processes, procedures and practices required to achieve an impact management outcome. A hierarchy of management tools used can also be used as seen below.



Policy Set of policies are principles, rules and guidelines formulated to reach an organisation's long-term goals.
Standards A document that provides requirements, specifications, guidelines or characteristics that can be used consistently to ensure that materials, products, processes and services are fit for their purpose.
Operating procedures Established or prescribed methods to be followed routinely for the performance of designated operations or in designated situations.
Key Performance Indicators Measurable value that demonstrates how effectively a company is achieving key business objectives.

Mitigation should include measures in the following order of priority. The aim is to prevent adverse impacts from happening or, where this is unavoidable, to limit their significance to an acceptable level.



Avoid or prevent Refers to considering options in project location, sitting, scale, layout, technology and phasing **to avoid impacts** on biodiversity, associated ecosystem services, and people. This is the best option, but Is not always possible. Where environmental and social factors give rise to unacceptable negative impacts mining should not take place. In such cases it is unlikely to be possible or appropriate to rely on the latter steps in the mitigation.
Minimise (Modification or control measures) Refers to considering alternatives in the project location ,sitting, scale, layout, technology and phasing that would minimise impacts on biodiversity and ecosystem services. In cases where there are environmental and social constraints every effort should be made to minimise impacts. Can also include changes to process and or practices to reduce risk; or control, either through physical control or operational practices to ensure acceptable performance is maintained.
Rehabilitate Refers to rehabilitation and pollution clean-up of areas where impacts are unavoidable and measures are provided to return impacted areas to near-natural state or an agreed land use after mine closure. Although rehabilitation may fall short of replicating the diversity and complexity of a natural system.
Offset Refers to measures over and above rehabilitation to compensate for the residual negative effects on biodiversity, after every effort has been made to minimise and then rehabilitate impacts. Biodiversity offsets can provide a mechanism to compensate for significant residual impacts on biodiversity.

Please note, a final mitigation hierarchy is monitoring.

Avoiding or preventing impacts

If the biodiversity (an ecosystem, habitat for threatened species, ecological corridor or area that provides essential ecosystem services) is of conservation value or importance, it is best to plan to avoid or prevent impacts altogether by changing the location, siting, method or processes of the mining activities and related infrastructure.

Minimising impacts

Minimising impacts of mining is a mitigation measure that deals with the environment in general. In areas where the biodiversity is to be affected is of conservational value or importance, then every effort should be made to minimise those impacts that cannot be avoided or prevented. Mining companies should strive to minimise impacts on biodiversity to ensure environmental protection. Section 2 of NEMA contains environmental management principles that resonates with minimising the impact rather than stopping at mitigation, this is imperative in the mining sector.

Rehabilitating impacted areas

Rehabilitation is the measures that are undertaken to "as far as it is reasonably practicable, rehabilitate the environment affected by the prospecting or mining operations to its natural or predetermined state or to a land use which aligns to the generally accepted principle of sustainable development. A closure plan is an essential part of rehabilitation and must be developed based on the establishment of the closure objectives and criteria.

Biodiversity offsets

Biodiversity offsets are measurable conservation gains that help to balance any significant biodiversity losses that remain after actions to avoid, minimise and restore negative impacts have been taken. They are the last stage of mitigation and should be considered after appropriate avoidance, minimisation, and rehabilitation/restoration measures have been applied already.

When dealing with management, impact management outcomes must:

- be set for the expected activity-based impacts;
- describe the desired outcome of the management measure/s prescribed or the standard to be achieved (environmental objective);
- be clearly documented and identified per project phase as in the impact identification and significance rating process (this must be aligned to the mines closure objectives, and must therefore include predicted long-term result of the applied management measures);
- be measurable to determine compliance, which includes time frames and schedule for the implementation of the management measures; responsibilities for implementation and long-term maintenance of the management measures; financial provision for long-term maintenance; and monitoring programmes to be implemented;
- be informed by stakeholder expectations; and
- ensure legal compliance;

Finally, the impact assessment must refer to the residual and latent impact after successful implementation of the management measures.

vii) The positive and negative impacts that the proposed activity (in terms of the initial site layout) and alternatives will have on the environment and the community that may be affected

This is an amendment of an already approved EMP therefore there are no alternatives.

viii) The possible mitigation measures that could be applied and the level of risk

This is an amendment of an already approved EMP therefore there are no alternatives.

ix) Motivation where no alternative sites were considered

This is an amendment of an already approved EMP therefore there are no alternatives.

x) Statement motivating the alternative development location within the overall site

This is an amendment of an already approved EMP therefore there are no alternatives.

h) Full description of the process undertaken to identify, assess and rank the impacts and risks the activity will impose on the preferred site (In respect of the final site layout plan) through the life of the activity

Refer to Part A(g)(v & vi) above for a full description of the process undertaken to identify, assess and rank the impacts and risks the activity will impose on the preferred site (In respect of the final site layout plan) through the life of the activity.

i) Assessment of each identified potentially significant impact and risk

This section includes all the known typical impacts of each of the activities (including those that could or should have been identified by knowledgeable persons) and not only those that were raised by registered interested and affected parties).

Refer to Part A(k)(i) for a complete impact assessment.

j) Summary of specialist reports

List of studies undertaken	Recommendations of specialist reports	Specialist recommendations that have been included in the EIA report	Reference to applicable section of report where specialist recommendations have been included.
Report on Geohydrological Investigation As Part of the EIA, EMP AND IWULA (Groundwater Complete, 2015)	It was indicated that it is the purpose of the surface rehabilitation to re-establish surface drainage to the pre-mining conditions as far as practical. The rehabilitation will aim to: - Restore normal infiltration rates to areas where recharge was reduced due to surface compaction such as the haul roads, - Restore normal infiltration rates in areas where recharge was increased (i.e. quarry area), - Maximise clean runoff by ensuring disturbed surface areas are vegetated and sloped to be free draining	All recommendations from report	Part A(k)(i)
Air Quality Specialist Report for the Proposed Tygerkloof Mine, Thabazimbi, Limpopo Province (Airshed Planning Professionals, 2015)	To ensure the lowest possible impact on nearby sensitive receptors and the environment, it is recommended that the air quality management plan as set out in this report be adopted. The recommended management plan includes: • The mitigation of sources of major emission; • The management of associated air quality impacts; and • Ambient air quality monitoring. Given that ambient air quality data is not available for the area, it is recommended that continuous dustfall, PM10, PM2.5 and NO2 monitoring be conducted as part of the project's air quality management plan. This should be undertaken until the air quality trends become apparent.	All recommendations from report	Part A(k)(i)

List of studies undertaken	Recommendations of specialist reports	Specialist recommendations that have been included in the EIA report	Reference to applicable section of report where specialist recommendations have been included.
	The locations of the monitoring exercise should include sensitive receptors (especially SR1 and SR5). This will ensure adequate planning and management intervention at these receptors should long term exceedance of the regulatory standards and guidelines occur		
Soil, land capability and land use assessment of the quarry and overburden dump footprints of Imerys Refractory Minerals proposed Tygerkloof Mine situated on portions 5 of the farm Tygerkloof 354 KQ near Thabazimbi (Gudani Consulting, 2015)	The impact on soil, land capability and land use are mitigated by means of the rehabilitation process which commences with stripping and stockpiling of topsoil before mining takes place and is not a process that starts with replacing of topsoil after or during the mining operation. Rehabilitation and subsequent mitigation of soil, land capability and land use consist therefore of the following phases: • Stripping and stockpiling of topsoil • Levelling of spoil material to a free draining surface • Replacing and levelling of topsoil and preparation of the surface • Soil amelioration and re-vegetation • The surface should be covered with stockpiled topsoil. Care should be taken to tip enough soil per square unit to reinstate the total required post mining soil depth at once. Spreading of soil over far distances and repeated traversing of heavy mechanical equipment should be minimised in order to prevent compaction in the lower profile which is difficult to alleviate afterwards. The dumped soil heaps	All recommendations from report	Part A(k)(i)

List of studies undertaken	Recommendations of specialist reports	Specialist recommendations that have been included in the EIA report	Reference to applicable section of report where specialist recommendations have been included.
	should thus only be levelled on top to reach the required soil thickness. Caterpillar-type tracked equipment is preferred for levelling of topsoil because these tracks cause less compaction. Bowl scrapers cause enormous compaction and should not be used. • The replaced topsoil thickness should be progressively monitored during replacement to verify if it is similar to the replacing depth provided in Table 9 and to prevent encountering shortages of topsoil.		
An Ecological Evaluation for The Tygerkloof Mine (Pachnoda Consulting CC, 2015)	• Footprint areas must be scanned for protected and near threatened tree species during a walk-trough of the affected area prior to the construction/mining phase. It is recommended that these plants be identified and marked prior to the • development. in order to obtain the necessary permits from the relevant authority. • Where possible, large and aged specimens of protected trees (e.g. Vachellia erioloba) and Elaeodendron transvaalensis should be retained and buffered. All buffered areas should form part of an open space network to promote movement of fauna when a high rate of natural disruption is expected and to conserve part of the seed bank diversity (essential for restoration). • Rehabilitation/restoration should make use of indigenous species, and preferably of species native to	All recommendations from report	Part A(k)(i)

List of studies undertaken	Recommendations of specialist reports	Specialist recommendations that have been included in the EIA report	Reference to applicable section of report where specialist recommendations have been included.
	the study site and immediate surroundings. The species selected should strive to represent habitat types typical of the ecological landscape prior to construction. • Reinstate/rehabilitate as a continual process – this will maximise the viability of the natural seed bank and prevent the unnecessary loss of topsoil during storage. • Checks must be carried out at regular intervals to identify areas where erosion is occurring. Appropriate remedial action, including the rehabilitation of the eroded areas, and where necessary, the relocation of the roads causing the erosion, are to be undertaken. • Limit haul traffic to daytime - most animals are nocturnal and the impact will be significantly reduced if night traffic is avoided. • Limit the road network to areas with low ecological sensitivity and plan roads to cross the least number of different habitat types - this will limit the richness of taxa that could be affected by the impact. • Allow movement of animals during operation and increase the permeability of the road network. • Allow for movement of small-bodied (and slow-moving) taxa by incorporating underpasses, especially near areas where a high probability of animal dispersal is		

List of studies undertaken	Recommendations of specialist reports	Specialist recommendations that have been included in the EIA report	Reference to applicable section of report where specialist recommendations have been included.
	anticipated (e.g. near drainage lines). • All roadside stormwater structures should be designed so as to prevent amphibian, reptile and small mammal access. Ditches/trenches should have slopes of less than 45° rather than vertical sides		
Environmental Noise Impact Assessment Report (Varicon CC, 2015)	• All maintenance and operating of equipment should be done as per specifications of the OEM's. • Effective maintenance of the vehicle engines and exhaust systems. • Hearing conservation programme as per DMR guidelines on Noise Control, including zoning of high noise areas, such as vehicles for people working in close proximity of the vehicle engines while operating • The use of approved hearing protection devices for the personnel involved with the mining process. • Limit the use of noise generation activities or vehicles or appliances after 22:00. • From an occupational perspective the mining workers should be protected through standards and procedures and monitored as requires through Section 12 of the MHSA.	All recommendations from report	Part A(k)(i)
(Phase I Cultural Heritage Resources Impact Assessment (African heritage consultants CC, 2015)	• There is no objection to the development of the new mine on Tygerpoort as none important Cultural Heritage resources or graves are present. If the area is cleared for mining purposes an archaeologist should be present to	All recommendations from report	Part A(k)(i)

List of studies undertaken	Recommendations of specialist reports	Specialist recommendations that have been included in the EIA report	Reference to applicable section of report where specialist recommendations have been included.
	identify and mitigate any possible archaeology sites, which might be exposed. • Rock Shelter This is a sensitive site which may contain important archaeology material and is next to the proposed new mining site. For this reason, it needs a proper Heritage Management Plan to safeguard it from vandalism and a 50 meter buffer area around the site. • Ancient Mine on Buffelsfontein The collapse of a section of the ancient mine was most probably the result of recent mining and blasting. This site urgently needs a Heritage Management Plan which should include measurements to prevent water entering the old shafts as well as a detail survey and mapping of the ancient mine and surface area in a phase II heritage investigation		

k) Environmental impact statement

(i) Summary of the key findings of the environmental impact assessment

1 Soil, land use and land capability

The impact on soil, land capability, and land use is inevitable. Some management measures can be implemented to reduce the impact; however, the focus is on adequate rehabilitation measures to mitigate these impacts.

2 Ecological

The impact on loss and clearing of vegetation communities and loss of floristic diversity, which goes hand in hand with fauna displacement, are high, but can be managed if the correct buffer zones are implemented. The location alternative for overburden placement is north of the quarry, thereby overlapping with sensitive mountain Bushveld and should be avoided. Areas with *low ecological value* is considered to be more feasible for the proposed activities although the standard mitigation measures

as listed above are applicable. Areas with *medium ecological sensitivity* is likewise feasible, although on condition that a functional open space network/corridor be set aside to provide *in situ* protection of near threatened tree taxa and aged (or significant clusters) of protected trees. A pre-construction screening (or "walk-through") of the habitat is recommended to identify areas with floristic taxa of 'conservation concern' (e.g. near threatened taxa) and to advice on the spatial configuration of the open space network. The rationale of the network is to provide protection to low-lying biodiversity and the seed bank and to facilitate post-mining rehabilitation through increased immigration and dispersal of fauna and floristic propagules.

The proposed mining application and activities will result in the loss and clearing of vegetation and faunal habitat types. When the “preferred mine layout” is superimposed (Figure 32 (Pachnoda, 2015)) over the ecological sensitivities of the respective habitat types it is evident that the proposed quarry coincides vegetation units of low (*Dichrostachys* thicket) to medium (open woodland) sensitivities. On the other hand, the proposed placement of the discard dumps correspond mainly to vegetation units of medium sensitivities. However, one of the dumps is proposed to be placed north of the quarry and will contravene onto habitat with low to high (mountain bushveld) ecological sensitivities.

According to the proposed mine layout (Figure 32 (Pachnoda, 2015)), a number of impacts are anticipated during the mining activities, especially when corresponding to the various vegetation units on the study site. A three-step approach should be used when such detrimental activities are likely to correspond to ecologically sensitive areas. These steps are of cardinal importance when planning mining activities, and should form an integral part of the decision-making process:

1. Avoidance: avoid or prevent the ecological impact from happening.

Avoidance measures are the first prize during any ecological planning. Examples will include not to mine at all and to avoid disturbing areas that are considered to be of high ecological sensitivity such as the mountain bushveld and savannoid grassland units.

2. Mitigate: minimise the ecological impact

Where avoidance is not possible, the impact on the ecological environment should be minimised by a suite of mitigation measures, for example by concentrating the mining activities on areas of low ecological sensitivity.

3. Compensate: provide an equivalent amount of ecological improvement in the region of the impact to balance the impact where it cannot be avoided or mitigated

Compensation (synonymous to offsets) is a last resort and implies an improvement in the area that is normally larger than the affected or impacted area. In addition, compensation measures should be applied in close proximity to where the proposed impact is likely to occur. Improvement should only happen in areas where similar ecological conditions prevail as to the impacted area (e.g. “a like for like or better” scenario). Typical examples of compensation include: the proclamation of conservation areas

larger than the impacted area, the restoration of altered habitat (through proper scientific conduct), the establishment of appropriate corridors and stepping stones to enhance animal movement and the enhancement of habitat that will facilitate the re-colonisation of rare and threatened species that used to occur naturally in the impacted area.

More often, these proposals demand long-term monitoring and management which makes them less feasible over time. The same argument applies for mitigation effort. Proper and effective mitigation structures call for proper planning during the design phase, which is often associated with immense engineering cost. However, if cost is not a stumble block, this could open a new era of ecological design which will bring a whole new meaning to the word "ecology" and not just merely a way to "cloud" issues which appears to be "good" to the spectator, although its intrinsic function is often worthless/useless.

The region is not characterised by aggressive alien vegetation therefore the impact on declared aliens are medium and could be lowered by proper management.

All other impacts on fauna can be properly managed.

3 Groundwater

Topsoil and overburden material are mostly inert, therefore no significant impacts on groundwater quality conditions are envisaged. Local groundwater levels are expected to remain unaffected by the planned opencast mining activities since the quarry floor is planned to remain largely above the local groundwater level.

Potential sources of contamination

Based on the fact that the rock material underlying the project area is inert and poses no risk for acid mine drainage, the conclusion is drawn that neither the proposed quarry nor its overburden dump is considered to be meaningful sources of groundwater contamination.

Potential pathways for contamination

In order for contamination to reach and eventually affect a receptor/s, it needs to travel along a preferred pathway. The effectiveness of a pathway to conduit contamination is determined by three main factors, namely:

- Hydraulic conductivity of pathway,
- Groundwater hydraulic gradient, and
- Area through which flow occurs.

All three abovementioned factors have a linear relationship with the flow of contamination through a preferred pathway, meaning an increase in any one of the three will lead to an increase in flow.

The following potential pathways were identified in the project area:

Unsaturated zone

Soil development along the mountainous regions is virtually non-existing with the unsaturated zone mainly being composed of scree and weathered rock. The unsaturated zone in the flatter and lower lying topographies is however composed of red, stony soils with a high base status and moderate water holding capability (Tygerkloof Mining & Rhino Andalusite Mine: Final Environmental Scoping Report, 2015). Underneath the soils the unsaturated zone is characterised by weathered or fresh rock and scree originating from the mountain. The unsaturated zone impacts on the aquifer in terms of both groundwater quality and quantity.

The permeability and thickness of the unsaturated zone are some of the main factors determining the infiltration rate, the amount of runoff and consequently the effective recharge percentage of rainfall to the aquifer.

The type of material forming the unsaturated zone as well as the permeability and texture will significantly influence the mass transport of surface contamination to the underlying aquifer(s). Factors like ion exchange, retardation, bio-degradation and dispersion all play a role in the unsaturated zone.

The thickness of the unsaturated zone was determined by subtracting the pre-mining static water levels in the project area from the topography. Water level measurements in boreholes of users in the area as well as in purpose drilled monitoring boreholes showed that the depth to water level, and thus the unsaturated zone, generally varies between ± 9 and 70 meters below surface.

Geological structures

Geological structures, typically north-west striking faults, are known to intersect the andalusite ore body at numerous locations. Intrusive dykes are also known to occur within the project area and may also act as sufficient pathways for contamination. The crystalline nature of an igneous dyke is characteristic of an aquiclude, however rapid cooling of its sides during intrusion into the cold Transvaal rocks lead to the formation of highly transmissive fracture zones.

Potential receptors of contamination

A receptor of groundwater contamination usually occurs in the form of a groundwater user that relies on groundwater for domestic, irrigation or livestock watering purposes. Surface water features (stream, river, dam, etc.) that rely on groundwater base flow for the sustainment of the aquatic environment are also considered to be important receptors.

Numerous groundwater users were located during the user survey and their positions relative to the proposed Tygerkloof mining activities are indicated in Figure 7 (Groundwater Complete, 2015). A near-perennial water course namely the Bierspruit is also located directly east of the project area (Groundwater Complete, 2015)).

Please note that due to the low sulphur content and relatively inert nature of the Transvaal Supergroup rocks underlying the project area, no significant groundwater quality impacts are envisaged and receptors will remain unaffected.

4 Air quality

Construction and closure phase are typically less than emissions during the operational phase. The significance rating of the construction closure phase is expected to be *'low'* for all PM and gaseous pollutants assessed. Sources of emission quantified included crushing and screening, material handling, vehicles travelling on unpaved roads, windblown dust from the stockpiles, vehicle exhaust and drying.

A distinction was made between 2 operational phase scenarios in order to distinguish emissions from the existing RAM operations **(scenario A)** and the proposed Tygerkloof Mine operations **(scenario B)**.

The main findings of the assessment are as follow:

<u>The receiving environment:</u>

- The area is dominated by winds from the north and north-northwest. Long term air quality impacts are therefore expected to be the most significant to the south and south east of the project area.
- Ambient air pollutant levels in the project area are currently affected by the following sources of emission; mining to southwest and north, vehicles tail-pipe emissions, open areas exposed to the wind, charcoal making and biomass burning.
- Thabazimbi is situated about 15km northeast of the project area. Nearby air quality sensitive receptors include informal settlements and residential houses situated within 100m to 1,000m of the project boundary.

<u>Impact of the proposed Project:</u>

- Construction and closure phases:
    - Construction and closure phase emissions were not quantified, since, as for all open-quarry mining operations, they are typically less than emissions during the operational phase. This is expected of construction and closure phase activities due to their temporary nature, and the likelihood that these activities will not occur concurrently at all portions of the site. The significance rating of the construction closure phase is expected to be 'low' for all PM and gaseous pollutants assessed.
- Operational phase:
    - Sources of emission quantified included crushing and screening, material handling, vehicles travelling on unpaved roads, windblown dust from the stockpiles, vehicle exhaust and drying.
    - Operational phase PM emissions ($PM_{2.5}$, PM_{10} and TSP) and gaseous emissions (CO, NO_x, and VOC) were quantified and utilized in simulations.

- Simulated annual average off-site $PM_{2.5}$ GLCs (for scenario A and B) were below the standard. The 4-day per year frequency of exceedance (FOE) of the daily SA NAAQS was exceeded for about 200 to 300 m to the north and south of the proposed project boundary, but not at any of the sensitive receptors.
- At nearby AQSRs (SR1 and SR 5), both long and short term impacts were not expected to exceed at the initial stage of the Tygerkloof Mine. However, as mining progresses across the pit, impacts are expected to exceed limit values at SR1 and probably at SR5. $PM_{2.5}$ impact due to existing RAM emissions is not expected to exceed the standard at any of the sensitive receptors for the remaining life of the mine.
- The significance rating of $PM_{2.5}$ impact is expected to be *'low'* for scenario A and B.
- Simulated annual average PM_{10} GLCs (for scenario A and B) exceed the standard outside the RAM and Tygerkloof boundary at a distance between 200 and 500 m. The 4-day per year FOE of the daily SA NAAQS was exceeded for about 1 to 2 km north and south of the proposed project boundary, but not at any of the sensitive receptors.
- At nearby AQSRs (SR1 and SR 5), long term impact is not expected to exceed the standard at the initial stage of the Tygerkloof Mine, while short term impact is expected to exceed limit values at SR5. As mining progresses across the pit, both short and long term impacts are expected to exceed at SR1 and SR5. PM_{10} impact due to existing RAM emissions is not expected to exceed the standards at any of the sensitive receptors for the remaining life of the mine.
- The significance rating of PM_{10} impact is expected to be *'medium'* for scenario A and B.
- The simulated maximum daily dustfall deposition rate due to operational phase did not exceed the NDCR non-residential standard (1,200mg/m^2-day) outside the boundaries of the RAM and Tygerkloof boundary for both scenario A and B. The residential limit (600 mg/m^2-day) is exceeded outside the boundaries but not at the sensitive receptors.
- As mining progresses across the pit, impacts due to Tygerkloof mine are expected to exceed the residential limit at SR1 and probably at SR5.
- The significance rating of TSP nuisance effect is expected to be *'low'* for scenario A and B.
- Simulated annual average NO_2 GLCs (for scenario A and B) were below the standard outside the RAM and Tygerkloof boundary. The 88-hour per year FOE of the hourly SA NAAQS was exceeded for about 200 to 500 m to the north and south of the RAM and Tygerkloof boundary, but not at any of the sensitive receptors.
- At nearby AQSRs (SR1 and SR 5), both long and short term impacts are not expected to exceed at the initial stage of the Tygerkloof Mine. However, as mining progresses across the pit, impacts are expected to exceed at SR1 and probably at SR5. NO_2 Impact due to existing RAM emission is not expected to exceed the standards at any of the sensitive receptors for the remaining life of the mine.
- The significance rating of NO_2 impact is expected to be *'medium'* for scenario A and B.

- CO and SO_2 impacts were not simulated due to insignificant emission rates. The impacts due to CO and SO_2 emissions are expected to be insignificant, as is typical of similar processes. The significance rating of CO and SO_2 impacts is expected to be *'low'* for scenario A and B.
- Simulated VOCs impact were insignificant and far below the adopted TCEQ guideline. The significance rating of VOCs impact is expected to be *'low'* for scenario A and B.

Recommendations are as follow:

To ensure the lowest possible impact on nearby sensitive receptors and the environment, it is recommended that the AQMP as set out in the specialist be adopted. The recommended management plan includes:

- The mitigation of sources of major emission;
- The management of associated air quality impacts; and
- Ambient air quality monitoring.
- Given that ambient air quality data is not available for the area, it is recommended that continuous dustfall, PM_{10}, $PM_{2.5}$ and NO_2 monitoring be conducted as part of the project's air quality management plan. This should be undertaken until the air quality trends become apparent.
- The locations of the monitoring exercise should include sensitive receptors (especially SR1 and SR5). This will ensure adequate planning and management intervention at these receptors should long term exceedance of the regulatory standards and guidelines occur.

5 Environmental noise

All measurements were conducted as part of the initial baseline measurements to compare disturbance levels of any future mining or any other activities on this site. All noise levels measured were below the prescribed requirements as referred to under 3.1. As this is a baseline survey and no mining activities are conducted on the proposed site yet, the measured results are very low and form a solid base for any future measurements and the evaluation of any activities that could increase the noise levels Some of the measurements were taken close to the existing Plant 5 and the readings were below the statutory requirements.

From an environmental perspective, there are no residents or settlements in close proximity of the operations that could be affected.

6 Surface water

The design of this SWMP is aligned with DWS's best practice guidelines to contain activities that may have a detrimental impact on the natural water environment, while providing controlled diversion of clean runoff to continue downstream. Successful implementation of the plan will reduce the risk of injury to staff or damage to property during a flood event. The storm water control will divert upstream runoff from the mountain catchment area away from site, while all runoff on site will be retained in pollution

control dams and decommissioned quarries. It remains the responsibility of the mine management to conduct regular inspections to prevent erosion along diversion berms and cleaning of trenches and pollution control dams to maintain its capacity. First priority should be given to construct the outstanding trenches upstream of the quarry and divert clean runoff from the workings. This also applies for the proposed Tygerkloof quarry.

7 Geology

Disturbance of the geology is unavoidable. The removal of ore is the core activity of any mining operation.

8 Visual aspect

The area has various visual impacts form already existing mines, including RAM. This impact is also unavoidable, but with adequate rehabilitation, this impact will be managed.

(iii) Summary of the positive and negative implications and risks of the proposed activity and identified alternatives

This is an amendment of an already approved EMP therefore there are no alternatives.

l) Proposed impact management objectives and the impact management outcomes for inclusion in the environmental management programme

Refer to Part A(g)(v) for all Proposed impact management objectives and the impact management outcomes for inclusion in the EIA/EMP Part B.

m) Final proposed alternatives

This is an amendment of an already approved EMP therefore there are no alternatives.

n) Aspects for inclusion as conditions of Authorisation

All management measures set out in this EIA/EMP must be complied to. The mine must further comply with any conditions set out under other authorisations.

o) Description of any assumptions, uncertainties and gaps in knowledge

The mitigation measures as described in this EMP was obtained from specialist studies and are adequate for the proposed activities.

p) Reasoned opinion as to whether the proposed activity should or should not be authorised

i) Reasons why the activity should be authorised or not

The mining extension will impact the environment, however with correct management measures and rehabilitation, these impacts will be minimised.

ii) Conditions that must be included in the authorisation

Additional conditions that may be considered are:

1. The mine must update the water monitoring requirements as soon as DWS has issued an IWUL.

q) Period for which the Environmental Authorisation is required

Based on the current levels of reserves, operations on the farm Tygerkloof are expected to continue at current production rates until the year 2030. where after final rehabilitation must still be done.

r) Undertaking

The EMP will, should it comply with the provisions of section 39 (4) (a) of the Act and the right be granted, be approved and become an obligation in terms of the right issued. As part of the proposed Environmental Management Programme, the applicant is required to provide an undertaking that it will be executed as approved and that the provisions of the Act and regulations thereto will be complied with.

s) Financial Provision

1 Plan showing the location and aerial extent of the aforesaid main mining actions, activities, or processes anticipated

Refer to Figure 3 for the site layout plan indicated the aforesaid main mining actions, activities, or processes anticipated.

2 Annual forecasted financial provision calculation

The financial provision calculations were done by Shangoni Management Services (2018). The financial provision for Tygerkloof is as follow:

Area / item	Cost
Haul road	R 1 008 000.00
Overburden dump disturbed area	R 848 880.00
Quarry	R 833 108.90
Sub-total	R 2 689 988.90
P&G (12%)	R 322 798.67
Contingency (10%)	R 268 998.89
Total	**R 3 281 786.46**

3 Confirmation of the amount that will be provided should the right be granted

The mine has an already exiting mining right.

4 Method of providing financial provision contemplated in Regulation 53

This amount is provided using a bank guarantee.

t) Deviations from the approved scoping report and plan of study

There is no deviation from the scoping report. All comments have been included in this EIA/EMP.

u) Other Information required by the competent Authority

None

v) Other matters required in terms of sections 24(4)(a) and (b) of the Act

None

PART B

ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT

1) Draft environmental management programme.

a) Details of the Environmental Assessment Practitioner

Refer to Part A(a) for the requirement for the provision of the details and expertise of the EAP.

b) Description of the Aspects of the activity

The requirement to describe the aspects of the activity that are covered by the draft EMP is already included in Part A(d) herein as required.

c) Composite map

Refer to Addendum 1 for all the maps.

d) Description of impact management objectives including management statements

i) Determination of closure objectives

1 End land use

Due to the nature of the mining activities and the accompanied residual impacts, the end land use will be similar to the land use prior to mining. The area will therefore be rehabilitated to an arable and grazing land use, with the exception of the wilderness areas on the mountain side.

2 Residual impacts

Groundwater level recovery, recharge rate and potential decant

Groundwater levels are expected to remain unaffected by the proposed opencast mining activities since the quarry floor is planned to remain largely above the local groundwater level. Decant predictions in an opencast mining environment is affected by the following:

- The MAP,
- Recharge to the mine void, expressed as a percentage of the MAP. Recharge on the other hand is affected by:
    - The size of the surface area disturbed by mining activities,
    - The transmissivity of the backfill material (coarse and fine tailings),
    - Surface water runoff,
- The overall porosity of the rehabilitated quarry area,
- The groundwater contribution to water inflow, which is determined by the hydraulic properties of the surrounding undisturbed aquifer/s (not relevant to Tygerkloof Project since no interaction is expected between the proposed quarry and underlying groundwater).

The water gradient within a rehabilitated quarry is generally very close to being zero as a result of the high transmissivity of the backfill material (coarse and fine tailings). Decanting of a quarry is therefore

most likely to occur wherever the quarry intersects the lowest surface elevation. The time it will take the proposed Tygerkloof Quarry to fill with water was calculated with the use of volume/recharge calculations and the results are provided in Table 51, while the most probable decant position is indicated in Figure 33.

The proposed Tygerkloof Quarry is expected to decant at an elevation of approximately 1,036mamsl and the decant position is indicated in Figure 34. The most probable time it will take the backfilled void to fill with water to the decant elevation was calculated to be in the order of 70 years after active mining has ceased (Table 51).

Decanting of a mine void generally occurs as a result of an excess volume of water that cannot be "absorbed" by the aquifer system. The excess water is generated by the increased recharge from surface due to the destruction of the aquifer structure.

An evaporation rate of approximately 2.6 Mm^3/y (Figure 5 (Groundwater Complete, 2015)) was calculated to occur from the surface of the backfilled quarry, which far exceeds the expected recharge volume of ± 90,260 m^3/y (Table 54). The backfilled quarry is expected to experience a net loss of water. The water level within the quarry is therefore unlikely to reach the surface, therefore decanting should not occur.

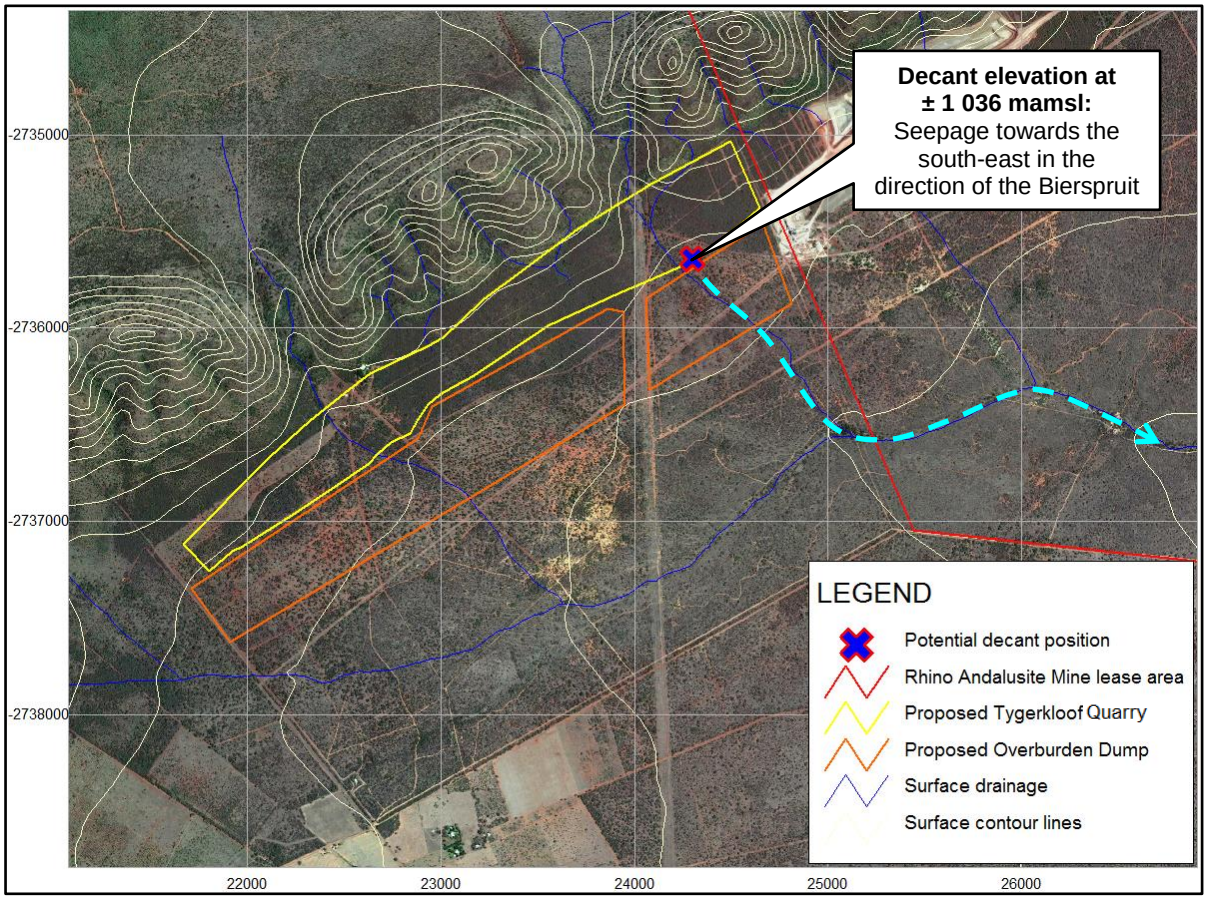


Figure 33: Potential decant position for the proposed Tygerkloof Quarry

Table 51: Time-to-fill calculations for the proposed Tygerkloof Quarry

General information		
Surface area	m^2	1,157,190
Decant elevation	mamsl	1,036
Total void volume	m^3	23,767,919
Mean annual precipitation	m/a	0.65
Backfilled void volume		
20% Porosity	m^3	4,753,584
25% Porosity	m^3	5,941,980
30% Porosity	m^3	7,130,376
Decant/Recharge rate		
10% Recharge	m^3/y	75,217
12% Recharge	m^3/y	90,261
14% Recharge	m^3/y	105,304
Time to fill		
Worst case scenario (20% Ø and 14% RCH)	Years	45
Most probable scenario (25% Ø and 12% RCH)	Years	66
Best case scenario (30% Ø and 10% RCH)	Years	95

Notes: Ø - Porosity,
RCH - Recharge

3 Closure objectives

Rehabilitation will aim to:

- Restore normal infiltration rates to areas where recharge was reduced due to surface compaction such as the haul roads,
- Restore normal infiltration rates in areas where recharge was increased (i.e. quarry area),
- Maximise clean runoff by ensuring disturbed surface areas are vegetated and sloped to be free draining.
- Replace topsoil and thereby the medium to restore land capability.
- Re-introduce indigenous vegetation into the area.

4 Rehabilitation process

Information for this section was extracted from the Soil, land capability and land use assessment (Rehab Green, 2017) with some inclusions from Imerys (material balance), Executive Summary (Galago Environmental Biodiversity and Aquatic Specialists, 2017), and Groundwater Impact Assessment (Groundwater Complete, 2017). This section has been updated with the change in backfilling of the quarries.

4.1 Principles for stripping and stockpiling of topsoil in general

- Stripping and stockpiling have an impact on soil, land capability and land use, but it is important to realise that the way this action is performed is also the first and one of the most important mitigation measures. The impact on soil, land capability and land use are mitigated by means of the rehabilitation process which commences with stripping and stockpiling of topsoil before mining takes place and is not a process that starts with replacing of topsoil after or during the mining operation. Rehabilitation and subsequent mitigation of soil, land capability and land use consist therefore of the following phases:
- Stripping and stockpiling of topsoil
- Filling of open pits and levelling of spoil material to a free draining surface
- Replacing and levelling of topsoil and preparation of the surface
- Soil amelioration and re-vegetation

If the first phase of rehabilitation namely stripping and stockpiling of topsoil, is not done with the aim of reinstating post-mining land capability similar to pre-mining land capability, then successful rehabilitation will not be achieved, and it will probably result in a serious deterioration from pre-mining to post-mining land capability.

In practice, even with optimal rehabilitation procedures applied, some deterioration from pre-mining to post-mining land capability is unavoidable. It is therefore crucial to follow the proposed rehabilitation procedures as far as possible in order to minimise degradation of soil characteristics and to re-establish the highest possible post-mining land capability.

The term topsoil refers to the A and B-horizons of the soil profile as defined in the Taxonomic Soil Classification system for South Africa. The A-horizon comprises the upper part (0-300 mm) of the soil profile and the B-horizon from 300 mm up to the stripping depth specified per soil type indicated in Figure 41. The characteristics of soil horizons (A- and B-horizons) are further described in Appendix E in terms of soil stripping, stockpiling and replacing.

Stripping, stockpiling and replacing of topsoil has a very high impact on soil, land capability and land use and the procedures followed during execution of these actions directly influence the post-mining land capability and consequently determine the degree of deterioration from pre-mining to post-mining land capability. They also directly determine the possible post-mining land uses.

During stripping and stockpiling the following principles should be aimed for:

- Topsoil is stripped with a dozer which would therefore not remove the OB material as it is more competent than the topsoil and requires an excavator for removal. This soil is stored as indicated in the layout plan for rehabilitation purposes.

- **Separate stockpiling of different soil type groups to obtain the highest post-mining land capability.** Topsoil quality or potential is not just limited to the grade of soil generally referred to as topsoil but can vary from very high to low due to various properties. Soil properties of different soil types can vary substantially e.g. high quality red and yellow well-drained soils and low-quality grey poorly drained wetland soils can occur over very short distances in the same field. Mixing of different soil types results in rapid changes in soil properties and characteristics such as texture, infiltration rates and water holding capacity over short distances after replacement, which will definitely adversely affect the post-mining land capability. Contrary to the general perception, separate stockpiling of different soil types does not have significant cost implications for the mine and only requires planning and continuing management.

- **Separate stripping, stockpiling and replacing of soil horizons (A and B-horizon) in the original natural sequence to combat hard-setting and compaction, maintain soil fertility and conserve the natural seed source.** The higher soil fertility of the A-horizon, especially phosphorus and carbon contents, declines significantly when it is mixed with the B-horizon, resulting in poorer re-vegetation success. It also increases the susceptibility to compaction and hard setting. The A-horizon also serves as a seed source which will enhance the re-establishing of natural species. The A and B-horizons should be stripped and stockpiled separately and replaced with the A-horizon overlying the B-horizon. Contrary to the general perception, separate stockpiling of different soil types and horizons does not have significant cost implications for the mine and only requires planning and continuing management. Separate stripping, stockpiling and replacing of the A and B horizons in the same sequence is the ideal procedure but goes along with practical, mechanical and cost implications and is mostly not achievable without proper management.

The soil horizons and properties influencing stripping and stockpiling procedures are discussed in Appendix E of the the Soil, land capability and land use assessment (Rehab Green, 2017).

4.2 Handling of topsoil during construction to decommissioning phase

Handling of topsoil from construction to decommissioning phase should be based on the following principles. **However, some deviation of the principles may take place in order to accommodate the engineering design and requirements for each specific structure.**

4.2.1 Stripping and stockpiling of topsoil at open pit footprint

The soil types that should be stripped at different depth and stockpiled separate from the overburden material is shown in Figure 34. The Figure should be read together with Table 52.

The following guidelines for stripping and stockpiling procedures need to be aimed for:

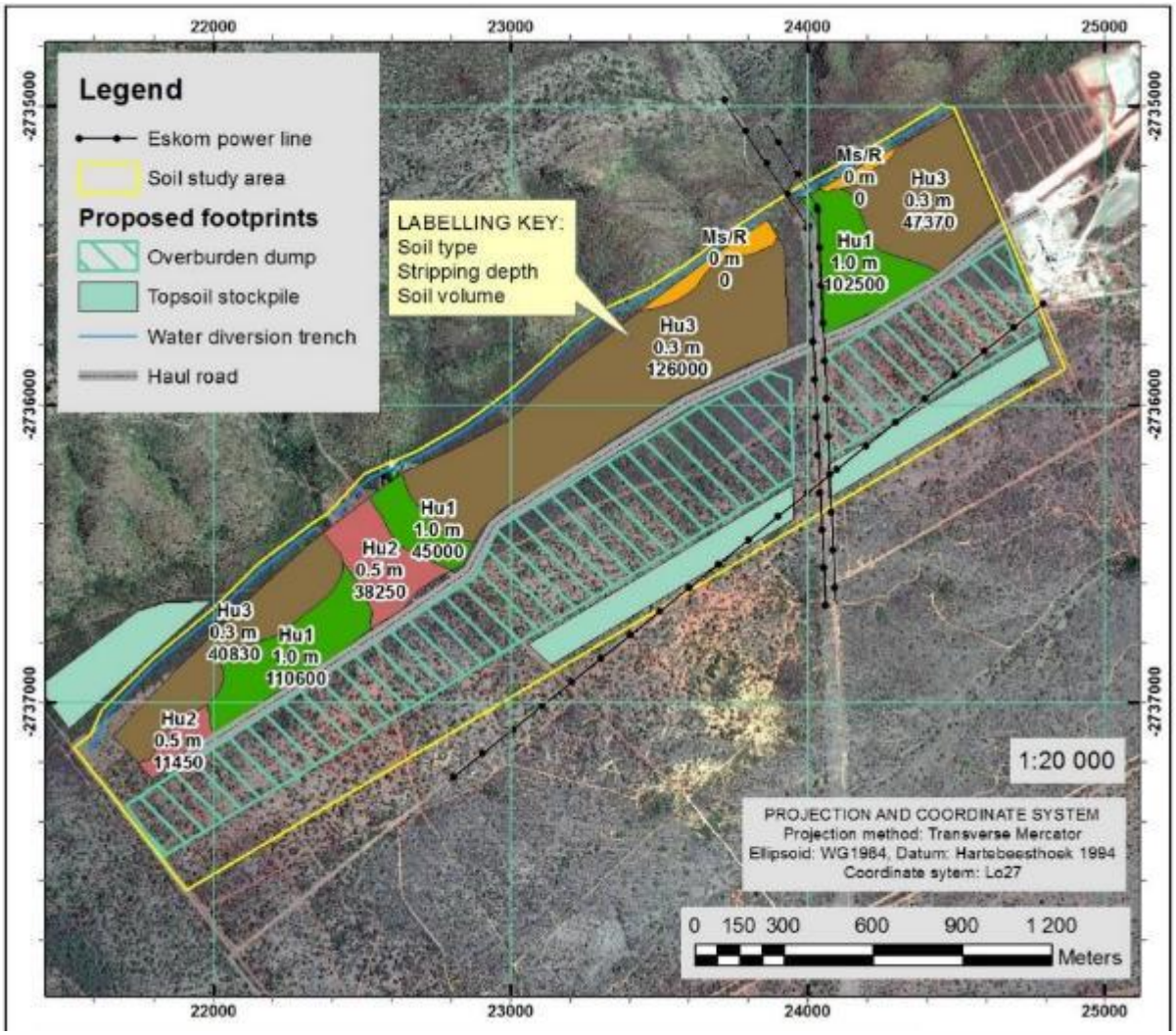
- Figure 34 and Table 52 show the soil types to be stripped at different depths in the proposed open pit area.

- The boundaries of the soil types that should be stripped at different depths, and stockpiled separately from the overburden dump, should be surveyed and staked by the mine surveyor before any soil stripping commences.
- Soils of soil type Hu1 is shown in green and should be stripped at a depth of 1 m. These are very high-quality soils, containing no gravel or coarse fragments and occur on gentle footslopes and should be replaced on similar positions. Soils of soil type Hu2 is shown in dark pink and are similar than those of Hu1 but are shallower and should be stripped at a depth of 0.5 m. Soils of soil type Hu3 is shown in brown and should be stripped at a depth of 0.3 m. These soils are very gravely and occur on steeper foot and midslopes and should be replaced in similar positions.
- The size and height of the stockpiles will be determined by the soil volume as indicated in Figure 35 and Table 52 and no stockpile height restriction is proposed as long as the soil type are stripped at depths as specified in Figure 34 and Table 52.
- The most suitable stockpile positions should be determined by the mine planner based on the mining sequence plan and need to be surveyed and staked by the mine surveyor.

Table 52 forms part of Figure 34 and shows the stripping depths per soil type, the areas and percentages as well as the total soil volume per soil type. It also shows the post-mining land capability class and replacing depth (topsoil thickness)

Table 52: Soil stripping, stockpiling and replacing guideline

Legend: Pre-mining stripping depths, soil volumes, post-mining replacing depths and land capability									
	Pre-mining					**Post-mining**			
Soil Type	**No of units**	**Strip depth (m)**	**Area (ha)**	**Area (%)**	**Soil volume (m^3)**	**Replacing**			**Land capability**
						Depth (m)	**Area (ha)**	**Area (%)**	
Hu1	3	1.0	25.81	23.38	258,100	1.0	25.81	23.38	Arable
Hu2	2	0.5	9.94	9.00	49,700	0.5	9.94	9.00	Grazing
Hu3	3	0.3	71.40	64.66	214,200	0.3	71.40	64.66	Grazing
Ms/R	2	0	3.27	2.96	0	0	3.27	2.96	Wilderness
Grand Total			**110.42**	**100**	**6.23**		**110.42**	**100**	



Legend: Pre-mining stripping depths, soil volumes, post-mining replacing depths and land capability

Soil Type	Pre-mining					Post-mining			
	No of units	Strip depth (m)	Area (ha)	Area (%)	Soil volume (m^3)	Replacing Depth (m)	Replacing Area (ha)	Replacing Area (%)	Land capability
Hu1	3	1.0	25.81	23.38	258100	1.0	25.81	23.38	Arable
Hu2	2	0.5	9.94	9.00	49700	0.5	9.94	9.00	Grazing
Hu3	3	0.3	71.40	64.66	214200	0.3	71.40	64.66	Grazing
Ms/R	2	0	3.27	2.96	0	0	3.27	2.96	Wilderness
Grand Total			110.42	100	522000		110.42	100	

Figure 34: Soil tripping and stockpiling guide map. Please note, the topsoil stockpile will change somewhat form this plan. (please note, the sequence of placement of topsoil and overburden has been amended in this EMP. Refer to Figure 3 for the changed sequence.)

4.2.2 Backfilling of open pit and levelling of material

This section has been updated from the previous EMP.

Before topsoil can be replaced, the quarry will be backfilled with fine and coarse tailings. The backfilled surface should be surveyed by a surveyor in order to ensure that it has the correct elevation and slopes to be free draining. A non-free draining surface results in local depressions of periodically saturated zones and increased percolation which usually leads to localised subsidence of backfilled material. Slopes of the backfilled surface should therefore change gradually since abrupt changes in slope gradient increase the susceptibility for erosion initiation. The overburden dumps will be sloped as necessary.

4.2.3 Replacing and levelling of stored topsoil and preparation of the surface

The backfilled surface should be covered with stockpiled topsoil. Care should be taken to tip enough soil per square unit to reinstate the total required post mining soil depth at once. Spreading of soil over far distances and repeated traversing of heavy mechanical equipment should be minimised in order to prevent compaction in the lower profile which is difficult to alleviate afterwards. The dumped soil heaps should thus only be levelled on top to reach the required soil thickness. Caterpillar-type tracked equipment is preferred for levelling of topsoil because these tracks cause less compaction. Bowl scrapers cause enormous compaction and should not be used.

The replaced topsoil thickness should be progressively monitored during replacement to verify if it is similar to the replacing depth provided in Table 52 and to prevent encountering shortages of topsoil.

4.2.4 Soil amelioration and re-vegetation

- The soil fertility status should be determined by soil chemical analysis after levelling (before seeding/re-vegetation).
- Soil amelioration should be done according soil analyses as recommended by a soil specialist, in order to correct the pH and nutrition status before re-vegetation.
- The footprint should be re-vegetated with a grass seed mixture of local grass and/or tree species. Rehabilitation/restoration should make use of indigenous species, and preferably of species native to the study site and immediate surroundings. The species selected should strive to represent habitat types typical of the ecological landscape prior to construction.
- Re-vegetation should be done as soon as possible and preferably in spring and early summer to stabilise the soil and prevent soil loss during the rainy season.
- Reinstate/rehabilitate as a continual process – this will maximise the viability of the natural seed bank and prevent the unnecessary loss of topsoil during storage.
- A short term fertiliser program should be based on the soil chemical status after the first year in order to maintain the fertility status for 2 to 3 years after rehabilitation until the area can be declared as self-sustaining.

- Checks must be carried out at regular intervals to identify areas where erosion is occurring. Appropriate remedial action, including the rehabilitation of the eroded areas, and where necessary, the relocation of the roads causing the erosion, are to be undertaken.

4.2.5 Post-mining land capability requirements

The post-mining land capability class will be determined mainly by the soil type and the thickness of the soil layer replaced on the backfilled surface. Other factors and characteristics that might influence the post-mining land capability are slope, erodibility, compaction and reduction of soil quality due to contamination of soils by subsoil, soft overburden or spoil material.

A post-mining land capability assessment needs to be done progressively at all areas rehabilitated during the operational phase. The assessment should be executed by a soil specialist by means of auger observations at a grid spacing of 100 x 100 m. This is required to evaluate the rehabilitation procedures and to verify that the topsoil thickness is as specified. A final post-mining land capability map needs to be compiled and should be submitted for closure purposes.

A post-mining soil depth and land capability evaluation by a soil specialist registered at the SACNASP in order to map the final post-mining land capability which will be used for final post-mining land uses and closure purposes.

ii) The process for managing any environmental damage, pollution, pumping and treatment of extraneous water or ecological degradation as a result of undertaking a listed activity

Refer to Part A(g)(v).

iii) Potential risk of acid mine drainage

ABA test results were obtained for the adjacent RAM, which shows that the rock material contains very low concentrations of sulphur and is non-acid forming (Geohydrological Study for Rhino Minerals – Rhino Andalusite Mine, 2010). Andalusite mining at RAM has been ongoing for a few decades in exactly the same manner and in the same geological and geochemical environment as proposed for the Tygerkloof Quarry. After all this time and exposure to water and oxygen of the exposed ore and waste rock, the groundwater and quarry water qualities do not indicate any acid forming tendencies. The andalusite, shale and banded iron formation are chemically inert and do not form poor quality leachate.

Since the RAM and proposed Tygerkloof Quarry are located within the exact same geological environment, similarly low concentrations of sulphur are expected for the project area and no significant acid formation should occur. No ABA tests were thus conducted for the purpose of this study.

iv) Steps taken to investigate, assess, and evaluate the impact of acid mine drainage

Refer above, not necessary.

v) Engineering or mine design solutions to be implemented to avoid or remedy acid mine drainage

Refer above, not necessary.

vi) Measures that will be put in place to remedy any residual or cumulative impact that may result from acid mine drainage

Refer above, not necessary.

vii) Volumes and rate of water use required for the mining operation

Water will only be removed from quarries if any accumulates. The water balance for Tygerkloof will form part of Rhino Andalusite Mine. This is included in the IWWMP.

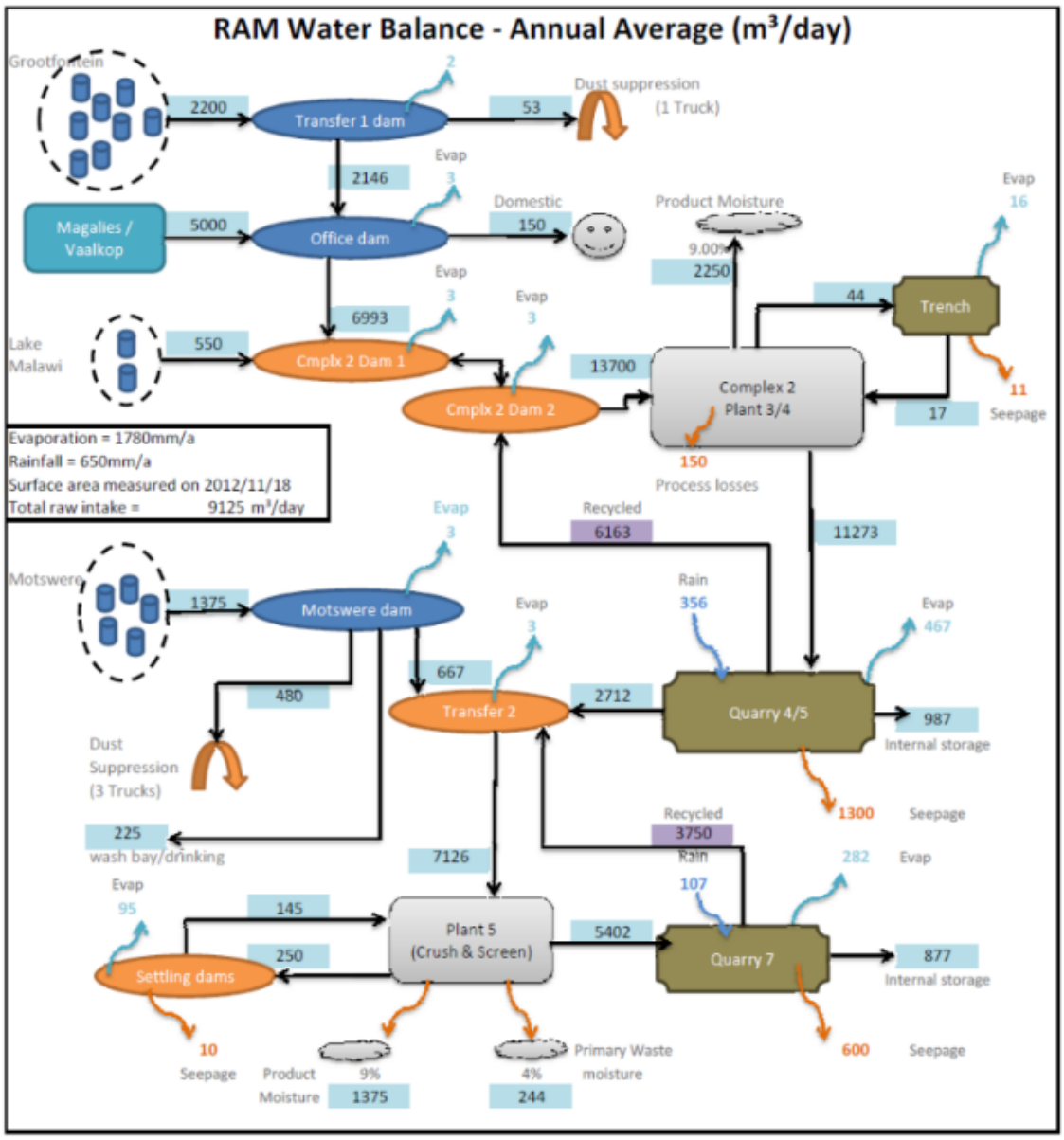


Figure 35: Rhino Andalusite Mine water balance 2015

viii) Has a water use licence has been applied for?

The mine is in the process to apply for an IWUL.

ix) Impacts to be mitigated in their respective phases

Refer to Part A(g)(v) as well as Part A(i) of this report.

e) Impact management outcomes

Refer to Part A(g)(v) as well as Part A(i) of this report.

f) Impact management actions

Refer to Part A(g)(v) as well as Part A(i) of this report.

g) Financial provision

(a) Describe the closure objectives and the extent to which they have been aligned to the baseline environment described under Regulation 22 (2) (d)

Rehabilitation will aim to:

- Restore normal infiltration rates to areas where recharge was reduced due to surface compaction such as the haul roads,
- Restore normal infiltration rates in areas where recharge was increased (i.e. quarry area),
- Maximise clean runoff by ensuring disturbed surface areas are vegetated and sloped to be free draining.
- Replace topsoil and thereby the medium to restore land capability.
- Re-introduce indigenous vegetation into the area.

(b) Confirm specifically that the environmental objectives in relation to closure have been consulted with landowner and interested and affected parties

This EIA/EMP was first send to all registered I&APs and stakeholders. All comments from them were included in the final EIA/EMP.

(c) Provide a rehabilitation plan that describes and shows the scale and aerial extent of the main mining activities, including the anticipated mining area at the time of closure

Refer to Part B(1)(d)(i)(4) for a rehabilitation plan.

(d) Explain why it can be confirmed that the rehabilitation plan is compatible with the closure objectives

The closure objective is to restore the land to a self-sustaining, aesthetically pleasing landform and planted to pasture that could be used for grazing by the surrounding communities. The rehabilitation step in the EIA/EMP aims to achieve this objective.

The financial provision will be updated on an annual basis. This financial provision update will be accompanied by a report on rehabilitation that has taken place.

(e) Calculate and state the quantum of the financial provision required to manage and rehabilitate the environment in accordance with the applicable guideline

Refer to Part A(s).

(f) Confirm that the financial provision will be provided as determined

Refer to Part A(s).

h) Mechanisms for monitoring compliance with and performance assessment against the environmental management programme and reporting thereon

Baseline monitoring is required to establish existing conditions that will help to define the requirements for site restoration and provide a basis for comparison of effects during the operation. Compliance monitoring should be carried out during the operation to ensure that the specified target limits are being met.

i) Monitoring of impact management actions

All impacts identified in the impact assessment must be monitored to ensure the correct management thereof takes place.

1 Mining plan and overburden placement

Mechanism for monitoring compliance:

- The geologists do the quarry design according to the layout plan and sensitivity map.
- Once this is done, the surveyor marks out the area, which is then further marked by and excavator.
- Prior to mining and placement of overburden, the personnel must inspect of overburden deposition to ensure no species of conservation concern is exposed.

Environmental component affected and impact	Monitoring and reporting frequency	Responsible persons
• Geology and the mineral resource. Loss of geology and mineral resource. • Soils, land capability, surrounding land use and landscape character. Removal of topsoil • Vegetation. Loss of floristic communities (affecting floristic richness, floristic structure, and ecological condition) and loss of declining, protected and near threatened plant taxa • Fauna. Deterring animals from utilizing nearby resources. • Visual aspect. Change in topography	Continuous.	Mine manager / site geologist and surveyor.

2 Soil stripping

Mechanism for monitoring compliance:

- The topsoil stripping depth and replacement depths should be monitored throughout the mining and rehabilitation process.
- It is recommended that depth markers are placed (by a surveyor) on surfaces that are prepared for topsoil replacement in order to guide operators and ensure correct post-mining soil depths.

Environmental component affected and impact	Monitoring and reporting frequency	Responsible persons
• Soils, land capability, surrounding land use and landscape character. Removal of topsoil	Weekly.	Mine manager / site geologist.

3 Soil erosion

Mechanism for monitoring compliance:

- Checks must be carried out to identify areas where erosion is occurring.
- Take photographs to indicate any signs of erosion.
- Inspections should be conducted on all channels, trenches, berms and pollution control dams to ensure function and capacity of infrastructure is maintained as well as maintenance where signs of erosion become evident. High risk erosion areas include all road and berms where surface water is concentrated into sheet flow.

Environmental component affected and impact	Monitoring and reporting frequency	Responsible persons
• Soil. Soil erosion • Surface water. Erosion and siltation	Monthly.	Mine manager / site geologist with specialist.

4 Site inspection for protected vegetation

Mechanism for monitoring compliance:

- A specialist must do a walk-through of the area to find protected and near threatened tree species.
- These species must then be pinned using a GPS and marked as per the management measures.

Environmental component affected and impact	Monitoring and reporting frequency	Responsible persons
• Vegetation. Loss of declining, protected and near threatened plant taxa	Once-off.	Mine manager / site geologist with specialist.

5 Alien vegetation monitoring

Mechanism for monitoring compliance:

- The mine must ensure that a specialist compile an alien eradication programme. This programme will indicate areas with alien vegetation.
- The mine personnel must further also monitor the area very any additional alien vegetation or regrowth.

Environmental component affected and impact	Monitoring and reporting frequency	Responsible persons
• Vegetation. Loss of floristic communities (affecting floristic richness, floristic structure, and ecological condition).	Once-off programme. Quarterly monitoring of regrowth.	Mine manager / site geologist with specialist.

6 Road kills

Mechanism for monitoring compliance:

- Road kills must be monitored, and a database crated of species killed to identify areas with a high frequency of mortalities.

Environmental component affected and impact	Monitoring and reporting frequency	Responsible persons
• Fauna. Loss of fauna richness during clearing of vegetation and loss of fossorial and stenotopic taxa with restricted dispersal abilities. Deterring animals from utilising nearby resources.	As it takes place.	Mine manager / site geologist.

7 Dustfall

Mechanism for monitoring compliance:

Method:

ASTM D1739 1998 (Reapproved 2017)

Summary of method:

Containers of a standard size and shape being prepared and sealed in a laboratory. These containers are then opened and set up at appropriately chosen sites. Particulate matter then settles into these containers for periods of about 30 days, where after the containers are then closed and returned to the laboratory.

Buckets may be removed 2 days before or 2 days after the 30-day period.

Equipment:

A stand with a shield and a container.

Network:

Dustfall monitoring will be conducted at 8 locations. Refer to Figure 36.

Sampling site should be in an open area, free of structures higher than 1m within a 20m radius.

Site selection:

Sampling sites should be away from local sources of pollution and objects that could affect the settling of particulate matter (e.g. trees, air exhausts and intakes).

Sampling points should be located approximately 30-50m away from a roadside.

Elevations to higher objects within 20 m should not exceed 30° from the horizontal.

Avoid sitting the containers near chimneys. Whenever possible, the sampling site shall be more than ten stack-lengths from an operating stack and upwind from it in accordance with the most frequent wind direction.

Accessibility and security from vandalism are major considerations in the selection of a site.

Where a specific emission source is monitored, the sampling point shall be located within a 2-km radius from this source

Site records:

The sampler will keep a site record for each sampling campaign. The site record will record the date, time, sample ID, weather conditions, stand condition, container condition and comments.

Unusual activities (such as fires, construction and demolition work, traffic diversions, etc.) occurring near the site that emit large amounts of particulate matter into the air should be recorded when observed.

Photographs will be taken of the container stands in their surroundings.

Where time of day and weather conditions permit, photographs can be taken of the four compass wind directions from each stand.

Analysis

The dustfall samples are filtered, dried and weighed by UIS Analytical services. (Refer to Appendix A for the certificate of accreditation awarded to UIS Analytical services). The filters with dust are then sent to Dustwatch for micro-scanning.

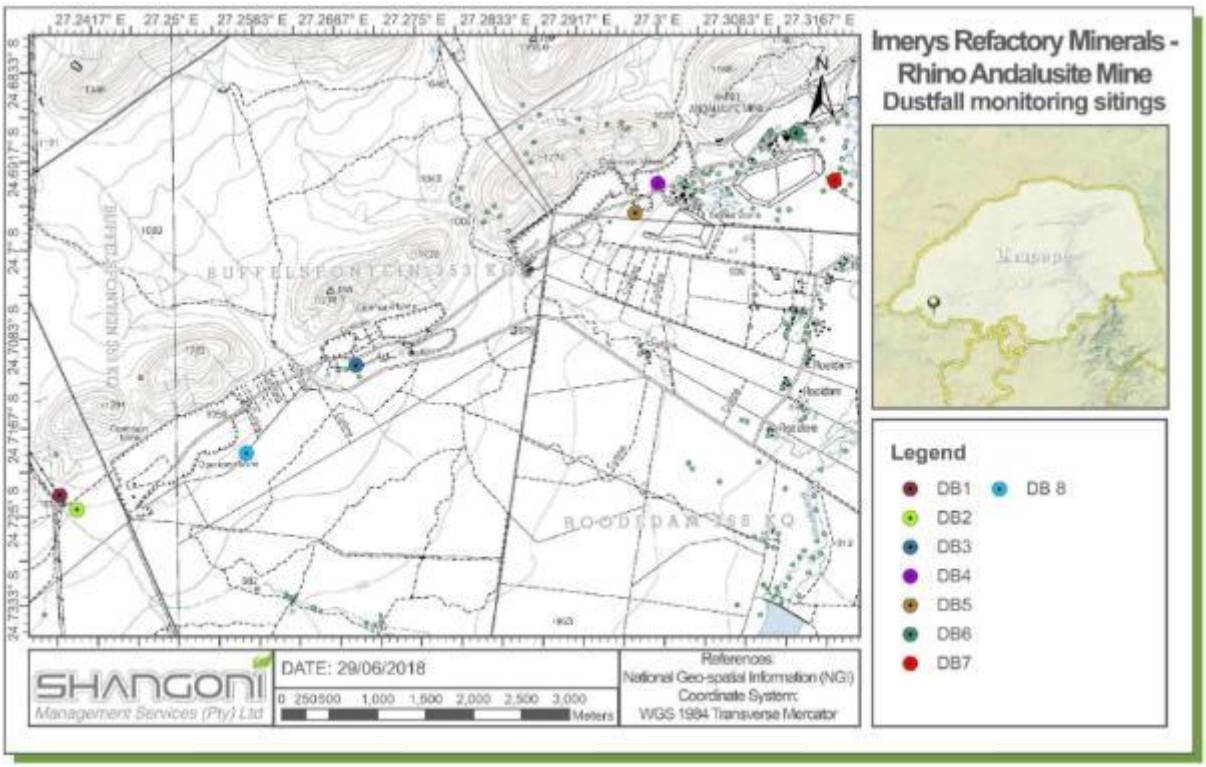


Figure 36: Dustfall monitoring sites. Refer to the dustfall monitoring report for a table of all these points.

Environmental component affected and impact	Monitoring and reporting frequency	Responsible persons
• Dust generation on air quality	Monthly monitoring. Quarterly in AEL reports.	Mine manager / site geologist.

8 Stack emissions

Mechanism for monitoring compliance:

- Stack emission testing on dust extraction filtration system on the dryer kiln.
- Three 1-hour tests are conducted during the survey.

Environmental component affected and impact	Monitoring and reporting frequency	Responsible persons
• Emissions on air quality.	Quarterly	Mine manager / site geologist.

9 Surface water monitoring

Mechanism for monitoring compliance:

Note, this section will be updated once the mine has obtained its IWUL.

Environmental component affected and impact	Monitoring and reporting frequency	Responsible persons
• Surface water. Surface water quality.	Quarterly (this depends on the IWUL conditions).	Mine manager / site geologist.

10 Biomonitoring

No natural water bodies are located on the property to conduct valuable biomonitoring. Drainage lines through the mining areas are non-perennial and does not sustain any aquatic life. The Bierspruit is the closest defined water drainage line. This is however also a non-perennial tributary and only has intermitted flow after heavy rains.

11 Groundwater monitoring

Mechanism for monitoring compliance:

Note, this section will be updated once the mine has obtained its IWUL.

Environmental component affected and impact	Monitoring and reporting frequency	Responsible persons
• Surface water. Surface water quality.	Quarterly (this depends on the IWUL conditions).	Mine manager / site geologist.

12 Water balance

Mechanism for monitoring compliance:

Note, this section will be updated once the mine has obtained its IWUL.

Environmental component affected and impact	Mechanism for monitoring compliance	Monitoring and reporting frequency	Responsible persons
• Water levels.	• Measure water input and output.	Annually.	Mine manager / site geologist.

13 Rehabilitation

Mechanism for monitoring compliance:

- A post-mining land capability assessment needs to be done progressively at all areas rehabilitated during the operational phase.
- The assessment should be executed by a soil specialist by means of auger observations at a grid spacing of 100 x 100 m. This is required to evaluate the rehabilitation procedures and to verify that the topsoil thickness is as specified.
- A final post-mining land capability map needs to be compiled and should be submitted for closure purposes.

Environmental component affected and impact	Monitoring and reporting frequency	Responsible persons
• Soils, land capability, surrounding land use and landscape character, vegetation. Removal of topsoil, Soil disturbance, Loss of topsoil and land capability,	Progressively.	Mine manager / site geologist.

Environmental component affected and impact	Monitoring and reporting frequency	Responsible persons
• Vegetation and fauna. Loss of fauna richness during clearing of vegetation and loss of fossorial and stenotopic taxa with restricted dispersal abilities.		

14 Environmental noise monitoring

No environmental noise monitoring has been proposed by the specialist. From an occupational perspective the mining workers should be protected through standards and procedures and monitored as requires through Section 12 of the MHSA.

15 Archaeological, historical and cultural aspects

Mechanism for monitoring compliance:

- The area must be inspected and monitored for any heritage resources prior to removal of vegetation and soil.

Environmental component affected and impact	Monitoring and reporting frequency	Responsible persons
• Archaeological, historical and cultural aspects. Destruction of heritage or archaeological resources.	Progressively.	Mine manager / site geologist.

16 Waste procedure

Mechanism for monitoring compliance:

- Inspect waste management on site against procedure.
- Information in the checklist includes:
  - Waste storage area: Area clean, no flammable material with oil and diesel, oil reclamation system working
  - Waste separated, placed into appropriate disposal skips/areas according to RAM standards
  - Waste containers/ drums/ skips in good condition
  - Hazardous waste containers / drums labelled
  - Waste skips not overflowing
  - Spill kit available for any accidental spillages
  - Fire extinguisher available on/ near site.

As part of the monitoring programme the following will also be conducted:

- Volumes of all waste generated (Domestic and Hazardous Waste) and disposed of will be monitored and measured on a monthly basis and records kept,
- All contractors and disposal agents, premises and disposal sites will be inspected twice yearly to ensure that all environmental and legal requirements are adhered to, and

- Volumes of mine residue generated and disposed of by the mine will be monitored on a monthly basis and records kept.

Environmental component affected and impact	Monitoring and reporting frequency	Responsible persons
• General	Monthly.	Mine manager / site geologist.

17 General site inspections

Mechanism for monitoring compliance:

- Site inspections on the entire mining area must take place. During this site inspection the following must also be inspected:
  - All roads and signage.
  - Maintenance records.
  - Diversion berm.
  - All surface water infrastructure.
  - Spill kits and removal of spillages.

- Internal auditing on the general operation, maintenance and incident reporting should be conducted.
- An incident register must be kept to, report on all environmental incidents. Incidents with the potential to pollute clean water resources must be reported to regional DWS within 24hours followed by a remediation action plan.

Environmental component affected and impact	Monitoring and reporting frequency	Responsible persons
• Soil and surface water. Pollution • Fauna. Deterring animals from utilising nearby resources. • Air quality. Impact on air quality. • Groundwater. Impact on groundwater quality and levels • Surface water. Potential of flooding. Erosion and siltation • Environmental noise. Environmental noise generation	Monthly.	Mine manager / site geologist.

18 Social and labour plan

Mechanism for monitoring compliance:

- Monitor and evaluate the SLP.

Environmental component affected and impact	Monitoring and reporting frequency	Responsible persons
• Socio-economic aspects. Job creation.	Continuous monitor. Annually reporting.	Site manager.

19 GN 704 Audits

Mechanism for monitoring compliance:

- Tygerkloof will need to comply with the Regulations GN 704, dated 4 June 1999, under the NWA, 1998, on the use of water for mining and related activities aimed at the protection of water resources.
- In addition to this, monitoring programmes will be reviewed and strengthened to assess the level of impact for areas of non-compliance with the requirements of GN 704.

Environmental component affected and impact	Monitoring and reporting frequency	Responsible persons
• Water compliance	Every two years.	

20 General Housekeeping Audits

Mechanism for monitoring compliance:

- These audits will cover the overall housekeeping on the site.

Environmental component affected and impact	Monitoring and reporting frequency	Responsible persons
• General	Monthly.	Mine management.

21 Legal compliance audit

Mechanism for monitoring compliance:

- Environmental Legal Compliance Audits will be performed to determine the status of compliance against all applicable legislation and policies.

Environmental component affected and impact	Monitoring and reporting frequency	Responsible persons
• General compliance	Every two years	Mine management

22 IWWMP monitoring

Mechanism for monitoring compliance:

- Annual update of the IWWMP includes a review on the adequacy and performance of the measures contained within this document. The IWWMP document is updated to address shortcoming in the operation of the mine.

Environmental component affected and impact	Monitoring and reporting frequency	Responsible persons
• IWUL compliance	Annual	

ii) Monitoring and reporting frequency

Refer above.

iii) Responsible persons

Refer above.

iv) Time period for implementing impact management actions

Refer above.

v) Mechanism for monitoring compliance

Refer above.

i) Indicate the frequency of the submission of the performance assessment report

The performance of the EIA/EMP will be assessed every two years. A financial provision will accompany the EIA/EMP which will be updated on an annual basis. This financial provision update will be accompanied by a report on rehabilitation that has taken place.

j) Environmental awareness plan

This section includes an environmental awareness plan describing the manner in which the applicant intends to inform his or her employees of any environmental risks which may result from their work and the manner in which the risks must be dealt with in order to avoid pollution or the degradation of the environment.

Environmental Awareness must be implemented by the mine in order to inform their employees and contractors of the environmental risk that may result from their work. This must be prior to any prospecting work done on site. Training must be given to all employees and contractors. Proof of all training provided must be kept on site. The training focuses on the following aspects:

- Explaining clearly what the environment is and what the environment consists of.
- Explain all activities that will take place on the site and the associated impacts.
- The mining personnel must be made aware of the mining plan with its buffers, the depth to which topsoil must be removed, and the location of the topsoil stockpiles and overburden placement.
- Operators of stripping equipment must be well informed of the correct stripping depth and that it is.
- Explain all restrictions and prohibitions of removal of any vegetation other than that on site, off-road driving, poaching of animals, etc.
- Mining personnel must be made aware of the protected vegetation species that occur on site and the prohibition to remove them before the mine has a permit to do so.

- All labour or staff should be advised on the biodiversity importance of the area.
- Intentional killing of any faunal species (in particular invertebrates and snakes) should be avoided by means of awareness programmes presented to the labour force. The labour force should be made aware of the conservation issues pertaining to the taxa occurring on the study site.
- Heritage awareness must be included in normal site induction for all employees, contractors and visitors to the subject properties. This will ensure that the general level of heritage awareness is raised and that there is compliance with the act.
- The sections of the HRA as highlighted above must be given to each visitor, contactor and employee or any other person acting on the sites or immediate surrounds.
- Personnel will not be made aware of the ancient mine.
- Visual aids such as pictures or photos can be used.

The following was extracted from the Environmental training procedure (BECS Environmental, 2016).

i) Induction training

1. Induction training is relevant to all new employees and contractors (including any employee and/or contractor that has not yet been trained on the environmental induction material) as well as all visitors to Tygerkloof Mine.
2. Training will be repeated every 18 months.

3. Induction training will include the following:
   a. Relevant impacts and management as per the approved and operational EMP of Cyferfontein Mine (these will be site- and job specific);
   b. Environmental procedures; and
   c. Environmental emergency procedure.
4. The trainee will after completion of induction:
   a. Sign the necessary induction form/book; and
   b. Have all relevant PPE necessary for the specific job.

ii) General environmental awareness training

1. Management will identify environmental awareness needs and related environmental topics.
2. The environmental awareness will include:
   a. The significant environmental impacts, actual or potential, of their work activities and the benefits of improved personal performance; and
   b. The potential consequences of departure from specified operating procedures.

3. Environmental awareness training will form part of the safety talks prior to each shift.
4. Visual aids will be used, where applicable to help with awareness training. These could be in the form of posters displayed at specific work areas after training was done.

iii) Competency training

1. Management will identify job-related training needs for all employees who have or can have a significant impact on the environment.
2. A training needs matrix will be completed for Tygerkloof Mine.
3. Job specific training will convey the importance of conformance with the environmental procedures. Simplified summaries of these procedures may be used to ensure better understanding at lower levels of the organisation.

4. Management will identify specialised training needs. for personnel performing tasks, which can cause significant environmental impacts, or personnel who needs specialised environmental knowledge for areas of responsibility. These courses will be sourced externally.
5. Management will undergo legal training from time to time. A summary of this training will also be given to employees of Tygerkloof Mine.

iv) Development of training material

1. The Health and Safety Officer will develop and maintain training material for induction training, general environmental awareness and competency training. This excludes specialised competency training which will be externally sourced.
2. This training material will be based on the approved and operational EMP as well as environmental procedures. Additional topics will also be included for general environmental awareness.
3. Training material will be reviewed using results from audits, changes to plant/operation, competency assessments and new significant aspects.

v) Scheduling of training

1. Once training topics and material have been compiled, the Health and Safety Officer will ensure employees are scheduled according to the needs identified.

vi) Training records

1. Upon completion of training, a training record will be completed. This may be in the following formats:
   a. Attendance registers;
   b. Sign off on procedure to demonstrate understanding of procedure; and/or
   c. Certificates of attendance / completion.

2. All training records will be kept for the period of employment plus an additional 5 years.

vii) Reconciliation to determine gaps in attendance

1. All employees and contractors must undergo all training as identified (as per training needs analysis). Reconciliation will be done on all training attendance registers, against the training schedules, to identify any shortcomings in training performed and reschedule if necessary.

viii) Competency assessment

1. An evaluation will be conducted on all employees and contractors. The aim is to identify both the effectiveness of training as well as the competence in performing the job.
2. Competency evaluation records will be completed by the approved training assessor and will be included with the attendance records.

k) Specific information required by the Competent Authority

1 Financial provision

The financial provision will be reviewed on an annual basis.

2 Procedures for environmentally related emergencies and remediation

The following was extracted from the Environmental Emergencies Procedure (BECS Environmental, 2016).

2.1 List of environmental incidents

Description or activity	Aspect	Impact	Associated procedure and other records
Diesel tank	Burst of pipe, leakage from tank	Major spillage causing soil pollution	Spill handling procedure, Environmental Emergency Response Plan, diesel MSDS,
		Any spillage into a water resource	
Diesel tanker	Off-loading and loading spillages	Major spillage causing soil pollution	Spill handling procedure, Environmental Emergency Response Plan, diesel MSDS
		Any spillage into a water resource	
		Any spillage into a water resource	
Abnormal rainfall/floods	Overflow of dirty water infrastructure or mine residue	Major spillage causing soil pollution	Environmental Emergency Response Plan
		Any spillage into a water resource	
Veld fires	Veld fire through mining area	Destruction of fauna and flora, hazard to community	Environmental Emergency Response Plan, smoke detectors and fire-hose inspection checklists

2.2 Major spillages onto soil or spillages into water resources

1. Tygerkloof Mine will as soon as reasonably practicable after obtaining knowledge of the incident, report through the most effective means reasonably available:
   a. the nature of the incident;
   b. any risks posed by the incident to public health, safety and property;
   c. the toxicity of substances or by-products released by the incident; and

d. any steps that should be taken in order to avoid or minimise the effects of the incident on public health and the environment to:
    i. the DWS and/or the Limpopo Department of Economic Development, Environment, and Tourism;
    ii. the South African Police Services and the relevant fire prevention service;
    iii. the relevant head of municipality; and
    iv. all persons whose health may be affected by the incident.

2. Tygerkloof Mine will, as soon as reasonably practicable after knowledge of the incident:
    a. 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;
    b. undertake clean-up procedures;
    c. remedy the effects of the incident;
    d. assess the immediate and long-term effects of the incident on the environment and public health; and
    e. and take such measures as the catchment management agency may either verbally or in writing direct within the time specified by such institution.

3. Steps to be taken to contain, minimise and clean-up are as follow:
    a. Isolate and evacuate the affected area to prevent unauthorised access;
    b. If safe to do so, isolate source of leak or spillage to prevent further losses;
    c. Use appropriate PPE;
    d. Protect stormwater drains around the affected area by sealing them off:
    - Construct berm walls cross-stream using soil if pollution has escaped into drainage ditches; and
    - If possible construct temporary retention dams across stream using soil, and divert flow into them.
    e. Transfer any residual contents and contaminated absorbents to suitable temporary storage containers;
    f. Obtain specialist advice on decontamination of surfaces, drains and interceptors;
    g. Remove any retention berms/temporary retention dams only when authorised; and
    h. Dispose of contaminated material as hazardous waste.

4. Tygerkloof Mine will, within 14 days of the incident, report to the DWS, and/or the Limpopo Department of Economic Development, Environment, and Tourism, and relevant head of municipality such information as is available to enable an initial evaluation of the incident, including:
    a. the nature of the incident;
    b. the substances involved, and an estimation of the quantity released and their possible acute effect on persons and the environment and data needed to assess these effects;

c. initial measures taken to minimise impacts;
d. causes of the incident, whether direct or indirect, including equipment, technology, system, or management failure; and
e. measures taken and to be taken to avoid a recurrence of such incident.

2.3 Drills

1. Emergency drills of above incidents will be held at least biannually.
2. The emergency drill should be a practical exercise where practicable or as a minimum, a desktop exercise.
3. A realistic scenario will be created, e.g. water can be spilled from an oil drum in order to test the reaction of personnel in line with the emergency procedure.
4. The emergency drill report should be completed.
5. It is advisable that photographs or videos should be taken for review after the drill has been conducted.
6. A debriefing session should be held after each drill to discuss any non-conformances or areas for improvement identified during the drill.

3 Waste procedure

A waste disposal procedure must be put in place that includes an appendix containing a checklist for the main waste collection sites. The main waste collection sites are the hazardous waste site at the contractor's yard, the waste collection points at the plants and offices, and the general waste collection area. Information in the checklist includes:

- Waste storage area: Area clean, no flammable material with oil and diesel, oil reclamation system working
    - Waste separated, placed into appropriate disposal skips/areas according to RAM standards
    - Waste containers/ drums/ skips in good condition
    - Hazardous waste containers / drums labelled
    - Waste skips not overflowing
    - Spill kit available for any accidental spillages
    - Fire extinguisher available on/ near site.

As part of the monitoring programme the following will also be conducted:

- Volumes of all waste generated (Domestic and Hazardous Waste) and disposed of will be monitored and measured on a monthly basis and records kept,
- All contractors and disposal agents, premises and disposal sites will be inspected twice yearly to ensure that all environmental and legal requirements are adhered to, and
- Volumes of mine residue generated and disposed of by the mine will be monitored on a monthly basis and records kept.

2) Undertaking

The EAP herewith confirms

a) the correctness of the information provided in the reports ☒

b) the inclusion of comments and inputs from stakeholders and I&APs ☒

c) the inclusion of inputs and recommendations from the specialist reports where relevant ☒

d) the acceptability of the project in relation to the finding of the assessment and level of mitigation proposed ☒

The EIA/EMP will, should it comply with the provisions of section 24N of NEMA as well as the applicable EIA Regulations i.t.o. NEMA, be approved, become an obligation in terms of the approved EIA/EMP and mining right issued.

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, and confirm that the above EIA & EMP compiled in accordance with Appendices 3 & 4 of the EIA Regulations.

Full Names and Surname	Salome Beeslaar
Identity Number	8310190032081
Designation	EAP
Signature	

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