GREATER SOUTPANSBERG GENERAAL PROJECT

ENVIRONMENTAL IMPACT ASSESSMENT AND ENVIRONMENTAL MANAGEMENT PROGRAMME

DMR References: LP 30/5/1/2/2/10044 MR
LP 30/5/1/2/2/10045 MR
LP 30/5/1/2/2/10047 MR
LP 30/5/1/2/2/10050 MR
LP 30/5/1/2/2/10053 MR
LP 30/5/1/2/2/10054 MR
LP 30/5/1/2/2/10058 MR
LP 30/5/1/2/2/10069 MR

JANUARY 2014

GREATER SOUTPANSBERG

GENERAAL PROJECT

SECTION 1

ENVIRONMENTAL MANAGEMENT PROGRAMME

REGULATION 50

PROJECT DETAILS

Name of Project	**Greater Soutpansberg - Generaal Project**
DMR Reference Numbers	LP 30/5/1/2/2/10044 MR
	LP 30/5/1/2/2/10045 MR
	LP 30/5/1/2/2/10047 MR
	LP 30/5/1/2/2/10050 MR
	LP 30/5/1/2/2/10053 MR
	LP 30/5/1/2/2/10054 MR
	LP 30/5/1/2/2/10058 MR
	LP 30/5/1/2/2/10069 MR
Name of Applicant	
LP 30/5/1/2/2/10044 MR	Chapudi Coal (Pty) Ltd
LP 30/5/1/2/2/10045 MR	Regulus Investment Holdings (Pty) Ltd
LP 30/5/1/2/2/10047 MR	Coal of Africa Limited
LP 30/5/1/2/2/10050 MR	Kwezi Mining Exploration (Pty) Ltd
LP 30/5/1/2/2/10053 MR	Kwezi Mining Exploration (Pty) Ltd
LP 30/5/1/2/2/10054 MR	Kwezi Mining Exploration (Pty) Ltd
LP 30/5/1/2/2/10058 MR	Kwezi Mining Exploration (Pty) Ltd
LP 30/5/1/2/2/10069 MR	Limpopo Coal Company (Pty) Ltd
Responsible person	Baldwin Khosa
Designation	Regulatory Affairs Manager
Physical address	The Campus Gabba Building (2nd floor) 57 Sloane Street Bryanston
Postal Address	PO Box 69517 Bryanston 2021
Telephone	011 575 4363
Facsimile	086 562 1335
E-mail	Baldwin.khosa@coalofafrica.com

Environmental Consultant	Jacana Environmentals cc
Responsible person	Marietjie Eksteen
Physical address	7 Landdros Mare Street, Polokwane
Postal Address	PO Box 31675, Superbia, 0759
Telephone	(015) 291 4015
Facsimile	(015) 291 5035
E-mail	marietjie@jacanacc.co.za

Public Participation Consultant	Naledi Development Restructured (Pty) Ltd
Responsible person	Lizinda Dickson
Physical address	143 Zambezi Avenue, Sinoville
Postal Address	PO Box 13509, Sinoville, 0129
Telephone	(012) 543 9093
Facsimile	(012) 543 9619
E-mail	lizinda@naledidev.co.za

Impact specialist consultants

Soil and land use capacity	Gudani Consulting - EcoSoil Consortium
Surface and Groundwater	WSM Leshika Consulting (Pty) Ltd
Biodiversity	Phaki Phakanani Environmental Consultants
Aquatic systems	Scientific Aquatic Services
Noise	Gudani Consulting
Air Quality	Royal Haskoning DHV
Heritage Resources	Mbofho Consulting and Projects
Socio-Economic	Naledi Development Restructured (Pty) Ltd
Macro-Economic	Mosaka Economic Consultants cc

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Glossary of Terms

TERM / ABBREVIATION	MEANING
ABA	Acid Base Accounting
AGIS	Agricultural Geo-referenced Information System
AMD	Acid Mine Drainage
AQA	National Environmental Management: Air Quality Act 39 of 2004
ARD	Acid Rock Drainage
ARS	Acute Respiratory Syndrome
BCM/h	Bank Cubic Meters per hour
Biome	A broad ecological unit representing major life zones of large natural areas – defined mainly by vegetation structure and climate
BMWP	British Biological Monitoring Working Party
CARA	Conservation of Agricultural Resources Act 43 of 1983
CBA	Cost Benefit Analysis
CLN	Customer Load Network
CoAL	Coal of Africa Limited
COPT	Chronic Obstructive Pulmonary Disease
CRR	Comments and Response Report
dBA	Decibels
DEA	Department of Environmental Affairs
DEMC	Desired Ecological Management Class
DMR	Department of Mineral Resources
DM	Dense Medium
DMS	Dense Medium Separator
DWA	Department of Water Affairs
DWS	Discouraged Work Seekers
Ecological integrity	Overall functioning of the ecological system as a whole
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity Classification
EMC	Ecological Management Class
EMP	Environmental Management Programme
ESA	Earlier Stone Age
ESP	Exchangeable sodium percentage
ESS	Ecosystem Services

TERM / ABBREVIATION	MEANING
EUR	Expanded Unemployment Rate
FAII	Fish Assemblage Integrity Index
FZ	Fractured Zone
GDP	Gross Domestic Product
GPS	Global Positioning system
GSP	Greater Soutpansberg Project
HIA	Heritage Impact Assessment
IAP	Interested and Affected Party
IDP	Integrated Development Plan
IHAS	Invertebrate Habitat Assessment System
IHIA	Intermediate Habitat Integrity Assessment
ISP	Internal Strategic Perspective
IUCN	International Union for Conservation of Nature and Natural Resources
IWUL	Integrated Water Use Licence
IWWMP	Integrated Water and Waste Management Plan
K2C	Kruger to Canyon Biosphere
LCC	Land Claims Commissioner
LEDET	Limpopo Department of Economic Development, Environment and Tourism
LEMA	Limpopo Environmental Management Act 7 of 2003
LM	Local Municipality
LMB	Limpopo Mobile Belt
LOM	Life of Mine
LSA	Late Stone Age
Mamsl	Meters above mean sea level
MAE	Mean Annual Evaporation
MAP	Mean Annual Precipitation
MAR	Mean Annual Run-off
Mbcm	Million Bank Cubic Metres
MIA	Mining Infrastructure Area
MPRDA	Mineral and Petroleum Resources Development Act 28 of 2002
MRA	Mining Right Application
MSA	Middle Stone Age
Mtpa	Million Tonnes Per Annum
MTS	Main Transmission Station

TERM / ABBREVIATION	MEANING
MSC	Mining Consulting Services
NBA	National Biodiversity Assessment
NEMA	National Environmental Management Act 107 of 1998
NEMBA	National Environmental Management: Biodiversity Act 10 of 2004
NEMWA	National Environmental Management: Waste Act 59 of 2008
NFA	National Forest Act 84 of 1998
NFEPA	National Freshwater Ecosystem Priority Areas
NGDB	National Groundwater Database
NHRA	National Heritage Resources Act 25 of 1999
NMD	Neutral Mine Drainage
NOMRA	New Order Mining Right Application
NOMR	New Order Mining Right
NWA	National Water Act 36 of 2008
NWCS	National Wetland Classification System
PEMC	Present Ecological Management Class
PES	Present Ecological State
PFD	Process Flow Diagram
POC	Probability of occurrence
PRECIS	Pretoria Computer Information Systems
QDS	Quarter Degree Square
RBCT	Richards Bay Coal Terminal
RDL	Red Data List
RDM	Resource Directed Measures
RE	Risk estimation
REC	Recommended Ecological Category
RHP	River Health Programme
RLT	Rapid Load-Out Terminal
ROM	Run of Mine
SAM	Social Accounting Matrix
SANBI	South African National Biodiversity Institute
SAR	Sodium Absorption Ration
SASS5	South African Scoring System version 5
SDF	Spatial Development Framework
SEIA	Socio-Economic Impact Assessment
SoER	State of the Environment Report

TERM / ABBREVIATION	MEANING
SSC	Species of Special Concern
SUR	Strict Unemployment Rate
TDS	Total Dissolved Solids
TFR	Transnet Freight Rail
TOPS	Threatened or Protected Species
TWQ	Target Water Quality
UNESCO	United Nations Education, Science and Cultural Organizations
VBR	Vhembe Biosphere Reserve
WBR	Waterberg Biosphere Reserve
WMA	Water Management Area
WQO	Water Quality Objective
WQT	Water Quality Threshold
WZ	Weathered Zone

1 DESCRIPTION OF THE BASELINE ENVIRONMENT

1.1 PROJECT BACKGROUND AND LOCATION

The Generaal Project forms part of the Greater Soutpansberg Projects (GSP) situated to the north of the Soutpansberg in the Limpopo Province. Figure 1 depicts the locality of the various GSP projects, from which it is evident that they are within close vicinity of each other, permitting possible rationalisation of infrastructure.

Based on the prospecting rights held in the Generaal Project area, Chapudi Coal (Pty) Ltd (Chapudi), Regulus Investment Holdings (Pty) Ltd (Regulus), Limpopo Coal Company (Pty) Ltd (LCC), Coal of Africa Limited (CoAL) and Kwezi Mining Exploration (Pty) Ltd (Kwezi) submitted similar applications for New Order Mining Rights (NOMRs) in terms of Section 22 of the Mineral and Petroleum Resources Development Act 28 of 2002 (MPRDA). The objective is to have a consolidated project with economically minable blocks which are contiguous.

Therefore, in parallel to the NOMR applications, the applicants will be applying for the consent of the Minister of Mineral Resources, to:

- Simultaneously with the granting of the NOMRs, cede certain of the mining rights from Chapudi, Regulus, LCC and CoAL to Kwezi in terms of Section 11 of the MPRDA; and
- After cession of the mining rights, consolidate these into one mining right for the Generaal Project in terms of Section 102 of the MPRDA.

Coal of Africa Limited (CoAL) is a shareholder of MbeuYashu (Pty) Ltd, with a shareholding of 74%. The remaining 26% is held by Rothe Investments (Pty) Ltd, a Black Economic Empowerment company as contemplated in the Mining Charter. MbeuYashu in turn holds a 100% shareholding in Chapudi and Kwezi.

The Generaal Project has shown a robust return in challenging market conditions. The primary product, hard coking coal, has demand in both South Africa and internationally, whilst the secondary thermal product (Eskom grade) adds significant value as a product booster. Coupled with the rest of the assets in the province, the Generaal Project is uniquely placed to contribute significantly and responsibly to developing Limpopo's mineral wealth, as well as participation in industrial growth as planned by the provincial government.

The Generaal Project is situated in the magisterial district of Vhembe, in the Limpopo Province, approximately 35 km north of the Makhado Town in the Makhado and Musina Local Municipal areas. Musina is situated approximately 70 km to the north – refer to Figure 2. Musina and Makhado are connected by well developed road infrastructure.

The Generaal Project area is located north of the Mutamba River and reaches from west of the N1 north eastwards to 5 km south of Tshipise, and is divided into two (2) sections, namely the Generaal Section and the Mount Stuart Section – refer to Figure 3. A single farm (Solitude 111 MS) is located further north with its southern border at the end of the Nzhelele Scheme canal. Two other farms (Maseri Pan 520 MS and Beck 568 MS) are located across the N1 at the Baobab Toll Plaza.

The Generaal Project is well situated with respect to major infrastructure, including rail, road and power. The N1 national road pass through the mining right application (MRA) area (Generaal Section) with the R525 running to the north of the project area in a west-east direction. Both of these roads carry sufficient traffic to impact on the ambient sound levels a distance away from these roads. The Makhado-Musina railway line runs in a north-south direction to the west of the Generaal Project area. Eskom grid power lines are located parallel to the N1 and are situated 6 km east of the farm Cavan 508 MS at their closest point.

The overall population density of the region beyond the Soutpansberg Range is low. The land coverage in the Generaal Project area is shown in Figure 4. The greater majority of present land use is game and cattle farming, with the operating of guest lodges and hunting the main activity. Irrigation downstream of the Nzhelele Dam occurs on both sides of the Nzhelele River and at the Mutamba River on Schuitdrift 179 MT (near the rivers' confluence) and Along the western boundary of the farm Mount Stuart 153 MT next to the Nzhelele River. Apart from the irrigation by surface water from the canal system and from the lower reach of the Mutamba River, the water requirements of households and livestock (including game) are supplied from groundwater sources.

Hunting, game trading and eco-tourism is an established socio-economic driver in the area. There are a number of properties utilized for trophy (for local and foreign tourists) and biltong hunting with ecotourism spin-off activities. The Tshipise Forever Resort is situated on the farm Honnet 137 MT, just north of the Mount Stuart Section.

1.1.1 SURFACE OWNERSHIP

The area covered by the NOMR applications includes twenty-three (23) farms as listed in Table 2 below. The majority of the properties are privately owned. The properties included in the NOMR applications are shown in Figure 5.

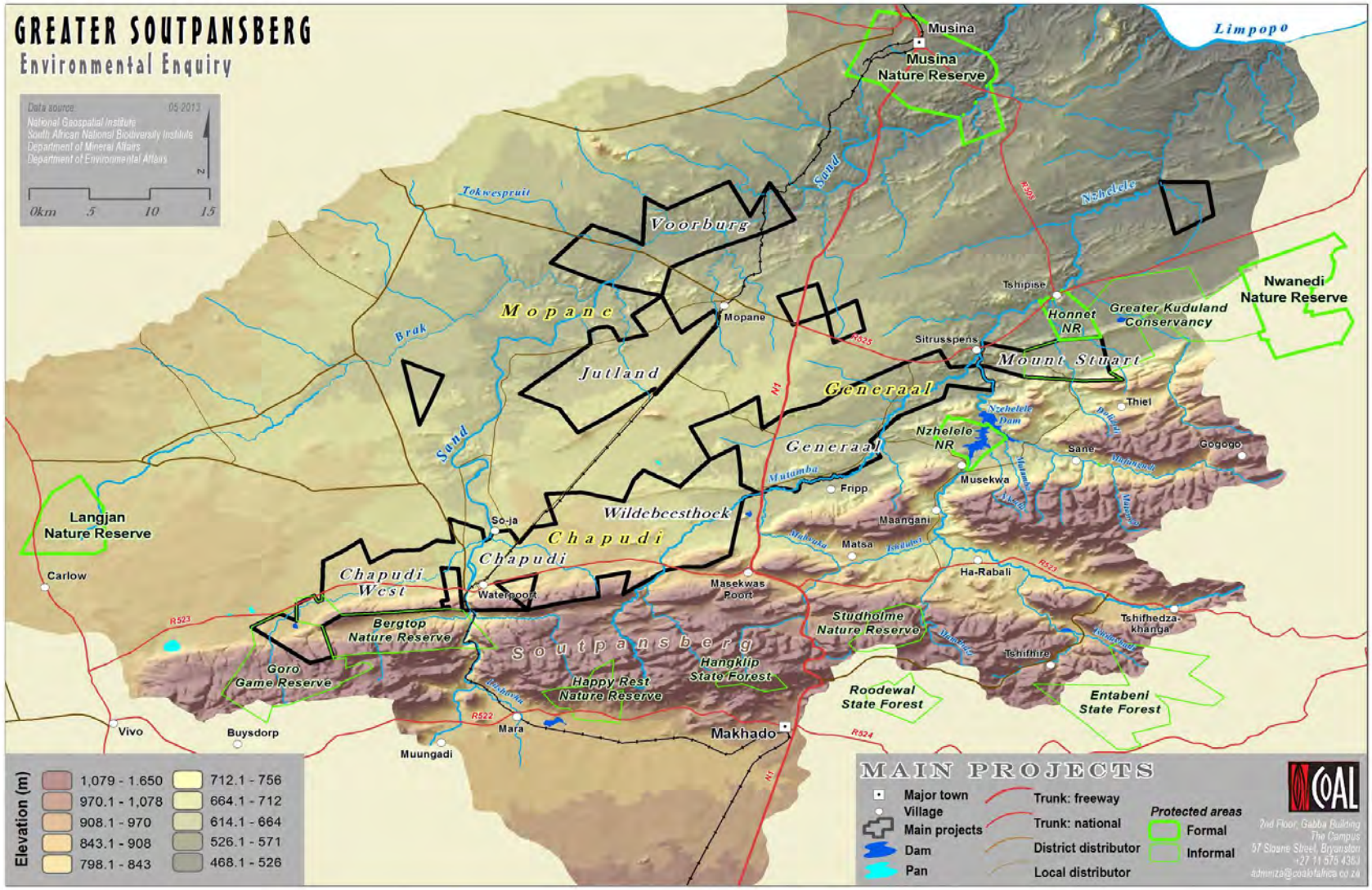


Figure 1: Location of Greater Soutpansberg Projects

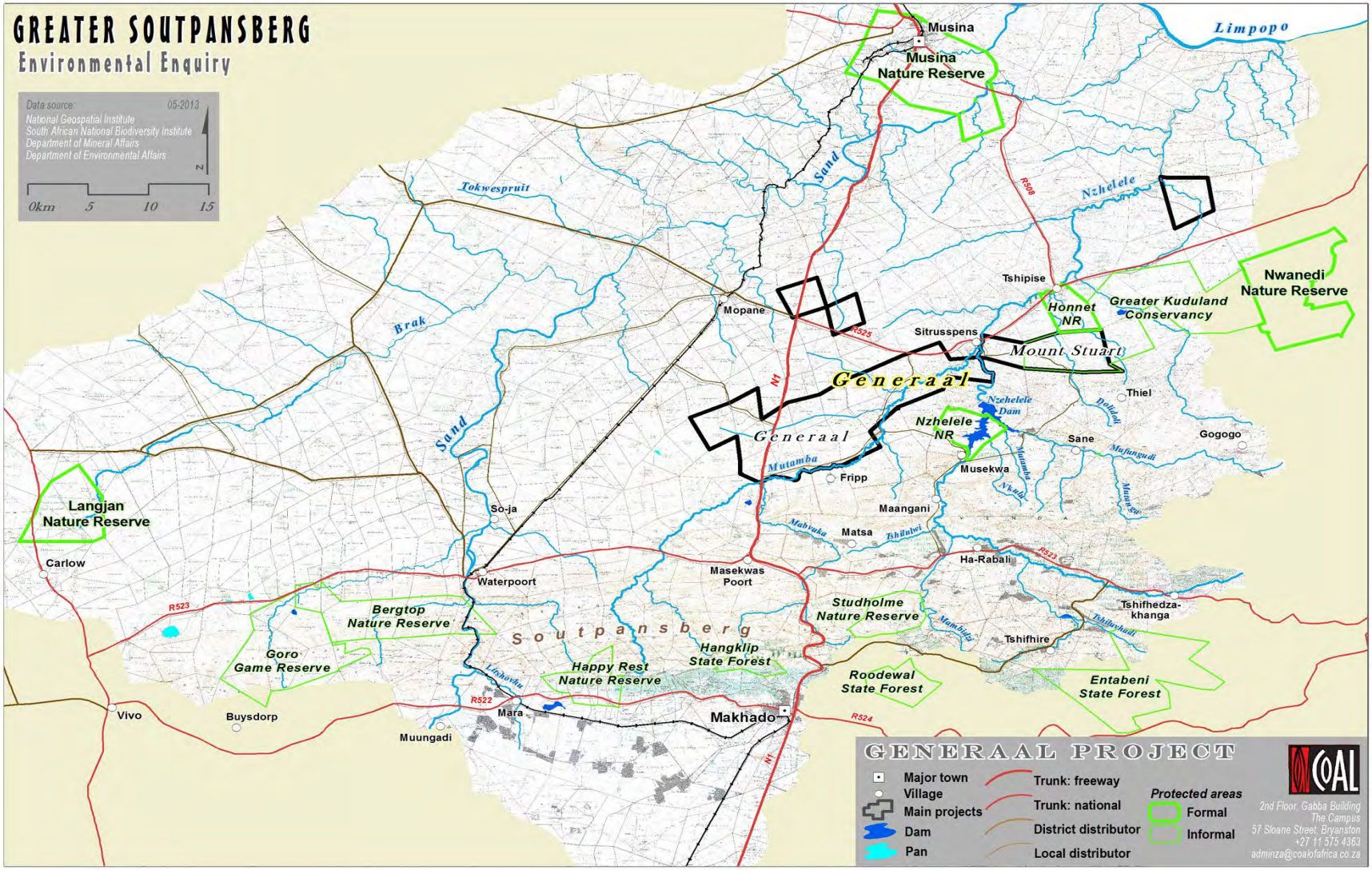


Figure 2: Generaal Project – Locality Map

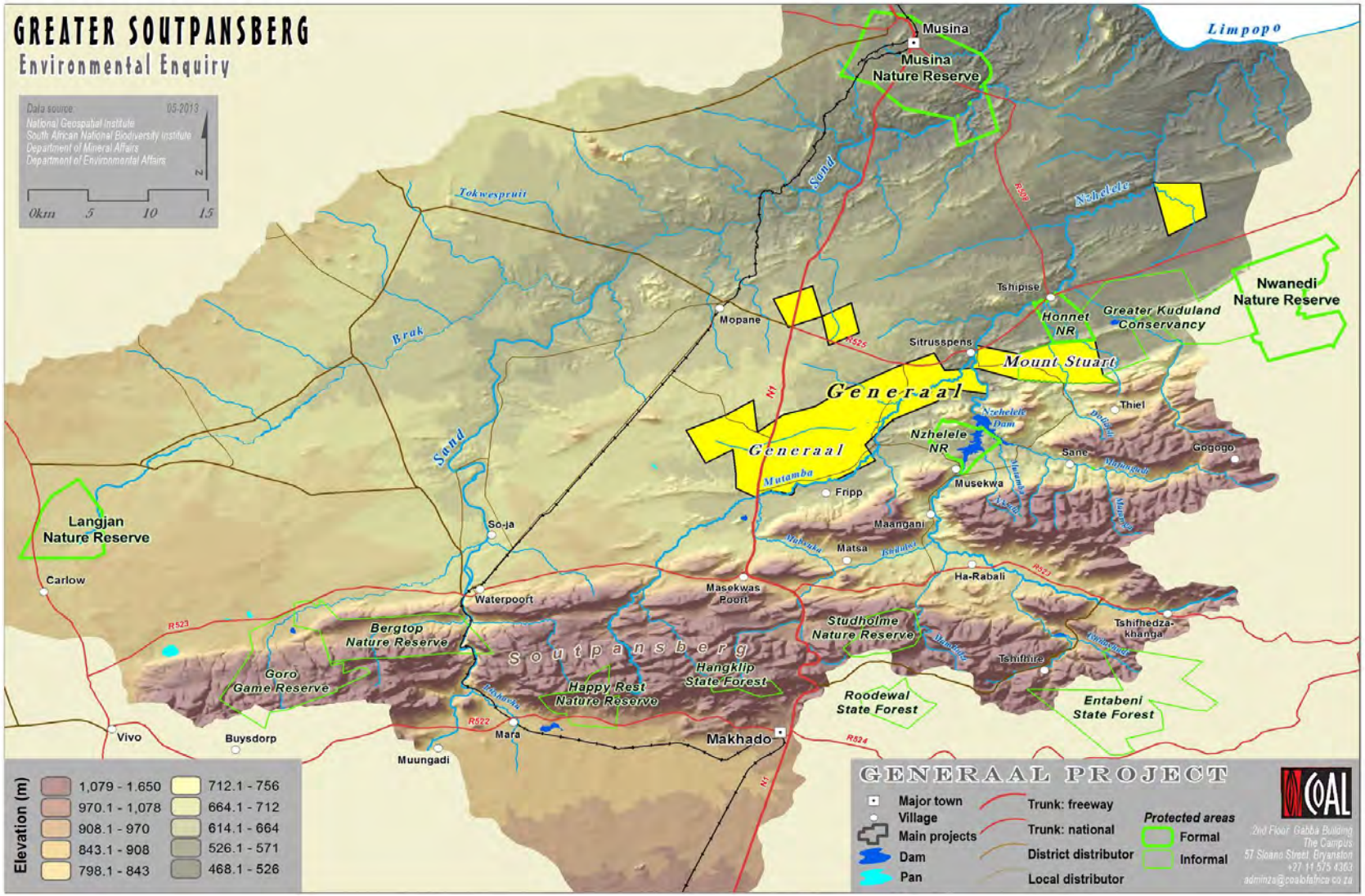


Figure 3: Location of Generaal and Mount Stuart Sections

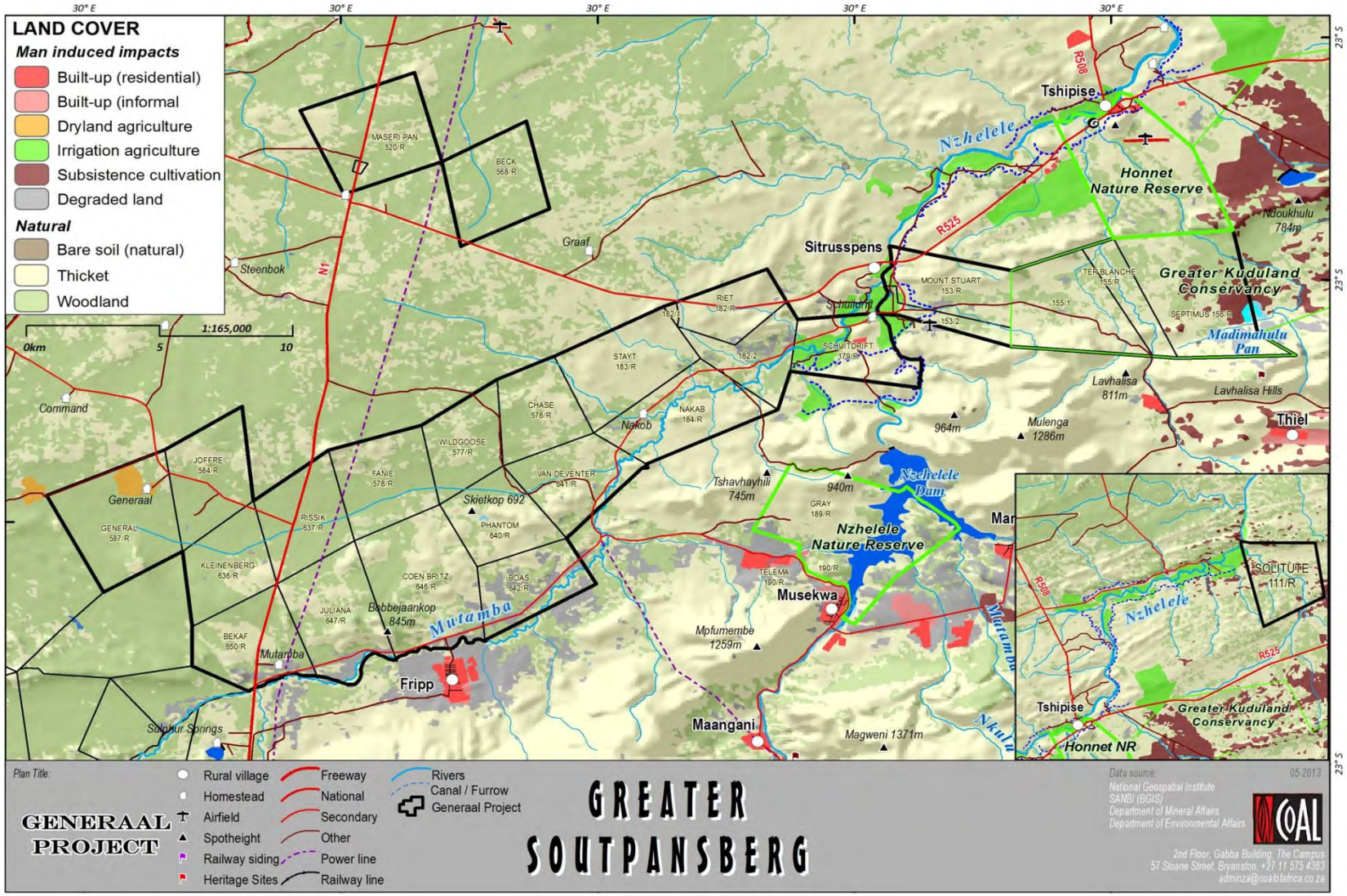


Figure 4: Land coverage in the Generaal Project area

1.1.2 COMMUNITY DESCRIPTION

Four villages are located to the south of the proposed Generaal Project area, namely Mudimeli on the farm Fripp 645 MS, south of the Generaal Section, and Makushu, Mosholombe and DoliDoli to the south of the Mount Stuart Section. The villages are provided with water from boreholes and from the Nzhelele Water Supply Scheme. Other villages are located further to the east and south.

The communities located within the vicinity of the Generaal project is indicated in Figure 6. In analysing the Census 2011 data available at village level for these communities the following is revealed:

Table 1: Surrounding communities

Settlement	Population	Households	Economically active	Unemployed#	Economically inactive	Younger than 15 yrs
Mudimeli	2892	678	17%	285 people (57%)	35%	48%
Makushu-Mosholombi	1506	396	25%	276 people (73%)	27%	48%
Pfumembe	717	189	21%	111 people (76%)	30%	50%
Ngudu	810	174	21%	111 people (66%)	31%	48%
Maranikwe (incl Starlight)	999	264	15%	81 people (54%)	37%	48%
DoliDoli	312	90	17%	24 people (44%)	38%	47%
Thiel	276	84	24%	51 people (77%)	28%	49%
Ndouvhada (Khomela)	1020	273	20%	129 people (62%)	28%	51%
Gaarside	267	69	10%	18 people (67%)	43%	47%
Smokey	234	66	1%	3 people (100%)	51%	48%
Honnet NR Worker village	174	69	48%	0 people (0%)	76%	9%
Total	9207	2352	18%	1089 people (61%)	39%	45%

#: Including unemployed and discouraged work seekers

1.1.3 LAND CLAIMANTS / TRADITIONAL AUTHORITY

MbeuYashu has consulted with the Regional Land Claims Commissioner (LCC) in Limpopo regarding the gazetted land claims for the farms covered by the Generaal Project and its surrounds.

Table 2 below depicts the claims which have been submitted to the Regional LCC by the various communities. This information has been mapped (refer to Figure 7) to show its relevance to the project. According to the Regional LCC the land claimants of the area include the Mamilwe and Mamuhohi communities (mainly in the Mount Stuart Section) and the Mulambwane community (mainly in the Generaal Section).

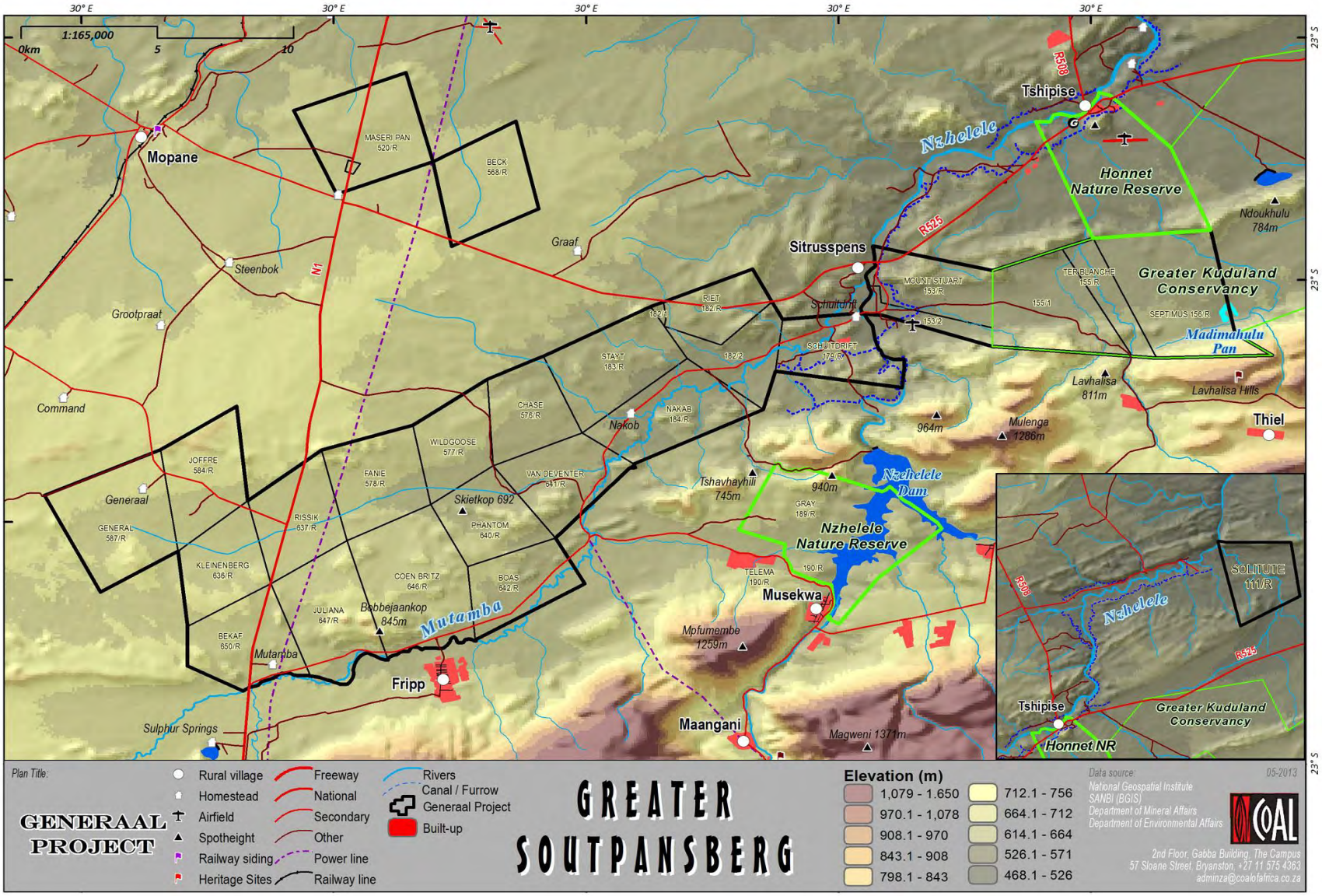


Figure 5: Surface properties included in Generaal NOMR applications

Table 2: Surface properties included in NOMR application

DMR Ref No	Applicant	Farm	Portions	Landowner	Title Deed Number	Extent (ha)	Land claimant
10045MR	Regulus	Schuitdrift 179 MT	All	Masiri (Pty) Ltd	T9355/1995	868.0481	Mamuhohi
10047MR	CoAL	Mount Stuart 153 MT	RE	Mount Stuart Boerdery (Pty) Ltd	T26411/1999	867.2701	Mamilwe
		Mount Stuart 153 MT	Ptn 2	Mount Stuart Boerdery (Pty) Ltd	T26411/1999	282.6556	Mamilwe
		Nakab 184 MT	All	Clint Howes Family Trust	T8273/2003	1155.7529	Mamilwe
		Septimus 156 MS	All		*tbc*		No Land Claimant
		Terblanche 155 MT	RE	Joy Stella Amm	T67252/1995	457.1988	No Land Claimant
		Terblanche 155 MT	Ptn 1	Julius & Louisa Petronella Raal	T67251/1995	1274.6533	Mamilwe
10069MR	LCC	Riet 182 MT	RE	Inyanga Trading 523 (Pty) Ltd	T92515/2007	617.5252	Mamilwe\Mamuhohi
		Riet 182 MT	Ptn 1	Clint Howes Family Trust	T8274/2002	23.4905	Mamilwe\Mamuhohi
		Riet 182 MT	Ptn 2	Masiri (Pty) Ltd	T1245/1970	706.2792	Mamilwe\Mamuhohi
		Stayt 183 MT	All	Clint Howes Family Trust	T8274/2002	1184.2782	Mamilwe\Mamuhohi
10054MR	Kwezi	Boas 642 MS	RE	Fumaria Property Holdings (Pty) Ltd	T67434/2012	528.4275	No Land Claimant
		Boas 642 MS	Ptn 1		*tbc*		No Land Claimant
10053MR	Kwezi	Generaal 587 MS	RE		*tbc*		Mulambwane
		Generaal 587 MS	Ptn 1		*tbc*		Mulambwane
		Generaal 587 MS	Ptn 2	Trove Investments (Pty) Ltd	T54703/1998	517.5598	Mulambwane
10050MR	Kwezi	Coen Britz 646 MS	All	Manupont 124 (Pty) Ltd	T107358/2002	1668.9183	No Land Claimant
		Juliana 647 MS	All	Manupont 124 (Pty) Ltd	T107358/2002	1207.9699	No Land Claimant
		Phantom 640 MS	All	Ptyprops 197 (Pty) Ltd	T3257/2006	869.6941	No Land Claimant
		Van Deventer 641 MS	All	Born Free Investments 399 (Pty) Ltd	T3257/2006	725.2747	No Land Claimant
10058MR	Kwezi	Beck 568 MS	All	Tobie Fourie & Seuns	T37495/2010	1047.2700	

DMR Ref No	Applicant	Farm	Portions	Landowner	Title Deed Number	Extent (ha)	Land claimant
10044MR	Chapudi	Bekaf 650 MS	All	Manupont 124 (Pty) Ltd	T107358/2002	1055.0233	Mulambwane
		Chase 576 MS	All	Born Free Investments 399 (Pty) Ltd	T3256/2006	845.4014	No Land Claimant
		Fanie 578 MS	All	Anna Susanna van der Merwe	T88135/1988	1046.6764	No Land Claimant
		Joffre 584 MS	All	Mulambwane Communal Trust	T51334/2008	631.9138	Mamuhohi\Mulambwane
		Kleinenberg 636 MS	All	Manupont 124 (Pty) Ltd	T107358/2002	881.0588	No Land Claimant
		Maseri Pan 520 MS	RE	Richmond Boerdery (Pty) Ltd	T10192/2008	1301.9557	No Land Claimant
		Rissik 637 MS	Ptn 1	Wesley Christoffel Fourie	T82998/1995	614.0852	Mulambwane
		Rissik 637 MS	Ptn 2	Siphuma Petrus Matodzi	T98265/2003	212.4652	Mulambwane
		Solitude 111 MS	RE	Kongo Trust	T93762/1997	885.5370	
		Solitude 111 MS	Ptn 1	Wesley Christoffel Fourie	*tbc*	614.0852	
		Solitude 111 MS	Ptn 2	Hendrik & Ronel van der Walt	T129691/2005	845.0281	
		Solitude 111 MS	Ptn 3	Kongo Trust	T93762/1997	11.4196	
		Wildgoose 577MS	All	Ptyprops 197 (Pty) Ltd	T3257/2006	800.7903	No Land Claimant

tbc: To be confirmed

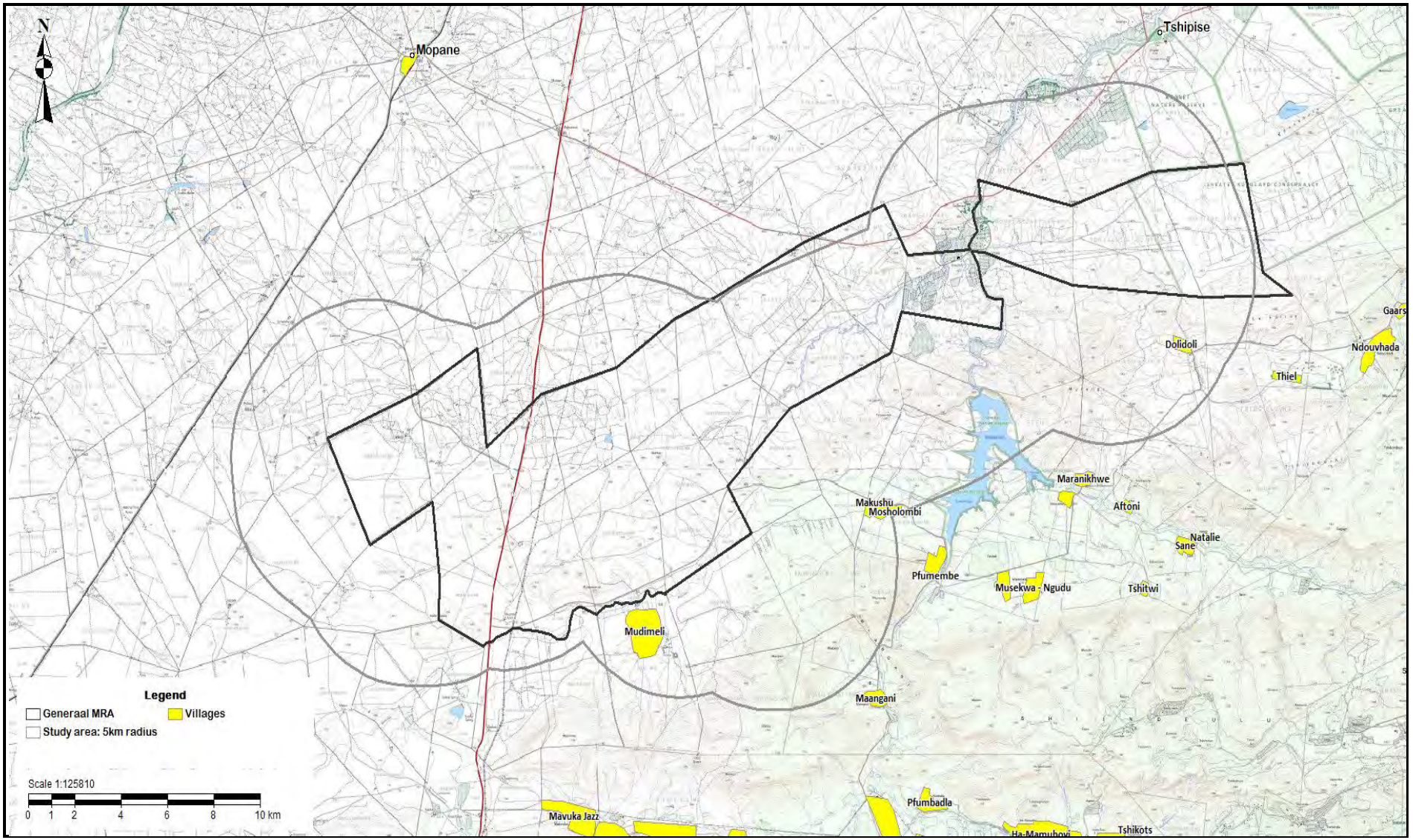


Figure 6: Location of communities in relation to the Generaal Project

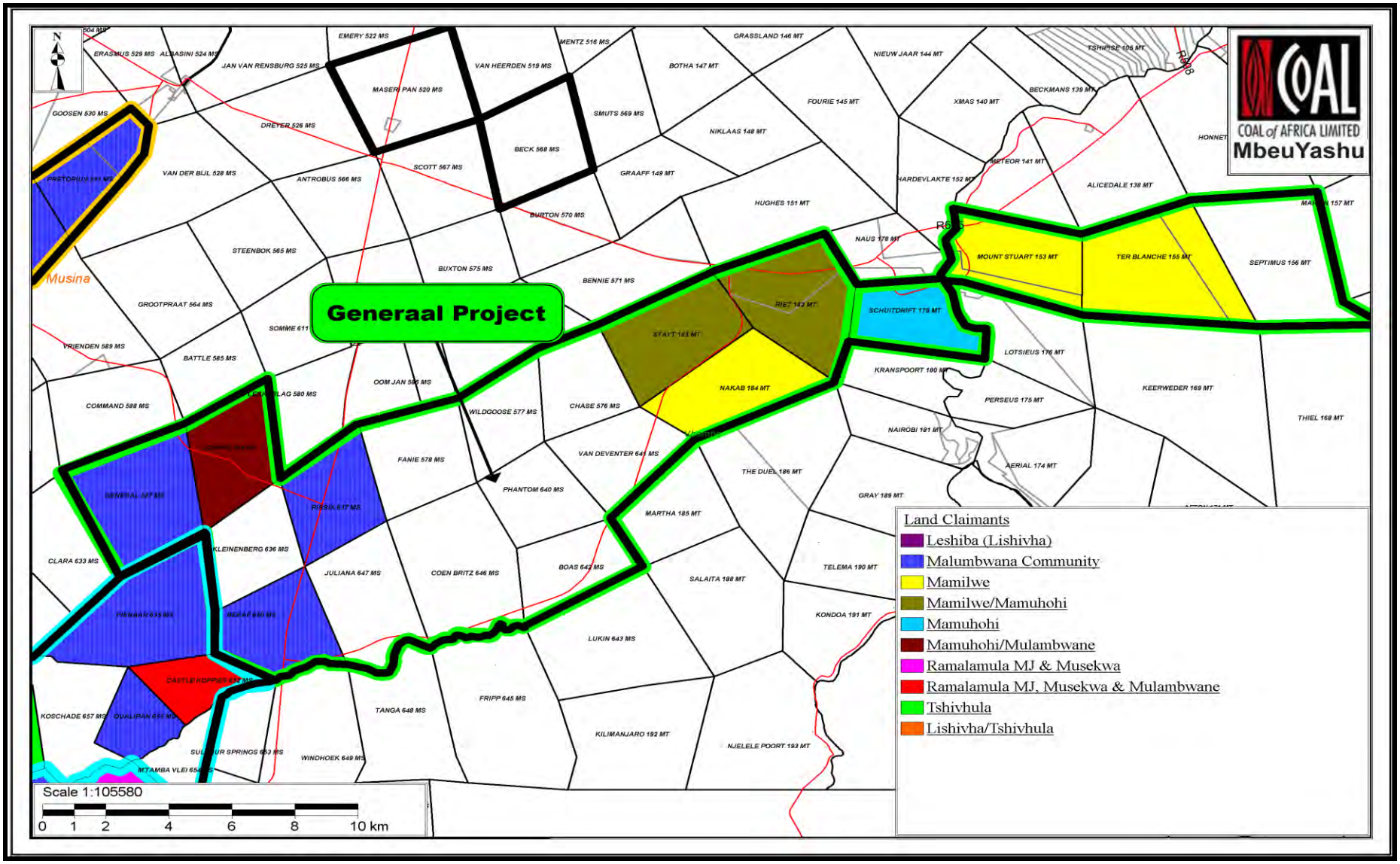


Figure 7: Generaal Project Land Claimants map

1.2 DESCRIPTION OF THE BIOPHYSICAL ENVIRONMENT

A number of specialist studies were performed for the Generaal Project, in line with the Plan of Study presented in the Scoping Report for the Generaal Project, August 2013. These are attached as Annexures as listed below.

Annexure	Aspect	Independent Consultant
ANNEX-1	Soils, Land Use & Capability	Gudani Consulting - EcoSoil Consortium
ANNEX-2	Surface Water	WSM Leshika Consulting (Pty) Ltd
ANNEX-3	Groundwater	WSM Leshika Consulting (Pty) Ltd
ANNEX-4	Biodiversity	Phaki Phakanani Environmental Consultants
ANNEX-5	Aquatic Systems	Scientific Aquatic Services
ANNEX-6	Ambient Noise	Gudani Consulting
ANNEX-7	Air Quality	Royal Haskoning DHV
ANNEX-8	Heritage Resources	Mbofho Consulting and Projects
ANNEX-9	Socio-Economic Aspects	Naledi Development Restructured (Pty) Ltd
ANNEX-10	Macro-Economic Aspects	Mosaka Economic Consultants cc

NOTE: This Section is a summary of the baseline information provided in the specialist reports, and should be read in conjunction with the specialist reports.

1.2.1 CLIMATIC DATA

1.2.1.1 Regional Climate

Limpopo Province is situated in a dry savannah sub region, characterized by open grasslands with scattered trees and bushes. Visible manifestations of underlying geology, contributing to slope and the formation of landscapes, comprising the visible features of an area of land, including the physical elements of landforms such as mountains, ridges, hills, plains and water bodies. The southern limit of the MRA area is underlain by the hard and resistant quartzites and conglomerates of the Soutpansberg Group and this give rise to prominent east-west striking mountains and valleys. The Soutpansberg mountain range is a major regional topographic feature and it extends in an east-west direction for a distance of approximately 130 km. The regional climate is strongly influenced by the east-west orientated mountain range which represents an effective barrier between the south-easterly maritime climate influences from the Indian Ocean and the continental climate influences (predominantly the Inter-Tropical Convergence Zone and the Congo Air Mass) coming from the north.

The Generaal Project is located in the hot-arid zone to the north of the Soutpansberg where the rainfall decreases to 400-500 mm. The area is situated in the summer rainfall region and rainfall occurs in the form of heavy thunderstorms or soft rain. The area is characterised as being hot and dry resulting in high evaporation rates and low rainfall. The area is characterized by cool, dry winters (May to August) and warm, wet summers (October to March), with April and September being transition months. Temperature range from 0.9°C to 39.9°C and the area is generally frost free.

The mountains give rise to wind patterns that play an important role in determining local climates. These wind effects include wind erosion, aridification and air warming.

1.2.1.2 Temperature

Average monthly minimum and maximum temperatures for the Tshipise Weather Station (No 0766277 1) some 5 km north-east of the Generaal Project area is shown in Table 15 below. Average daily maximum and minimum summer temperatures (November to February) at the weather station range between ~33°C and ~20°C, while winter temperatures (May to August) range between ~28°C and ~7°C respectively. The high average temperatures are reflected by the fact that the minimum average daily summer temperature is a high 20°C and the minimum average daily winter temperature does not dip below 7°C.

Table 3: Temperature data for Tshipise for the period from 1994 to 2006

Month		Temperature (° C)		
	Highest Recorded	Average Daily Maximum	Average Daily Minimum	Lowest Recorded
January	42.2	32.8	21.5	12.6
February	41.4	32.3	21.5	14.9
March	42.9	31.5	20.1	13.0
April	40.9	30.1	16.3	5.7
May	42.3	27.9	11.2	1.7
June	34.3	25.6	8.2	-0.4
July	34.1	25.0	7.3	-1.2
August	37.4	27.8	10.3	1.7
September	41.2	27.7	12.9	3.6
October	41.4	29.1	16.5	8.0
November	42.5	32.2	20.1	11.1
December	43.4	33.1	21.0	13.8
Year	43.4	29.6	15.6	-1.2

Source: Weather SA (Station No 0766277 1)

The Department of Agriculture's Agricultural Geo-referenced Information System (AGIS) hosts a wide spectrum of spatial information maps for public use. The two figures below indicate the maximum and minimum annual temperature for the region that was obtained from their natural resources atlas on climate.

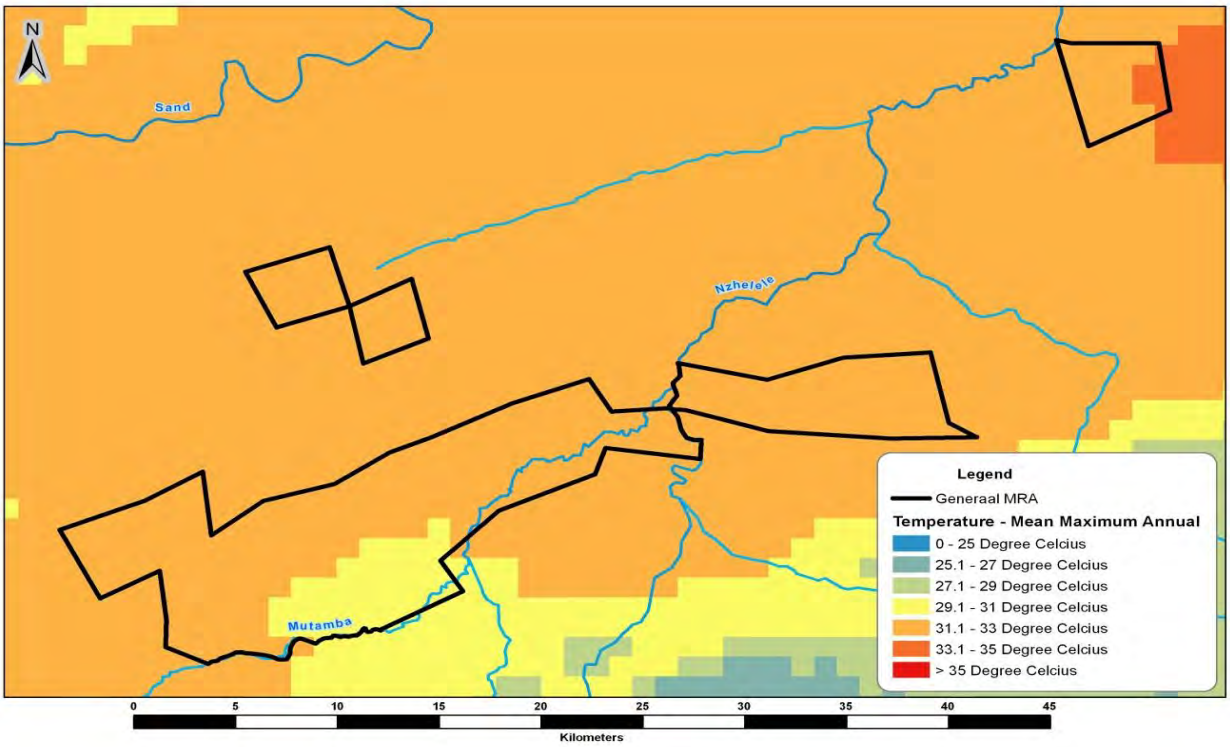


Figure 8: Mean annual maximum temperature

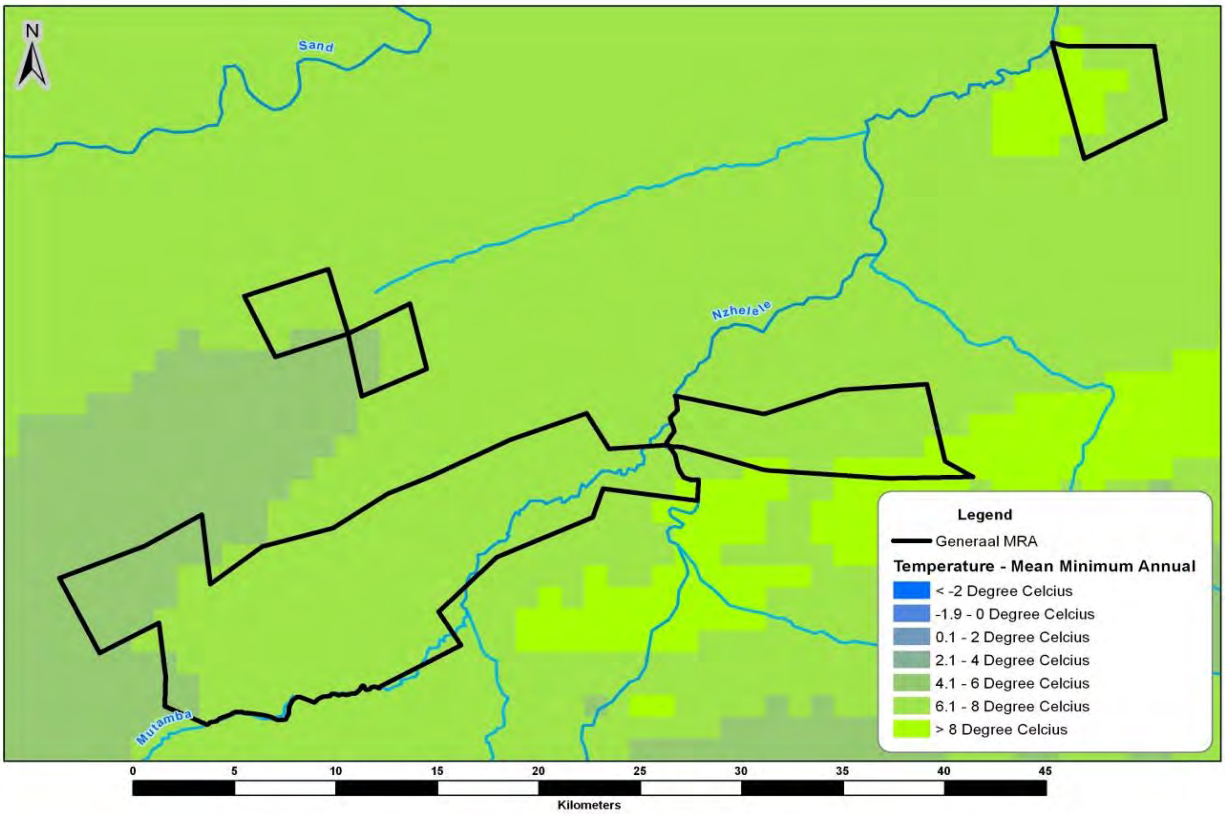


Figure 9: Mean annual minimum temperature

1.2.1.3 Winds

The wind field for the proposed Generaal Project is presented in Figure 10 below. Wind roses comprise of 16 spokes which represents the direction from which winds blew during the period. The colours reflect the different categories of wind speeds. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories. Based on an evaluation of the meteorological data obtained from the South African Weather Services, the following deductions regarding the prevailing wind direction and wind frequency can be assessed.

Looking at Figure 10 below, the predominant wind direction within the Generaal Project area is mainly from the south eastern region. Secondary winds originate from the eastern region. At the site, 0.1% of the total wind field accounted for calm conditions over the area.

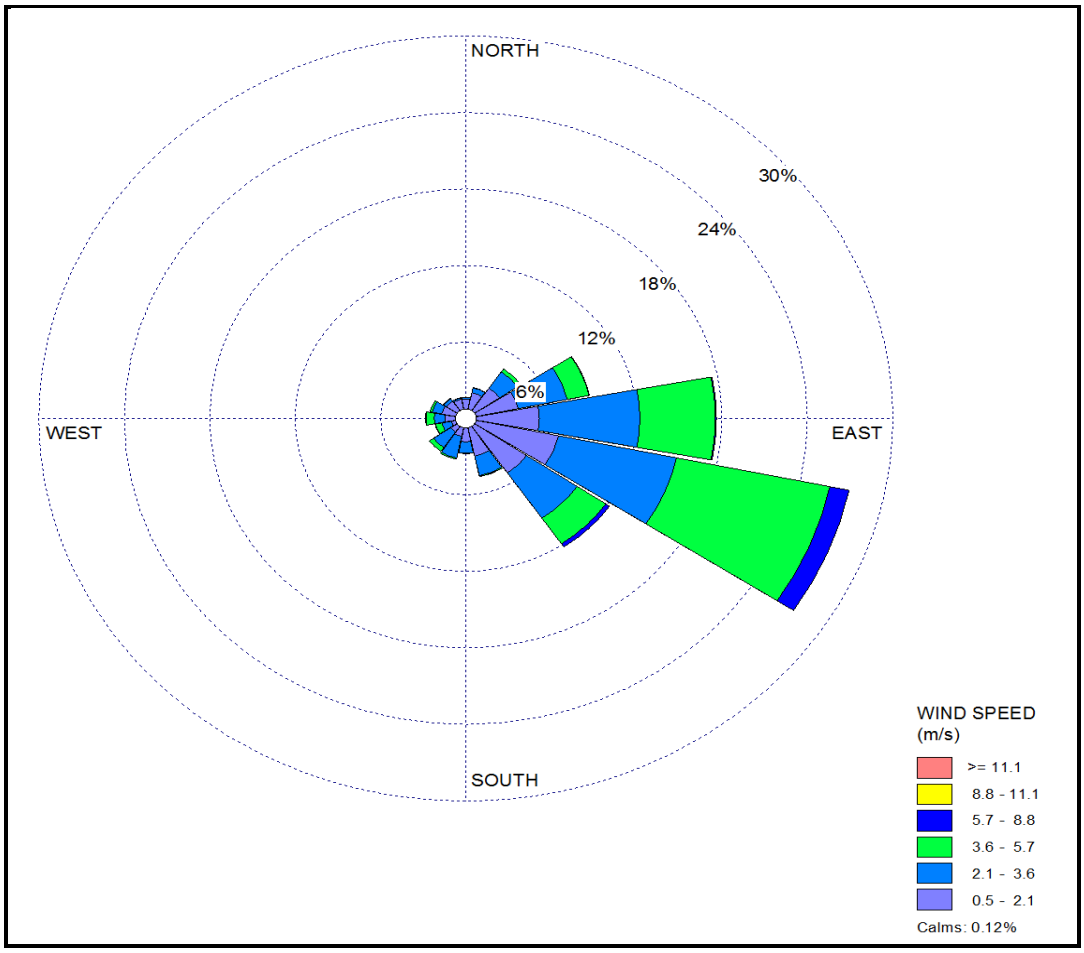


Figure 10: Period wind rose for the Generaal Project for the period Jan 2009 – Dec 2012

Figure 11 below illustrates the wind frequency distribution for the Jan 2009 - Dec 2012 monitoring period. 42.2 % of the time accounted for wind speeds within the range of 0.5 - 2.1 m/s. The second highest wind class 2.1 - 3.6 m/s occurred for 33.5% of the time.

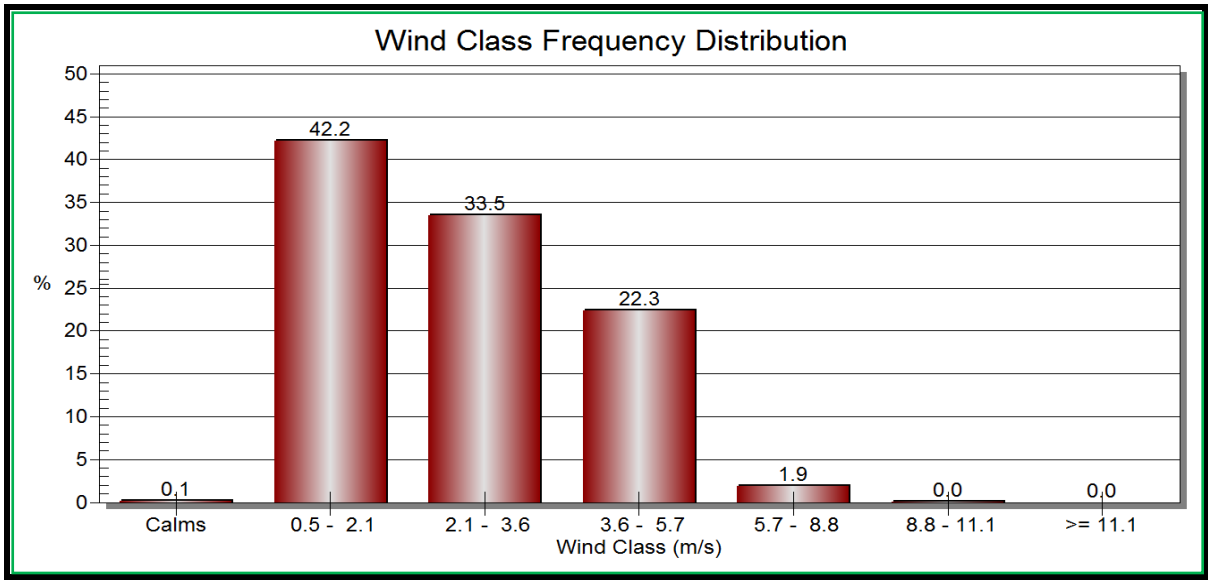


Figure 11: Wind class frequency distribution

Atmospheric stability is commonly categorized into six stability classes. These are briefly described in the table below. The atmospheric boundary layer is usually unstable during the day due to turbulence caused by the sun's heating effect on the earth's surface. The depth of this mixing layer depends mainly on the amount of solar radiation, increasing in size gradually from sunrise to reach a maximum at about 5-6 hours after sunrise. The degree of thermal turbulence is increased on clear warm days with light winds. During the night-time a stable layer, with limited vertical mixing, exists. During windy and/or cloudy conditions, the atmosphere is normally neutral.

A neutral atmospheric potential neither enhances nor inhibits mechanical turbulences. An unstable atmospheric condition enhances turbulence, whereas a Stable atmospheric condition inhibits mechanical turbulence. Majority of the wind class fell within Class F (very stable conditions) which occurred for 37.4% of the time.

A	Very unstable	calm wind, clear skies, hot daytime conditions
B	Moderately unstable	clear skies, daytime conditions
C	Unstable	moderate wind, slightly overcast daytime conditions
D	Neutral	high winds or cloudy days and nights
E	Stable	moderate wind, slightly overcast night-time conditions
F	Very stable	low winds, clear skies, cold night-time conditions

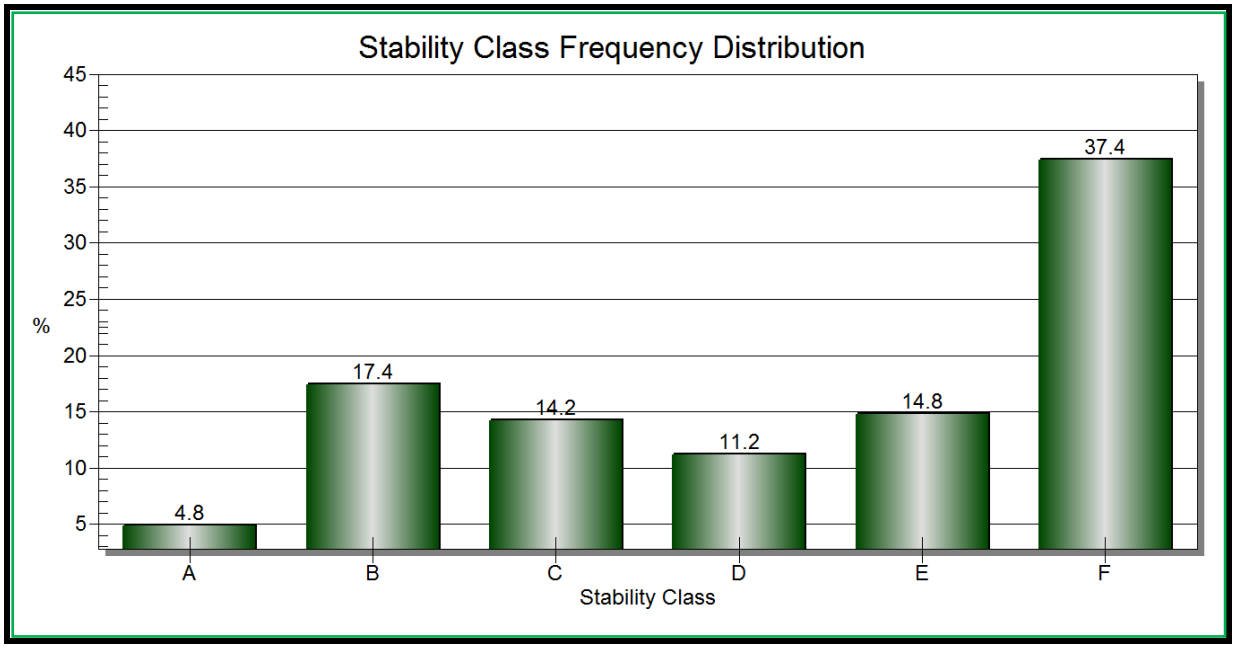


Figure 12: Atmospheric stability class frequency distribution

Due to the high stability levels indicated above, it is likely that an inversion layer will develop, particularly in the early hours of winter mornings. This phenomenon has the possibility of increasing ground level pollution concentrations.

1.2.1.4 Mean Annual Precipitation and Mean Monthly Rainfall

The Generaal Project is located in the Nzhelele River Basin. The major rivers in the project area consist of the Mutamba and Nzhelele Rivers, which are tributaries of the Limpopo River. The Nzhelele basin covers an area of approximately 425 km^2, which is 1% of the entire Limpopo basin. The Nzhelele basin elevation ranges from 1670 mamsl in the south to 220 mamsl in the north where it joins the Limpopo River. The Basin's mean annual precipitation (MAP) distribution is shown in Figure 13 and varies between 900 mm in the south and 300 mm to the north.

The Generaal Project falls however within the hot-arid zone to the north of the Soutpansberg that has a MAP in the lower 400 - 500mm range.

Note that the region is also within the impact zone of tropical cyclones occurring in the Indian Ocean which may cause high-intensity rainfalls leading to peak run-off events. These events occurred here for example in 1958 (Astrid), 1976 (Danae), 1977 (Emily) and 2000 (Eline) (Van Bladeren and Van der Spuy, 2000).

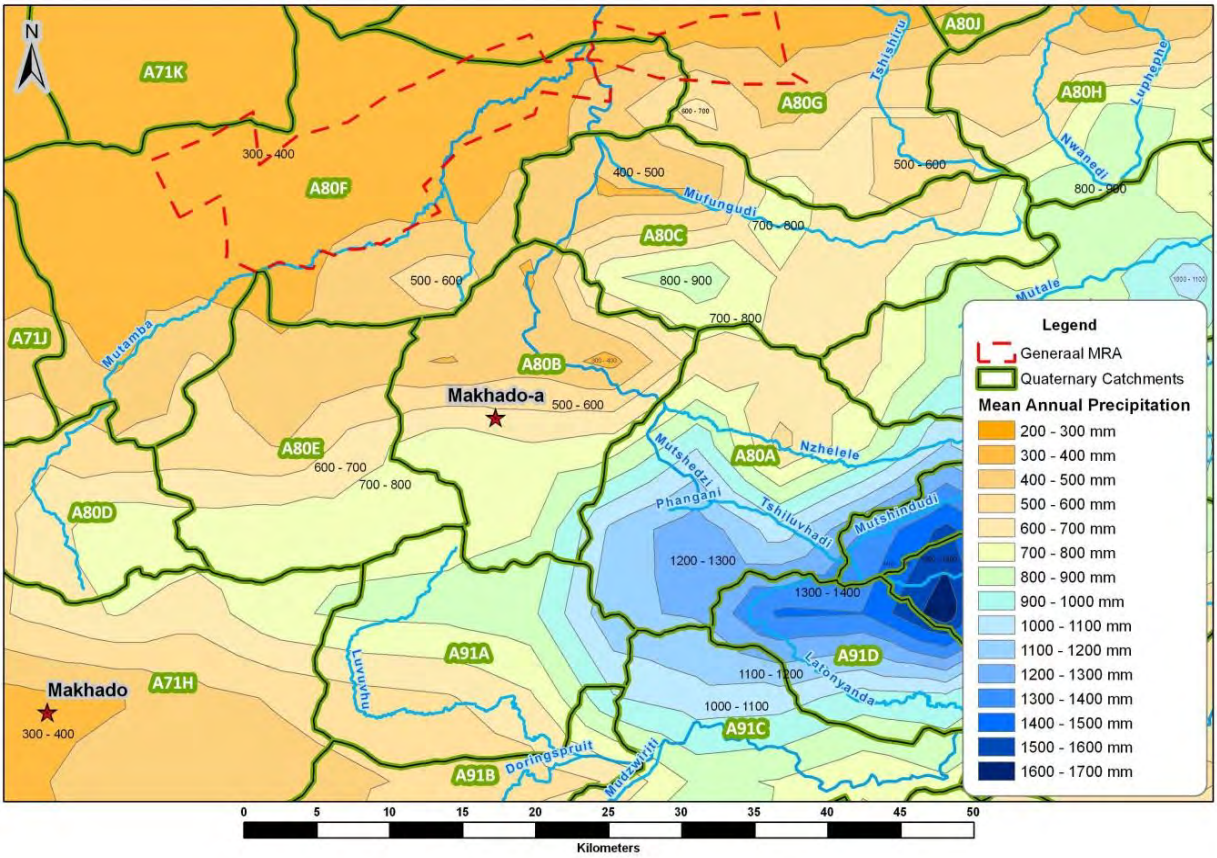


Figure 13: Mean annual precipitation

The majority of the Generaal Project area spans across quaternary catchments A80F and only a small portion falls within catchment A80G, a portion of Mount Stuart Section, as defined in the WR2005, Study (Middleton and Bailey, 2009) and shown in Figure 14.

The quaternary catchments are located in Rainfall Zone A8A and A8B. The mean monthly precipitation values are given in Table 4. The maximum monthly rainfall occurs in January and the lowest in August.

Table 4: Mean monthly rainfall distribution of site rainfall zones A8A and A8B

Rainfall Zone	Mean Monthly Precipitation (% Distribution)											
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
A8A	6.46	11.81	15.17	20.17	18.66	13.16	5.40	2.29	1.63	1.66	1.15	2.43
A8B	6.18	12.96	16.18	20.30	18.86	12.71	5.23	2.14	1.15	1.05	0.73	2.51

(Source: Middleton and Bailey (2009). Water Resources of South Africa, 252005 Study. WRC Rep No TT381.)

The absolute monthly rainfall (% distribution x MAP) in the in the site's quaternary catchments are shown in Table 5. The average rainfall for the catchment has been determined and the maximum rainfall of 73 mm occurs in January and the lowest of 3 mm in August. The data in the table is shown in Figure 15.

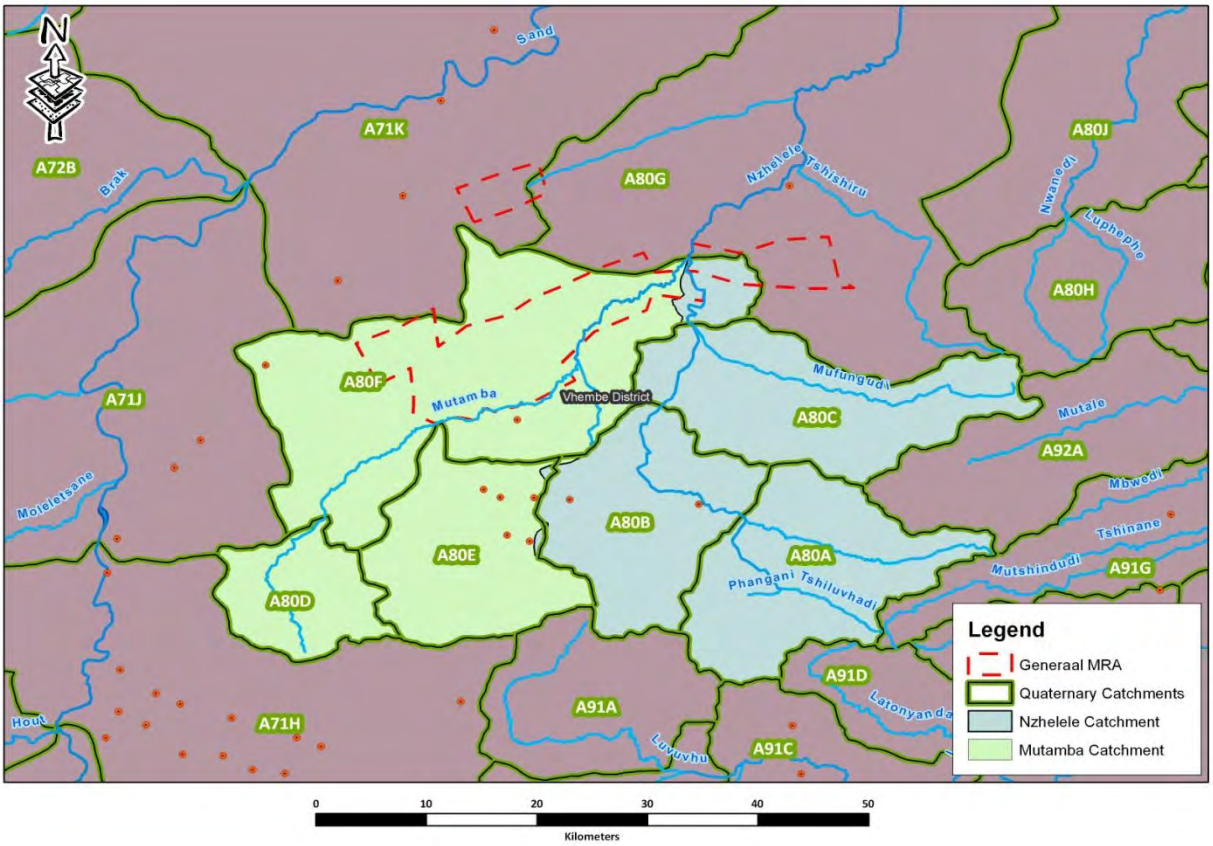


Figure 14: Quaternary catchments affected by the Generaal Project

Table 5: Mean monthly quaternary rainfall (mm) in the catchment areas relevant to the Generaal Project

Quaternary Catchment	MAP (mm)	Rainfall Zone	Mean Monthly Precipitation (mm)											
			OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
A80F	388	A8A	25	46	59	78	72	51	21	9	6	6	4	9
A80G	333	A8B	21	43	54	68	63	42	17	7	4	3	2	8
Average	361		23	45	57	73	68	47	19	8	5	5	3	9

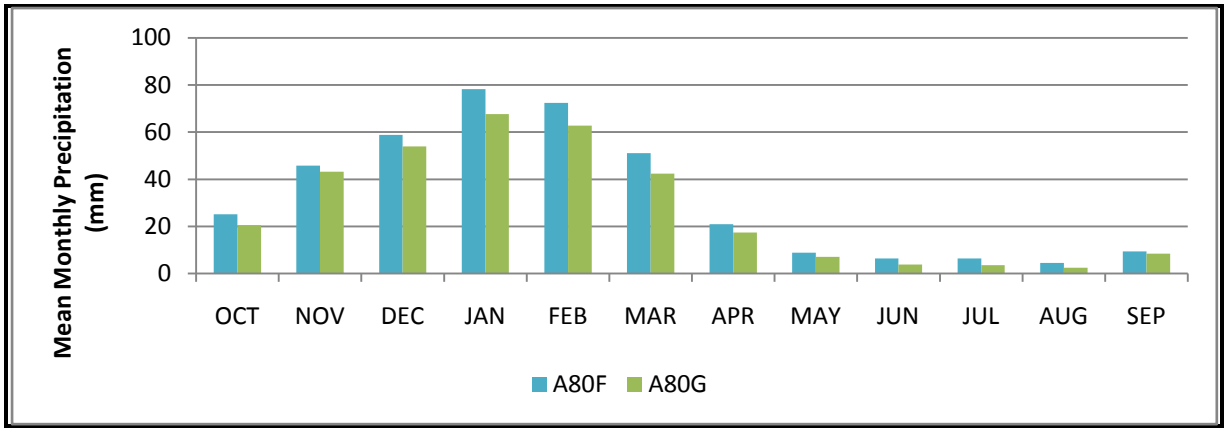


Figure 15: Distribution of mean monthly precipitation (mm)

1.2.1.5 Run-off and Evaporation

The Generaal Project is situated mainly within the Nzhelele River Sub-Basin, which is a tributary of the Limpopo River. The upper reaches of the Nzhelele River, including its tributary the Mutamba River, originate from the Soutpansberg Mountain range in the vicinity of Makhado, approximately 50 km south of the Generaal Project area. The Mutamba River drains a substantial dry Bushveld area, an area north of the mountains which is drier than the feeder areas of the Nzhelele River. The unit runoff in the Mutamba River is therefore less than in the Nzhelele River where quaternary catchment A80A, draining high rainfall areas, contributes most of its runoff as shown in Table 5.

The total net catchment area at the point where the Mutamba River and Nzhelele River converge at the exit of quaternary catchment A80F is 1 837 km^2. This is approximately 56 km south-west of the Limpopo River confluence.

The catchment hydrological data of this summer rainfall region are summarized in Table 4 below. The MAR values are based on the net catchment areas shown in the table. More than half of the Nzhelele River Basin runoff of 90 million m^3/a (including quaternary A80G) is derived from quaternary catchment A80A where the rainfall is over 900 mm/a.

Run-off data were generated on a quaternary catchment area scale in the WRSM2000 model, an enhanced version of the original Pitman rainfall-run-off model, since there are no reliable long term measured flow data for most of the catchment. Note that the present day MAR is not reflected in the table since it shows the naturalized run-off generated within the catchment. To obtain the present run-off, all surface water uses in the catchment area must be subtracted.

Table 6: Catchment data (from WR2005) Nzhelele River Basin

Quaternary catchment	Net area (km^2)	MAP (mm)	MAR (mcm)	Gross MAE (mm) (Zone 1B)	Irrigation area (km^2)	Forest area (ha)
A80A	287	938	44.42	1400	5	0
A80B	251	659	11.8	1450	3	0
A80C	294	576	7.56	1600	2	0
A80D	128	622	5.85	1450	0.51	0
A80E	247	622	11.32	1450	0.51	0
A80F	491	388	3.37	1750	0	0
A80G	1230	333	5.72	1900	21	0

The naturalized run-off in the Nzhelele River upstream of the outlet of quaternary catchment A80F has been compiled from data in WR2005 and the resultant MAR is 84.31 million m^3/a as shown as shown in Table 7.

Table 7: Nzhelele River naturalized run-off at the exit of quaternary catchment A80F

Quaternary Catchment	Rainfall Zone	Mean Monthly Natural Runoff (mcm)												Natural MAR (mcm)
		OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	
A80A	Nzhelele & Mutshedzi	0.57	0.95	1.74	7.28	14.06	10.24	3.99	1.97	1.36	0.99	0.73	0.55	44.42
A80B	Nzhelele	0.78	1.24	2.24	9.05	16.95	12.69	5.37	2.81	1.93	1.39	1.02	0.76	11.80
A80C	Nzhelele & Mufungudi	0.91	1.43	2.57	10.26	18.78	14.16	6.27	3.38	2.30	1.64	1.20	0.89	63.78
A80D	Western Mutamba	0.13	0.18	0.30	1.07	1.59	1.18	0.51	0.26	0.20	0.17	0.14	0.12	5.84
A80E	Kandanama	0.25	0.35	0.59	2.06	3.07	2.28	0.98	0.51	0.38	0.33	0.28	0.24	11.32
A80F	Mutamba & Nzhelele	1.33	2.05	3.64	14.41	24.70	18.16	7.86	4.18	2.91	2.16	1.64	1.27	84.34

Mean Annual Evaporation (MAE) data is given in Table 6, while the monthly evaporation pattern (as percentages of the total) is given in Table 8 below. Note that both the Nzhelele River and the Mutamba River fall within the same evaporation zone.

Table 8: Monthly evaporation distribution

Month	Evaporation (%)
October	10.46
November	10.03
December	10.68
January	10.43
February	8.49
March	8.49
April	6.94
May	6.55
June	5.40
July	6.08
August	7.42
September	9.03

Source: WR90, evaporation zone 1B, based on data from Albasini Dam

1.2.2 SOILS

1.2.2.1 Parent Material

The lithology of the area is: Fine-grained felsic, siliciclastic sedimentary, as well as mafic and ultramafic volcanic rocks. It consists of arenite, basalt, dolerite, gneiss, marble, mudstone, sedimentary sands and shale.

Footprints in the western parts are mainly on sand of the Quaternary System as well as on shale, sandstone, siltstone, mudstone and conglomerate and basalt. Footprints in the Mount Stuart area are situated on basalt, shale, mudstone and sandstone and the footprint on Keerweder is situated on basalt, sandstone, shale, quartzite and diabase.

The regional parent materials of the area are illustrated in Figure 16. The following parent materials are found and have an influence on the soil properties.

- Alluvium, mudstone, sandstone, siltstone, shale and coal of the Clarens Formation and undifferentiated strata of the Karoo Sequence.
- Alluvium.
- Basalt of Letaba Formation; shale, mudstone and sandstone of the Klopperfontein and Solitude Formations, Karoo Sequence.
- Basalt, sandstone, shale and quartzite of the Waterberg Group. Diabase also present.
- Beit Bridge Complex, Malala Drift Formation; leucogneiss, metaquartzite, and amphibolite. Gumbu Gneiss, marble, gneiss; metaquartzite and amphibolite.
- Beit Bridge Complex; amphibolite and metapelite of the Malala Drift Group with leucocratic feldspathic gneiss of the Gumbu Group.
- Calc-silicate rocks, marble, scapolite rocks and leucocratic quartz-feldspathic gneiss of the Gumbu Group, Beit Bridge Complex; basalt, quartzite, conglomerate, sandstone and shale of the Soutpansberg Group, Stayt Formation.
- Fine-grained red and white sandstone of the Clarens Formation, Karoo Sequence.
- Mainly sand of the Quaternary System.
- Quartzite, conglomerate, sandstone and shale of the Stayt Formation, Soutpansberg Group; argillaceous sandstone of the Clarens Formation, Karoo Sequence.
- Quartzite, sandstone and conglomerate of the Wyllies Poort Formation with, in the south, sandstone, conglomerate, shale and basalt of the Fundudzi Formation, Soutpansberg Group. Diabase dykes and sills are common.
- Quartzite, sandstone and conglomerate of the Wyllies Poort Formation, Soutpansberg Group. Also diabase.
- Shale, sandstone, siltstone, mudstone and conglomerate of the Karoo Sequence; also Sibasa-Basalt.
- Soutpansberg Group, Nzhelele Formation; sandstone, shaly in places as well as quartzite.

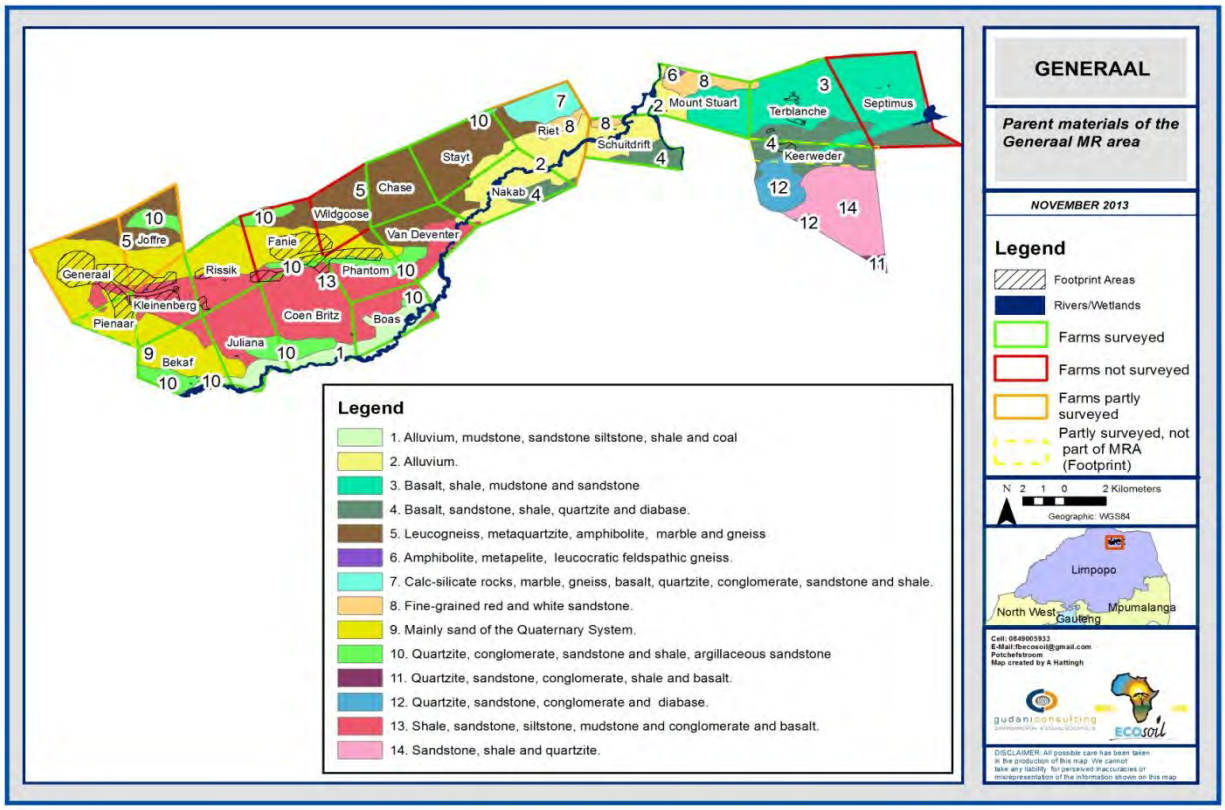


Figure 16: Parent material of the Generaal Project area

1.2.2.2 Land Types

Eleven land types are found in the MRA area – note: Land types Fb360, IB311 and IB442 are illustrated on the farm Keerweder but do not form part of the MRA and will not be influence by mining activities. The numbers of the text corresponds with the number in Figure 4. Land types found in the study area, in the ranking order of area covered, are:

Ae269: Red-yellow apedal, freely drained soils:

- Red apedal soils deeper than 300 mm deep and has a high base status. The soils have favourable physical properties. Soil depth may be restricted in some areas. Soils have excessive drainage, high erodibility and low natural fertility. Soils highly suited to arable agriculture where climate permits.
- 3927 ha.
- Parent material is: shale, sandstone, siltstone, mudstone and conglomerate of the Karoo Sequence; also Sibasa-Basalt.
- Soil depth is generally between 450mm - 750mm.

Ae305: Red-yellow apedal, freely drained soils:

- Red soils with high base status and deeper than 300 mm. Soils may have restricted soil depth in some areas. Soils have excessive drainage, high erodibility and low natural fertility. Freely drained, structureless soils, with favourable physical properties. Soils are generally of poor suitability for arable agriculture.

- 3645 ha.
- Parent material is: Mainly sand of the Quaternary System.
- Soil depth is generally less than 750mm.
- Clay content is on average less than15%.
- Plant available water content is between 41 - 60 mm, indicating low potential soils.

Ah89: Red-yellow apedal, freely drained soils:

- Red and yellow with a high base status and usually less than 15% clay. Soils are of intermediate suitability for arable agriculture where climate permits.
- 3632 ha.
- The parent material is of the Beit Bridge Complex, Malala Drift Formation; leucogneiss, metaquartzite, and amphibolite. Gumbu Gneiss, marble, gneiss; metaquartzite and amphibolite.
- Soil depth is between 450mm - 750mm.
- Plant available water content is between 41 - 60 mm.

Ae265: Red-yellow apedal, freely drained soils:

- Red apedal soils with a high base status deeper than 300 mm. It has no dominant soil potential class. Soils are freely drained, structureless soils and have favourable physical properties, but may have restricted soil depth, excessive drainage, high erodibility and a low natural fertility.
- 2871 ha.
- Parent material is: Basalt of Letaba Formation; shale, mudstone and sandstone of the Klopperfontein and Solitude Formations, Karoo Sequence.
- Soil depth is generally between 450mm - 750mm
- Plant available water content is between 41 - 60 mm, indicating low potential soils.
- Clay content is on average less than15%.
- Clay content is on average less than 15%.
- Plant available water content is between 61 - 80 mm.

Ah88: Red-yellow apedal, freely drained soils:

- Red and yellow soils with a high base status. The soils have favourable physical properties, but may have restricted soil depth, excessive drainage, and high erodibility risk and have a low natural fertility. Soils are highly suited to arable agriculture in areas where soil depth and climate permits.
- 1999 ha.
- The parent material is alluvium.
- Soils have usually less than 15% clay.
- Soil depth ranges between 450mm - 750mm.
- Plant available water content is between 61 - 80 mm.

Ib312: Miscellaneous land classes:

- Non soil land classes (rocky area) with miscellaneous soils. This area has restricted land use options. Not suitable for agriculture or commercial forestry; suitable for conservation, recreation or water catchments. May have water-intake from other areas.
- 1241 ha.
- Parent material is: Quartzite, conglomerate, sandstone and shale of the Stayt Formation, Soutpansberg Group; argillaceous sandstone of the Clarens Formation, Karoo Sequence.
- Soils are less than 450mm deep and the clay content is less than 15%.
- Plant available water content is between 21 - 40 mm, indicating very low potential soils.

Fb358: Glenrosa and/or Mispah forms (but other soils may occur):

- Soils are classed as lithosols (shallow soils on hard or weathering rock) and have restricted soil depth; associated with rockiness, but may receive water runoff from associated rock. Soils are not suitable for arable agriculture, but are suitable for forestry or grazing where climate permits. Lime is rare or absent in upland soils but generally present in low-lying soils.
- 1075 ha.
- Parent material is basalt, sandstone, shale and quartzite of the Waterberg Group. Diabase may also be present.
- Soil depth is less than 450mm and clay content less than 15%.
- Plant available water content is between 21 - 40mm, indicating very low potential soils.

Ia151: Miscellaneous land classes:

- Undifferentiated deep deposits. Soils are freely drained, structureless and have favourable physical properties, but may have restricted soil depth in some areas, have excessive drainage, high erodibility, low natural fertility. Soils are highly suited to arable agriculture where climate permits.
- 763 ha.
- The parent material is alluvium, mudstone, sandstone, siltstone, shale and coal of the Clarens Formation and undifferentiated strata of the Karoo Sequence.
- Soil depth is generally deeper than 750mm and the clay content is between 15% - 35%.
- Water holding capacity is between 81 - 100 mm.

Ib313: Miscellaneous land classes:

- Rock areas with miscellaneous soils. The area is classified as a non-soil land class. It has restricted land use options. It is not suitable for agriculture or commercial forestry, but may be suitable for conservation, recreation or as water catchments. These areas may have water-intake from other areas.
- 430 ha.
- Parent material is fine-grained red and white sandstone of the Clarens Formation, Karoo Sequence.
- Soils are less than 450mm deep and the clay content is less than 15%.
- Plant available water content is between 0-20 mm, indicating very low potential soils.

Fc481: Glenrosa and/or Mispah forms (but other soils may occur):

- Soils are classed as lithosols (shallow soils on hard or weathering rock) and have restricted soil depth; associated with rockiness, but may receive water runoff from associated rock. Lime is generally present in the entire landscape. Soils are not suitable for arable agriculture, but are suitable for forestry or grazing where climate permits.
- 406 ha.
- The parent material is calc-silicate rocks, marble, scapolite rocks and leucocratic quartz-feldspathic gneiss of the Gumbu Group, Beit Bridge Complex; basalt, quartzite, conglomerate, sandstone and shale of the Soutpansberg Group, Stayt Formation.
- Soil depth is generally less than 450mm and the clay content less than 15%. Plant available water content is between 21 - 40mm, indicating very low potential soils.

Fc489: Glenrosa and/or Mispah forms (other soils may occur):

- Soils are classed as lithosols (shallow soils on hard or weathering rock) and have restricted soil depth with associated with rockiness, but may receive water runoff from associated rock. Soils are not suitable for arable agriculture, but are suitable for forestry or grazing where climate permits. Lime generally present in the entire landscape.
- 39 ha.
- The parent material is of the Beit Bridge Complex; amphibolite and metapelite of the Malala Drift Group with leucocratic feldspathic gneiss of the Gumbu Group. Soil depth is generally less than 450mm and the clay content less than 15%.
- Plant available water content is between 21 - 40mm, indicating very low potential soils.

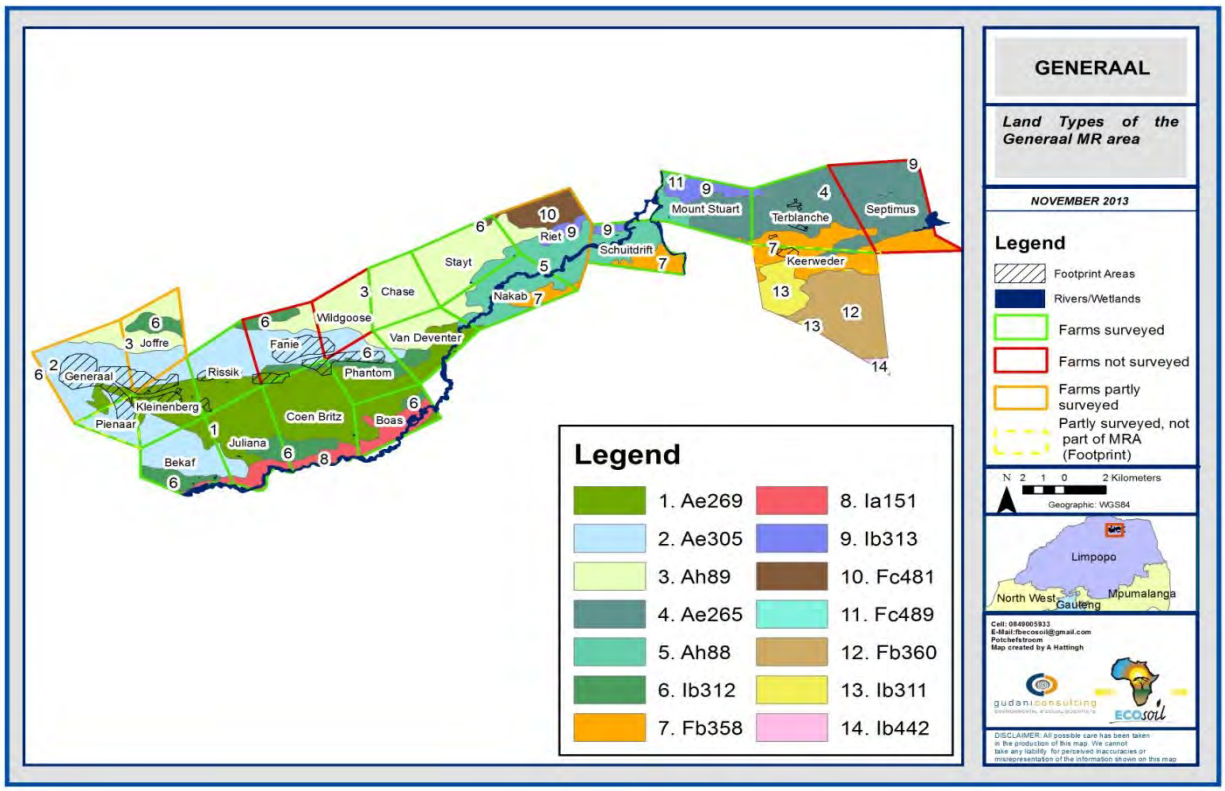


Figure 17: Land types of the Generaal Project area

1.2.2.3 Soil Forms

The soils vary significantly in physical and chemical composition over the different areas. They are strongly influenced by the underlying rocks (geology) from which they were derived, as well as by their position in the landscape and the origin of the parent material (in-situ versus colluvium/alluvium derived).

The major soil forms that generally have similar characteristics were grouped together in soil associations to simplify the data for interpretation purposes (Figure 18). The soil physical properties of the different soil groups are presented in Table 9. Associations occurring on the proposed development and the number of soil form occurrences (in brackets), are as follow:

1.2.2.3.1 Red apedal soils

- Hutton (Hu) [190]: Has an Orthic A-Horizon over a Red Apedal A-Horizon over unspecified materials, like hard or weathered rock, stone or gravel.
- Plooysburg (Py) [10]: Has an Orthic A-Horizon over a Red Apedal A-Horizon over a hardpan horizon.

The depth of the apedal red soils in this study area ranges between 30cm to deeper than 150cm (average 100cm). Clay content of the top soil ranges between 3 and 28% (average 9.6%), at 50cm the clay content ranges between 3 and 32% (average 12.7%), at 100cm the clay content ranges between 3 and 45% (mean 12%), at 150cm the clay content ranges between 3 and 25% (average 9%).

1.2.2.3.2 Yellow-brown apedal soils

- Clovelly (Cv) [19]: Has an Orthic A-Horizon over a Yellow Brown Apedal A-Horizon over unspecified materials, like hard or weathered rock, or gravel.
- Askham (Ak) [5]: Has an Orthic A-Horizon over a Yellow Brown Apedal A-Horizon over hardpan carbonate.

The average depth of the apedal yellow soils in this study area range from 45-150cm with an average of 86cm. Clay content of the top soil ranges between 3 and 15% (average 9.9%), at 50cm the clay content ranges between 5 and 32% (average 13.3%), at 100cm the clay content ranges between 5 and 18% (average 9.9%), at 150cm the clay content ranges between 5 and 18% (average 9%).

1.2.2.3.3 Neocutanic soils

- Oakleaf (Oa) [49]: Has an Orthic A-Horizon over a Neocutanic B-Horizon over unspecified materials, without signs of wetness in the subsoil.
- Gamoep (Gm) [4]: Have an Orthic A-Horizon over a Neocutanic B-Horizon over a hardpan- or soft carbonate horizon respectively.
- Tukulu (Tu) [2]: Has an Orthic A-Horizon over a Neocutanic B-Horizon over unspecified materials, with signs of wetness in the subsoil.

In this study area the average depth of the neo-cutanic soils range from 40-150cm (average 90cm). Clay content in the top soil ranges between 12 and 25% (mean 17%), at 50cm the clay content

ranges between 18 and 35% (average 25%), at 100cm the clay content ranges between 18 and 35% (mean 25%), at 150cm the clay content averages 35%.

1.2.2.3.4 Carbonate soils

- Coega (Cg) [80] and Brandvlei (Br) [3]: Have an Orthic A-Horizon over a hardpan- or soft carbonate horizon respectively.

The depth ranges from 10-40cm (average 18cm). The clay content in the top soil ranges between 5 and 28% (average 15%).

1.2.2.3.5 Neocarbonate soils

- Augrabies (Ag) [43]: Has an Orthic A-Horizon over a Neocarbonate B on unspecified materials.
- Prieska (Pr) [6] and Addo (Ad) [1]: Have an Orthic A-Horizon over a Neocutanic B on a hardpan- or soft carbonate horizon respectively.

In this study area the average depth of the neocarbonate soils range from 40-150cm with an average of 89cm. Clay content in the top soil range between 13 and 28% (average 21.7%), at 50cm the clay content ranges between 15 and 38% (average 29.9%), at 100cm the clay content ranges between 22 and 45% (average 29%), at 150cm the clay content ranges between 22 and 38% (average 29%).

1.2.2.3.6 Structured soils

- Shortlands (Sd) [2]: Has an Orthic A-Horizon over a Red Structured B- Horizon. Although this soil form does not have Pedocutanic properties it has soil structure in the sub soil and only occurs once in the entire area. It is therefore grouped in this class.
- Swartland (Sw) [4]: Has an Orthic A-Horizon over a Pedocutanic B- horizon on Weathered rock (saprolite).
- Valsrivier (Va) [2]: Has an Orthic A-Horizon over a Pedocutanic B-Horizon without signs of wetness in the sub-soil.

In this study area the average depth of the structured soils range from 30-100cm with an average of 61cm. Clay content in the top soil ranges between 15 and 40% (average 29%), at 50cm the clay content varies between 30 and 45% (average 39%).

1.2.2.3.7 Shallow rocky soils

- Mispah (Ms) [201]: Has an Orthic A-Horizon over hard rock.
- Glenrosa (Gs) [120]: Has an Orthic A-Horizon on a Lithocutanic B-Horizon.
- Outcrop (OC) [2]: No soil present, only bare rock.

The average depth of these soils varies from 0 to 45cm (average 21.2cm). The clay content in the top soil varies between 3 and 30% (average 15%).

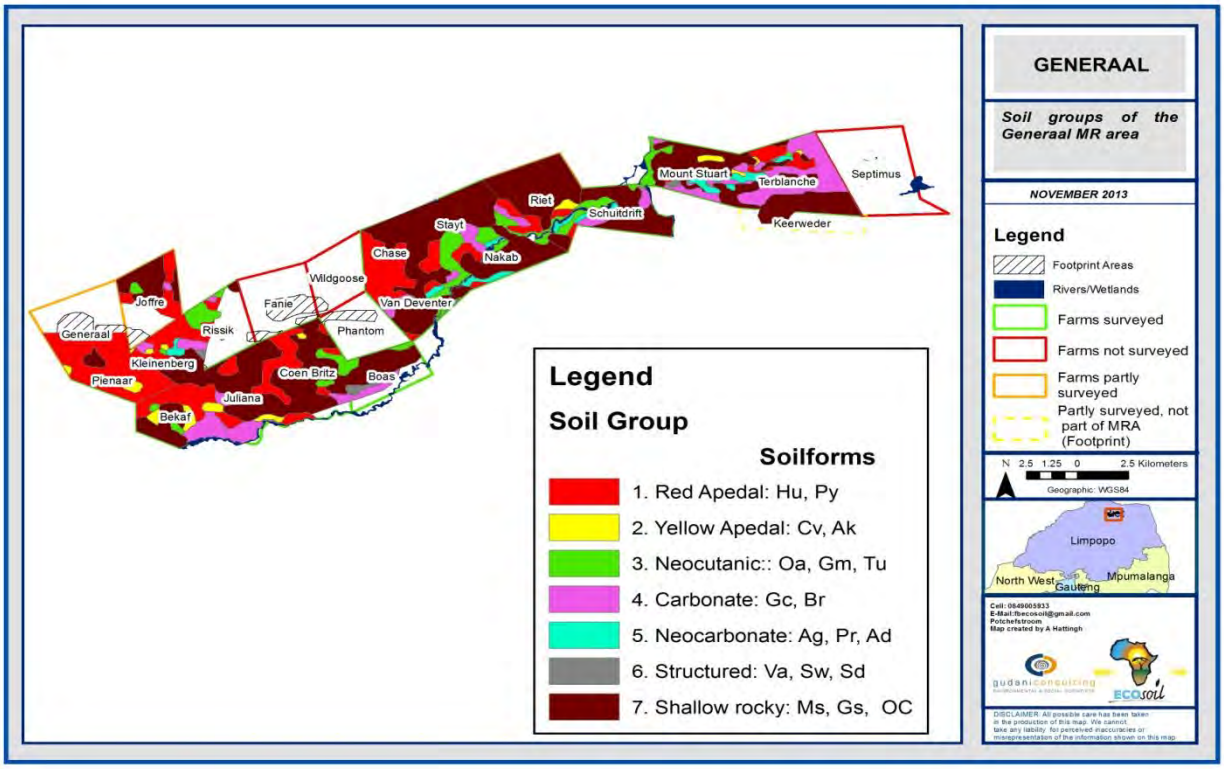


Figure 18: Soil groups (associations) and forms of the Generaal Project area

Although soil forms can give a slight indication of soil capability, it cannot give an indication of agricultural potential. Soil forms give an indication of expected soil colour, properties and soil forming processes.

- Large areas of the farms Generaal, Pienaar, Kleinenberg, Joffre, Chase and Bekaf are covered with Hutton and Clovelly soil forms. These deep soils can be considered as medium potential, where climatic conditions are favourable. However this is not the case in the project area and the potential of these soils are downgraded to Class III (due to climatic constraints).
- Shallow rocky soils are dominant in the farms Coen Britz, Boas, Juliana, Stayt, Van Deventer, Nakab and Riet.
- Neocutanic soils are mainly found in small areas on the farms Schuitdrift, Riet and Rissik.
- Carbonate soils are found in some areas on the farms Bekaf, Juliana, Mount Stuart and Terblanche.

Table 9: Summary of different soil physical properties of the soil groups

Properties	Soil Group 1	Soil Group 2	Soil Group 3	Soil Group 4	Soil Group 5	Soil Group 6	Soil Group 7
Soil association	Red Apedal	Yellow - brown Apedal	Neo-cutanic	Carbonate	Neo-carbonate	Structured Soils	Shallow, rocky
Soil forms	Hu, Py	Cv, Ak	Oa, Gm, Tu	Cg, Br	Ag, Pr, Ad	Sd, Sw, Va,	Ms, Gs
Dominant soil	Hutton	Clovelly	Oakleaf	Coega	Augrabies	Swartland	Glenrosa
Soil family	1200	1200	1120	1000	1120	1122	1100
Soil Depth cm	30-150	45-150	40-150	10-40	40-150	30-100	0-45

Properties	Soil Group 1	Soil Group 2	Soil Group 3	Soil Group 4	Soil Group 5	Soil Group 6	Soil Group 7
Average rooting depth cm	100	86	90	18	89	61	21
Infiltration rate	Fast 15-20mm/h	Fast 15-20mm/h	Slow 5-10mm/h	Very Slow <5mm/h	Slow 5-10mm/h	Very Slow <5mm/h	Slow 5-10mm/h
Consistency	Loose	Loose	Friable	Soft	Soft	Hard	Loose
Structure	Apedal	Apedal	Weak blocky	Apedal	Weak blocky	Strong blocky	Apedal
Clay % A (aver)	3-28(9.6)	3-15(9.9)	12-25(17)	5-28(15)	13-28(21.7)	15-40(29)	3-30(15)
Clay % 50cm	3-32(12.7)	5-32(13.3)	18-35(25)	Soil not 50cm	15-38(29.9)	30-45(39)	Soil not 50cm
Clay% 100cm	3-45(12)	5-18(9.9)	18-35(25)	-	22-45(29)	-	
Clay% 150cm	3-25(9)	5-18(9.9)	35	-	22-38(29)	-	
PAW mm/profile	24-179 (91)	41-161 (75)	24-201 (109)	4-153 (21)	53-205 (110)	43-138 (84)	0-65 (23)
Field capacity mm	40-344 (153)	65-279 (125)	38-392 (201)	7-286 (37)	95-412 (83)	92-282 (170)	0-122 (39)
Wilting point mm	15-180 (62)	24-118 (50)	14-190 (93)	3-133 (16)	42-212 (102)	48-144 (86)	0-57 (17)
Drainage	Fast	Fast	Moderate	Poor	Moderate	Poor	Moderate
Gravel/Rocks A-Horizon	-	-	-	R1	G3	-	R5
Gravel/rocks B1 Horizon	G1	G1	G3	R6	G3	-	R
Gravel/rocks B2 Horizon	G1	G1	G3	-	G3	G3	-
Wetness	0	0	0	0	0	W1	0
Compactability	High	High	High	Moderate	High	Moderate	Low
Erodibility	Very High	Very High	High	Very High	Very High	High	Very High
Potential Nematode Infestation	High	High	Moderate	Low	Low	Low	High

1.2.3 PRE-MINING LAND CAPABILITY

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

Table 10: Criteria for Pre-Development Land Capability

Criteria for Wetland

- Land with organic soils or supporting hygrophilous vegetation where soil and vegetation processes are water determined.

Criteria for Arable land

- Land, which does not qualify as a wetland.
- The soil is readily permeable to a depth of 750 mm.
- The soil has a pH value of between 4.0 and 8.4.
- The soil has a low salinity and SAR
- The soil has less than 10% (by volume) rocks or pedocrete fragments larger than 100 mm in the upper 750 mm.
- Has a slope (in %) and erodibility factor (K) such that their product is <2.0
- Occurs under a climate of crop yields that are at least equal to the current national average for these crops.

Criteria for Grazing land

- Land, which does not qualify as wetland or arable land.
- Has soil, or soil-like material, permeable to roots of native plants, that is more than 250 mm thick and contains less than 50 % by volume of rocks or pedocrete fragments larger than 100 mm.
- Supports, or is capable of supporting, a stand of native or introduced grass species, or other forage plants utilisable by domesticated livestock or game animals on a commercial basis.

Criteria for Wilderness land

- Land, which does not qualify as wetland, arable land or grazing land.

The land capability according to the COM (1991) classification of the surveyed area is presented in Figure 19 and is summarised per farm in Table 11.

- Wetlands are defined as: "Land with organic soils or supporting hygrophilous vegetation where soil and vegetation processes are water determined". In this study area the following criteria was used:
    - Riparian zones were not delineated, and only wetland soil parameters per definition were used.
    - Small farm dams and pans that fell between two observation points (based on the grid size in the ToR) were not mapped.

- Footprints on the surveyed areas are generally covered by soils classified with a mixture of arable, wilderness and grazing capability.
- The farms Generaal, Pienaar and Kleinenberg, as well as on the farms Rissik and the northern parts of Bekaf have deep soils. Deep soils are also found on the south-western parts of Chase and north western parts of Van Deventer and the areas surrounding the river on the farms Riet and Schuitdrift. According to the COM (1991) classification these deep soils can be regarded as arable, especially under irrigation. According to the agricultural classification these soils are classified as classes III to IV (Table 12), the restriction being the low rainfall and sandy conditions.

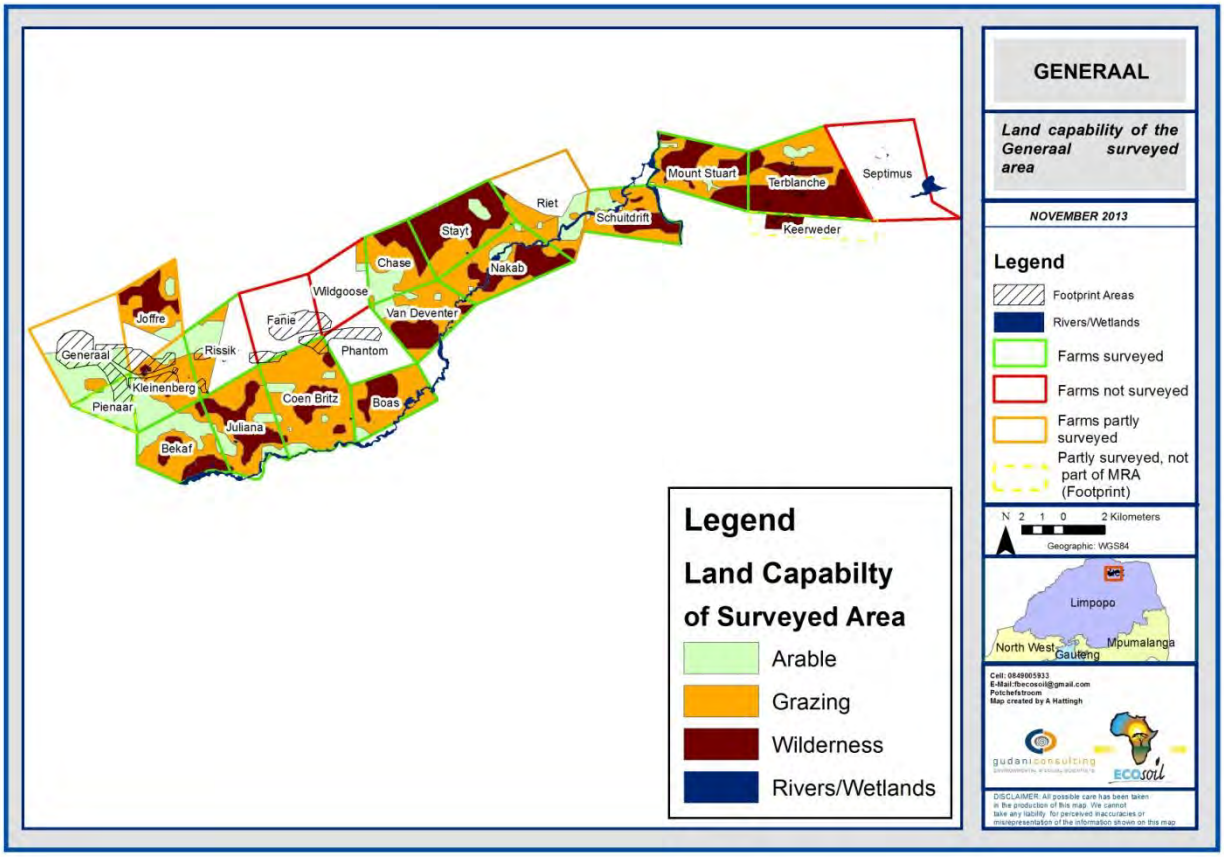


Figure 19: Land capability of the surveyed areas

Table 11: Land capability classes and areas of each farm respectively for the study area

Farm name	Area (Ha)	Not surveyed	Arable	Grazing	Wilderness	Wetland
Bekaf	1043		308.9	475.6	250.0	8.3
Boas	856		35.4	566.9	217.7	35.9
Chase	848		216.8	395.5	235.8	
Coen Britz	1673		151.8	1234.3	277.8	9.5
Fanie	1044	1044				
Generaal	1461	786.4	623.5	51.6		
Joffre	1015	266.4	104.6	358.2	285.3	
Juliana	1225	17.8	161.2	602.0	422.6	21.7
Kleinenberg	883		375.7	467.8	39.4	

Farm name	Area (Ha)	Not surveyed	Arable	Grazing	Wilderness	Wetland
Mount Stuart	1137		58.0	505.3	562.0	11.8
Nakab	1156		77.6	593.5	442.7	41.8
Phantom	870	870				
Pienaar	403		399.5	3.3		
Riet	1347	766.4	189.1	317.1	44.6	29.9
Rissik	999	555.1	212.3	231.8		
Schuitdrift	867		125.8	442.0	233.9	65.3
Septimus	1676	1676				
Stayt	1186		63.5	308.5	813.8	
Terblanche	1727		58.3	648.2	1020.1	
Van Deventer	957		120.0	526.6	290.5	20.1
Wildgoose	734	734				
Keerweder	127				127.0	
Total	**23234**	**6715**	**3282**	**7728**	**5263**	**244**
% of Area	**100**	**28.9**	**14.1**	**33.3**	**22.7**	**1.1**

1.2.3.1 Agricultural Potential Assessment

For purposes of international and national technology transfer and simplicity, the methodology was aimed at reflecting the classic concepts of land capability, as established by Klingebiel and Montgomery (1961) as far as possible. These concepts were to be brought under parameters suited to South African conditions and the local availability of data.

External factors like climate, topography, erosion factors, surface rock and water quality parameters are brought in consideration to determine the present agricultural potential.

- The soils of Group 1-2 are classified as a class III potential. The biggest restraint being texture, percolation and soil fertility. These soils can be irrigated. Soil fertility problems can be overcome with chemical and biological fertilizers and management practices.
- The soils of Group 3 are classified as a class III-IV. The biggest restraint being texture, percolation and erosion potential.
- The soils of Group 4 are classified as a class V-VI potential. The biggest restraint being shallow soils, erosion and surface rock.
- The soils of Group 5 are classified as a class IV potential. The biggest restraint being slow infiltration rates, erosion and surface rock.
- The soils of Group 6 are classified as a class V potential. The biggest restraint being slow infiltration rates, soil structure and poor drainage.
- The soils of Group 7 are classified as a class VII potential. The biggest restraint being surface rock, shallow soils.
- The soils of Group 8 are wetland areas and classified as a class VIII potential.

Table 12: Agricultural Potential Classification of land capability classes according to agricultural classification system

Soil Management Unit	Soil Group 1	Soil Group 2	Soil Group 3	Soil Group 4	Soil Group 5	Soil Group 6	Soil Group 7	Soil Group 8
Soil Types	Red Apedal	Yellow Apedal	Neo Cutanic	Carbonate	Neo Carbonate	Pedo cutanic	Shallow rocky	Wetland
Soil depths cm	30-150	45-150	40-150	10-40	40-150	30-100	0-45	-
Average soil depth cm	100	86	90	18	89	61	21	-
Limiting Factors	Texture, Water-holding capacity	Texture, Water-holding capacity	Erosion, Depth, Surface rock	Surface Rock, Erosion	Surface Rock, Erosion	Structure, Erosion, Wetness	Rock, Depth	Water-logging
External Factors	Climate, Water Quality	Climate, Water Quality	Climate, Water Quality	Climate, Water Quality	Climate, Water Quality	Climate, Water Quality	Climate, Water Quality	Climate, Water Quality
Land capability	Arable, crop production	Arable crop production	Arable / Grazing	Grazing / Wilderness	Wilderness / Grazing	Grazing	Wilderness	Wetland
Agricultural potential	Low to medium	Low to medium	Low to medium	Marginal	Marginal	Low	Marginal	Marginal
Agricultural Classification	III	III	III-IV	VI	IV-V	VI	VII	VIII

1.2.4 PRESENT LAND USE

Most of the Generaal Project area can be classified as rural with commercial farming as the main activity.

The overall population density of the region beyond the Soutpansberg Range is low. The greater majority of present land use is game and cattle farming, with the operating of guest lodges and hunting the main activity. Irrigation downstream of the Nzhelele Dam occurs on both sides of the Nzhelele River and at the Mutamba River on Schuitdrift 179 MT (near the rivers' confluence) and along the western boundary of the farm Mount Stuart 153 MT next to the Nzhelele River. Dryland agriculture is indicated on the farms Generaal 587 MS and Rissik 637 MS as identified on satellite imagery. Only 324 ha of the total project area are cleared for crop production of which 168 ha are under irrigation.

Apart from the irrigation by surface water from the Nzhelele canal system and from the lower reach of the Mutamba River, the water requirements of households and livestock (including game) are supplied from groundwater sources.

The majority of area is presently covered with thicket bushveld of the Mopani veld (Acocks classification) woody species and used for grazing purposes for either cattle or game farming. Very small areas are covered with high density woody species, especially on the farms Schuitdrift and Mount Stuart along the rivers. Hunting, game trading and eco-tourism is an established socio-economic driver in the area. There are a number of properties utilized for trophy (for local and foreign tourists) and biltong hunting with ecotourism spin-off activities. The Tshipise Forever Resort is situated on the farm Honnet 137 MT, just north of the Mount Stuart Section.

Small areas has no or very scarce basal cover especially on the farms Boas, Nakab and Generaal. Due to the very low clay contents of the area degraded areas are highly susceptible to wind erosion. Water erosion may also occur.

According to previous studies, combined with the present study, the present land use can be summarized as follow (Figure 20):

- Commercial (or cleared) land: 324 ha (168 ha irrigated and 156 ha dry land)
- Degraded forest and woodland: 149 ha
- Thicket and bushland: 22 487 ha
- Woodlands: 50.1 ha
- Wetlands: 224 ha
- Total: 23 234 ha

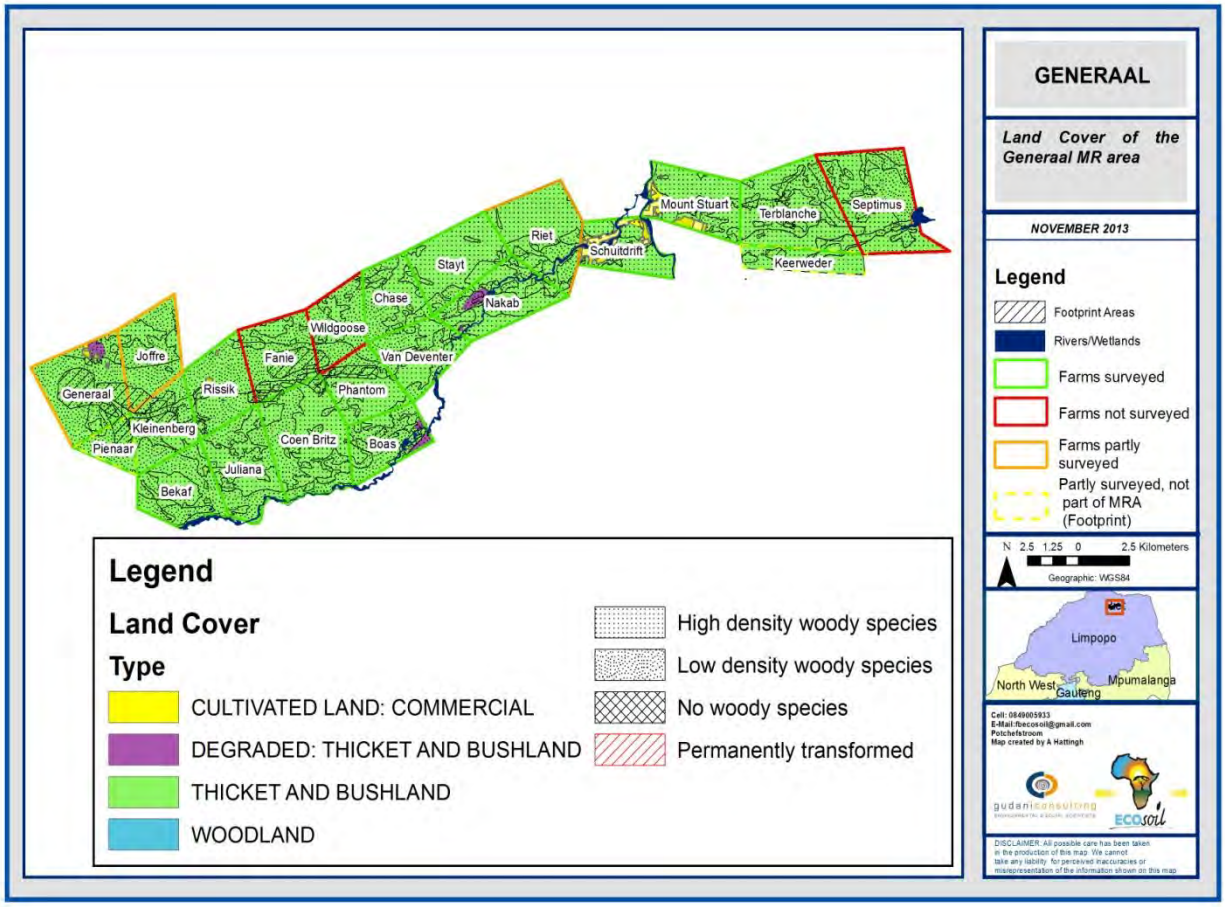


Figure 20: Present land use of the Generaal Project area

1.2.5 BIODIVERSITY (FLORA AND FAUNA)

1.2.5.1 Flora

1.2.5.1.1 Biome

The vegetation of the study area belongs to the broad vegetation group the Savannah Biome (Low and Rebelo, 1996). The Savannah Biome is the largest Biome in Southern Africa, occupying 46% of its area, and over one-third the area of South Africa. It is well developed over the Lowveld and Kalahari region of South Africa and is also the dominant vegetation in Botswana, Namibia and Zimbabwe. A grassy ground layer and a distinct upper layer of woody plants (trees and shrubs) are characteristic of the Savannah Biome. Where this upper layer is near the ground (low growing) the vegetation may be referred to as Shrubveld, where it is tall and dense, as Woodland, and the intermediate stages are locally known as Bushveld.

The environmental factors delimiting the biome are complex and include (Low and Rebelo, 1996):

- Altitude ranges from sea level to 2 000 m;
- Rainfall varies from 235 to 1 000 mm per year;
- Frost may occur from 0 to 120 days per year; and
- Almost every major geological and soil type occurs within the biome.

A major factor delimiting the biome is the lack of sufficient rainfall, which prevents the upper (tree and shrub) layer from dominating, coupled with fires and grazing, which keep the grass layer dominant. Summer rainfall is essential for the grass dominance, which, with its fine material, fuels near-annual fires. In fact, almost all species are adapted to survive fires, usually with less than 10% of plants, both in the grass and tree layer, killed by fire. Even with severe burning, most species can resprout from the stem bases (Low and Rebelo, 1996).

The shrub-tree layer may vary from 1 to 20m in height, but in Bushveld typically varies from 3 to 7m. Soil depth is one of the critical factors that determine tree height in the biome. The shrub-tree element may come to dominate the vegetation through bush encroachment in areas that are being overgrazed (Low and Rebelo, 1996).

Most of the savannah vegetation types are used for grazing, mainly by cattle or game. In the southernmost savannah types, goats are the major stock.

Representation of the savannah biome in conservation areas in South Africa is good in principle, mainly due to the presence of the Kruger- and Kalahari Gemsbok National Parks within the biome. However, the large areas conserved in South Africa, belies the fact that half of savannah vegetation types are inadequately conserved, in having less than 5% of their area in reserves. However, much of the area is used for game farming and can thus be considered effectively preserved, provided that sustainable stocking rates and sound environmental practices are maintained. Tourism and hunting has become important utilisation options in the savannah biome.

1.2.5.1.2 Veld types

According to Mucina & Rutherford (2006), three veld types occur in the project area (Figure 21):

- Musina Mopane Bushveld on the plains (Least Threatened)
- Limpopo Ridge Bushveld on scattered hills and rocky outcrops (Least Threatened)
- Soutpansberg Mountain Bushveld on the Soutpansberg Mountain ridges to the south (Vulnerable)

Vulnerable vegetation types have lost more than 20% of their original extent, which could result in some ecosystem functions being altered.

Least Threatened applies to vegetation and is used when no significant disruption of ecosystem functioning is assumed and the vegetation types still have more than 80% of their original extent untransformed.

No Endangered or Critically Endangered Ecosystems (2011) as defined in terms of the NBA are affected by the proposed development as the classification of the vegetation units do not trigger the NBA.

Musina Mopane Bushveld

The Musina Mopane Veld is characterized by undulating to very irregular plains with some hills, at an altitude of around 600m. On areas with deep sandy soils, the *Kirkia acuminata* (white seringa) is one of the dominant tree species along with *C. mopane* (Mopane), *C. apiculatum* (Red Bushwillow) and *Grewia spp*. (Raisin bushes). The herbaceous layer is poorly developed, especially where mopane occurs in dense stands. This vegetation type is classified as poorly protected and "Least threatened" with 2% statutorily conserved in the Mapungubwe National Park, as well as the Nzhelele, Nwanedi, Musina and Honnet Nature Reserves. About 3% is transformed, mainly by cultivation, and soil erosion is moderate to high. The conservation target is 19%.

The geology consists mainly of gneisses and meta-sediments of the Beit Bridge Complex, with variable soils from deep red/brown clays to deep, freely drained sandy soils, to shallower types including skeletal Glenrosa and Mispah soil forms. The mean annual precipitation varies between 300 – 400 mm and the area is generally frost-free.

Important taxa include trees such as *C. mopane* (Mopane), *A. digitata* (Baobab), *A. nigrescens* (Knobthorn), *C. apiculatum* (Red Bushwillow), *A. senegal var. leiorhachis* (Slender Three-hook Thorn) and *Commiphora mollis* (Velvet Corkwood). Conspicuous small trees and shrubs include *G. bicolor* (White Raisin), *G. flava* (Velvet Raisin), *B. foetida subsp. rehmanniana* (Stink Shepherd's tree) and *T. prunioides* (Lowveld Cluster-leaf). The grass layer is characterized by *Aristida spp.* (Three-awn grasses), *S. uniplumis* (Silky Bushman grass), *S. pappophoroides* (Sand Quick), B. deflexa (False Signal grass), *E. cenchroides* (Nine-awned grass) and *U. mosambicensis* (Bushveld Signal grass).

Limpopo Ridge Bushveld

This vegetation type covers the irregular hills and ridges of much of the area in the vicinity of the Limpopo River. The altitude varies from 300 m to 700 m in the east, with some hills reaching 1 000 m in the west. The vegetation structure is moderately open savannah with a poorly developed ground layer. *K. acuminata* (White Seringa) is prominent on many of the ridges along with *A. digitata* (Baobab). On shallow calcareous gravel and calc-silicate soils, the shrub *Catophractes alexandri* is dominant. Areas of sandstone of the Clarens Formation are prominent in places such as

Mapungubwe National Park. Although not as prominent as at Mapungubwe National Park, sandstone ridges also occur in the study area. The mean annual precipitation varies from 300-400 mm and the area is generally frost-free.

Important plant species include the *A. digitata* (Baobab), *S. birrea* (Marula), *C. mopane* (Mopane), *C. glandulosa* (Tall Common Corkwood), *T. prunioides* (Lowveld Cluster-leaf), *B. albitrunca* (Shepherd's tree) and various figs, e.g. *F. tettensis*.

This vegetation type is classified as moderately protected and "Least Threatened", with some 18% statutorily conserved in the Kruger and Mapungubwe National Parks. Only about 1% is transformed, mainly by cultivation and mining. The conservation target is 19%.

Soutpansberg Mountain Bushveld

This vegetation unit is characterised by a dense tree layer and poorly developed grassy layer covering the mountain ridges of the Soutpansberg. The topography of the east-west orientated ridges of the mountain changes drastically over short distances, resulting in orographic rain on the southern ridges and a rainshadow effect on the northern ridges. Because of this topographic diversity, the Soutpansberg Mountain Bushveld comprises a complex mosaic of sharply contrasting kinds of vegetation within limited areas. The main vegetation variations are subtropical moist thickets (mainly along the lower-lying southern slopes, on clayey soils of volcanic origin), mistbelt bushclumps (within the mistbelt of the southern and central ridges; on rugged quartzitic outcrops with shallow sandy soils), relatively open savanna sandveld (on both deep and shallow quartzitic sands along the relatively dry middle and northern slopes of the mountain), and an arid mountain bushveld (along the very arid northern ridges of the mountain).

The geology consists mainly of reddish or brown sandstone and quartzite, conglomerate, basalt, tuff, shale and siltstone of the Soutpansberg group. The unit experiences summer rainfall with dry winters. Mean annual precipitation id between 450 and 900 mm.

Important plant species include *Burkea africana, Ochna pulchra, Enneapogon cenchroides, Catha edulis, Flueggea virosa, Mimusops zeyheri, Syzygium legatii* and *Parinari capensis*.

This vegetation type is classified as moderately protected and "Vulnerable", with some 2% statutorily conserved in the Blouberg, Happy Rest and Nwanedi Nature Reserves. About 21% is transformed, mainly by cultivation and plantations. The conservation target is 24%.

1.2.5.1.3 Vegetation communities and sensitivity mapping

The study area is dominated by tree and shrub forms of *Colophospermum mopane*, *Terminalia prunoides, Commiphora spp., Grewia spp. and Boscia albitrunca.* The herbaceous layer is not well developed, probably due to low rainfall and overgrazing, and consists mostly of grasses such as *Aristida congesta subsp. congesta, Aristida adscensionis, Tragus berteronianus, Bothriochloa insculpta and Microchloa caffra.*

The plant species diversity is regarded as fairly low and has been supplemented with data collected from previous surveys in the area, due to the seasonal sampling limitations. A plant species list is provided in Appendix 1 of the Biodiversity Specialist Report (ANNEX-4).

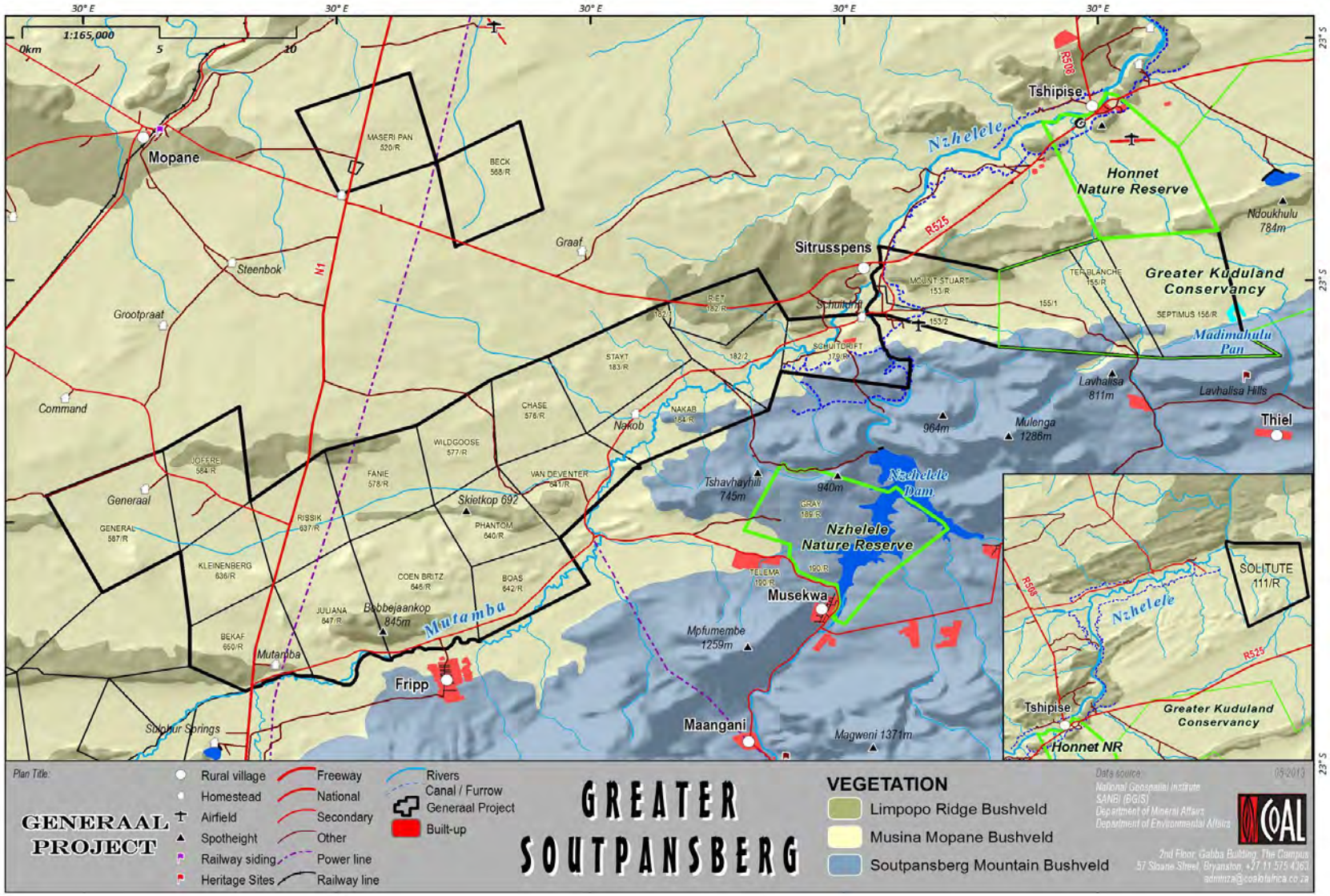


Figure 21: Vegetation of the site and surrounding area (Mucina and Rutherford, 2006)

Different plant communities develop as a result of differences in climate, geology, topography, rockiness, drainage, soil texture, soil depth, slope, and historic management. Each plant community usually represents a different habitat, has its own inherent grazing and browsing capacity, and represents specific habitats for certain types of faunal species.

The vegetation survey was conducted during the middle of the dry season and the possibility of encounteringherbaceous annuals and flowering plants was very low. The herbaceous layer, especially the grass layer, is heavily utilised and often influences diversity of the herbaceous species. Herbaceous plants are an important food source for game, especially in dry seasons and drought periods when the grass layer is depleted. Many of these plants are annuals and also do not appear every season. Geophytic species (plants with underground storage organs) are dormant during dry periods. The importance of long-term monitoring actions / surveys is imperative to assess the true diversity of a specific area, especially arid areas. The study was thus largely a field verification of previous studies and thus limited to those areas that were actually assessed.

The entire study area has not been mapped fully, as not all farms within the Generaal Project area were accessible. The following distinct vegetation communities were identified (Figure 22):

The River Ecosystems – Within the study area there are basically two river systems, the ephemeral Mutamba River, with a number of tributaries and the Nzhelele River. The riparian tree zone occurs on the river banks on both sides of the two river systems. This zone is approximately 10-20 m, or sometimes even up to 50 m wide, and indigenous trees and shrubs make up the canopy cover in this zone. In the case of the Nzhelele River, a number of areas along its banks have been affected by agriculture. The Mutamba River in the project area is considered to be in a pristine state. As the rivers in the area are considered as an ecological unit, the river banks, terraces and river bed are not separated for the description of the vegetation, but treated as a unit. Typical species include: *Acacia nigrescens, Acacia robusta, Combretummossambicensis, Ficus sycomorus, ZanthocercisZambesiaca*and *Phragmites australis.* River systems are always considered to be ecologically sensitive, and are thus given a very high (No-Go) sensitivity. This is due to the unique habitats they provide and support for several flora and fauna species. The river systems provide migration corridors for many species. River systems are particularly important due to the water transport and associated biological, economic, health and cultural values. The provision of clean and healthy water to people, agriculture and natural biological systems is of utmost importance in this arid region.

The Ridges Ecosystem – These hills and ridges form part of the Soutpansberg foothills, but as they are somewhat separated from the main mountain, not so high and not so diverse in plant species composition, although there are a number of species of special concern present. They also tend to form 'islands' within the typical Mopane veld matrix and are thus considered to have a High sensitivity. The vegetation is typical mountain bushveld, with many woody species present. Typical species include: *Kirkia acuminata, Terminalia prunoides, Grewia flavescen* and*Commiphora mollis.* The ridges north of the Soutpansberg are generally considered to be rich in plant species and ecologically of medium sensitivity. This is an excellent area for conservation and ecotourism, and most of this ecosystem is situated on a privately owned up-market game farm and conservation area. These ridges tend to be dotted around the landscape and form refuge islands within the typical Mopaneveld matrix for certain fauna and flora species.

The Plateau Ecosystem – The ridges discussed above form a flat to slightly undulating plateau on the crest of the ridges. The plateau often has deeper soils and tends to be vegetated with grassland or sparse woodland. The plateau areas form part of the Ridges Ecosystem and therefore also have a High sensitivity. Most ridge areas mapped have a central plateau area. Typical species include *Kirkia acuminata* and *Combretum apiculatum.* The ridges north of the Soutpansberg are generally considered to be rich in plant species and ecologically have at least a medium sensitivity. The plateau forms part of the ridges.

Mopane (Plains) Bushveld – A number of bushveld communities occurring on the level plains with distinct species assemblages can be differentiated within the study area. These communities are often highly fragmented and are often associated with slight variations in the underlying soils. Whilst it is possible to differentiate the communities using ordination techniques, they are difficult to distinctly map as the boundaries are not usually distinct and vary along a continuum. Sampling time limitations further exacerbated this. They are thus grouped together for the purposes of this report and generally have a Medium sensitivity. In general this vegetation is not rare and not threatened, except that it is often prone to droughts and then often overgrazed. There is concern on the presence of large number of the protected tree species, *Sclerocarya birrea* (Marula), *Adansonia digitata* (Baobab) and large numbers of various species of *Commiphora.*

- Combretum apiculatum-Commiphora Arid Bushveld
- Acacia tortilis, Zanthocercis zambesiaca Bushveld
- *Terminalia prunoides* Bushveld
- *Terminalia sericea* Bushveld
- Mopane Bushveld
- *Acacia tortilis-Cataphractus*Veld on limestone
- *Kirkia-Acacia senegal* Bushveld
- Degraded Shrubveld

Old Fields, Current Agriculture and Secondary re-growth – Various old fields occur within the study area, some irrigated with water from the Nzhelele River. Smaller patches of old fields, some lying fallow for many years, occur on numerous farms as well. The vegetation of the old fields (not currently cultivated) is either open secondary grassland, or an open thornveld, dominated by *Acacia tortilis* and *Dichrostachys cinerea.* Typical species include*: Acacia tortilis* and *Urochloa mosambisence.* The agricultural fields and old fields have low conservation value and low sensitivity, and are, from an ecological point of view, ideal for the development of mining infrastructure.

For further description of the vegetation communities, refer to Section 5 of the Biodiversity Specialist Report (ANNEX-4).

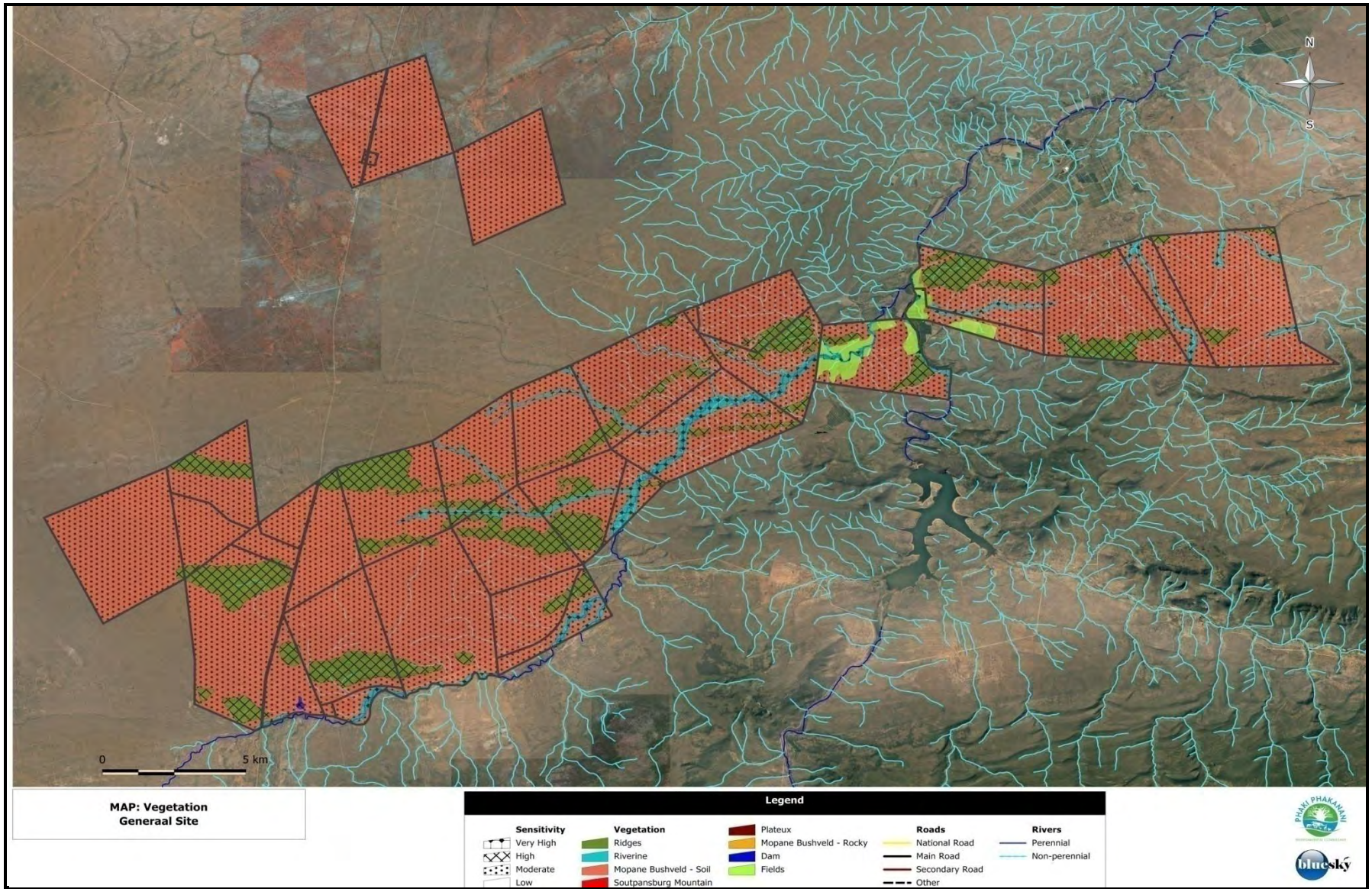


Figure 22: Vegetation communities and sensitivity mapping

1.2.5.1.4 Protected and endemic flora

Table 13 lists the protected flora that could potentially occur within the site, having distributions within Limpopo and the Soutpansberg, although many may not be present at lower altitudes such as is the case for the Generaal Project. These were investigated during the site visit; however, due to seasonal (winter) constraints during the site visit, the presence/absence of these species could not be confirmed.

Table 13: List of protected flora species that may occur in the project area

**Status	Conservation Status
LEMA12	Limpopo Environmental Management Act, No. 7 of 2003. Schedule 12: Protected plants
NFA	National Forest Act, No. 84 of 1998.
RED-E	J. Golding (ed), 2002. *Southern African Plant Red Data lists* (Southern African Botanical Diversity Network Report 1). Pretoria, South Africa: National Botanical Institute – Endemic species
HAHN	Hahn, 2003. Soutpansberg Endemic Flora
RED-RDL	J. Golding (ed), 2002. *Southern African Plant Red Data lists* (Southern African Botanical Diversity Network Report 1). Pretoria, South Africa: National Botanical Institute – Red data listed
TOPS-E	Threatened or Protected Species Regulations, Govt Notice No. R152 of 23 February 2007 – Endangered species
TOPS-P	Threatened or Protected Species Regulations, Govt Notice No. R152 of 23 February 2007 – Protected species
TOPS-V	Threatened or Protected Species Regulations, Govt Notice No. R152 of 23 February 2007 – Vulnerable specie

Botanical Name	Afrikaans Name	English Name	**Status	Presence*
Acacia erioloba		Camel Thorn	RED-RDL (DE)	C
Adansonia digitata	Kremetartboom	Baobab	NFA, LEMA12	C
Adenia gummifera var. *gummifera*		Monkey Rope	RED-RDL (DE)	N
Adenium multiflorum	Impalalelie	Impala lily	LEMA12	C
Adromischus umbraticola subsp. *ramosus*			RED-RDL (DD)	N
Alepidea peduncularis			RED-RDL (DD)	N
Aloe angelica		Williespoort Aloe	HAHN	N
Aloe littoralis	Mopanie-aalwyn/Bergaalwyn	Mopane Aloe littoralis	LEMA12	N
Aloe swynnertonii		Vumba Aloe	RED-RDL (DD)	N
Aloe vossii			RED-RDL (DD)	U
Aristida scabrivalvis subsp. *contracta*	Pers-steekgras	Purple three-awn grass	RED-E	N
Balanites maughamii	Fakkelhout	Torchwood	NFA	C
Barleria holubii	Kleinblaar-barleria	Small-leaved Barleria	RED-RDL	N
Blepharis spinipes			HAHN	N
Boscia albitrunca	Witgat	Shepherd's tree	NFA	C
Bowiea volubilis subsp. *volubilis*		Climbing Onion	RED-RDL (VU)	N
Ceratotheca saxicola			HAHN	N
Ceropegia cimiciodora			RED-RDL (VU)	N
Cineraria alchemilloides subsp. *alchemilloides*			RED-RDL (Rare)	N
Combretum imberbe	Hardekool	Leadwood	NFA	C
Combretum vendae		Venda Bushwillow	HAHN	C
Cryptocarya transvaalensis			RED-RDL (DE)	N
Curtisia dentata		Assegai	RED-RDL (NT)	N

Botanical Name	Afrikaans Name	English Name	**Status	Presence*
Cyamopsis dentata			RED-E	N
Delosperma zoutpansbergense		Ice Plant	HAHN	N
Dicoma montana			HAHN RED-RDL (Rare)	N
Duvalia procumbens			HAHN	N
Elaeodendron transvaalense		Bushveld Saffron	RED-RDL (NT)	N
Encephalartos hirsutus		Venda Cycad	HAHN	N
Euphorbia aeruginosa			HAHN	N
Gunnera perpensa		River Pumpkin	RED-RDL (DE)	N
Harpagophytum procumbens	Duiwelsklou	Devil's Claw /Grapple plant	TOPS-P	N
Hibiscus waterbergensis			RED-RDL	N
Hoodia corrorii subsp. lugardii	Ghaap	Ghaap	LEMA12,TOPS-P	N
Huernia spp *Huernia nouhuysii*		Huernia (all species) – Zebraflower, Toad plant, Owl-eye, etc.	LEMA12 RED-RDL (VU)	N
Ilex mitis var. *mitis*		African Holly	RED-RDL (DE)	N
Ipomoea bisavium			HAHN RED-RDL (Rare)	N
Justicia montis-salinarum			RED-RDL (Rare)	N
Kalanchoe crundallii			HAHN	N
Khadia borealis			RED-RDL (Rare)	N
Myrothamnus flabellifolius			RED-RDL (DD)	N
Mystacidium brayboniae			HAHN RED-RDL (NT)	N
Ochna glauca	Bloublaarrooihout	Bird's eye/blue-leaved ochna	RED-RDL	N
Ocotea kenyensis		Transvaal stinkwood	RED-RDL (VU)	U
Orbea hardyi			RED-RDL (Rare)	N
Orbea maculata subsp. *maculate*			RED-RDL	N
Orbea spp		Orbea (all species)	LEMA12	N
Otholobium polyphyllum			RED-RDL	N
Panicum dewinteri			HAHN RED-RDL (NT)	N
Pavetta tshikondeni			HAHN	N
Peristrophe cliffordii		Peristrophe	LEMA12, RED-RDL, RED-E	N
Peristrophe gillilandiorum		Peristrophe	LEMA12, RED-RDL, RED-E	N
Philenoptera violacea	Appelblaar	Apple-leaf /Raintree	NFA	C
Plinthus rehmannii			RED-RDL	N
Prunus africana		Red Stinkwood	RED-RDL (VU)	U
Psoralea repens			RED-RDL	N
Rapanea melanophloeos			RED-RDL (DE)	N
Rhus magalismontana subsp. coddii	Bergtaaibos		HAHN	N
Rhynchosia vendae			HAHN	N
Sartidia jucunda			RED-RDL (VU)	N
Sclerocarya birrea subsp. *caffra*	Maroela	Marula	NFA	C
Sesbania leptocarpa/mossambicensis			RED-E	N
Spirostachys Africana	Tambotie	Tamboti	LC	C

Botanical Name	Afrikaans Name	English Name	**Status	Presence*
Stapelia spp	Aasblom	Carrion Flower/Stapelia (all spp)	LEMA12	N
Streptocarpus caeruleus			HAHN	N
Tavaresia/Decabelone spp		Ghaap (all species)	LEMA12	N
Tylophora coddii			RED-RDL (Rare)	N
Warburgia salutaris	Peperbasboom	Pepper-bark tree	RED-RDL (EN)	N
Zoutpansbergia caerulea			HAHN	N

*** Presence: C-Confirmed; N-Not confirmed, but possibly present; U-Unlikely.**

Many species are dormant or a positive identification is not possible during the winter months, and their presence/absence could not be confirmed.

Tree species present that are protected in terms of the National Forests Act (NFA) include:

- *Acacia erioloba* (Camel Thorn)
- *Adandonia digitata* (Boabab)
- *Balanites maughamii* (Torchwood)
- *Boscia albitrunca* (Shepherd's tree)
- *Combretum imberbe* (Leadwood)
- *Philenoptera violacea* (Apple leaf)
- *Sclerocarea birrea* (Marula)

1.2.5.1.5 Introduced or exotic/alien plants

Due to the low rainfall, the project area is generally free of unwanted species and is likely to remain so. Introduced and exotic plants are limited to developed, disturbed and riparian areas.

Table 14: Exotic and weed plant species found within the site

Botanical Name	Common Name	CARA Status*	Presence/Comment
Argemone subfusiformis	Mexican poppy	1	Scattered, often in disturbed areas, can become problematic if left uncontrolled.
Caesalpinia gilliesii	Bird of paradise	1	Scattered, often in disturbed areas, can become problematic if left uncontrolled.
Melia azedarach	Syringa	3	Scattered, uncommon outside of riparian area and along watercourses.
Ricinus communis	Castor Oil Bush	2	Scattered, often in disturbed areas, can become problematic if left uncontrolled.
Sesbania punicea	Dorset pea	1	Scattered, often in disturbed areas, can become problematic if left uncontrolled.
Cereus jamacaru	Queen of the Night	2	Scattered, often in disturbed areas or old human habitations, can become problematic if left uncontrolled.
Causuarina	Beefwood		Scattered, often in disturbed areas, can become problematic if left uncontrolled.

*CARA Status: Refer to relevant legislation section for clearing requirements.

The Mexican Poppy, Castor Oil Bush and Dorset Pea can become invasive as weedy pioneers in disturbed areas and would require control during post mining rehabilitation.

1.2.5.2 Fauna

1.2.5.2.1 Mammals

The Soutpansberg has a remarkable diversity of mammals that make up 60% of the total number of species that occur in South Africa. More mammal species have been recorded in the Soutpansberg than in the Cape Floristic Kingdom, which was previously recorded at 127. The Kruger National Park only contains two more species of mammals than the Soutpansberg, which is particularly rich in bats, carnivores and larger hoofed animals.

Of the 104 mammal species (listed in Appendix 2 of ANNEX-4) known to occur within the Mopane bushveld area, there are 2 species which are critically endangered:

- Black Rhinoceros (*Diceros bicornis michaeli*)
- Short eared Trident Bat (*Cloeotis percivali*)

There are 2 endangered species:

- Tsessebe (*Damaliscus lunatus lunatus*)
- African wild dog (*Lycaonpictus*)

11 Near threatened species:

- South African Hedge-hog (*Atelerix frontalis*)
- Serval (*Leptailurus serval*)
- Spotted Hyaena (*Crocuta crocuta*)
- Brown Hyaena (*Hyaena brunnea*)
- Honey Badger (*Mellivora capensis*)
- Leopard (*Panthera pardus*)
- Goeffroy's Horseshoe Bat (*Rhinolophusclivosus*)
- Darling's Horseshoe Bat (*Rhinolophus darlingi*)
- Hildebrandt's Horseshoe Bat *(RhinolophusHildebrandtii*)
- Schreiber's Long-fingered Bat (*Mimiopterus schriebersii)*
- White Rhinoceros *(Ceratotherium simum)*

And 6 vulnerable species include:

- Roan antelope (*Hippotragus equinus*)
- Sable antelope (*Hippotragus nigerniger*)
- Cheetah (*Acinonyx jubatus*)
- Lion (*Panthera leo*)
- Ground pangolin(*Manis temminckii*)
- Giant rat (*Cricetomys gambianus*)

1.2.5.2.2 Avifauna

According to the Soutpansberg Birding Route Organization, the Soutpansberg Mountains and Limpopo River Valley hosts over 540 bird species. This is 56% of the South African avifauna and 76% of the South African terrestrial and fresh water avifauna, excluding vagrants and oceanic avifauna. The Soutpansberg Mountain Range itself hosts between 380 and 400 species. The western Soutpansberg covers an area of 900 km^2 and has 298 species of avifauna (Stuart, Stuart, Gaigher & Gaigher, 2001). The quarter degree Grid Square 2230AA (an area of about 700km^2) has 338 native species and the quarter degree Grid square which includes The Greater Kuduland Conservancy 2130DA (700 km^2 with 412 species) and the Greater Kuduland Conservancy itself (150 km^2 with 304 species). A complete list of potential bird species is provided in Appendix 2 of ANNEX-4.

The Generaal Project area is located outside but directly adjacent (to the west) of SLBR Birding Area D (Figure 23).

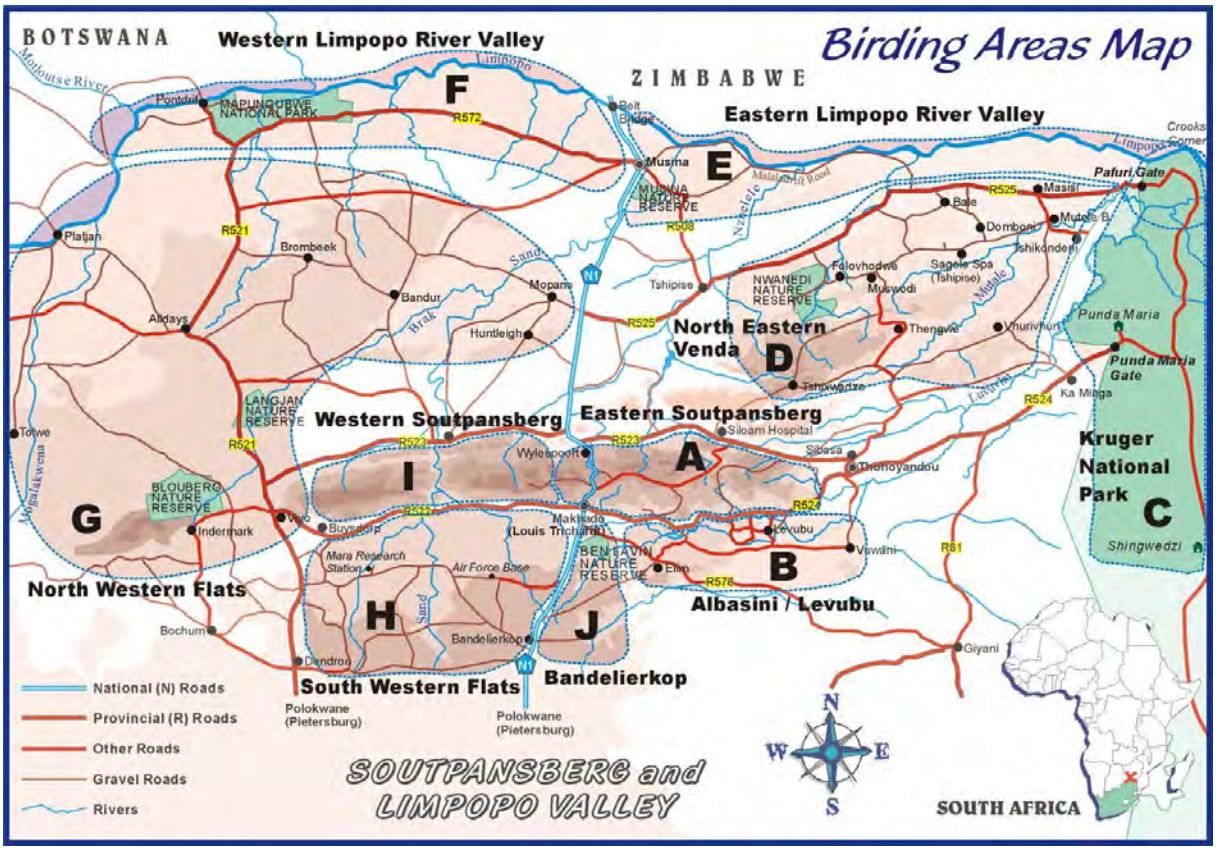


Figure 23: SLBR Birding areas

There are 38 birds of prey species which includes Species of Special Concern (SSC) of the Soutpansberg:

- Cape vulture(*Gyps coprotheres*)
- Crowned eagle (*Stephanoaetus coronatus*)
- Forest Buzzard (*Buteotrizonatus*)
- Bat Hawk (*Macheiramphus alcinus*)
- Crested Guineafowl (*Guttera pucherani*)
- Blue spotted wood dove (*Turtur afer*)

- Knysna Turaco (Tauraco corythais)
- Pel's fishing Owl (*Scotopeliapeli*)
- Mottled spinetail *(Telecanthura ussheri*)
- Narina Trogon (*Apaloderma narina*)
- African Broadbill (*Smithornis capensis*)
- Grey Cuckoo-shrike (*Coracina caesia*)
- African golden Oriole (*Oriolus auratus*)
- Eastern bearded Robin (*Erythropygia quadrivirgata*)
- Gorgeous Bush Shrike (*Telephorusquadricolo*r)
- Black Fronted bush-shrike (*T. Nigrifrons*)
- Golden Backed Pytilia (*Pytilia afra*)
- Green Twinspot (*Mandingoa nitidula*)
- Pink Throated-Twinspot (*Hypargos margaritatus*)

The Blouberg Nature Reserve is situated approximately 100 kilometres from the study area to the west. The mountain in this reserve houses the largest breeding colony of Cape Vulture (endangered) in the world. An additional colony is located on the farm Buffelspoort 222 IS, south of the Soutpansberg. These birds have extensive home ranges (300 km or greater) and the entire study area falls well within the birds feeding ground. Furthermore, the game farms and wilderness areas are likely to provide important foraging habitat for the vultures (especially the Buffelspoort population).

At least 5 Red Data species that are listed as vulnerable occur in the area:

- White-Backed Night heron (*Gorsachius leuconotus*)
- Cape Vulture, Martial Eagle (*Polemaetus bellicosus*)
- African fin-foot (*Podica senegalensis*)
- Grass Owl (*Tyto capensis*)
- Pel's Fishing Owl

11 near threatened species:

- The Black Stork (*Ciconia nigra*),
- Bat Hawk (*Macheiramphus alcinus*)
- Ayres' Eagle (*Hieraetus ayresii*)
- Crowned Eagle
- Peregrine Falcon (*Falco peregrines minor*)
- Lanner Falcon (*Falco biarmicus*)
- Half collared King-fisher (*Alcedo semitorquata*)
- African Broadbill
- Orabge Thrush (*Zoothera gurneyi*)
- Wattled-eyed Flycatcher (*Platysteira peltata)*
- Pink -Throated Twinspot

Birds are attracted to the Mopane veld for food and nesting grounds. Weavers make use of many trees for nest building and breeding, with some species making use of only one species of tree, and others a variety tree species. Weavers are attracted to Mopane veld as many tree species therein have thin branch tips to bind nests to and thorns, to provide protection against predatory nest

raiders. The buffalo weaver (*Dinemellia dinemelli)* limits its breeding to the Baobab (*Adansonia digitata*).

Bee-eaters (*Merops* spp) use steep river banks to dig tunnel nests which offer an advantage. Rollers, such as the Lilac breasted Roller (*Coraciascaudatus),* make use of cavities in trees for nesting, many Mopane trees naturally develop cavities in their trunks when they become old.

Birds of Prey (Raptors) are site specific in terms of breeding. The Mopane veld offers a wide variety of habitats that is utilized as nesting habitats for Raptors. For example, African Fish Eagles (*Haliaeetus vocifer*) build large nests in forked branches of large trees near water courses, while Crowned Eagles make use of similar trees situated in heavily forested areas. Martial Eagles and Black Eagles (*Ictinaetus malayensis*) nest on large cliff faces, while Spotted Eagle Owls (*Bubo africana*) use small cliff edges or edges on river banks to breed. Raptors are attracted to the Mopane veld due to habitat and an abundance of prey, which includes; rodents and birds for the small Raptors and small mammals for larger Raptors. The number of large Raptors that were surveyed for the purpose of the proposed mine was limited, due to the fact that they have large home ranges. For example the Martial Eagle has a home range of up to 100 km², and therefore the resident pair of Martial Eagles will keep out any of its own species within the radius of 100 km.

1.2.5.2.3 Reptiles

There are over 400 reptile species in southern Africa, with a possible occurrence of 120 species in the Mopane bushveld. Reptiles are important as they aid in the control of rodents and provide food for many animals (secretary birds, raptors and carnivorous mammals). They occupy every habitat within the Mopane veld, and certain species occupy restricted habitats (niches). Any form of destruction/development will have extremely negative effects on these reptiles. A complete list of reptiles is provided in Appendix 2 of ANNEX-4.

There are 4 species that could occur in the Mopane bushveld with a near threatened status:

- Distant's ground agama (*Agama aculeate distant)*
- Southern African Python (*Python natalensis*)
- Soutpansberg Flat Lizard (*Platysaurus relictus*)
- Soutpansberg Rock Lizard (*Australolacerta rupicola*)

There are 4 species that hold a vulnerable status and could occur within the Mopane bushveld:

- South African Python(*Python natalensis*)
- Muller's velvet gecko (*Homopholis mulleri*)
- Cryptic Dwarf Gecko (*Lygodactylus nigropunctatus incognitus)*
- Soutpansberg Dwarf Gecko (*Lygodactylus ocellatus soutpansbergensis*)

There is one exotic species, the Tropical house gecko (*Hemidactylus mabouia),* along with the presence of the Nile crocodile which was recorded in the SandRiver. The presence of the crocodile is a result of recent flooding of the Limpopo River where the crocodiles escaped from a crocodile farm.

Table 15: Reptile Species of Special Concern (SSC) that have been identified

SCIENTIFIC NAME	COMMON NAME	HABITAT	POTENTIAL IMPACT
Homopholos mulleri	Muller's Velvet Gecko	Likely to occur within the mature trees of the Mopane Bushveld.	Destruction of trees during bush clearing will result in a loss of habitat
Lygodactylus nigropunctatus incognitus	Cryptic dwarf gecko	Restricted to outcrops of the Soutpansberg, with isolated populations within the Musina plain.	Direct destruction of outcrops during mining operations.
Lygodactylus Occendentalis soutpansbergensis	Soutpansberg Dwarf Gecko,	Restricted to the mountain outcrops of the Soutpansberg, with isolated outcrops within the Musina Plain.	Destruction of outcrops during mining operations.
Typhlosaurus lineatus subtaeneatus	Striped-bellied Blind legless skink	Restricted to sandy soils within the Musina Plain.	Habitat destruction during mining operations.
Australolacerta rupicola	Soutpansberg rock lizard	Restricted to the Soutpansberg mountain tops.One record, however, confirmed that it can occur within outcrops north of the Soutpansberg.	Destruction of outcrops leading to the destruction of habitat.
Python natalensis	Southern Rock Python	Found throughout the habitat.	Destruction of habitat resulting in conflict with humans.
Amblyodipsas microphthalma nigra	Soutpansberg Purple glossed snake	Restricted to Aeolian soils within the Musina Plain.	Destruction of habitat during mining operations
Xenocalamus tranvaalensis	Speckled Quill-snouted snake	Restricted to Aeolian soils of the Musina Plain.	Destruction of the habitat during mining operations.
Platysaurus relictus	Soutpansberg Flat Lizard	Restricted to the Soutpansberg	Destruction of outcrops leading to habitat destruction.

1.2.5.2.4 Amphibians

Amphibians are difficult to survey as many of them are nocturnal and many are restricted to permanent water bodies. The correct time to survey frogs is during times of high rainfall or whilst it is raining. One can identify frogs by the calls (vocalization) of the males during breeding season.

As the surveys were conducted in July (which is out of frog season), there is a lack of species recorded. There is a possibility of 26 amphibian species that could occur within the Mopane veld, of which 1 species is considered endangered, the Northern Forest Rain Frog (*Breviceps silvestris*). There are 2 species which are protected under the NEMBA under the Threatened and Protected Species Rating; the Giant African Bull Frog (*Pyxicephalus adspersus*) and the African Bull Frog (*Pyxicephalus edulis*). A complete species list is provided in Appendix 2 of ANNEX-4.

1.2.5.2.5 Invertebrates

An elimination process was undertaken when investigating invertebrate (insects). Firstly, insects were categorized and analysed according to the insects' occurrence within the Limpopo Province

and its distribution in terms of the study area (the northern area of the Limpopo Province). They were then cross referenced for specific occurrence in the Mopane bushveld through important factors, such as; dietary requirements, flora and micro habitat. Other important factors include; cultural, pest, ecological factors and conservation status.

For example, the *Pontia helice* (Meadow White Butterfly) occurs within the Limpopo Province as well as throughout South Africa. It was therefore excluded from this report as it will not be affected by the mining activities. However, the *Sagra bicolor* (Swollen-legged Leaf beetle) only occurs in the Limpopo Province, the northern parts of the North West Province and Mpumalanga, it has limited distributed throughout South Africa and has therefore been included.

Invertebrate communities consist of decomposers, herbivores, parasites and predators (carnivores), and all occur within the Mopane veld. However, even though a particular species is dependent on the Mopane veld, they have been documented to survive on other vegetation habitats.

Termites

There are seven species of termites that occur in the northern region of the Limpopo Province (Picker, Griffiths & Weaving, 2004), with three important species occurring within the study area: *Amitermes hastats* (Black Mound Termite), *Odontotermes badius* (Common Fungus-growing Termite) and *Macrotermes natalensis* (Large Fungus-growing Termite).

Termites play a major role in the Mopane veld ecology:

- They aid in moribund tree decomposition (collapsed old dead trees) thus bringing them to the soil surface to decay.
- They provide a means of burying plant matter underground, which in turn increasing the nutrient value of the soil.
- An abandoned moribund termite mounds serve as a refuge for reptiles, such as snakes and geckos.
- They also act as a food source for animals such as birds, small mammals and larger mammals, such as the aardvark.

Thus said, Termites are a major contributor to the ecological functioning of the Mopane veld. The ecological balance between termites and the woodland will be disrupted as a result of unsound human development practices. For example, termites might consume too many trees and affect development by devouring fence poles, wooden structures and buildings. Termites have more mobility as they spread to new areas via flying ants. Therefore, Termites are highly important as they build their nests around and against trees, and then convert the tree into soil (when the tree dies) to provide nutrients for new plants and trees to grow.

Butterflies and moths

Many butterfly species are habitat specific and can be regarded as bio-indicator of rare ecosystems (Terblanche, 2012). According to Woodhall (2005) it is preferable to survey butterflies at specific times of the year, mainly springtime and early summer, or late summer to autumn. Since the rainy season had no yet commenced during the site-visit, many plant species were still dormant and thus, a full butterfly survey was unable to be completed.

There are 9 Red Data Butterfly species which could occur within the study area. According to Henning, Terblanche & Ball (2009) threatened butterfly species of the Limpopo Province are:

- *Alaena margaritace* (Wolkberg Zulu): critically endangered
- *Aloeides stevensoni* (Steven's POrt): Vulnerable
- *Anthene crawshayi juanitae* (Juanita's Ciliated Blue/Hairtail): Vulnerable
- *Dingana jerinae* (Jerine's Widow): vulnerable
- *Erikssonia edgei* (Edge's Acraea Copper) :critically endangered
- *Lepidochry sops lotana* (Lotana Blue critically): endangered
- *Pseudonympha swanepoeli* (Swanepoel's Brown): critically endangered
- *Telchinia induna salmontana* (Soutpansberg Acraea): vulnerable.
- *Anthene liodes* (Liodes Ciliated Blue/Hairtail) is not threatened but is of special conservation concern due to its very restricted range in South Africa

The greater Soutpansberg area can support over 250 butterfly species (Woodhall, 2005). The *Acraea machequena* and *Acraea lygus* are both rare species with limited distributions in South Africa and could occur within the Mopane veld.

Over 50 species of butterflies occur within the Mopane bushveld. Out of the habitats investigated, it was found that the butterfly species were most abundant within the riparian zones. The most important species identified are as follows and are listed in terms of their distribution and association to the Mopane Veld:

- White-cloaked Skipper (*Leucochitonea levubu*)
- Friar (*Amauris niavius*)
- African Monarch (*Danaus chrysippus*)
- Guinea Fowl (*Hamanumida daedalus*)
- Green-veined Charaxes (*Charaxes candiope*)
- Foxy Charaxes (*Charaxes jasius*)
- Club-tailed Charaxes (*Charaxes zoolina*)
- Straight-line Sapphire (*Lolaussilas*)
- Swanepoel's Copper (*Aloeides swanepoeli*)

Ant Lions

There are 14 species of Ant lion that occur within the Mopane bushveld area (Picker, Griffiths & Weaving, 2004). Ant lions control the ant population in South Africa, and they are all predators.

The larval stage of the Ant lions life-span is terrestrial, later they become flying insects that resemble dragonflies. Ant lions burrow funnel traps into loose sand whilst submerging themselves in the centre of the burrow to wait for prey to fall into the trap. They are not sand specific and can be found in many different types of soil; the main factor for their occurrence is loose dry soils.

Although certain species occur throughout South Africa, some species are limited to the Mopane veld. The most important species are:

- Gregarious antlion (*Hagenomyia tristis)* whose larvae live off soft vegetation under trees.
- Large grassland antlion (*Creoleon Diana*) which lives in the Acacia grassland.
- Grassland Ant lions (*Distoleon pulverulentus*) whose larvae live in shallow loose sand.

- *Neuroleon* whose larvae live in fine sand under over hanging rock.
- Dotted veld ant lion (*Palpares sobrinus*), the larvae travels freely in loose sand and lie just below the surface to ambush and drag prey under.
- Mottled veld ant lion (*Palpares caffer*) whose larvae travel freely in loose soil just beneath the surface to ambush prey and drag them under the sand.
- Hook tailed ant lion (*Palparidius concinnus*), the larvae live and feed in deep sand.
- Blotched long-horned antlion (*Tmesibasis lacerate*), with this species, the larvae live under stones.

Lady Birds (Family: Coccinellidae)

Lady birds are important invertebrates as they are a form of biological pest control for citrus farming. The larvae are commonly black with conspicuous yellow or white markings. Adults and larvae are usually carnivorous (feeding on various homopteran bugs, small insects and mites), except for the subfamily *Epilachninae* which are herbivorous. 5 carnivorous species occur within the Mopane veld, (Picker, Griffiths & Weaving, 2004) namely:

- Black Two-spot Ladybird (*Chilocorus distigma*) which feeds on Aloe white scale.
- Humbug Ladybird (*Micraspis striata*), which feeds on small insects (such as thrips).
- Spotted Amber Ladybird (*Hippodamia variegate*), a specialized feeder of aphids.
- Lunate Ladybird (*Cheilomenes lunata*), specialist feeder of aphids (including wheat aphids).
- Black Mealy Bug Predator (*Exochomus flavipes*), which feeds on aphids, mealy bugs, soft scales and cochineal insects.

There are two species of lady birds which are herbivorous and are known pests, namely:

- Nightshade Ladybug (*Epilachna paykulli*) which is a pest for feeding on the leaves of potato leaves, solenaceous plants, and tomatoes.
- Potato Ladybird (*Epilachna dregei*); which feeds on leaves of potatoes and tomatoes.

Mygalomorph Spiders (with reference to Baboon Spiders)

Mygalomorph spiders are a primitive group of spiders and mainly consist of tarantulas, baboon spiders and trap door spiders. It is important to note that all baboon spiders are protected by the NEMBA Threatened or Protected Species (TOPS). Baboon spiders (*Arachnida Theraphosidae*) with a high conservation status in the Limpopo Province are:

- *Ceratogyrys bechuanicus,* they are not threatened but all *Ceratogyrus* species are protected by TOPS.
- *Ceratogyrys brachycephalus*, all *Ceratogyrus* species are protected by TOPS.
- *Pterinochilus*, all *Pterinochilus* species are protected by TOPS.

Baboon spiders belonging to the *Ceratogyrus* family (Horned baboon spiders) are mainly found in the Limpopo Province. It is of importance to the pet trade and is on the TOPS list with other baboon spider genera *Harpactira* and *Pterinochilus*.

Ceratogyrus bechuanicus and *Ceratogyrus brachycephalus* are usually only found in small colonies, whereas Baboon spiders, such as *Pterinochilus* are usually in much larger colonies. The distribution of *Ceratogyrus bechuanicus* ranges from Botswana, Central Namibia, Zimbabwe and Mozambique to

the northern parts of South Africa (Dippenaar-Schoeman, 2002). *Ceratogyrus bechuanicus* has also been recorded in the western Soutpansberg (Foord, Dippenaar-Schoeman & Van der Merwer, 2002).

In contrast to *Ceratogyrus bechuanicus*, *Ceratogyrus brachycephalus* has a more restricted distribution. They are confined to localities in central Botswana, southern Zimbabwe and the extreme north of Limpopo (De wet & Dippenaar-Schoeman, 1991: Dippenaar-Schoeman, 2002). *Ceratogyrus* bechuanicus is well represented in the Kruger National Park (De wet & Schoonbee, 1991). *Ceratogyrusbrachycephalus* has only been found in the Messina Provincial Nature Reserve, while its historical distribution includes the Langjan Nature Reserve (De wet & Schoonbee 1991). *Ceratogyrusbrachycephalus* with a much smaller distribution has a higher conservation priority than *Ceratogyrus bechuanicus*.

There appears to be no threatened baboon spider species on the site, although care must be taken to provide for natural no-go areas to provide habitat if there should be on the site. The diversity of micro habitats supports the statement that baboon spiders are present on the site.

There is an abundance of orb web spiders within the Mopane Veld which encourages the female wasp of *Batozonellus fuliginosus* into the bushveld as it specializes in preying on orb web spiders.

Scorpions

Hadogenes troglodytes, a non-threatened rock scorpion, is habitat sensitive and therefore protected by TOPS. *Hadogenes troglodytes* is sensitive to habitat destruction owing to its small brood size and slow rate of reproduction (Leeming, 2003). *Hadogenes troglodytes* is restricted to rocky outcrops and mountain ranges in the northern parts of South Africa (Leeming, 2003) and is the longest scorpion in the world. *Opistophthalmus wahlbergi* is known from the area and is protected by TOPS.

Wasps

Wasps are known as insect predators. Wasps either occur throughout the entire South Africa or have widespread distributions within South Africa; none of which are exclusively dependant on or are have exclusive distribution within the Mopane veld. The cricket hunter wasp (*Chlorion maxillosum*) preys on the giant burrowing cricket (*Brachytrupes membranaceus*), which is restricted to the Mopane veld.

Dung Beetles

Dung beetles perform an important ecological function in the bushveld. Dung beetles convert animal dung into humus and deliver manure under the ground, thus aiding in nutrient delivery to plant roots.There are over 700 dung beetle species throughout South Africa. The conservation important dung beetles within the area are:

- *Scarabaeus schulzeae*
- *Metacatharsius sp*
- *Proagoderus lanista*
- *Onitis obenbergeri*

Other important dung beetles which do not have a listed conservation status are:

- Green dung beetle (*Garreta nitens*)
- Grooved dung beetle (*Heteronitis castelnaui*)
- Trident dung beetle (*Heliocopris neptunus)*
- Plum dung beetle (*Anachalcos convexus)*
- Bi-coloured dung beetle (*Proagoderus tersidorsis*)
- Large Copper dung beetle (*Kheper nigroaeneus)*
- Fork nosed dung beetle (*Coptorhina klugi*)

These dung beetle species were identified as important due to their exclusive distribution within the Mopane veld and limited distribution throughout South Africa etc.

Mopane Moth (Imbrasia Belina)

The larvae of the Mopane Moth feed on a large variety of plants including Mopane (*Colophospermum Mopane*), *Ficus, Terminalia, Trema* and *Rhus*. They form an important constituent (after evisceration and drying) of the local diet. Outbreaks of this species defoliate shrubs which deprives game of available food. After the moths appear, the Mopane trees recover. This species is in competition with the Speckled Emperor moth (*Gynanisa maja*) and can compete for Mopane trees during the larvae stage, especially when outbreaks occur by both species simultaneously. The Mopane moth is opportunistic and their larvae may feed on citrus trees therefore they may become a pest for the citrus farmers in the surrounding areas.

Other invertebrates of importance are listed in Table 16.

Table 16: Table of Invertebrate Species having Ecological Importance

INSECT SPECIES	ECOLOGICAL IMPORTANCE/COMMENT
Dung beetles	Converts dung into humus which provides nutrients to the soil. 17 difference species occur within the Mopane bushveld.
Armoured darkling beetle	The beetle larvae live in the soil and feeds on roots and plant detritus, converting the matter into soil nutrients. Its presence was confirmed in the Sand River, 4 were found in the pit traps on one occasion.
Corn cricket	This insect feeds on acacia leaves and forms a major food source for bat eared foxes, birds and jackals. There are citrus farms in proximity to the proposed mining area, where the insect has been known to become pests.
Giant burrowing cricket (*Brachytrupes membranaceus*)	Occur mainly within Mopane Veld, and is hunted by the cricket hunter wasp (*Chlorion maxillosum*). The Giant burrowing cricket is the largest and loudest cricket in the world.
Bush hoppers (family *Euschmidtiidae*)	Mainly occurs within the Limpopo Province.
Brachytypus rotundifrons (no common name)	Distribution is restricted to the Limpopo Province.
Pantoleistes princeps	Occurs within the Mopane Veld and is associated with termite mounds.
Homoeocerus auriculatus	Occurs within Mopane veld, and feeds on both indigenous and alien acacia species (*Acacia mearnsii*).
Leptoglossus membranaceus	This insect is a pest to citrus farmers, as the fruit which they feed on will drop from the tree. There are many Citrus farms in the area.
Dieuches	A ground dwelling insect that feeds on dassie (*Hyrax*) dung.
Edible stinkbug (*Encosternum delegorguei*)	A diurnal insect that feeds on Acacia and other shrubs and trees. The bug (harugwa), a local delicacy, is killed in hot water and squeezed to

INSECT SPECIES	ECOLOGICAL IMPORTANCE/COMMENT
	remove the almost nauseating secretion then roasted or dried. Also eaten in South Africa raw or cooked.
Red Scale (*Aonidiella aurantii*)	This is a pest of citrus trees as its toxic saliva cause yellow spots. Most citrus trees in the area are infested with thus bug.
Aloe white scale (*Duplachionaspis exalbida*)	This is a pest to aloes and sever infestations can cause leaf tips to wither. Populations are generally kept under control by wasps and ladybird beetles.
Marsh ground beetle (*Bradybaenus opulentus*)	Predator of small insects and occurs mainly within Mopane veld
Butterflies	50 species occur within the Mopane bushveld. The most important species are: White-cloaked Skipper (*Leucochitonealevubu*), Friar (*Amaurisniavius*), African Monarch (*Danauschrysippus*), Guinea Fowl (*Hamanumidadaedalus*), Green-veined Charaxes (*Charaxescandiope*), Foxy Charaxes (*Charaxesjasius*), Club-tailed Charaxes (*Charaxeszoolina*), Straight-line Sapphire (*Lolaussilas*) and Swanepoel's Copper (*Aloeidesswanepoeli*).
Bees	Bees form a major role in pollination of the plants and trees in Mopane Veld. There are several species of bees throughout the Limpopo Province, the most important being the Honey bee (*Apis mellifera*). The CapeHoney bee invades and supplants colonies of the less aggressive African Honey bee. Although they are very important as crop pollinators, honey bees may deprive more specialized and efficient indigenous bees of pollen and nectar, effectively reducing pollination of wild flowers. Honey bees are also important for honey production for humans. Bee populations are on the decline due to a disease called American Foul Disease (AFD).) This disease affects the immune system of the bee, thus allowing pathogens to enter and destroy the bee, and subsequently the entire colony.
Mopane bee (*Meliponula* sp.)	This small bee is stingless and is known for trying to collect moisture from eyes and mouths of humans, although not dangerous, it is an irritant in the Mopane bushveld.

1.2.5.2.6 Faunal sensitive areas

Areas sensitive from a faunal perspective are related to the habitat present. Sensitive areas include the river systems and drainage lines as well as areas having exposed rocky outcrops usually having notable populations of reptiles.

1.2.5.3 Biodiversity and Ecosystem Processes

1.2.5.3.1 National Biodiversity Assessment (NBA, 2011)

No NBA 2011 Endangered or Critically Endangered Ecosystems are affected by the proposed development.

1.2.5.3.2 Biodiversity Proxy

The Biodiversity Proxy was created by combining a layer created through the interpolation of species grid information compiled by the Vhembe Biosphere Reserve (VBR) scientific group with the Conservation Status of the SANBI vegetation. Values were then subtracted using the land cover to reflect transformation and impacts.

In general the Biodiversity for the affected area is moderate (Figure 24), becoming high along the south-western portions around the Mutamba River.

1.2.5.3.3 Ecosystem Services

Using the Ecosystem Services (ESS) Classification developed for the Department of Environmental Affairs (DEA) by Transboundary Consulting Africa (2012), the ESS Index for the Generaal Project and surrounding areas was compiled by combining the values of the Provisioning (Food, Fresh Water and Mineral Value), Regulating (Carbon Sequestration, Groundwater Regulation and Water Purification), Supporting (Biomass Production, Threatened Ecosystems and Conservation Status) and Cultural (Scenic Value, Preservation Value, Heritage Value and Human Impacts) Service.

The Ecosystem Services are moderate for most of the affected area (Figure 25).

Broad ecosystem delineation is limited to the terrestrial Mopane and mixed veld areas, sandstone ridges, rocky ridges and outcrops and the Mutamba River with associated riverine forest, floodplains and large drainage lines.

The Mutamba River riverine forest and floodplains are important dry season refuge areas for many faunal species in their natural state. It is also a centre of floral diversity. Some of these areas, however, are degraded and overgrazed. The Mutamba River does provide a source of water, while the deeper alluvial soils may provide better forage than areas inland of the riparian zone. Any impacts on the sensitive aquatic ecosystems, regardless of the source, need to be avoided.

Impacts on this system include erosion, deforestation through flooding, habitat loss and degradation and the associated impacts on faunal and floral diversity, dewatering, water abstraction as well as increased sedimentation. Continued impacts on the riverine ecosystems may also ultimately reduce the capacity of this system to absorb dramatic flooding events.

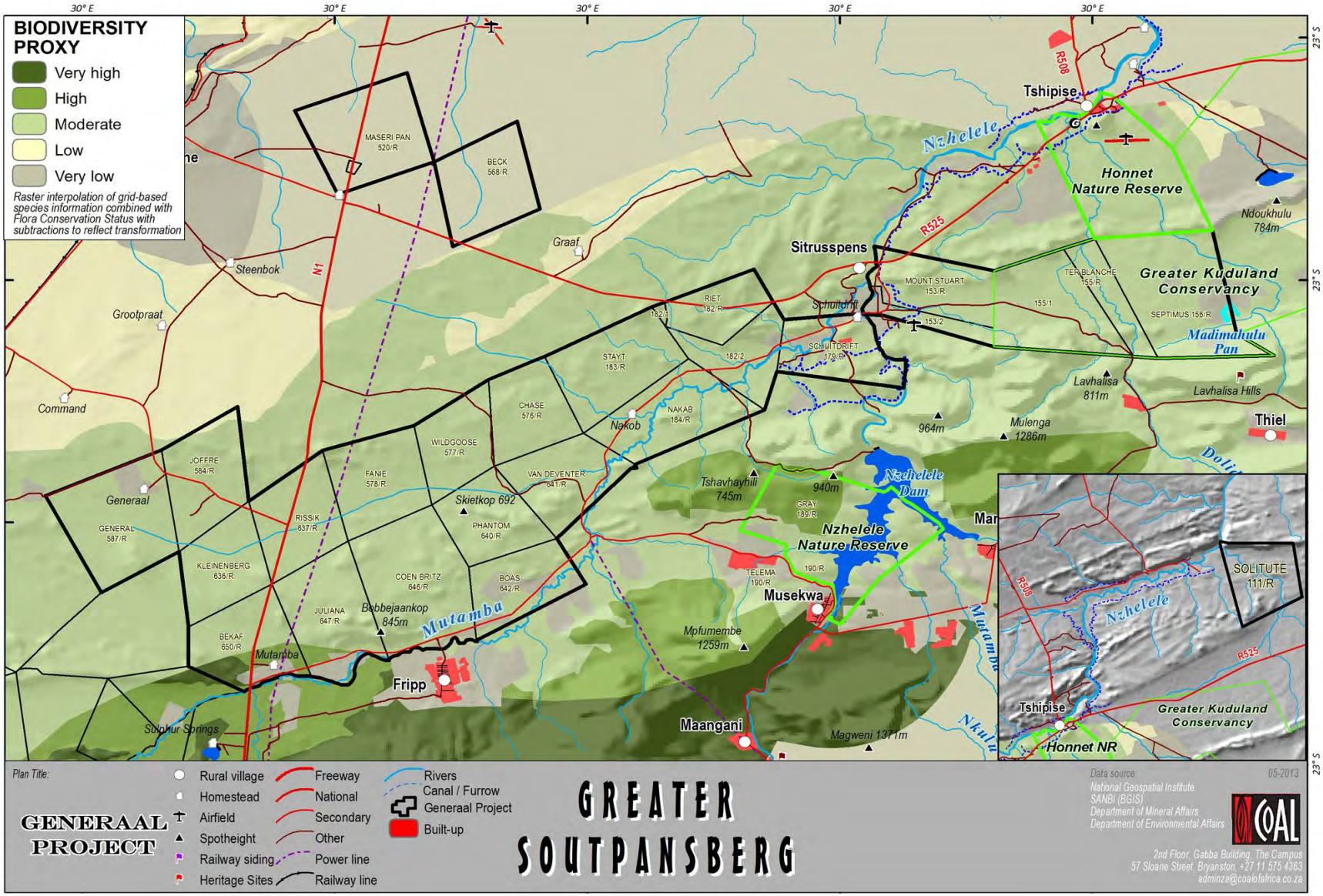


Figure 24: Biodiversity Proxy of the Generaal Project area and surrounds

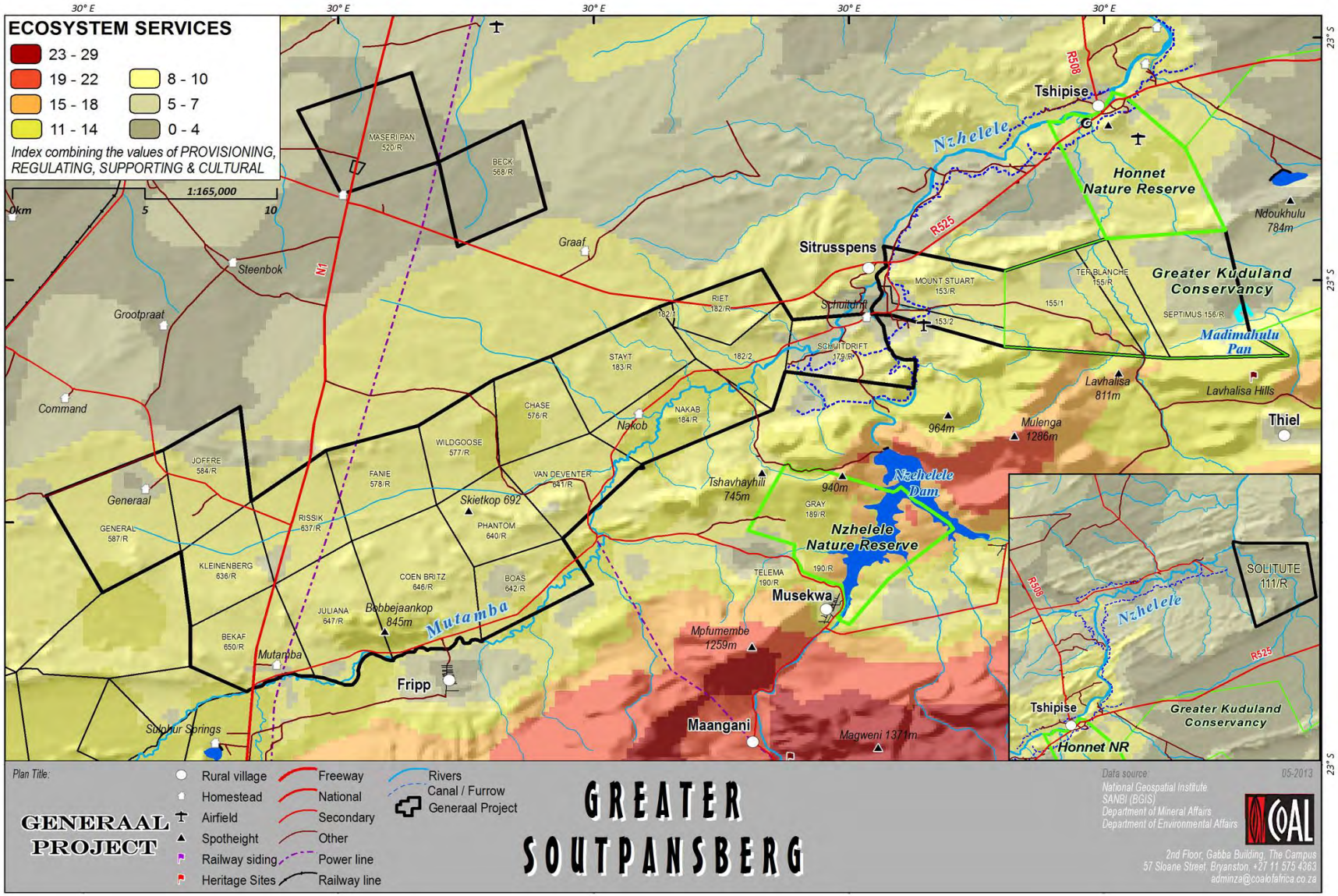


Figure 25: Ecosystem Services of the Generaal Project area and surrounds

1.2.6 AQUATIC ENVIRONMENT

1.2.6.1 Ecoregions

When assessing the ecology of any area (aquatic or terrestrial), it is important to know which ecoregion the area is located within. This knowledge allows for improved interpretation of data to be made, since reference information and representative species lists are often available on this level of assessment, which aids in guiding the assessment.

The Generaal Project area falls within the Limpopo Plain Ecoregion and is located within the A71K, A80F and A80G quaternary catchments, although the area within the A71K quaternary catchment is very limited and won't be directly impacted by the proposed mining activities.

Figure 26 indicates the aquatic ecoregions and quaternary catchment of the Generaal Project area.

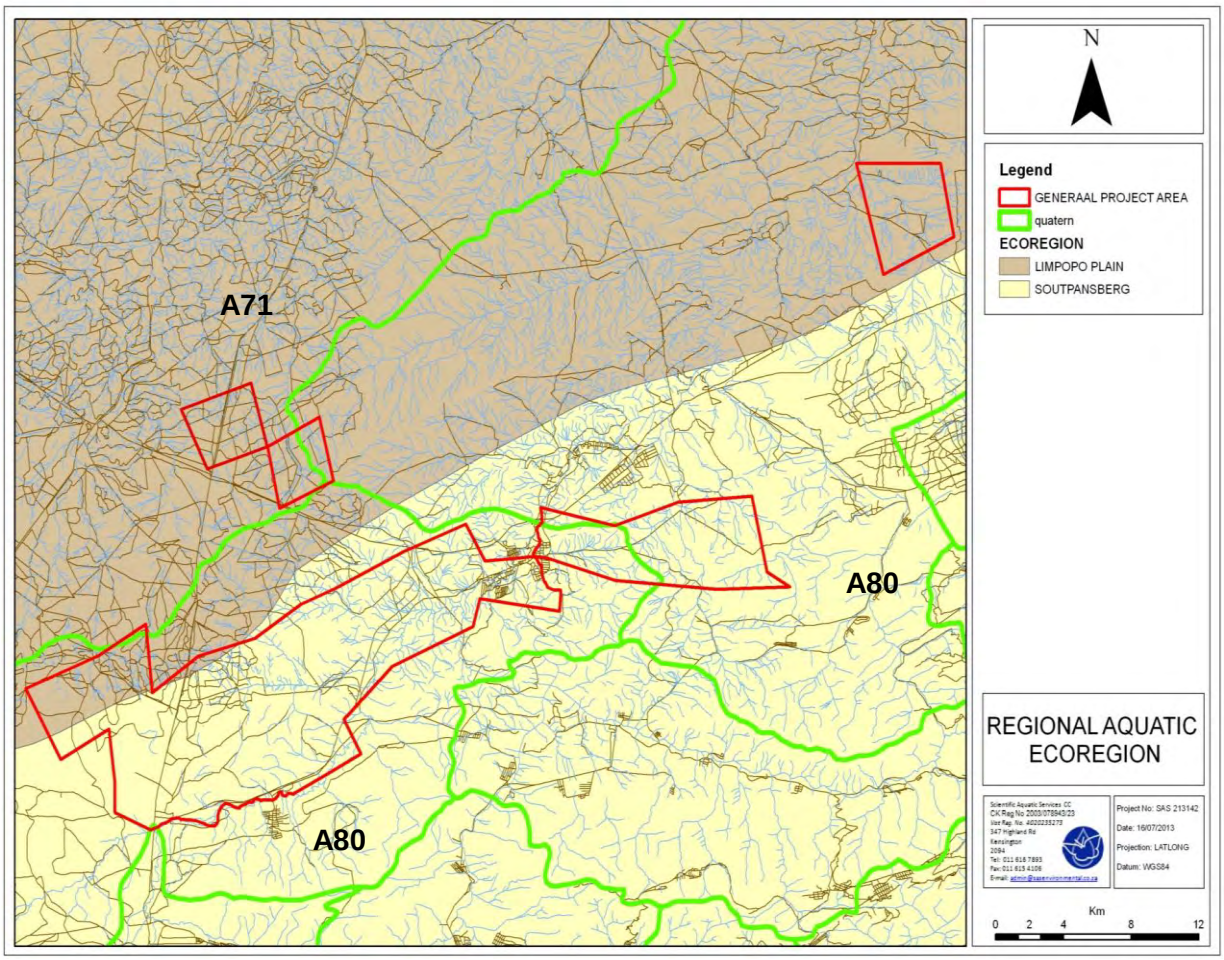


Figure 26: Ecoregions associated with the Generaal Project area (Mucina and Rutherford, 2006)

1.2.6.2 Ecostatus

Water resources are generally classified according to the degree of modification or level of impairment. The classes, used by the South African River Health Program (RHP), are presented in the table below and will be used as the basis of classification of the systems in future field studies.

Table 17: Classification of river health assessment classes in line with the RHP

Class	Description
A	Unmodified, natural.
B	Largely natural, with few modifications.
C	Moderately modified.
D	Largely modified.
E	Extensively modified.
F	Critically modified.

Studies undertaken by the Institute for Water Quality Studies assessed all quaternary catchments as part of the Resource Directed Measures for Protection of Water Resources. In these assessments, the Ecological Importance and Sensitivity (EIS), Present Ecological Management Class (PEMC) and Desired Ecological Management Class (DEMC) were defined and serve as a useful guideline in determining the importance and sensitivity of aquatic ecosystems, prior to assessment or as part of a desktop assessment.

This database was searched for the catchment of concern in order to define the EIS, PEMC and DEMC. The results of the assessment are summarised in the table below.

Table 18: Summary of the ecological status of quaternary catchments A80F and A80G based on Kleynhans (1999)

Catchment	Resource	EIS	PESC	DEMC
A80F	Nzhelele River	High	Class D	B: Sensitive system
A80G	Nzhelele River	Moderate	Class D	C: Moderately sensitive system

A80F

According to the ecological importance classification for the quaternary catchment, the system can be classified as a Sensitive system which, in its present state, can be considered a Class D (largely modified) stream.

The points below summarise the impacts on the aquatic resources in the A80F quaternary catchment (Kleynhans, 1999):

- The aquatic resources within this quaternary catchment have been marginally affected by scouring of the system.

- Flow modification within the catchment is considered very high due to the control of flow by a dam upstream.
- Marginal impacts from inundation of the system occur.
- Riparian zones and stream bank conditions are considered to be moderately impacted by erosion.
- A low impact occurs as a result of the introduction of in-stream biota with special mention of *Azzola sp*. (Water Fern) and *Cyprinus carpio* (Carp).
- Impacts on water quality in the system are considered high as water released by the dam has a modified temperature and quality.

In terms of ecological functions, importance and sensitivity, the following points summarise the conditions in this catchment:

- The riverine systems in this catchment have a high diversity of habitat types.
- The site has a moderate importance in terms of conservation with special mention of a gorge in the system.
- The riverine resources in this system have a moderate intolerance to flow and flow related water quality changes.
- The aquatic resources in the area have a high importance in terms of migration of species and form a transition zone between mountain and lowveld. Special mention is made of the migration of eels, fish and birds.
- The system is considered to be of high importance in terms of rare and endemic species conservation. Some species may occur upstream of Nzhelele Dam.
- The aquatic resources in this catchment are moderately important in terms of the provision of refuge areas.
- The riverine resources in this system have a moderate sensitivity to changes in water quality and flow. The gorge area is particularly sensitive to changes in flow.
- The aquatic resources in this area are of high importance in terms of Species/Taxon richness with up to 16 different species present.
- The system is of high importance with regards to unique or endemic species with special mention of *Barbus eutenea* (Orangefin Barb), *Barbus lineamaculatus* (Line-spotted Barb) and *Barbus maculatus*.

A80G

According to the ecological importance classification for the quaternary catchment, the system can be classified as a Sensitive system which, in its present state, can be considered a Class D (largely modified) stream.

The points below summarise the impacts on the aquatic resources in the A80G quaternary catchment (Kleynhans, 1999):

- The aquatic resources within this quaternary catchment have been moderately affected by the possible deposition of ferric oxide into the system.
- Flow modification within the catchment is considered very high.
- Marginal impacts from inundation occur as a result of weirs in the system.

- Riparian zones and stream bank conditions are considered to be highly impacted by agriculture, overgrazing and cultivation.
- A marginal impact occurs as a result of the introduction of instream biota.
- Impacts on water quality in the system are high. These impacts are a result of agricultural runoff into the system, sewage point sources and high pressure water released into the system.

In terms of ecological functions, importance and sensitivity, the following points summarise the conditions in this catchment:

- The riverine systems in this catchment have a moderate diversity of habitat types.
- The site has a moderate importance in terms of conservation.
- The riverine resources in this system have a moderate intolerance to flow and flow related water quality changes.
- The aquatic resources in the area have a high importance in terms of migration of species. Special mention is made of the migration of eels, fish and birds.
- The system is considered to be of high importance in terms of rare and endemic species conservation. Some species may occur upstream of Nzhelele Dam.
- The aquatic resources in this catchment are moderately important in terms of the provision of refuge areas.
- The riverine resources in this system have a moderate sensitivity to changes in water quality and flow.
- The aquatic resources in this area are of high importance in terms of Species/Taxon richness with up to 16 different species present.
- The system is of high importance with regards to unique or endemic species with special mention of *Barbus eutenea* (Orangefin Barb), *Barbus lineamaculatus* (Line-spotted Barb) and *Barbus maculatus*.

1.2.6.3 Ecological Importance

According to the ecological importance classification for the A80 quaternary catchments, the system can be classified as a Sensitive system which, in its present state, can be considered a Class D (largely modified) stream. The most significant riverine resource within the Generaal Project area within the A80F quaternary catchment is the Mutamba River, a major tributary of the Nzhelele River and the Nzhelele River itself. The Dolidoli River was the only other system observed with surface water at the time of assessment. These systems all form part of the Sand River catchment which in turn is a large tributary of the Limpopo River.

The RSA Wetland Types (2010) and National Freshwater Ecosystem Priority Areas (NFEPA) (2011) databases were consulted to define the ecology of the wetland or river systems within the Generaal Project Area that may be of ecological importance. Aspects applicable to the Generaal Project area and surroundings are discussed below:

- The Generaal Project area falls within the Limpopo Water Management Area (WMA). The subWMA indicated for the Generaal Project area is the Sand subWMA.

- The subWMA is not regarded important in terms of fish sanctuaries, rehabilitation or corridors.
- The subWMA is not listed as a fish Freshwater Ecosystem Priority Area.
- Both the Mutamba and Nzhelele Rivers are perennial systems classified as Class D (largely modified) rivers and are not indicated as free flowing, flagship or as FEPA Rivers.
- The Sand River is a perennial system classified as a Class B (largely natural) river and is not indicated as a free flowing or flagship river. However, the Sand River is indicated as a FEPA river.
- Numerous wetland features are located within the Generaal Project area, these include bench slope and valley floor wetland features. Both natural and artificial wetland features occur within the Generaal Project area, two wetland features are considered natural while five are considered artificial.
- Wetlands within the Generaal Project area were ranked according to general importance. All wetland features were ranked as Rank 6 with no importance indicated. No wetland features within the Generaal Project area are considered important with regards to the conservation of biodiversity.
- No wetland features within the Generaal Project area are indicated as FEPA wetlands.
- No RAMSAR wetlands are located within or close to the Generaal Project area.
- No wetlands are indicated to fall within 500m of an IUCN threatened frog point locality.
- According to the NFEPA database (2011), none of the wetland features within the Generaal Project area are considered of significant biodiversity importance. All wetland features are indicated to be in a heavily to critically modified condition and are not considered important with regards to the conservation of biodiversity in the area.

1.2.6.4 Wetland Assessment

Due to the extent of the study area as well as restricted access to many farms, sites were selected considered to be representative of the characteristics of the features within the study area. Selection of areas representative of the different feature groups, took place with the use of desktop methods (contours, flood lines, digital satellite imagery and topographical maps indicating depressions or drainage lines) after which selected points of interest were identified which are representative of the various systems. Each point of interest was assessed during the field survey to distinguish between true wetland and non-wetland as well as true riparian and non-riparian habitat.

Features within the study area were categorised with the use of the Classification System for Wetlands and other Aquatic Ecosystems in South Africa (Ollis, 2013). Three main feature groups are present within the study area, namely depressions (small pans), rivers (Nzhelele River, Mutamba River and Dolidoli River) and smaller drainage lines. Within the area several artificial earth dams were also observed, some of which are perennial with others that only seasonally or ephemerally hold surface water and support vegetation adapted to life in saturated soils.

These four groups were then assessed to determine importance in terms of function and service provision as well as Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) of the systems. The bullets below summarise the key findings – refer to ANNEX-5 (Aquatic Specialist Study, SAS 2013) for detail description:

- The average score calculated for the Mutamba River with the use of the Wetland IHI, indicates that the feature can be considered to fall within PES Category A (Unmodified). A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged. It is also notable that there is a general decreasing trend in wetland habitat integrity in a downstream direction largely as a result of increased water abstraction. This results in slightly lower ecological scores in the area of the Generaal Project in relation to the upstream areas although the habitat integrity at this point can still be considered largely natural with few modifications (Class B).
- The score calculated for the Nzhelele and Dolidoli Rivers with the use of the wetland IHI, indicates that these features can be considered to fall within PES Category B indicating largely natural conditions with few modifications. It is however notable that in the vicinity of the local villages a significant reduction in wetland habitat integrity is evident. The average score calculated for the smaller drainage lines with the use of the IHI, indicates that the features can be considered to fall within PES Category A (Unmodified/Natural). Smaller drainage lines have been left largely undisturbed with limited change for hydrology and geomorphology identified.
- The results obtained for the function and service provision indicated the Mutamba River, Nzhelele River and Dolidoli River to be of similar importance in terms of function and service provision, with the highest scores calculated for water supply, biodiversity and tourism and recreation. The smaller pans as well as drainage lines calculated scores that fall within a moderately low class and therefore cannot be considered of exceptional importance in terms of function and service provision despite the drainage lines being in a largely unmodified state.
- Wet-Health was used to determine the PES of the smaller pans within the study area. The pans have been largely undisturbed and therefore can still generally be considered to be in good condition and are considered to be relatively important in terms of biodiversity support in the area although overall functional importance is limited. The wetland Pans were defined as being moderately important (class B systems).
- VEGRAI was used to assess the response of riparian vegetation to impacts within rivers as well as smaller drainage lines. The mean scores calculated for the drainage lines and Mutamba River both fall within Class B (largely natural) and mean average scores calculated for the Nzhelele River and Dolidoli River fall within Class C (moderately modified). Based on the findings of the study it is evident that from a wetland point of view, the EIS of the river systems are largely similar. All the larger riverine systems along with the smaller drainage lines can be defined as Class B systems indicating a high EIS. The small pans identified on site also calculated an EIS score included within a high EIS Class (Class B).

The following general conclusions were drawn upon completion of the aquatic assessment – refer to ANNEX-5 (Aquatic Specialist Study, SAS 2013) for a detail description of the assessment methodologies and results obtained during the site visit:

- Increased concentrations of dissolved salts were observed in a downstream direction on the Mutamba River with the EC being 6.3 times higher at site GSP13 site compared to the GSP9 site at the most upstream point.

- The Mutamba River is likely to display a naturally high level of variability in dissolved salt concentration linked to seasonality of flow. Close monitoring of these trends will be required in future.
- Spatially there was a 14.0% decrease in pH value in a downstream direction between sites GSP9 and GSP13.
- From a temporal perspective pH value decreased by 1.1% at GSP9 from 2009 to 2013. The observed variations can be attributed to natural temporal variation.
- Dissolved oxygen (DO) concentration decreased by 25.4% in a downstream direction between sites GSP9 and GSP13.
- Dissolved oxygen concentration at upstream site GSP9 falls well within the recommended range, whilst that at the downstream site (GSP13) is below the recommended range indicating that some limitations on the aquatic community in the lower sections of the Mutamba River in the vicinity of the Generaal Project will occur.
- There is significant variation in dissolved oxygen over time. The observed variation in dissolved oxygen concentration is likely to be attributed largely to natural variation with biological activity within the system at each point considered to be a significant driver of the variation in the system.
- The temperatures observed at each of the points are deemed natural for the time of year and the nature of the systems.
- Both the Nzhelele River and the Dolidoli River have elevated salt concentrations evident prior to mining taking place indicating that the systems naturally carry a relatively high concentration of dissolved salts.
- Increased concentrations of dissolved salts were observed in a downstream direction. The change was, however, much less pronounced than that observed for the Mutamba River.
- Compared to the Nzhelele River, EC in the Dolidoli River (GSP17) was much higher (69.3% compared to GSP15 and 88.0% compared to GSP16).
- Spatially there was a 4.2% decrease in pH value in a downstream direction between sites GSP15 and GSP16. The observed changes in pH value thus fall within the recommended percentage change range from a spatial perspective. The pH, observed in the Dolidoli River was more neutral than that of the Nzhelele River system.
- DO concentration decreased by 8.0% in a downstream direction between sites GSP16 and GSP17. DO concentration at all the sites on the Nzhelele River and Dolidoli river fall well within the recommended range. The observed variation in DO concentration is likely to be attributed largely to natural variation in biological activity within the system at each point.
- It is evident that DO saturation was significantly lower in the Dolidoli River than in the Nzhelele River which will limit the ability to support more sensitive aquatic taxa.
- The temperatures observed at each of the points are deemed natural for the time of year and the nature of the systems.
- Based on the IHIA index an overall score of 65.3% was calculated for GSP14 (class “C” and hence considered “Moderately modified”). For GSP15 an average score of 54.6% was calculated, placing this site in class “D” (“Largely modified”).
- Habitat diversity and structure at site GSP15 was considered highly suitable for supporting a diverse and sensitive aquatic macro-invertebrate community. In comparison habitat

diversity and structure at site GSP14 was considered inadequate for supporting a diverse and sensitive aquatic macro-invertebrate community.

- As for the Mutamba River, habitat limitations are likely to limit the diversity, abundance and sensitivity of the aquatic community significantly due to the ephemeral nature of the system.
- At site GSP14, the Nzhelele River may be considered to be in a class E (severely impaired) condition according to the Dickens & Graham (2001) classification system. According to the Dallas (2007) classification system, the site can be classified as class D.
- Stream conditions at site GSP15 may also be considered to be in a class E (severely impaired) condition according to the Dickens & Graham (2001) classification system. However, according to the Dallas (2007) classification system, the site can be classified as class C.
- The latter classification is in agreement with the IHAS assessment, where habitat conditions at GSP15 appear more suited to supporting a diverse and sensitive aquatic macro-invertebrate community when compared to GSP14.
- Due to the degree of sensitivity of the system to habitat changes and loss of instream flow, careful design and operational procedures will be required to limit the impact on the Nzhelele River.
- The MIRAI results in terms of (ecological category classification) largely follow the same trends as that obtained using the SASS class classifications with both sites having an ecostatus score of Class D indicating largely modified conditions.
- The FRAI largely corresponds to that obtained for the MIRAI. Because the habitat (and hence potential drivers) was fairly homogenous between the sites, the refined EC was also similar. The EC for the system indicates that some loss of fish community integrity of the system has occurred, however there is still a significant diversity and abundance of fish present in the system. The EC values calculated during the current assessment are, however, in congruence with results obtained using macro-invertebrate indices (MIRAI and SASS5).
- Both the Nzhelele River and the Mutamba River are expected to exhibit broad variability in aquatic community integrity on a temporal scale due to variations in flow and habitat availability within the system. As more data on the system is collected, better inferences on the ecological condition of the community will be possible.

Based on the findings of the aquatic study the Mutamba River is seen to be a water stressed system with the degree of water stress increasing in a downstream direction. Some recovery of the system does however occur in the lower reaches but impacts on the aquatic ecology of the lower reaches of the system are still considered to be likely. The Mutamba River can be considered to be a system of reduced EIS in relation to the Nzhelele River due to the limited provision of refugia and in the local area and the limited support it provides to the aquatic ecology of the area. The system is however deemed important in terms of the provision of services to the terrestrial fauna of the area as well as fair significance from a socio-cultural point of view. It is deemed essential that all effort is made to ensure that impacts on the Mutamba River as a result of the proposed Generaal Project are minimised.

The Nzhelele River can be considered to be a system of high aquatic EIS due to the provision of refugia and in the local area and the support it provides to the aquatic ecology of the area. The system is also deemed important in terms of the provision of services to the terrestrial fauna, such

as the provision of drinking water of the area as well as a high significance from a socio-cultural point of view, with special mention of water provision for agriculture. It is deemed essential that all effort is made to ensure that impacts on the Nzhelele River as a result of the proposed Generaal Project are minimised.

1.2.6.5 Present Ecological State and Recommended Ecological Class

According to the resource directed measures for protection of water resources a wetland or river may receive the same class for the PES, as the Recommended Ecological Class (REC), if the habitat is deemed in good condition, and therefore must stay in good condition. Otherwise, an appropriate REC should be assigned in order to prevent any further degradation as well as to enhance the PES of the feature. The results obtained from the assessments indicate a relatively low level of transformation on all levels of ecology. It is therefore recommended that the features be assigned the same REC as the PES Class calculated.

Table 19: Assigned REC classes

Feature	VEGRAI Ecostatus	Wetland PES Classes	EIS Class	REC Class
Mutamba River	B	B	B	B
Nzhelele River	C	C	B	B
Dolidoli River	D	B	B	B
Smaller drainage lines	A	A	B	B
Smaller pans	*	A	B	B

* = not applicable

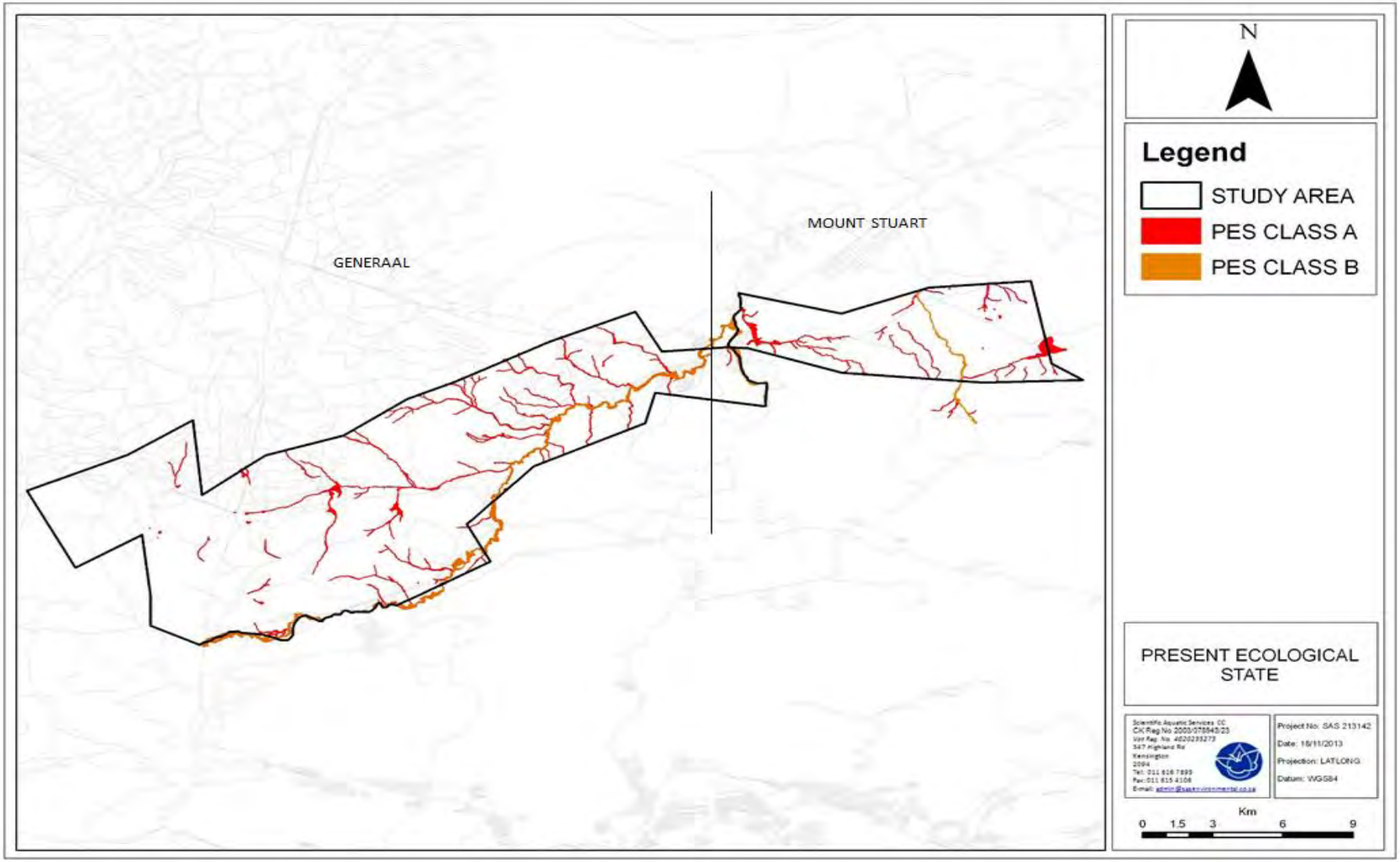


Figure 27: PES of the wetland systems in the Generaal Project area

1.2.7 SURFACE WATER

1.2.7.1 Locality and Background Information

Figure 28 below shows the Generaal Project in relation to the quaternary catchments areas of the Nzhelele and Mutamba Rivers.

The only existing DWA registered dams in the Nzhelele River Basin upstream of the site is the following:

- Mutshedzi Dam, registered with DWA as A805-14, Category II in catchment A80A.
- Nzhelele Dam in the Nzhelele River, registered with DWA as A800-01, Category III at outlet of catchment A80C.
- Plantation Makhado Dam in quaternary catchment of A80A, registered as A802-22, Category unknown.

There are no major dams in the Mutamba River catchment.

Surface water is utilized for irrigation from the Nzhelele canal system and from the lower reach of the Mutamba River. The water requirements of households and livestock (including game) are supplied from groundwater sources.

The eastern part of the Generaal Project area is bisected by the watershed of quaternary catchment A80G and A80F. Only a small portion of Mount Stuart Section falls within catchment A80G, while the Generaal Section is almost wholly inside catchment A80F.

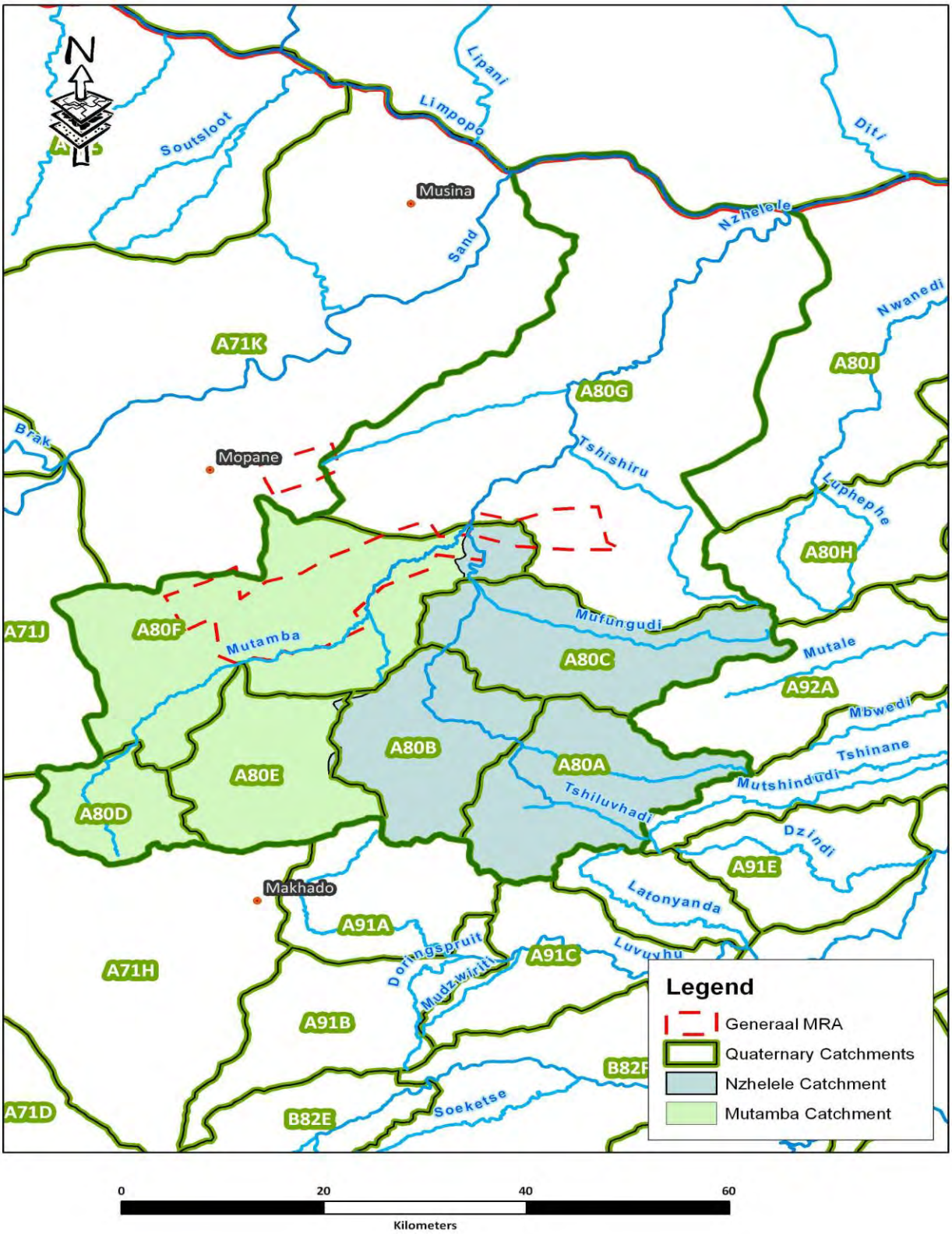


Figure 28: Generaal Project in relation to the quaternary catchment areas of the Nzhelele and Mutamba Rivers

1.2.7.2 Surface Water Quality

There are no published surface water quality data for the Mutamba River. DWA collects water quality data at the dams on the Nzhelele River system, upstream from Nzhelele Dam. This information is not deemed applicable to the point of interest in the river which is far downstream of the dams being monitored, with the Nzhelele Dam in between. Long storage times in the large volume of water stored in the dam will alter the quality profile. Limited water sampling had been conducted in 1980 and 1981 in the Nzhelele River downstream of the dam and the results are shown in Table 20. The water sampling localities are shown in Figure 29.

All samples are evaluated against the "Target Water Quality Range" as published by DWA (2nd ed., 1996) in "South African Water Quality Guidelines" for various water uses. This range is equal to the "No Effect Range". It thus specifies good or ideal water quality instead of water quality which is just acceptable or "Fit for Use".

The points range from close to the Limpopo River (A), southwards to B where there is a low weir on the river, used as road crossing. Point C is at a road crossing the river 10 km upstream from point D. Point D is at the bridge on R508 where the river is close to the Tshipise Resort.

The results above indicate high salinity levels with the target quality levels exceeded for Electrical Conductivity, nitrate, fluoride, chloride and potassium. A trend is shown with the values of elements measured downstream at A being in general higher than those measured at D.

Table 20: Water quality sampling in Nzhelele River (1980/81)

Macro-elements											
Element	Unit	DWA Database: Nzhelele River						Aquatic Ecosystem WQT	Drinking Water WQT	Agriculture WQT (irrigation)	Agriculture WQT (livestock)
Figure Ref No		A	A	B	C	D					
Gauge Number		100398	100597	100604	100605	100598					
DATE		Aug-80	Oct-81	Oct-81	Oct-81	Oct-81					
pH		8.61	8.4	8.12	8.21	8.17			6.0 - 9.0	6.5-8.4	
E.C	mS/m	216.6	181.3	167.8	191.2	164.4			150	40	
TDS	mg/l								1000		1000
NO_3	mg/l	0.02	0.63	0.75	0.06	0.55		0.5	6	5	100
F	mg/l	2.72	2.59	2.41	2.84	2.6		0.75	1	2	2
SO_4	mg/l	215.9	193.6	158.8	181.6	164.5			400		1000
Cl	mg/l	296.7	256.5	219	255	186.7			200	100	1500
Ca	mg/l	31.3	27.6	32.2	35.3	31.5			150		1000
Mg	mg/l	58.1	49.6	44	50.9	47.2			100		500
Na	mg/l	361.9	327.3	281.3	334.5	288.5			200	70	2000
TAL	mg/l	382.2	392.5	378.5	406.9	417					
K	mg/l	2.65	1.87	1.82	1.94	1.4					
CO_3	mg/l										
P	mg/l	0.005	0.006	0.003	0.003	0.01					

Source: DWA Website: http://www.dwa.gov.za/iwqs/wms/data/A_reg_WMS_nobor.htm

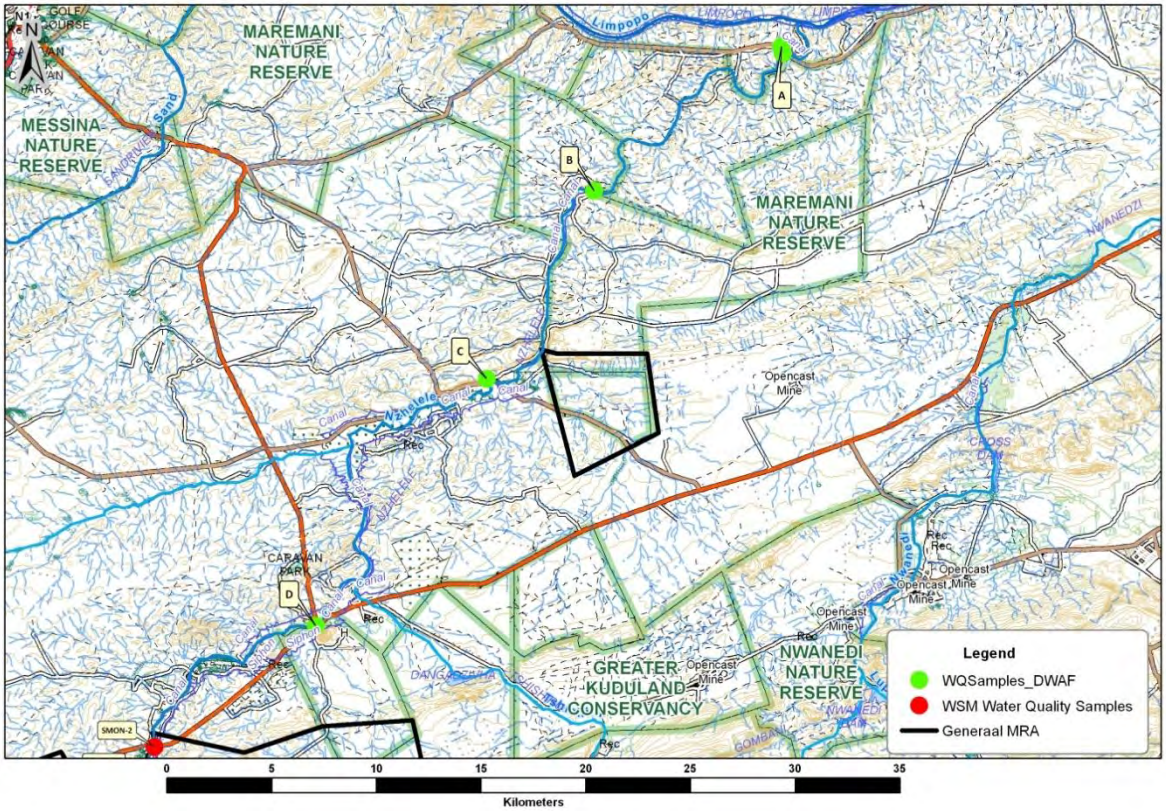


Figure 29: Water sampling points in the Nzhelele River (DWA)

Water quality sampling was done as part of the surface water assessment for the Makhado Colliery Project (WSM Leshika Consulting, 2012) and a long-term monitoring programme is under way. All but two of the monitoring points are located in the Mutamba River and its major downstream tributary, the Kandanama River. The other two points are in the Nzhelele River just upstream (Smon-13) and downstream (Smon-2) of its confluence with the Mutamba River (refer to Figure 30). Due to the arid nature of the area, streams and the rivers are mostly dry and surface flow only occurs after significant downpours. The surface flow after storms events are also often of short duration and therefore the sampling sets do not include all monitoring points. The test results of the samples collected between 2009 and 2011 are shown in Table 21.

In January 2013 an extreme rainfall event occurred in the northern Limpopo region. At the mine site over 300 mm of rain was measured in 6 days. The Mean Annual Precipitation (MAP) as measured by the close by weather station at Mutamba Ranch is only 304 mm. The runoff after this event, where the MAP occurred in less than one week, was of sufficiently long duration to enable collection of the first full set of surface water samples. The test results are shown in Table 22 (WSM Leshika Consulting, 2013).

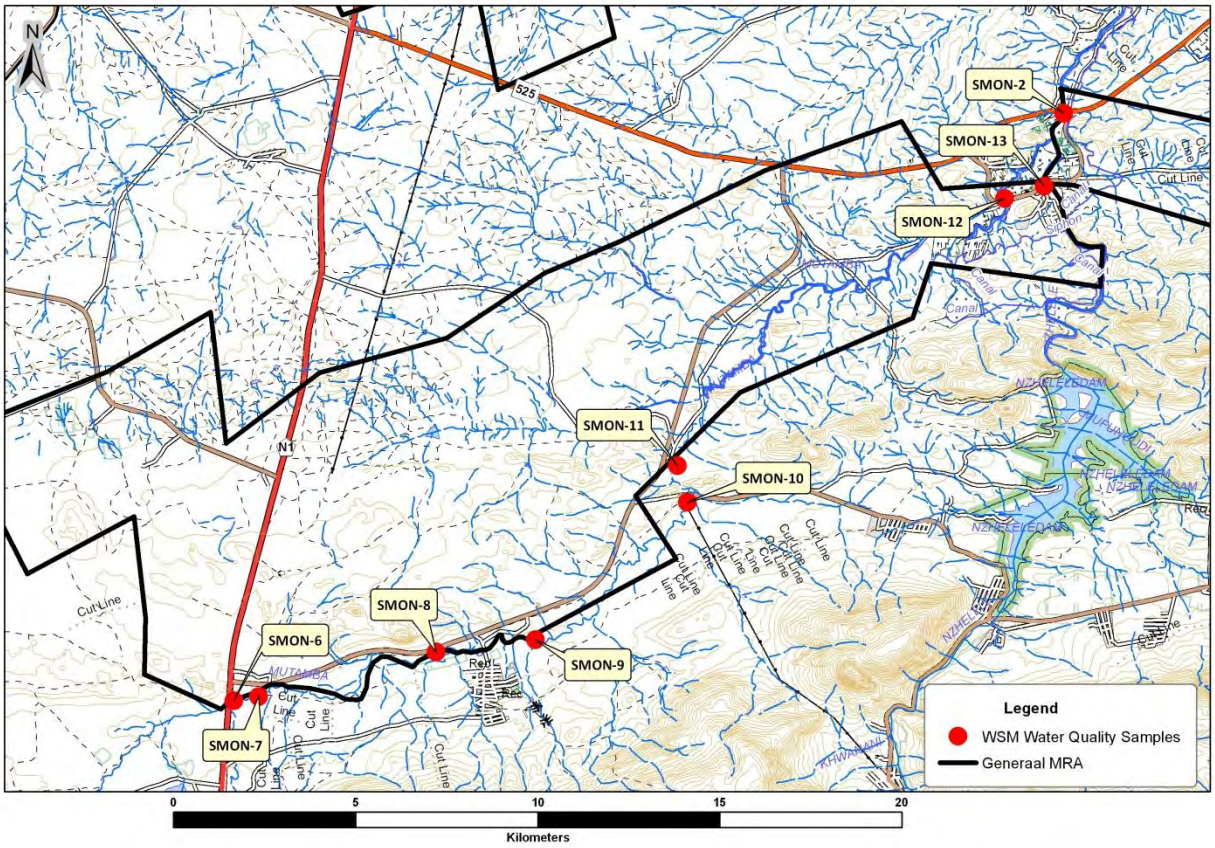


Figure 30: Locality of Makhado Project long term surface water monitoring points

The 2008/2011 results indicate fairly pristine water at the monitoring points except for elevated levels of nitrate. In contrast, the 2013 values indicate a sudden decrease in water quality from Smon-11 and further downstream. The value at Smon-13 in the Nzhelele River upstream of the Mutamba River confluence is quite good. The values at Smon-2 downstream of the confluence are on par with the Mutamba River values. There is only a small area of irrigation development upstream of Smon-13 of about 50 ha which may indicate that Smon-13 values reflect the Nzhelele Dam quality.

Micro-biological tests were conducted on samples taken in the Mutamba River in March 2009 and in May 2011 and the test results are given in Table 23. The results are evaluated against the health risk levels for drinking water (DWA, 1996) and it showed faecal coliform contamination at health risk levels for all samples, with the higher values occurring in the main stem of the Mutamba River (Smon9 to Smon11). With the river mostly dry, the first major rainfall event of the wet season will wash pollutants down so that high levels of microbiological contamination may occur.

Table 21: Mutamba River water quality data 2009/11

Macro-elements													
Element	Unit	WSM Leshika Monitoring Results 2009 to 2011								Aquatic Ecosystem WQT	Drinking Water WQT	Agriculture WQT (irrigation)	Agriculture WQT (livestock)
Figure Ref No													
WSML Number		Smon-6	Smon-6	Smon-8	Smon-9	Smon-9	Smon-10	Smon-10	Smon-11				
DATE		03/2009	12/2011	12/2011	03/2009	05/2011	05/2011	12/2011	05/2011				
pH		8.3	7.5	8.1	8.4	7.20	7.2	8.2	7.3		6.0 - 9.0	6.5-8.4	
E.C	mS/m	26.1	12.2	25.1	29.9	13.6	8.8	21.1	34.5		150	40	
TDS	mg/l	238	91	228	194	105	72	174	320		1000		1000
NO_3	mg/l		0.8	1.1		2.64	31.68	1.3	1.32	0.5	6	5	100
F	mg/l	0.5	<0.2	0.20	0.3	0.30	0.10	0.20	0.80	0.75	1	2	2
SO_4	mg/l	12	11	29	11	17	15	17	59		400		1000
Cl	mg/l	25	7	30	31	10	11	14	38		200	100	1500
Ca	mg/l	16	12	42	21	18	12	30	20		150		1000
Mg	mg/l	9	7	19	10	7	6	15	7		100		500
Na	mg/l	18	7	19	21	6	4	15	46		200	70	2000
TAL	mg/l		56	96		44	28	100	52				
HCO_3			56	96		44	28	100	52				
CO_3	mg/l		<5	<5		<5	<5	<5	<5				
P	mg/l		<0.025	<0.025		0.6	7.2	<0.025	0.3				

Table 22: Mutamba River water quality data 2013

Macro-elements														
Element	Unit	Makhado Mine Monitoring Results									Aquatic Ecosystem WQT	Drinking Water WQT	Agriculture WQT (irrigation)	Agriculture WQT (livestock)
Figure Ref No														
WSML Number		Smon-6	Smon-7	Smon-8	Smon-9	Smon-10	Smon-11	Smon-12	Smon-13	Smon-2				
DATE		Jan-13												
pH		7.9	8.2	8.2	8.3	8	8	8	8	8.2		6.0 - 9.0	6.5-8.4	
E.C	mS/m	8.3	18.8	22.8	23.3	19.1	160.9	64.9	37.7	146.5		150	40	
TDS	mg/l	64	122.2	148.2	151.5	124.2	1045.9	421.9	245.1	952.3		1000		1000
NO_3	mg/l	0.2	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	0.5	6	5	100
F	mg/l	<0.2	0.11	0.15	0.13	0.13	5.8	0.89	0.35	1.4	0.75	1	2	2
SO_4	mg/l	<5	13.75	32.18	28.46	5.66	301.98	28.4	25.52	99.94		400		1000
Cl	mg/l	<5	13.9	12.5	12.8	5.5	144.4	60.9	17.5	142.4		200	100	1500
Ca	mg/l	18	13.59	16.48	15.92	17.57	62.07	28.63	17.3	33.36		150		1000
Mg	mg/l	9	5.72	6.75	6.35	6.02	17.4	21.32	8.27	31.95		100		500
Na	mg/l	3	13.06	20.2	19.81	11.27	282.21	80.27	48.92	268.62		200	70	2000
TAL	mg/l													
HCO_3														
CO_3	mg/l													
P	mg/l	5.9	0.45	0.52	0.36	0.17	0.16	0.12	0.64	0.3				

Table 23: Results of microbiological tests

ANALYSES	UNIT	DATE	Smon1	Smon6	Smon3	Smon9	Smon10	Smon11	Target Water Quality Range for Drinking Water		
									Negligible risk	Slight risk	Health risk
Faecal Coliform	/100 mℓ	Mar-09	-	5200	-	6000	-	-			
		May-11	330	-	90	2900	26000	3600	0	0 -10	>10

1.2.7.3 Current Surface Water Use

The Generaal Project area is located north of the Mutamba River and reaches from west of the N1 north eastwards to 5 km south of Tshipise. The overall population density of the region beyond the Soutpansberg Range is low. The greater majority of present land use is given to game and cattle farming, with the operating of guest lodges and hunting the major activity.

Irrigation within the area downstream of the Nzhelele Dam occurs on both sides of the Nzhelele River and at the Mutamba River on Schuitdrift up to the confluence of the two rivers, all in quaternary catchment A80F. Irrigation continues downstream along the Nzhelele River along the western boundary of Mount Stuart within quaternary catchment A80G. Apart from the irrigation by surface water from the canal system and from the lower reach of the Mutamba River, the water requirements of households and livestock (including game) are supplied from groundwater sources.

The only other significant water use in the area is domestic use by the rural urban sector. Three villages are located to the south of the proposed MRA area, namely Fripp (on the right bank of the Mutamba River) and Makushu, Mosholombe and DoliDoli to the south east. The villages are provided with water from boreholes and from the Nzhelele Water Supply Scheme. Other villages are located further to the east in the mountain valleys south (and upstream) of Nzhelele Dam.

The Internal Strategic Perspective study (DWA, 2004) of the Nzhelele River has found that the catchment is clearly stressed and this is due to over-allocation and/or overdevelopment of the irrigation sector. This is the current situation before implementation of the ecological Reserve. No new allocations to the irrigation sector are possible at present, while additional allocations for domestic use will have to be sourced from groundwater. The preferred option for making more water available is water conservation and demand management.

1.2.7.4 Drainainage System and Main Stem Hydrology

Figure 31 shows the major rivers and the general flow directions of the drainage systems for the Mutamba River and Nzhelele River basins. The 1:100- year flood-lines for the major rivers have been determined and are included in Figure 32 and Figure 33.

Figure 31 also gives a graphical representation of the drainage density of the two catchments. The drainage density for the upper reaches of the Mutamba River is significantly less than its lower reaches. The Nzhelele River however seems to be well drained as a whole throughout its entire basin.

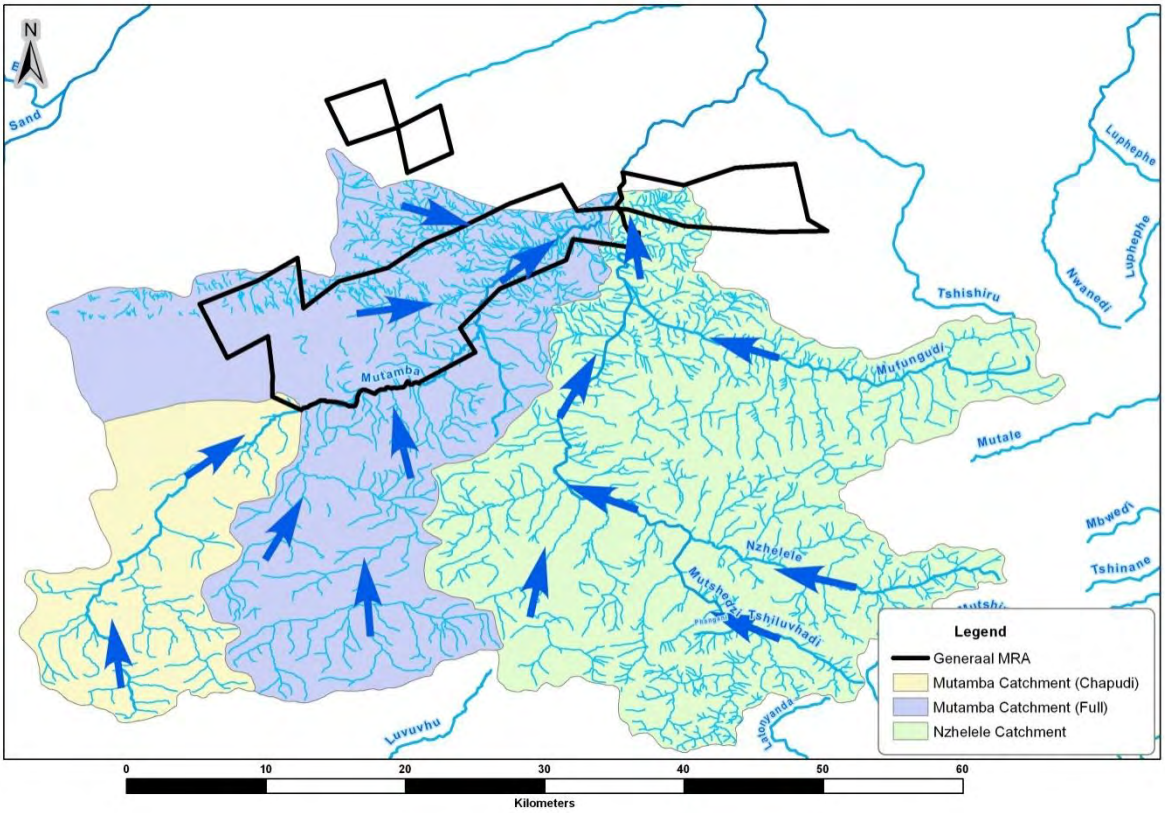


Figure 31: Major rivers and general drainage direction

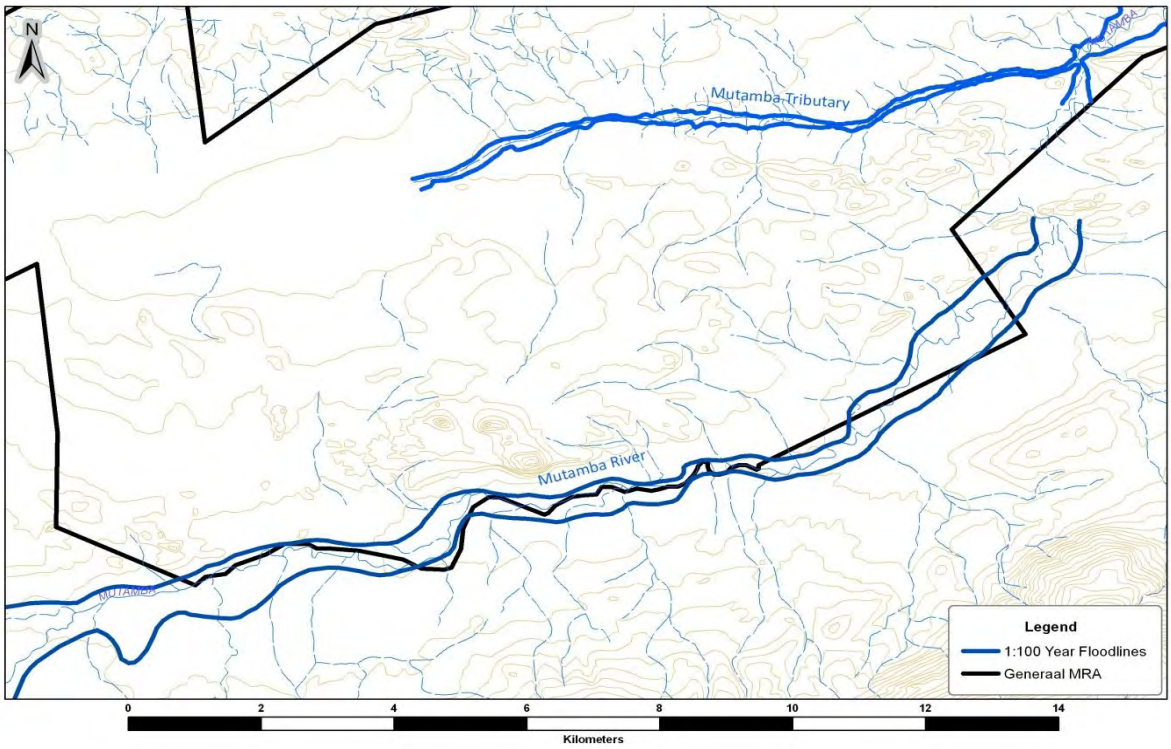


Figure 32: South-western section drainage lines and major river flood-lines

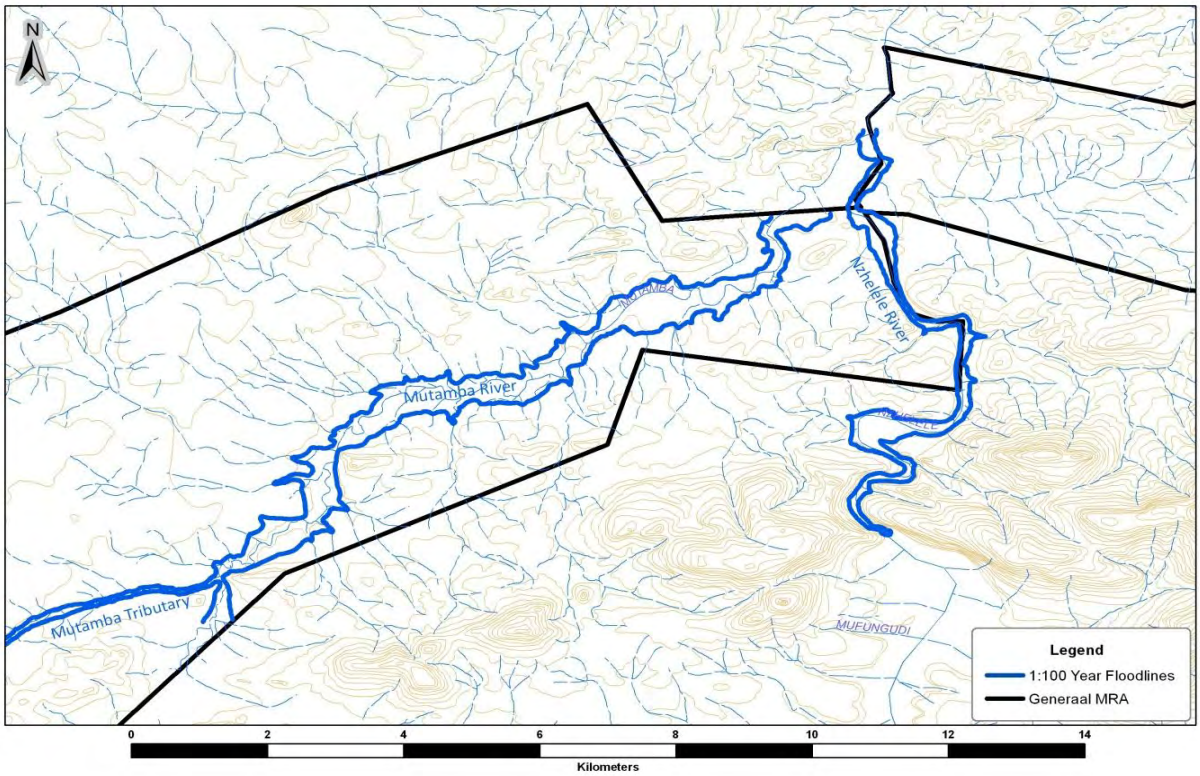


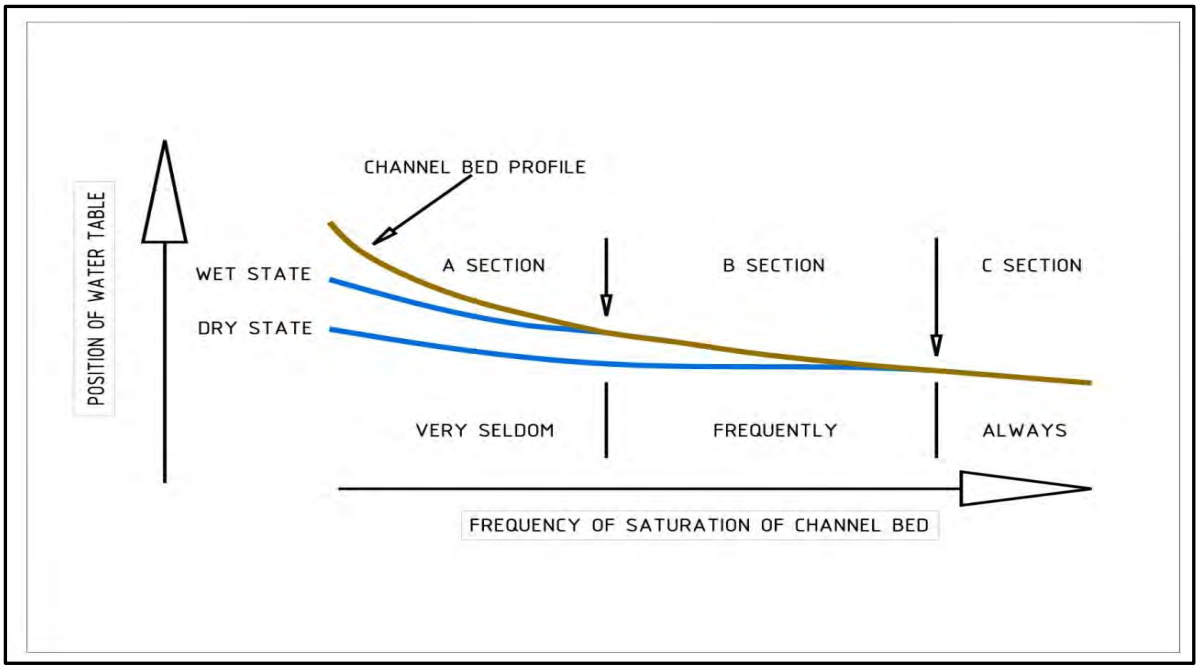
Figure 33: North-eastern section drainage lines and major river flood-lines

1.2.7.4.1 Stream classification

River channels may be classified according to guidelines by DWA in "*A practical field procedure for identification and delineation of wetlands and riparian areas*" as shown below (taken from DWA, 2005). Three sections along the length of a watercourse is defined, with the upper Section A defined as being above the zone of saturation and it therefore does not carry base flow. They are mostly too steep to be associated with alluvial deposits and are not flooded with sufficient frequency to support riparian habitat or wetlands. This type does however carry storm runoff during fairly extreme rainfall events but the flow is of short duration, in the absence of base flow. The 'A' watercourse sections are the least sensitive watercourses in terms of impacts on water yield from the catchment.

On the site, Section A channels occur on the mountain slopes and foothill slopes in this dry region, also along the smaller streams on the lower region.

Even the Mutamba River is classified as only a Section B stream. According to the DWA guidelines, the “B” Sections are those channels that are in the zone of the fluctuating water table and only have base flow at any point in the channel when the saturated zone is in contact with the channel bed. In these B Sections, base flow is intermittent with flow at any point in the channel depending on the current height of the water table. Because the channel bed is in contact with, or in close proximity to, the water table, residual pools are often observed when flow ceases. The gradient of the channel bed is flat enough in these sections for deposition of material to take place and initial signs of flood plain development may be observed.



1.2.7.4.2 Flood peak calculations

Flood peak assessments of the Sand and Mutamba Rivers have done, and is described in detail in Section 4 of the Surface Water Impact Assessment report, 2013 (ANNEX-2). It is not repeated here.

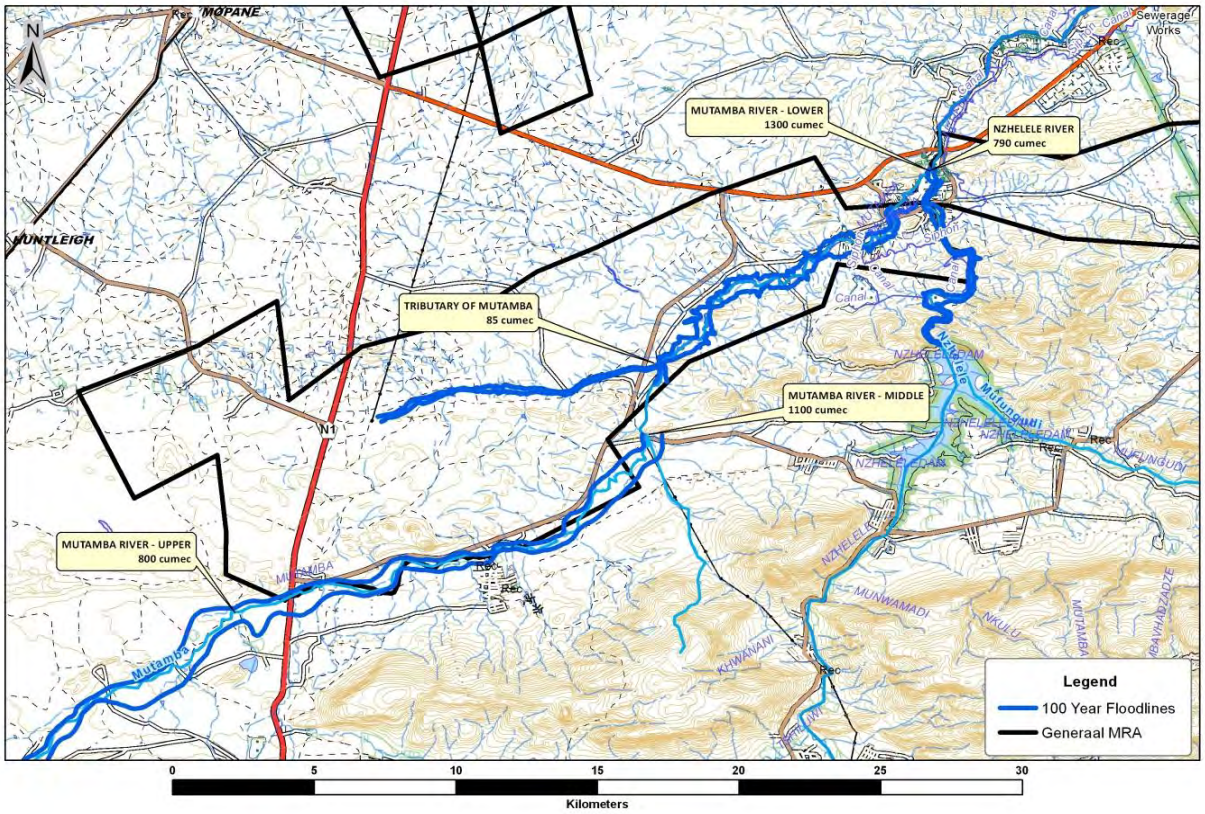


Figure 34: Locality of calculated flood peaks for the Mutamba River

1.2.8 GROUNDWATER

1.2.8.1 Hydrocensus

A borehole census was conducted on the mining right application area over the following farms; Riet 182 MT, Skuitdrif 179 MT, Mount Stuart 153 MT, Terblanche 155 MT, Septimus 156 MT, Stayt 183 MT, Chase 576 MS, Nakab 184 MT, Wildgoose 577 MS, Fanie 578 MS, Van Deventer 641 MS, Rissik 637 MS, Phantom 640 MS, Kleinenberg 636 MS, Coen britz 646 MS, Juliana 647 MS, Bekaf 650 MS and Generaal 587 MS. Data was collected on some of the farms outside of the application area such as Japie 574 MS, Oom Jan 586 MS, Keerweerder 169 MT (DoliDoli) and Thiel 168 MT (Ndouvhada). Where possible water levels were measured and abstraction information obtained. Water samples were taken for macro and micro chemical analysis. The borehole localities are indicated on Figure 35. The hydrocensus borehole data are summarized in Tables 5 and 6 of the Groundwater Specialist Report (ANNEX-3).

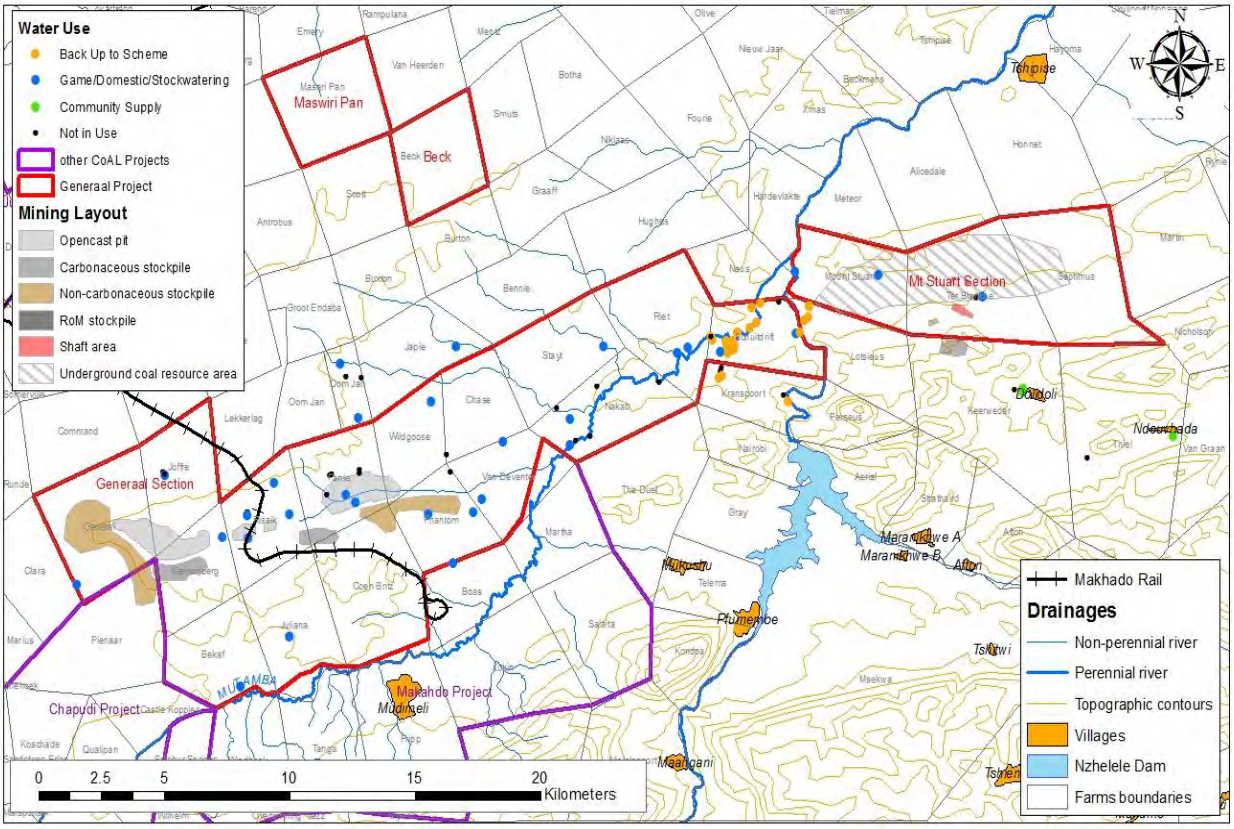


Figure 35: Generaal Project hydrocensus borehole localities

1.2.8.2 Piezometry and Groundwater Flow

If the water table is undisturbed, the groundwater surface tends to mimic a subdued form of the topography. Water levels measured during the hydrocensus exhibited water levels ranging from artesian to 35 meters below ground level (mbgl).

The water level data was colour coded according to set piezometric height ranges from which a piezometric contour map was drawn (see Figure 36). Groundwater flow direction is perpendicular to the piezometric contours and towards the drainages.

Groundwater is used on a small scale within the mine application area and as a result water levels are probably close to the natural state. Some weakly artesian boreholes occur on the Mt Stuart Section where the elevated hydrostatic head of the mountain has an influence.

Springs occur where the water table intersects the surface, usually along some structure. The well-known hot spring at Tshipise is associated with a large dolerite sill and two secondary fault systems in conjunction with the Tshipise Fault.

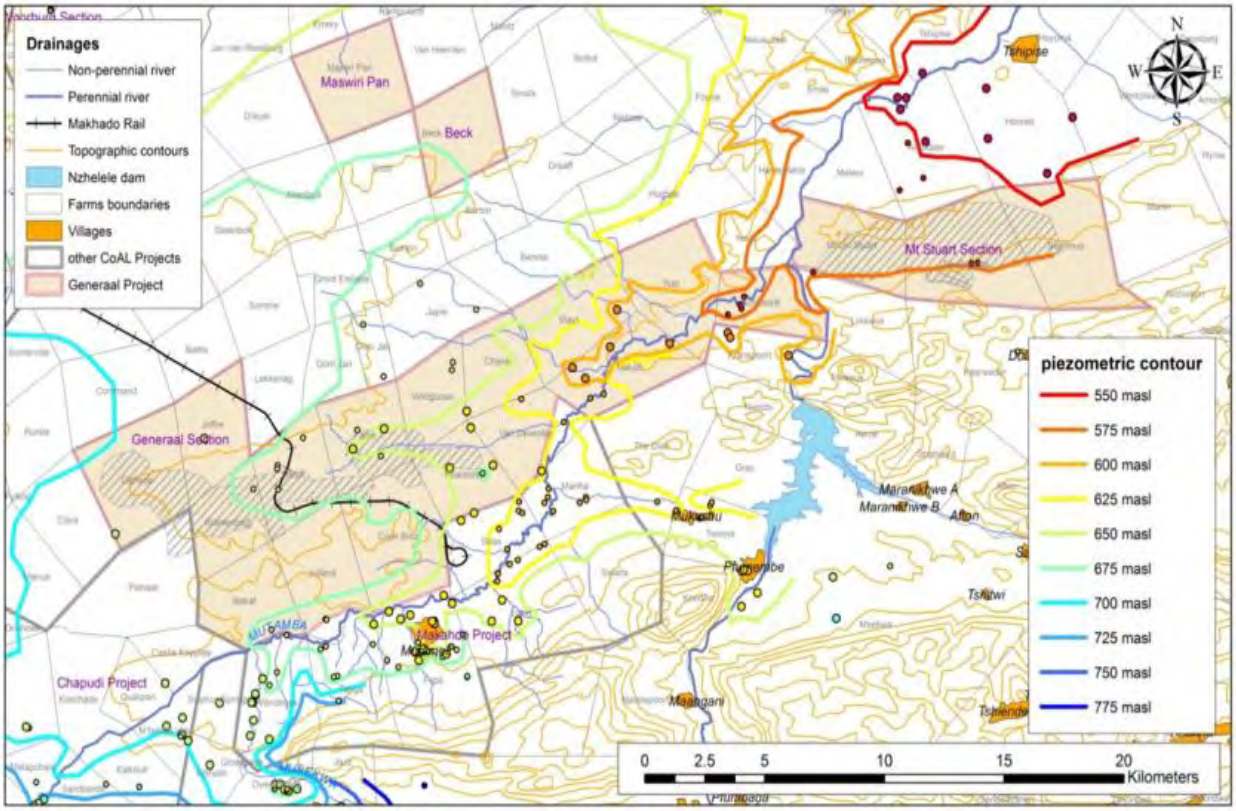


Figure 36: Piezometric contour map

1.2.8.3 Impact of Regional Geology on the Hydrogeology of the Project Area

Groundwater flow in the study area is towards the Mutamba and Nzhelele Rivers. Groundwater derived from recharge in the mountains is generally of better quality than that derived from direct recharge onto Karoo and basement rocks. Elevated salt content is indicative of the arid climate and contact with upper Karoo strata.

The Generaal Section can be regarded as having a low to moderate groundwater potential with groundwater occurrences confined to the major structures. The Generaal Section is situated mostly north of the Mutamba where recharge is low.

The Mount Stuart Section has a higher groundwater potential because of the proximity to the mountains (higher recharge) and the presence of E-W trending faults systems at the base of the mountain and within the mountain valleys which can store and transmit groundwater. These fractured systems are recharged by Nzhelele River where high yielding boreholes associated with these fault systems have been developed. In addition the Nzhelele River also has well developed alluvial deposits. Both these aquifer types are utilized by irrigation farmers in the area as a backup water supply to the Nzhelele Scheme during drought periods.

1.2.8.4 Groundwater Quality

Groundwater quality is dependent on the concentrations of soluble salts and the residence time of water within the host rock. Most of the water derived from secondary aquifers reflects the aridity of the study area with elevated salt content.

The chemistry data is presented with reference to the Water Quality Threshold (WQT) according to DWA-SA Water Quality Guidelines for Rivers and Streams for the following water uses:

i Drinking water

ii Agriculture-irrigation

iii Agriculture-livestock

1.2.8.4.1 Macro chemistry

Table 24: DWA Water Quality Threshold Classification – Macro chemistry

Species	pH	E.C	TDS	NO_3	F	SO4	Cl	Ca	Mg	Na
Unit		mS/m	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Drinking	6.0 - 9.0	150	1000	6	1	400	200	150	100	200
Agriculture (irrigation)	6.5 - 8.4	40		5	2		100			70
Agriculture (livestock)			1000	100	2	1000	1500	1000	500	2000

A total of 41 hydrocensus samples were analysed for pH and major and micro elements. The chemistry results are listed in the table below. Concentrations exceeding the WQT for any of the above uses are marked in red.

TDS is a general indicator of water quality. The histogram indicates that 45% of the samples were below 1000 mg/l and of potable quality. The remaining 55% are above 1000 mg/l but no sample was found to exceed 5000 mg/l within the project area. Water quality in the application area can be described as being of good to moderate quality. The TDS data was plotted and contoured to depict the spatial distribution of TDS concentrations in groundwater for the Generaal Project area and surrounds (Figure 37).

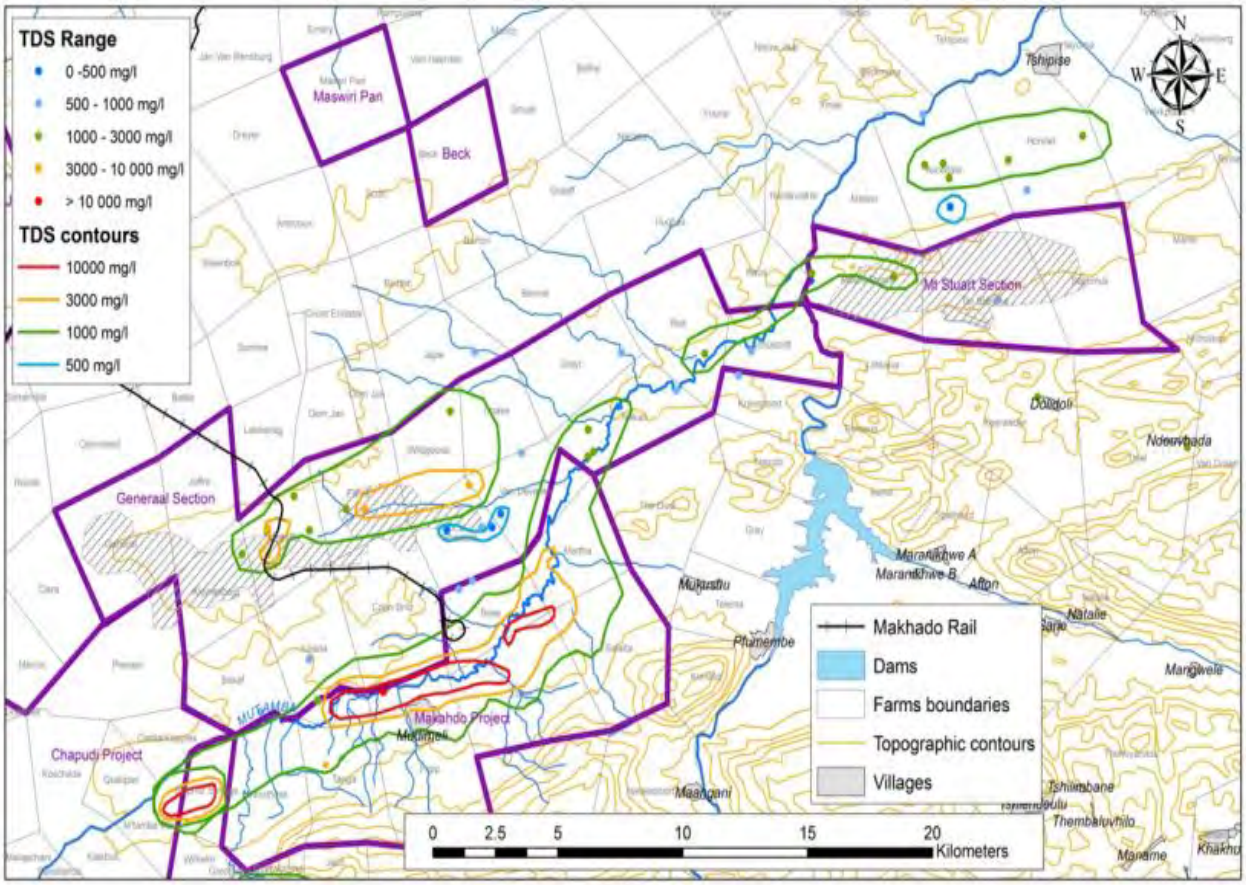


Figure 37: TDS contour map

Table 25: Macro-chemistry with DWA Classification

Species			E.C	TDS	NO_3	F	SO_4	Cl	Ca	Mg	Na
Unit	date	pH	mS/m	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
BF-1	15/07/2011	7.5	139	898	0.7	3.1	157	181	56	53	159
BF-2	15/07/2011	6.9	773	4960	0.8	0.8	185	0	237	372	778
BF-4	15/07/2011	7.3	72	461	0.5	0.4	28	62	42	43	44
BOAS -1	3/04/2008	6.7	135	984	0.0	0.5	62	186	165	107	110
EKL-15	23/05/2011	7.8	142	832	3.0	0.5	11	151	33	46	143
EKL-16	5/09/2011	7.4	85	524	0.6	0.2	27	121	36	22	74
FANI-1	14/11/2011	7.7	201	1290	0.2	3.7	5	380	8	9	390
FANI-2	14/11/2011	7.2	525	3360	3.0	0.5	157	0	122	235	614
H18-0006	15/07/2011	7.9	294	1718	0.2	0.4	110	552	34	16	511
H25-0010	8/09/2013	7.3	246	1601	64.0	0.3	127	333	161	144	150
H29-0011	8/09/2013	7.2	179	1165	29.8	0.2	50	224	141	70	154
Jap-1	8/09/2013	7.1	143	929	9.2	1.8	46	63	77	100	121
Kran-1	8/09/2013	7.9	104	676	1.6	2.8	105	111	25	12	194
Mon-13	27/06/2011	7.8	108	612	0.5	1.8	49	141	65	63	115
Mon-13	15/07/2011	8.6	99.7	580	0.5	1.6	45	98	58	61	109
Mon-18	8/02/2011	8.6	150	932	5.6	0.6	41	196	26	40	174
Mon-18	15/07/2011	8.7	140	862	0.2	0.6	39	184	54	59	212
Mon-24	23/04/2012	7.4	150	932	8.1	1.0	57	120	95	98	109
MTS-1	8/09/2013	7.9	154	998	1.4	2.8	18	241	28	37	256
Nak-2	21/06/2011	7.2	242	1452	7.7	2.3	138	346	91	108	274
Nak-3	21/06/2011	7.4	331	1986	0.2	3.0	170	519	83	124	529
Nak-4	21/06/2011	7.5	276	1662	3.4	3.7	159	442	61	95	421
Ojan-1	8/09/2013	7.6	232	1507	18.5	2.4	98	236	75	110	301
PHAN-1	12/09/2011	7.6	93	612	13.0	0.5	48	53	117	61	31
PHAN-2	12/09/2011	7.6	79.9	444	4.3	0.2	6	35	66	49	43
PHAN-3	12/09/2011	7.4	80.9	490	5.8	0.2	10	36	57	54	42
PHAN-3	23/04/2012	7.2	89.5	548	5.3	0.2	10	40	62	62	53
Riet-2	8/09/2013	7.5	298	1936	3.2	1.7	317	525	68	98	440
RIS-1	19/11/2012	7.4	782	4720	0.0	0.5	76	2282	190	370	988
RIS-2	19/11/2012	7.8	441	2802	2.9	0.6	240	1036	103	198	632
RIS-3	19/11/2012	7.4	312	2022	2.2	1.2	176	630	123	185	334
RIS-4	19/11/2012	7.7	369	2288	4.6	0.6	130	748	58	146	591
RIS-5	19/11/2012	8	498	3072	1.7	0.5	130	1236	143	200	677
RIS-6	19/11/2012	7.7	415	2562	1.2	0.7	103	1083	128	189	501
Sdrif-15	8/09/2013	7.7	124	804	3.4	4.2	147	146	53	30	175
Ter-1	8/09/2013	7.7	191	1243	8.2	1.4	79	218	60	75	273
Ter-3	8/09/2013	7.9	116	757	1.4	0.6	45	90	73	71	90
WILDG-1	12/09/2011	7.4	198	1270	10.0	1.3	113	195	118	111	167

1.2.8.4.2 Micro chemistry

Table 26: DWA Water Quality Threshold Classification – Micro chemistry

Element	Al	As	B	Cd	Co	Cr	Cu	Fe	Mn	Mo	Ni	Pb	Se	V	Zn
Unit	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Drinking	0.50	0.05		0.005		0.050	1.3		0.4			0.010	0.05	0.100	5.000
Agriculture(irrigation)	5.00	0.1	0.5	0.010	0.05	0.100	0.2		0.02	0.010	0.200	0.200	0.02	0.100	1.000
Agriculture(livestock)	5.00	1	5	0.010	1	1.000	0.5		10	0.010	1.000	0.100	0.05	1.000	20.000

The chemistry results are listed in the table below. Concentrations exceeding the WQT for any of the above uses are marked in red. It must be noted that concentrations exceeding the WQT are often below the detection limit for some elements.

The ICP scan (analysis method) detection limit for Cd, Mo and Pb is below or on the WQT concentration value. Elevated B occurs in the groundwater samples from Rissik, Stayt and Fanie. Sub-economic Cu, Zn mineralization along the Tshipise fault on the farm Stayt is reflected by slightly elevated Zinc and V values in the water (Mon-24).

1.2.8.5 Groundwater Use

Groundwater abstraction is on a small scale mainly for farmsteads, hunting/game lodges and game and stock watering. Irrigation occurs (Figure 38) on the farms Mount Stuart (494 ML/annum) and Maswiri (824 ML/annum) but they utilize surface water from the Nzhelele Irrigation Scheme with groundwater as a back-up when surface water is not available. There are numerous high yielding boreholes developed for this purpose, as gauged from pump installations, although mostly in a state of disrepair. These holes have not been used for several years and quantitative data was not available from the owners/managers at the time of census. The boreholes abstract water mostly from the fractured rock aquifers consisting of the E-W fault systems within the Karoo and Soutpansberg strata.

The total estimated existing groundwater abstraction for the Generaal Project area is estimated at 117 m^3/day or 43 ML/annum (Table 27). This excludes backup ground water that is utilized during drought periods when the Nzhelele Scheme allocation is inadequate to sustain the citrus orchards.

Generaal MRA area is about 22 800 ha or 228 000 000 m^2. Average annual recharge over the area is taken as 4.7 mm/annum (see chapter 6.4) or 0.0047 m/annum. Therefore average annual recharge volume is 228 000 000 X 0.0047 = 1 071 600 m^3/annum or 2 935 m^3/day. This is more than 25 times the existing use and it can therefore be concluded that groundwater is underutilized. However during drought periods when the irrigation farmers need the backup groundwater the groundwater resources could be heavily utilised.

Table 27: Micro-chemistry from historical data with DWA Classification

Element	Al	As	B	Cd	Co	Cr	Cu	Mn	Mo	Ni	Pb	Se	V	Zn
Unit	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
BF-1	0.10	0.01	0.35	0.005	0.025	0.025	0.025	0.05	0.025	0.025	0.020	0.020	0.025	0.025
BF-2	1.65	0.01	0.64	0.005	0.025	0.025	0.037	1.54	0.025	0.025	0.020	0.020	0.025	0.319
BF-4	0.10	0.01	0.19	0.005	0.025	0.025	0.025	0.27	0.044	0.025	0.020	0.020	0.025	0.025
EKL-15	0.10	0.13	0.25	0.005	0.025	0.025	0.025	0.14	0.025	0.025	0.020	0.020	0.036	0.025
EKL-16	0.14	0.01	0.16	0.005	0.025	0.025	0.083	0.60	0.025	0.025	0.020	0.020	0.025	0.196
FANI-1	0.20	0.01	0.78	0.005	0.025	0.025	0.025	0.04	0.025	0.025	0.020	0.020	0.025	0.102
FANI-2	0.10	0.01	0.74	0.005	0.025	0.025	0.025	0.03	0.025	0.025	0.020	0.020	0.037	0.025
H18-0006	0.10	0.01	0.96	0.005	0.025	0.025	0.025	0.03	0.025	0.025	0.020	0.020	0.025	0.157
H25-0010	<0,01	<0,03	0.25	<0,01	<0,01	<0,01	<0,01	<0,01	<0,05	<0,01	<0,09	0.02	0.05	0.06
H29-0011	<0,01	<0,03	0.31	<0,01	<0,01	<0,01	<0,01	<0,01	<0,05	<0,01	<0,09	0.03	0.02	0.08
Jap-1	<0,01	<0,03	0.21	<0,01	<0,01	<0,01	<0,01	0.20	<0,05	<0,01	<0,09	<0,02	0.03	1.00
Kran-1	<0,01	<0,03	0.28	<0,01	<0,01	<0,01	<0,01	<0,01	<0,05	<0,01	<0,09	<0,02	<0,01	<0,01
Mon-13	0.59	0.01	0.37	0.005	0.025	0.025	0.025	0.07	0.060	0.025	0.020	0.020	0.025	0.025
Mon-13	0.10	0.01	0.41	0.005	0.025	0.025	0.025	0.34	0.025	0.025	0.020	0.020	0.025	0.025
Mon-18	0.10	0.01	0.22	0.005	0.025	0.025	0.025	0.03	0.025	0.025	0.020	0.020	0.050	0.025
Mon-18	0.13	0.01	0.36	0.005	0.025	0.025	0.025	0.03	0.025	0.025	0.020	0.020	0.030	0.025
Mon-2	0.13	0.01	0.98	0.005	0.025	0.025	0.025	1.40	0.025	0.025	0.020	0.020	0.025	0.025
Mon-24	2.81	0.03	0.29	0.005	0.025	0.025	0.025	0.42	0.025	0.025	0.020	0.020	0.025	2.210
MTS-1	<0,01	<0,03	0.33	<0,01	<0,01	<0,01	<0,01	0.05	<0,05	<0,01	<0,09	0.03	<0,01	0.01
Nak-2	0.10	0.01	0.50	0.005	0.025	0.025	0.025	0.03	0.025	0.025	0.020	0.020	0.025	0.025
Nak-3	0.49	0.01	0.97	0.005	0.025	0.025	0.025	0.91	0.025	0.071	0.047	0.034	0.177	1.550
Nak-4	0.12	0.01	0.69	0.005	0.025	0.025	0.025	0.03	0.025	0.025	0.020	0.020	0.032	0.036
Ojan-1	<0,01	<0,03	0.71	<0,01	<0,01	<0,01	0.02	<0,01	<0,05	<0,01	<0,09	<0,02	0.03	0.02
PHAN-1	0.10	0.01	0.10	0.005	0.025	0.025	0.025	0.03	0.025	0.025	0.020	0.020	0.032	0.025
PHAN-2	0.10	0.01	0.16	0.005	0.025	0.025	0.025	0.03	0.025	0.025	0.020	0.020	0.026	0.025
PHAN-3	0.11	0.02	0.17	0.005	0.025	0.025	0.025	0.03	0.025	0.025	0.020	0.020	0.025	0.027
PHAN-3	0.10	0.01	0.16	0.005	0.025	0.025	0.092	0.03	0.025	0.025	0.020	0.020	0.040	0.096
Riet-2	<0,01	<0,03	0.75	<0,01	<0,01	<0,01	<0,01	0.02	<0,05	<0,01	<0,09	<0,02	0.02	0.03
RIS-1	0.14		0.57	<0.005		<0.025		0.93	<0.025	<0.025	<0.020		<0.025	
RIS-2	0.12		0.58	<0.005		<0.025			<0.025	<0.025	<0.020		<0.025	0.290
RIS-3	0.14		0.86	<0.005		<0.025		0.03	<0.025	<0.025	<0.020		<0.025	1.010
RIS-4	<0.01		0.76	<0.005		<0.025			<0.025	<0.025	<0.020		<0.025	
RIS-5	0.13		0.70	<0.005		<0.025			<0.025	<0.025	<0.020		<0.025	
RIS-6	0.13		0.47	<0.005		<0.025		0.07	<0.025	<0.025	<0.020		<0.025	0.054
Sdrif-15	<0,01	<0,03	0.24	<0,01	<0,01	<0,01	<0,01	<0,01	<0,05	<0,01	<0,09	<0,02	0.01	0.01
Ter-1	<0,01	<0,03	0.39	<0,01	<0,01	<0,01	<0,01	0.30	<0,05	<0,01	<0,09	<0,02	0.03	0.35
Ter-3	<0,01	<0,03	0.22	<0,01	<0,01	<0,01	<0,01	<0,01	<0,05	<0,01	<0,09	0.02	<0,01	0.01
WILDG-1	0.10	0.01	0.35	0.005	0.025	0.025	0.027	0.03	0.035	0.025	0.020	0.020	0.025	0.073

Table 28: Estimated Groundwater Use

Quat	Owner/Business	Farms	Estimated Groundwater Use					Comments
			House hold and Lodges (m3/day)	Game and stock watering (m3/day)	Cleared Land (Ha)	Irrigated Land (Ha)	Total Estimated groundwater use ML /annum	
A80F	Ekland Safaris	Generaal 587 MS	5	3	25	0	11	Water use for Lodges, game and dams
		Kleinenberg 636 MS	0	3	-	-		
		Bekaf 650 MS	12	3	-	-		
		Juliana 647 MS	0	1	-	-		
		Coen Britz 647 MS	0	2	-	-		
	Malumbane Community Trust	Joffre 584 MS	5	3	-	-	3	Water use for domestic cattle and game
	W C Fourie	Rissik 637 MS	5	3	-	-	3	Water use for domestic cattle and game
	S P Matodzi	Rissik 637 MS	0	2	8	0	1	Water use for domestic cattle and game
	L H Traut	Rissik 637 MS	2	1	-	-	1	Water use for domestic cattle and game
	A S van der Merwe	Fanie 578 MS	5	3	-	-	3	Water use for domestic cattle and game
	Tony Zambakides	Wildgoose 577 MS	3	3	-	-	2	Water use for domestic and game
		Phantom 640 MS						
	Born Free Investments	Chase 576 MS	3	3	-	-	2	Water use for lodge, domestic and game
		Van Deventer 641 MS						
	Clint Howes	Stayt 183 MT	1	2	-	-	1	Water use for lodge, domestic and game
		Nakab 184 MT						
	Maswiri Boerdery	Riet 182 MT	3	3	-	-	14	Water use for lodge, domestic and game. Irrigation from Nzhelele scheme 830 Ml/annum
		Skuitdrift 179 MT	30	3	172	105		
		Kranspoort	0	0	-	-		
		Lotsieus	0	0	-	-		
		Perseus	0	0	-	-		
A80G	Mount Stuart Boerdery	Mount Stuart 153 MT	1	2	119	63	2	Water use for domestic and game. Irrigation from Nzhelele scheme 500 Ml/annum
		Terblanche 155 MT	0	2	-	-		
		Septimus 156 MT	0	0	-	-		
		TOTAL	117 m3/day				43 ML/annum	

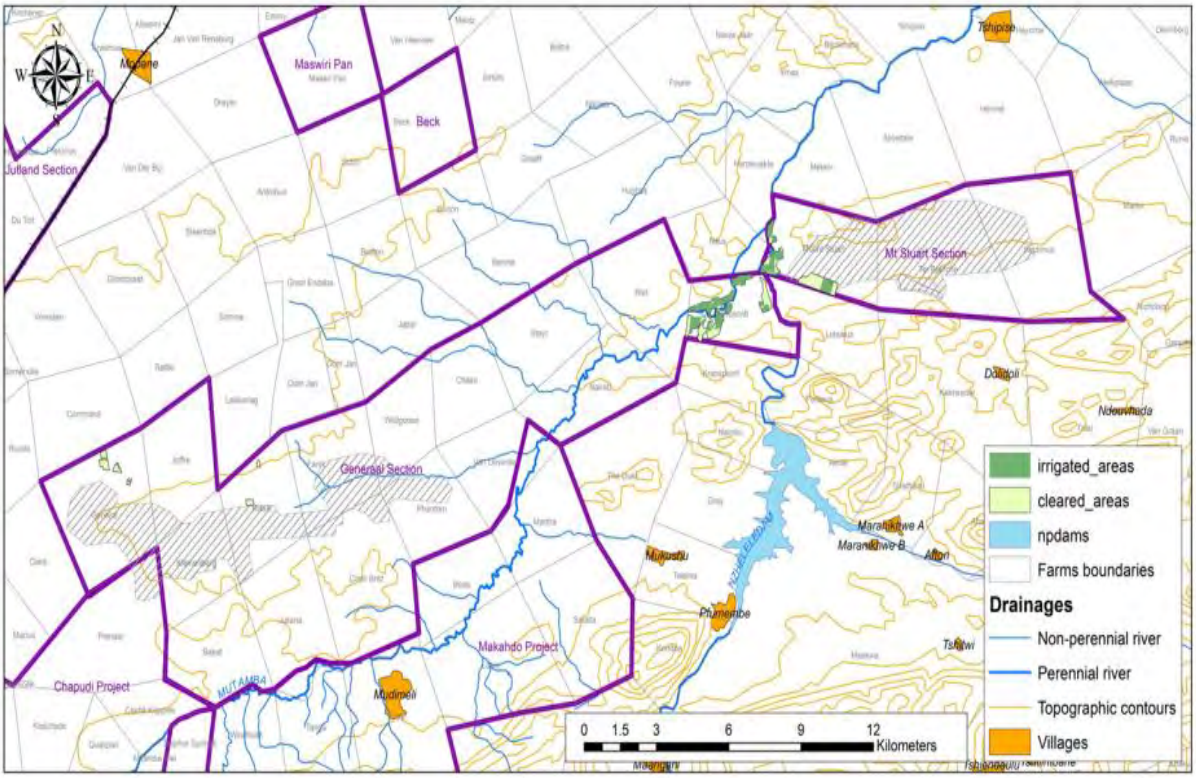


Figure 38: Irrigated and cleared areas

1.2.8.6 Regional Groundwater Flow

To determine the orientation of groundwater flow on a regional scale, water levels were available from 965 boreholes. Historic data from 657 boreholes was obtained from the National Groundwater Database (NGDB), and the remainder was collected by hydrocensus during the study for Makhado Colliery Project and the present study. These data were converted to absolute water levels by determining borehole elevation from Google Earth. The MODFLOW model (Section 6, ANNEX-3), was utilised to generate current water levels as a piezometric map (Figure 39). The model was also utilised to generate a map of water level under virgin conditions (Figure 40).

Regional groundwater flow is oriented northeast towards the Limpopo River (Figure 40). Flow volumes are extremely low due to the low permeabilities and low recharge, especially in the northern half of the catchment underlain by the Limpopo Mobile Belt and overlain by alluvium.

In the south, where the catchment is underlain by Karoo and Soutpansberg rocks and where mining is proposed, a local northward hydraulic gradient is present due to high recharge in the Soutpansberg Mountains. A significant cone of depression exists around the Sand River directly north of the Soutpansberg Mountains due to the large scale irrigation from groundwater (Figure 39). Quantifying abstraction is problematic, since not all the lands are irrigated every year. Irrigation was estimated from lands identified as being irrigated on the most recent Google Earth images, i.e. 2009.

Under natural conditions, groundwater drains via localised springs, as base flow to the perennial tributaries flowing from the Soutpansberg, and by evapotranspiration by riverine vegetation along the main river channels.

Groundwater is of good quality in the Soutpansberg rocks, which is the main recharge zone; however, increased salinity occurs northwards as groundwater flows through saline Karoo sediments, accumulating salts. Low recharge rates in the drier terrain north of the Soutpansberg also results in low recharge rates to dilute these salts. The movement of groundwater passing through saline deposits of the Karoo rocks, and subsequent evapotranspiration by riverine vegetation, causes a rapid salt accumulation northward, with a peak salt load along the fringes of the channels lying over Karoo rocks, like the Mutamba, the Brak and Sand Rivers, resulting in poor natural water quality.

The Mufungudi entering Nzhelele Dam, the Kandanama River a tributary of the Mutamba River, entering the catchment in the south along the N1 highway, and the upper reaches of the Mutamba emerging from the Soutpansberg are perennial, but lose water to groundwater as they flow out of the Soutpansberg, becoming ephemeral. This water is abstracted by boreholes for irrigation on the farms Windhoek, Grootgeluk and Overwinning along the Kandanama, and by irrigation boreholes along the Sand River on Sterkstroom, Sitapo, Sutherland and Waterpoort, or is utilized by riparian vegetation. Very little surface runoff is believed to recharge the regional aquifers north of the Soutpansberg, since high salinity levels in the Karoo aquifers suggest it is not recharged by fresh water from the river. In comparison, groundwater is of good quality in the Karoo aquifer along the southern tributaries such as the Kandanama River, where river losses take place. Isotope studies conducted during the Makhado Colliery Project investigation confirm this.

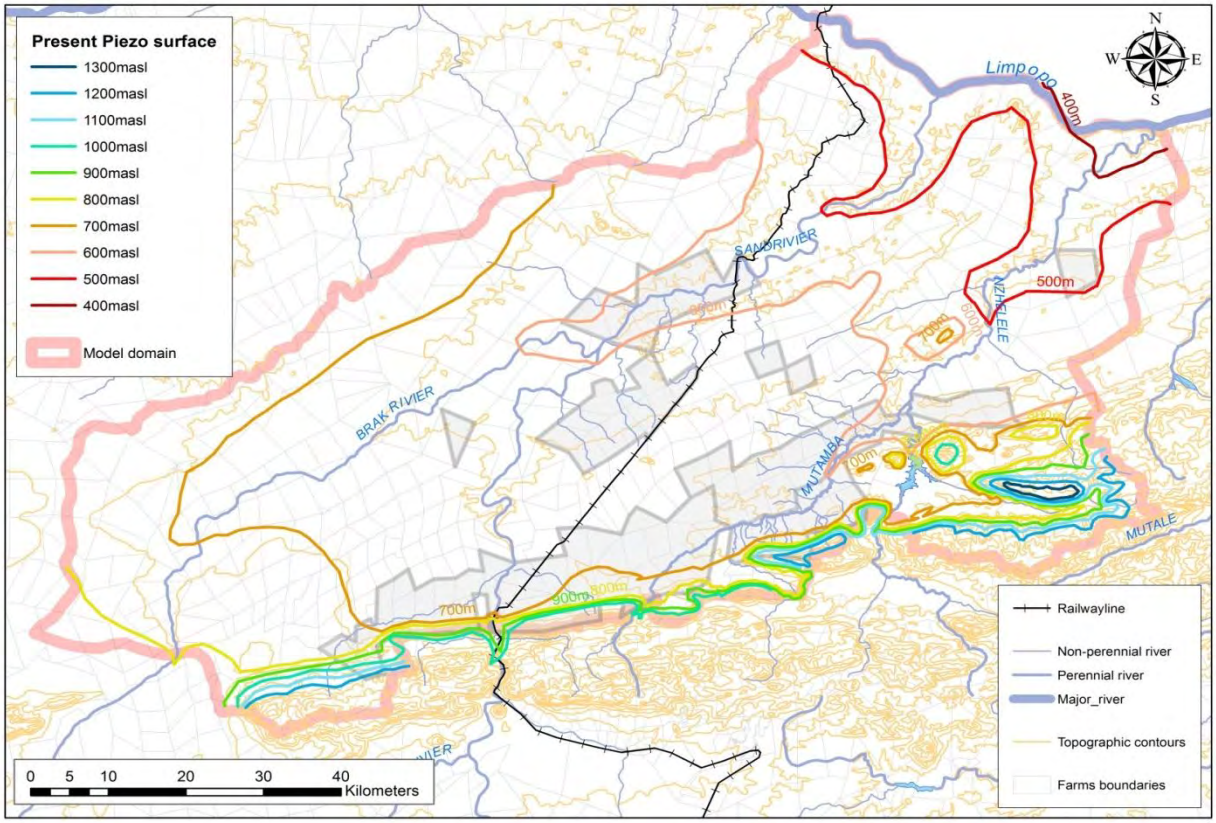


Figure 39: Steady state water levels under current conditions (mamsl)

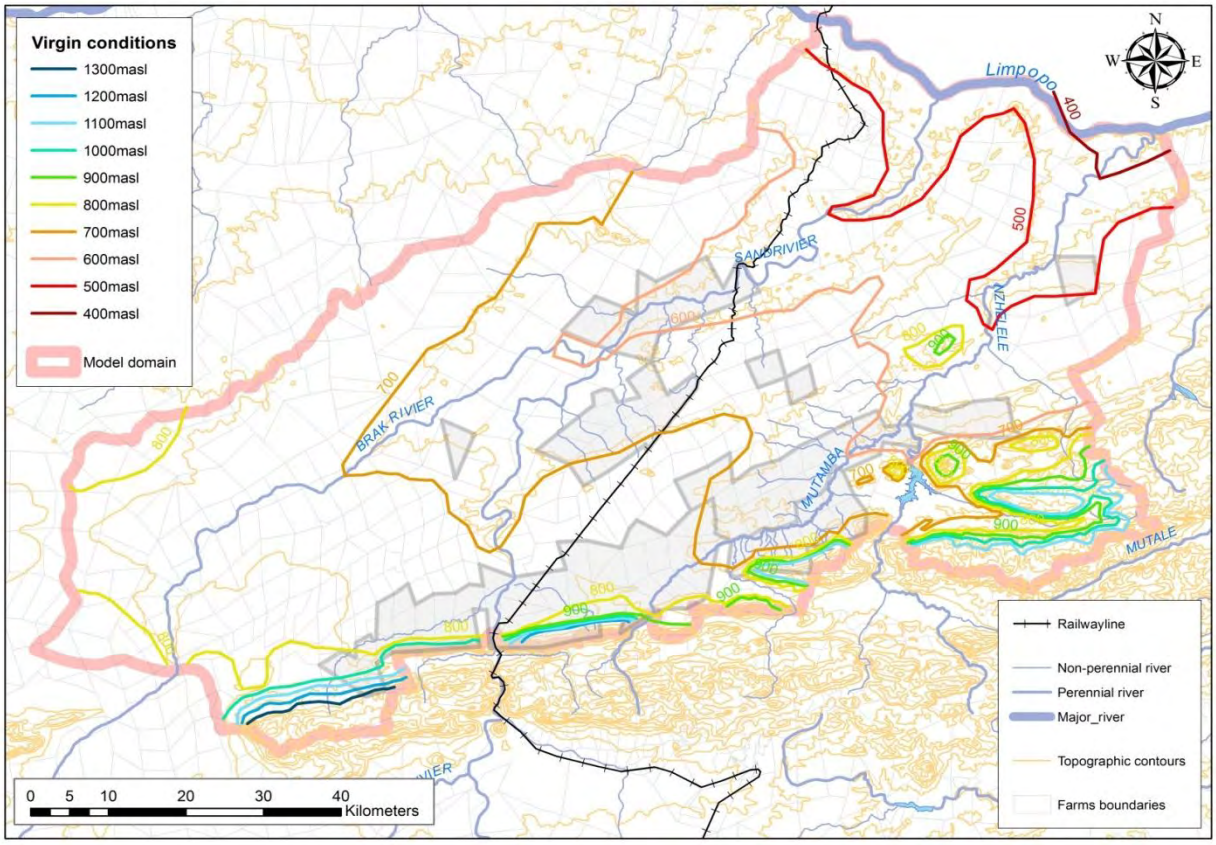


Figure 40: Steady state water levels under virgin conditions (mamsl)

1.2.9 AIR QUALITY

1.2.9.1 Baseline Air Quality

A qualitative discussion of each identified polluting source in the project area is provided in the subsection below. The aim of this section is to highlight the potential contribution of surrounding sources to the overall ambient air quality in the area.

- Domestic fuel burning
- Agricultural activities
- Unpaved roads
- Veld fires
- Mining activities

1.2.9.1.1 Domestic fuel burning

There are numerous low income household within the surrounding villages and communities such as Mudimeli, Mosholombe, Makushu Village and DoliDoli village. It is anticipated that these low income household use domestic fuels such as coal and wood for cooking and space heating purposes. The use of coal, wood and paraffin are a common medium for both heating and cooking purposes as the resource is economic and easily attainable.

However biomass and coal smoke contains a large number of pollutants an known health hazards, including criteria pollutants such as particulate matter, carbon monoxide, nitrogen dioxide, sulphur dioxide (mainly from coal) as well as formaldehyde, and polycyclic organic matter, including carcinogens such as benzo[*a*]pyrene (Ezzati and Kammen, 2002).

The combustion of coal is an incomplete process which results in the emission of carbon monoxide, methane and nitrogen dioxide. Exposure to indoor air pollution (IAP) from the combustion of solid fuels has been implicated with varying degrees of evidence, as a causal agent of several diseases in developing countries, including acute respiratory infectious (ARI) and otitis media (middle ear infection), chronic obstructive pulmonary disease (COPD), lung cancer (from coal smoke), asthma, cancer of the nasopharynx and larynx, tuberculosis, perinatal conditions and low birth weight, and diseases of the eye such as cataract and blindness (Ezzati and Kammen, 2002).

Even in electrified areas, it is noted that household make use of domestic fuels either due to the high energy cost or the continued use of traditional fuels.

1.2.9.1.2 Agricultural activities

Agricultural activity can be considered a significant contributor to particulate emissions, although tilling, harvesting and other activities associated with field preparation are seasonally based. The main focus internationally with respect to emissions generated due to agricultural activity is related to animal husbandry, with special reference to malodours generated as a result of the feeding and cleaning of animals. The types of livestock assessed included pigs, sheep, chicken, goats and cattle, with game farming being the largest commercial enterprise. Odorous pollutants associated with animal husbandry are ammonia and hydrogen sulphide. However it is unlikely that these sources will contribute significantly to the cumulative particulate load in the area.

Little information is available with respect to the emissions generated due to the growing of crops. The activities responsible for the release of particulates and gases to atmosphere would however include:

- Particulate emissions generated due to wind erosion from exposed areas;
- Particulate emissions generated due to the mechanical action of equipment used for tilling and harvesting operations;
- Vehicle entrained dust on paved and unpaved road surfaces;
- Gaseous and particulate emissions due to fertilizer treatment; and
- Gaseous emissions due to the application of herbicides and pesticides.

1.2.9.1.3 Unpaved roads

A concern resulting from unpaved road in the Generaal project area is fugitive dust emissions and particulate matter. Dust is transport by the prevailing wind condition. When vehicles travel on unpaved roads, the force of the wheels on the road surface causes the pulverisation of surface materials. Particle are lifted and dropped from the rolling wheels and the road is exposed to stronger air currents in turbulent shear with the surface.

Exhaust tailpipe emissions from vehicles is a significant source of particulate emissions and can be grouped into primary and secondary pollutants. Primary pollutants which are CO_2, CO, hydrocarbons, SO_2, NO_X, particulates and lead are those emitted directly into the atmosphere and secondary pollutants which are nitrogen dioxide, ozone which is a photochemical oxidant, hydrocarbons, sulphuric acid, sulphates, nitric acid and nitrate aerosol are those formed in the atmosphere as a result of chemical reactions. Toxic hydrocarbons include acetylaldehyde, benzene and formaldehyde, carbon particles, sulphates, aldehydes, alkanes, and alkenes.

1.2.9.1.4 Veld fires

Limpopo has a high risk of veld fires. A veld fire is defined as a large scale natural combustion process that consumes various ages, sizes, and types of flora growing outdoors in a geographical area. Consequently, veld fires are potential sources of large amounts of air pollutants that should be considered when attempting to relate emissions to air quality. The size and intensity, even the occurrence, of a veld fires depend directly on such variables as meteorological conditions, the species of vegetation involved and their moisture content, and the weight of consumable fuel per hectare (available fuel loading).

The major pollutants from veld burning are PM, CO and VOCs. Nitrogen oxides are emitted at rates of from 1 to 4 g/kg burned, depending on combustion temperatures. Emissions of SO_x are negligible (USEPA, 1996). A study of biomass burning in the African savannah estimated that the annual flux of particulate carbon into the atmosphere is estimated to be of the order of 8 Tg C, which rivals particulate carbon emissions from anthropogenic activities in temperate regions (Cachier *et al*, 1995).

1.2.9.1.5 Mining activities

Mining operations are generally associated with significant sources of fugitive dust emissions which occur due to wind erosion of extensive, poorly controlled impoundments or other large material storage piles. Such sources are frequently associated with localised nuisance dust that contributes to the concentration of fine particulate matter in the atmosphere. Whereas high dust fallout rates have been measured to occur in close proximity to poorly controlled impoundments, the contribution of such impoundments to airborne fine particulate concentrations is lower. The potential effects are significantly increased in areas where residential settlements occur in close proximity.

Other emissions generated due to mining operations are generally associated with surface mining activity. Dust fallout and inhalable particulate emissions are generated due to aeolian action on exposed storage piles, material transfer activity, vehicle entrainment on both paved and unpaved road networks, drilling and blasting operations, as well as due to various process related emissions (crushing and screening of ore and ore products).

Due to planned and existing mining activity located near the Generaal Project area, there is the possibility that air quality impacts from other mines could influence the cumulative air quality impacts at and near the site.

1.2.9.2 Ambient Monitoring

1.2.9.2.1 Particulate Matter

Ambient monitoring was undertaken by Royal HaskoningDHV at the proposed Makhado Colliery project for a period of one year (March 2012 – March 2013). Monitoring was undertaken using the Grimm and Davis monitoring equipment which meets the quality standards required by SANS (South African National Standards). The monitor was installed within the Mudimeli Village (Figure 41).

Figure 42 illustrates the PM_{10} and $PM_{2.5}$ for the July 2012 – April 2013 monitoring period. Variable levels of PM were experienced at the site. The SANS standard for PM_{10} of 120 µg/m^3 were exceeded on 5 occasions:

- 28 July (130.3 µg/m^3)
- 16 August (120.95 µg/m^3)
- 26 August (169.66 µg/m^3)
- 1 September (120.95 µg/m^3)
- September (175.2 µg/m^3)

There were no recorded exceedences of the newly gazetted $PM_{2.5}$ standard of 65 µg/m^3.

Figure 41: Grimm monitor including surrounding schools

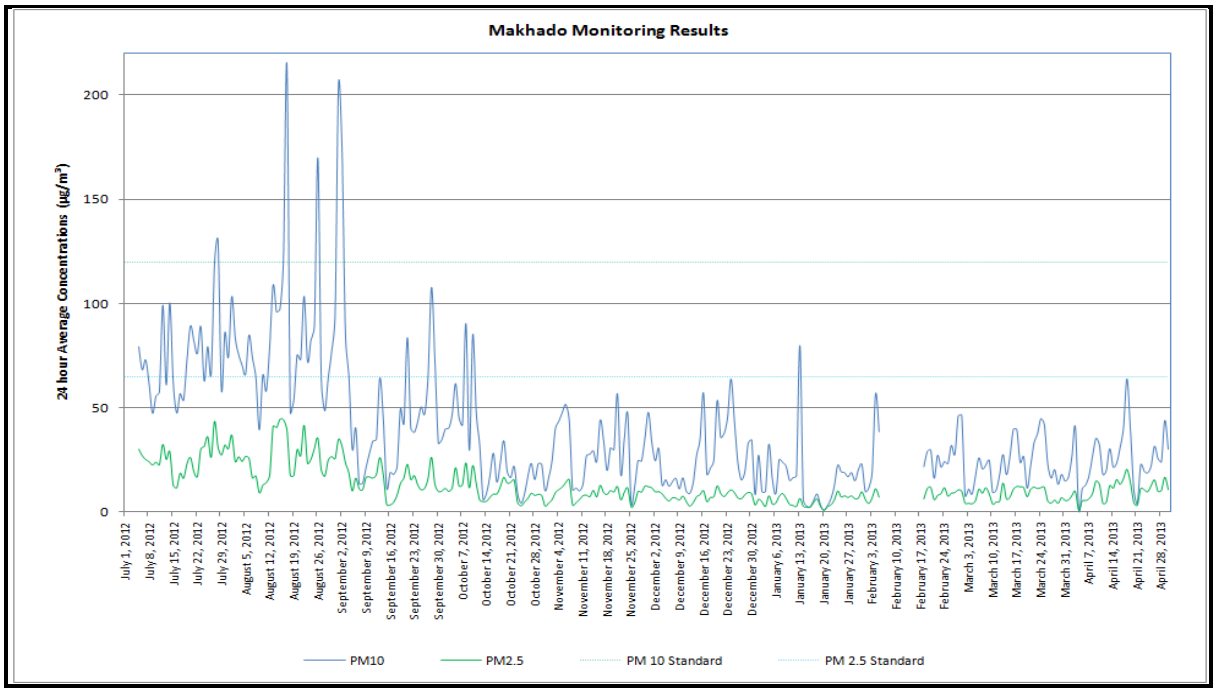


Figure 42: Particulate matter monitoring at the Makhado Colliery

The study area is situated in the semi-arid zone of the Soutpansberg. The area is within the impact zone of the tropical cyclone occurring in the Indian Ocean, which results in high rainfall peaks. The project area is characteristic of cool dry winters and warm wet summers. The wind field for the

monitoring period is illustrated in Figure 43, which shows a predominant wind direction from the South eastern region.

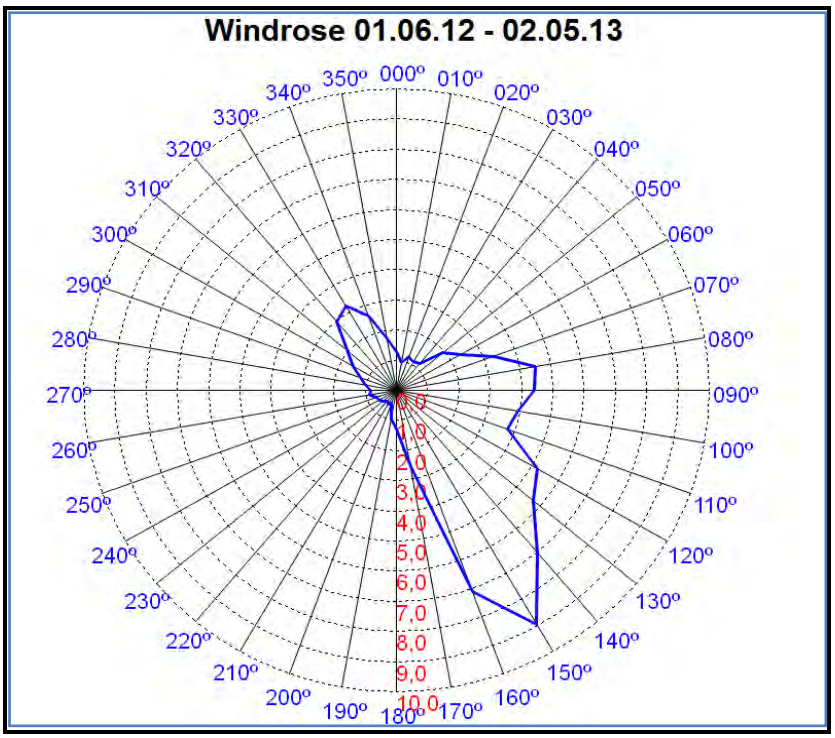


Figure 43: Wind rose for the July 2012 – April 2013 monitoring period

1.2.9.2.2 Dust fallout monitoring

The Makhado Colliery currently carries out dust fallout monitoring at three designated location: Fripp dustwatch, Windhoek dustwatch and MCC dustwatch (Figure 44). Dust fallout monitoring was initiated in August 2010.

The industrial limit of 1200 mg/m^2/day was exceeded at MCC monitoring point during August 2012 with 1254 mg/m^2/day. The domestic standard of 600 mg/m^2/day was exceeded during the following months:

- August 2010 - MCC, 937 mg/m^2/day
- September 2010 - MCC, 817 mg/m^2/day
- October 2010 - MCC, 933 mg/m^2/day
- November 2010 – MCC, 990 mg/m^2/day
- October 2011 – Windheok, 714 mg/m^2/day
- December 2011 – Windhoek, 623 mg/m^2/day and MCC, 775 mg/m^2/day
- February 2012 – Windhoek, 642 mg/m^2/day and MCC, 610 mg/m^2/day
- August 2012 – Windhoek, 666 mg/m^2/day
- September 2012 – MCC, 880 mg/m^2/day

The dust fallout rate is highest during the winter month of August and spring months (September, October and November). The dust fallout concentration coincides with windy conditions and low levels of precipitation. Dust suppression techniques for example continuous watering should be considered during the dry and windy seasons in order to limit the impacts of dust fallout within the area.

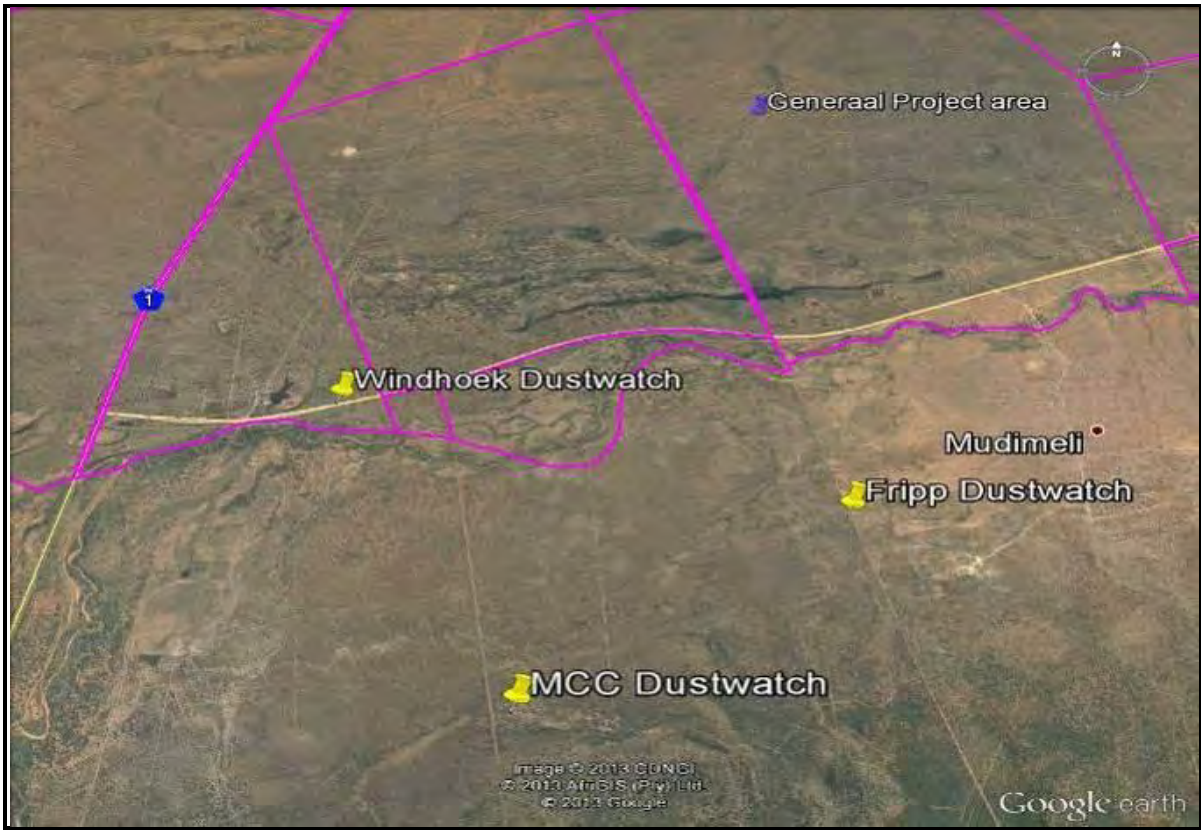


Figure 44: Dust fallout monitoring

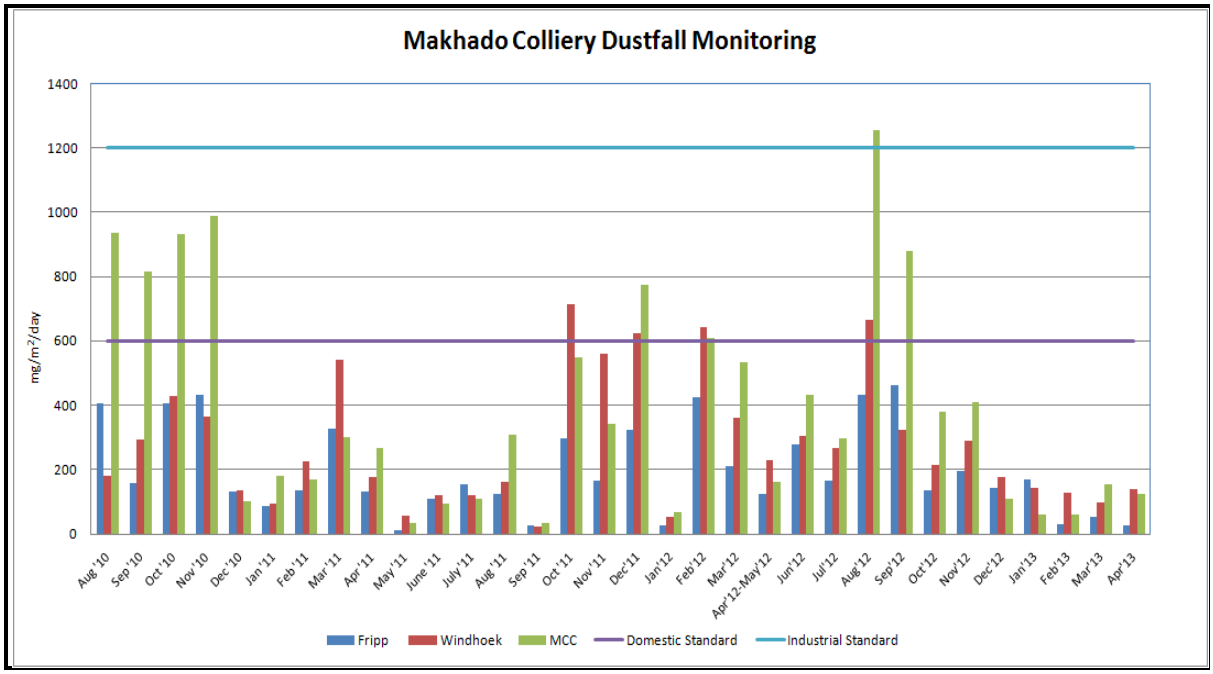


Figure 45: Dust fallout monitoring during the July 2012 – April 2013 monitoring period

1.2.10 AMBIENT NOISE

1.2.10.1 Noise Criteria of Concern

The criteria that will be used to determine the significance of the noise impact during the EIA phase were drawn from the criteria for the description and assessment of environmental impacts from the EIA Regulations, published by the DEA (April 1998) in terms of the NEMA, SANS 10103 as well as guidelines from the World Health Organization (WHO).

There are number of criteria that are of concern for the assessment of noise impacts. These can be summarised in the following manner:

- Increase in noise levels: People or communities often react to an increase in the ambient noise level they are used to, which is caused by a new source of noise. With regards to the Noise Control Regulations (promulgated in terms of the ECA), an increase of more than 7 dBA is considered a disturbing noise. This is also the criteria promoted to define the potential on potentially sensitive receptors. Refer to Figure 46.
- Zone Sound Levels: Also referred as the acceptable rating levels, it sets acceptable noise levels for various areas. Refer to Table 29.
- Absolute or total noise levels: Depending on their activities, people generally are tolerant to noise up to a certain absolute level, e.g. 65 dBA. Anything above this level will be considered unacceptable.

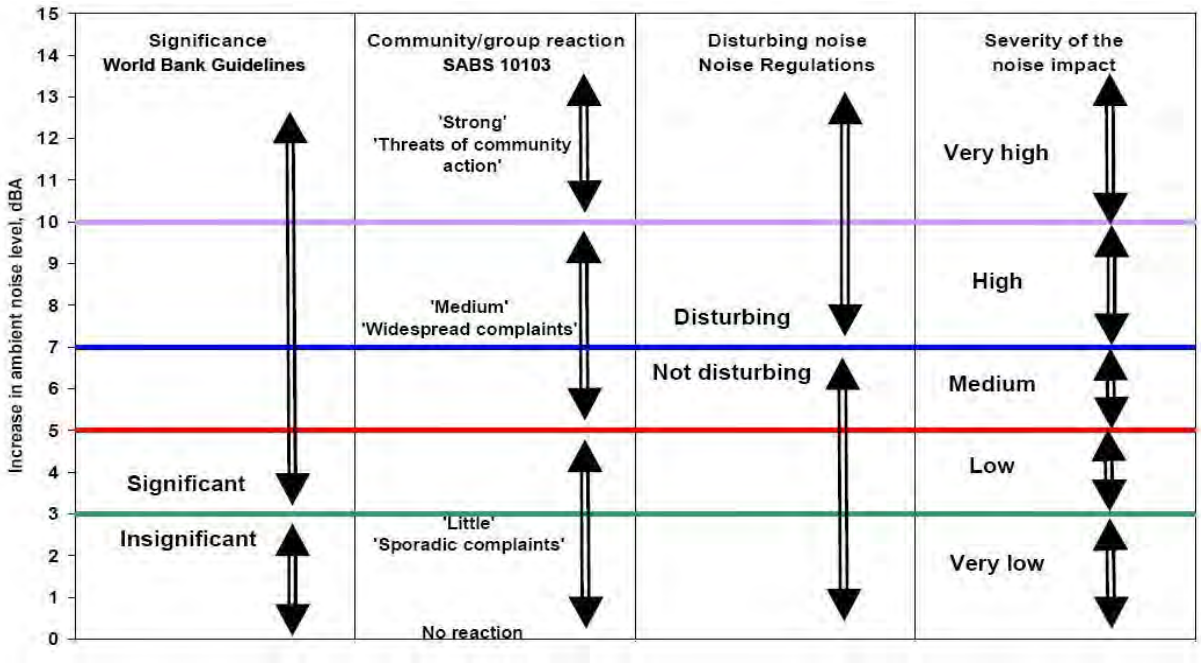


Figure 46: Criteria to assess the significance of impacts stemming from noise

In South Africa the document that addresses the issues concerning environmental noise is SANS 10103 (Edition 6 of 2008 – refer to Table 29). It provides the maximum average background ambient sound levels, $L_{Req,d}$ and $L_{Req,n}$, during the day and night respectively to which different types of developments may be exposed. Based on onsite measurements, considering both the $L_{Aeq,10min}$ and L

$_{A90}$ measurements, the ambient sound levels on and around the proposed activity correspond to the rating levels for an rural area. Zone Sound Levels therefore used would be:

- Day (06:00 to 22:00) – $L_{Req,d}$ = 45 dBA.
- Night (22:00 to 06:00) – $L_{Req,n}$ = 35 dBA.

SANS 10103 also provides a guideline for estimating community response to an increase in the general ambient noise level caused by an intruding noise. If Δ is the increase in noise level, the following criteria are of relevance:

- Δ ≤ 3 dBA: An increase of 3 dBA or less will not cause any response from a community. It should be noted that for a person with average hearing acuity, an increase of less than 3 dBA in the general ambient noise level would not be noticeable.
- < Δ ≤ 5 dBA: An increase of between 3 dBA and 5 dBA will elicit 'little' community response with 'sporadic complaints'. People will just be able to notice a change in the sound character in the area.
- < Δ ≤ 15 dBA: An increase of between 5 dBA and 15 dBA will elicit a 'medium' community response with 'widespread complaints'. In addition, an increase of 10 dBA is subjectively perceived as a doubling in the loudness of a noise. For an increase of more than 15 dBA the community reaction will be 'strong' with 'threats of community action'.

Table 29: Acceptable zone sound levels for noise in districts (SANS 10103)

1	2	3	4	5	6	7
Type of district	**Equivalent continuous rating level ($L_{Req.T}$) for noise,** dBA					
	Outdoors			**Indoors, with open windows**		
	Day-night $L_{R,dn}$[a]	**Day-time $L_{Req,d}$[b]**	**Night-time $L_{Req,n}$[b]**	**Day-night $L_{R,dn}$[a]**	**Day-time $L_{Req,d}$[b]**	**Night-time $L_{Req,n}$[b]**
RESIDENTIAL DISTRICTS						
a) Rural districts	45	45	35	35	35	25
b) Suburban districts with little road traffic	50	50	40	40	40	30
c) Urban districts	55	55	45	45	45	35
NON RESIDENTIAL DISTRICTS						
d) Urban districts with some workshops, with 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

In addition, the number of $L_{A,max}$ events above 60 dBA (60 dBA outside, 45 dBA inside a dwelling assuming 15 dBA attenuation) should be identified and where possible defined, to confirm whether there exist a risk of loud noises that could result in sleep disturbances. Where identified, management measures should be considered to minimize the significance of this impact.

1.2.10.2 Existing Ambient Sound Levels

1.2.10.2.1 Measurement procedure

Ambient (background) noise levels were measured at appropriate times in accordance with the South African National Standard SANS 10103:2008 "The measurement and rating of environmental noise with respect to land use, health, annoyance and to speech communication". The standard specifies the acceptable techniques for sound measurements including:

- type of equipment (Class 1);
- minimum duration of measurement;
- microphone positions and height above ground level;
- calibration procedures and instrument checks; and
- supplementary weather measurements and observations.

1.2.10.2.2 Limitations: Acoustical measurements and assessments

Limitations due to environmental acoustical measurements include the following:

- Ambient sound levels are the cumulative effects of innumerable sounds generated at various instances both far and near. A high measurement may not necessarily mean that noise levels in the area are always high. Similarly, a low sound level measurement will not necessarily mean that the area is always quiet, as sound levels will vary over seasons, time of the day, faunal characteristics, vegetation in the area and meteorological conditions (especially wind). This is excluding the potential effect of sounds from anthropogenic origin. It is impossible to quantify and identify the numerous sources that influenced one 10-minute measurement using the reading result at the end of the measurement;
- Defining ambient sound levels using the result of one 10-minute measurement will be very inaccurate (very low confidence level in the results) for the reasons mentioned above. The more measurements that can be collected at a location the higher the confidence levels in the ambient sound level determined (at that location). The more complex the sound environment, the longer the required measurement (especially when at a community or house);
- Determination of existing road traffic and other noise sources of significance are important (traffic counts etc);
- Measurements over wind speeds of 3 m/s could provide data influenced by wind-induced noises;
- Ambient sound levels recorded near rivers, streams, wetlands, trees and bushy areas can be high due to faunal activity which can dominate the sound levels around the measurement point. This generally is still considered naturally quiet and understood and accepted as features of the natural soundscape, and various cases sought after and pleasing;
- Considering one sound descriptor is not sufficient for and acoustical assessment. Parameters such as L_{AMin}, L_{AIeq}, L_{Aeq}, L_{Ceq}, L_{AMax}, LA_{10}, LA_{90} and spectral analysis forms part of the many variables to be considered;
- It is technically difficult to correctly measure the spectral distribution of a large equipment in an industrial setting due to the other noise sources active in the area;

- Exact location of a sound level meter in an area in relation to structures, vegetation and external noise sources will impact on the measurements; and
- As a residential area develops the presence of people will result in increased sounds. These are generally a combination of traffic noise, voices, animals and equipment (incl. TV's and Radios). The result is that ambient sound levels will increase as an area matures.

1.2.10.2.3 Existing activities / contributing factors

The following environmental components may contribute or alter the sound character of the area:

- ***Topography***: The proposed operation falls in an area that can be described as Extremely Irregular Plains. The Soutpansberg Mountains is just south of the operation. Excluding the mountain to the south there are little local features that could act as noise barriers considering practical distances at which sound propagates.
- ***Surrounding Land Use***: The area in the vicinity of the proposed operation is currently classified as Vacant or Unspecified. A number of the farms in the vicinity are used for game ranching and lodges. Agricultural activities are mainly limited closer to the Nzhelele River, downstream of the Nzhelele Dam. Identified activities are unlikely to influence ambient sound levels in the area.
- ***Roads and Railways***: The most important road (in terms of acoustics in the study area) is the N1 National route to Musina. The N1 carries sufficient traffic to impact on the ambient sound levels a distance away from the road. The R525 running east towards Tshipise runs along the northern border of the project area, but does not carry any traffic of acoustic significance. Aerial images also highlighted a number of smaller farming roads not expected to carry any traffic of acoustic significance. The Makhado-Musina railway line runs to the west of the Generaal Project area and is reported to carry four trains per day (Cosijn, 2012) but is too far from the main project site to impact on ambient sound levels in this area.
- ***Residential Areas***: A number of communities reside in the area, namely Mudimeli on the farm Fripp 645 MS, south of the Generaal Section, and Makushu, Mosholombe and DoliDoli to the south of the Mount Stuart Section.
- ***Other Industrial Activities***: Most of the site is rural with little significant industrial noise sources. The Masequa Brick Works is situated on the farm Windhoek just east of the N1 to the south of the Generaal Project.
- ***Ground Conditions and Vegetation***: The proposed Generaal Project is located within the Savannah biome, characterized by a grassy ground layer and a distinct upper layer of woody plants (trees and shrubs). Where this upper layer is near the ground (low growing) the vegetation may be referred to as Shrubveld, where it is tall and dense, as Woodland, and the intermediate stages are locally known as Bushveld (BGIS, 2011).The natural veldt has been significantly disturbed in areas due to agriculture and game farming. It is the opinion of the author that the ground surface is sufficiently covered to assume 50% soft ground conditions for modelling purposes. It should be noted that this factor is only relevant for sound waves being reflected from the ground surface, with certain frequencies slightly absorbed by the vegetation.

1.2.10.2.4 Ambient sound measurements

Ambient sound measurements were collected from the 18th September to the 20th September 2013. A total of five different class-1 sound level meters as well as two portable weather stations were used. The internal clocks were set to GMT+2. All the instruments were set to measure the appropriate variables in 10-minute bins till the measurements were stopped. The sound level meters therefore would measure "average" sound levels over a period of 10 minutes, save the data and start with a new 10-minute measurement till the instrument is stopped.

Measurement locations were numbered as GBN01 to GBN04 for Generaal and MBN01 for Mount Stuart (see Table 30). These measurements were conducted over a period of approximately 20 – 24 hours.

Table 30: Generaal Day/night-time measurement locations (Datum type: WGS84)

Point name	Farm	Latitude	Longitude
GBN01	Generaal 587 MS	-22.738694°	29.855115°
GBN02	Juliana 647 MS	-22.798749°	29.912220°
GBN03	Van Deventer 641 MS	-22.747230°	29.997023°
GBN04	Van Deventer 641 MS	-22.741031°	29.984244°
MBN01	Mount Stuart 153 MT	-22.679986°	30.099426°

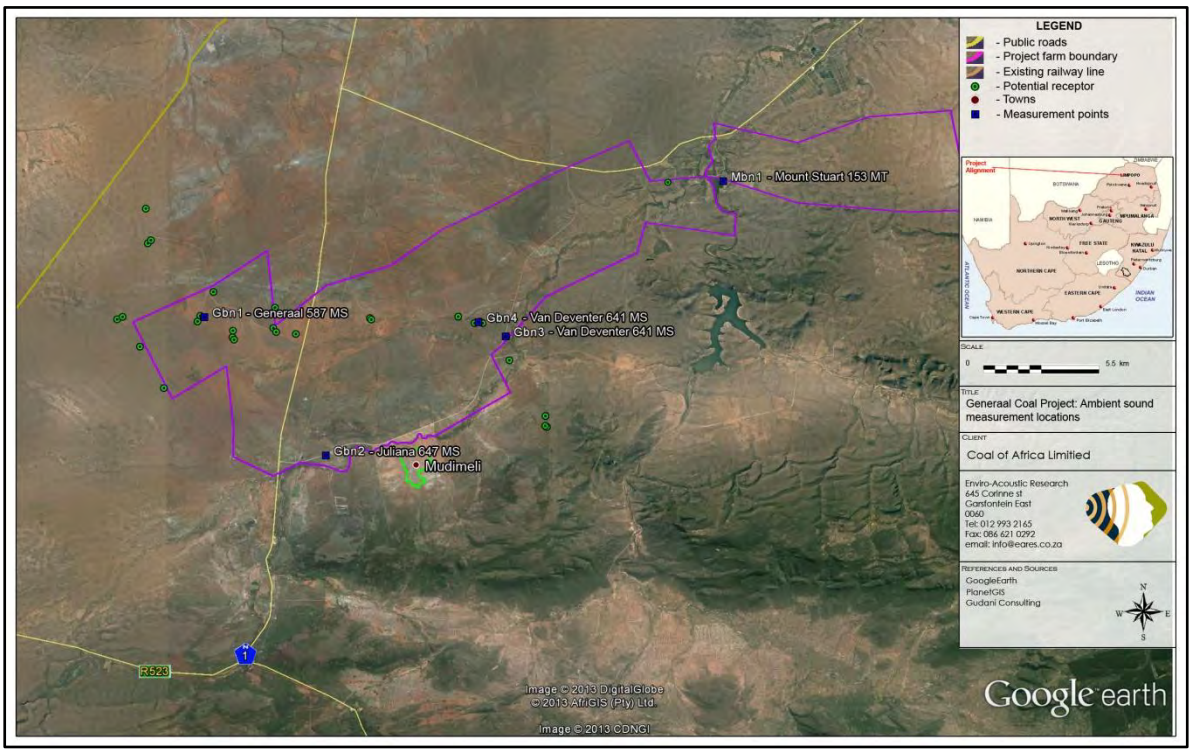


Figure 47: Location of ambient sound level measurements

1.2.10.2.5 Traffic counts

Traffic counts were done on the N1 from 19 to 20 September 2013. This is because road traffic is one of the major sources of noise in the world, especially in urban areas. In quiet rural areas traffic can be heard as far as 2 000 meters from a road, impacting on ambient sound levels up to 1 000 meters from that road.

Road traffic generally dominates the frequency bands between 40 – 160 Hz as well as 630 – 2 500 Hz (peaking at 63 and 1 000 Hz – for road traffic travelling at ±120 km/h on a tar road). The 40 – 160 Hz frequency band is generally dominated by noises originating from the vehicle engine and exhaust (engine revolutions and harmonics). The 630 – 2 500 frequency band generally relates to noise generated due to the road surface/tyre surface interaction. While speed does impact on the shape of the graph, it still allows the identification of road traffic noises from roads in most cases.

Traffic counts on the N1 indicated a relatively busy road, with traffic ranging between 200 vehicles per hour during the afternoon) to less than 60 vehicles per hour (between 02:00 and 04:00). Approximately 10 – 15% of these vehicles are heavy articulated trucks. This road is busy enough to significantly impact on the sound levels (and spectral characteristics) up to a distance of up to 1,000 meters from the road.

1.2.10.2.6 Results

- ***GBN01***: The loudest equivalent sound levels recorded at this location were due to faunal "natural" sounds dominating most of the night-time measurements as well as some day measurements. Daytime data indicated likely faunal, dwelling as well as vehicle sounds. Night-time measurements provided clear spectral characteristics. Considering the $\mathbf{L_{Aeq,I}}$ measured data ambient sound levels conform to *"Urban districts"* (55 and 45 dBA day/night-time rating). Measured $L_{Aeq,f}$ levels during the day and night conformed to the recommendation of 55 dBA and 45 dBA respectively set out by the World Health Organization (WHO), World Bank and International Finance Corporation (IFC) for a residential area. The area, although seems rural from a visual perspective, has high sound contribution from faunal species and specifically during the night-times.
- ***GBN02***: The data indicates a relatively naturally quiet area with the background sounds from an electrical motor (quiet periods, 50Hz). A significant number of measurements illustrated a spectral graph typically associated with an area where wind-induced noises dominate even though the anemometer did not indicate any significant winds. It is possible that the anemometer was located at a location where the effect of wind was not measured directly due to shielding from the nearby buildings. Considering the $\mathbf{L_{Aeq,I}}$ measured data ambient sound levels conform either to a *"Urban districts"* (55 and 45 dBA day/night-time). The levels are higher than the expected "*rural*" rating when considering the character of the area. Measured $L_{Aeq,f}$ levels during the day and night does conform to the recommendation of 55 dBA and 45 dBA respectively set out by the WHO, World Bank and IFC for a residential area.
- ***GBN03***: The loudest equivalent sound levels recorded at this location were due to faunal noise, with the road potentially impacting on the lower frequencies (albeit not as loud as the faunal noises). Measured daytime data indicate sound levels typical of an area with an *"Urban districts"* rating (55and 45 dBA Rating). Considering the fact that faunal activity was

very predominant during the night, natural noises did influence data and hence the rating level. Measured $L_{Aeq,f}$levels during the day and night does conform to the recommendation of 55 dBA and 45 dBA respectively defined by the WHO, World Bank and IFC for a residential area. The area, although seems rural from a visual perspective, has high sound contribution from faunal species and specifically during the night-times.

- ***GBN04***: The loudest equivalent sound levels recorded at this location were mainly due to faunal related noise sources. Considering the $\mathbf{L_{Aeq,l}}$ measured data ambient sound levels conform to a *"Urban districts"* (55 and 45 dBA day/night-time) rating level, with some daytime measured data potentially indicating a lower 50 dBA rating. Measured $L_{Aeq,f}$ levels during the day and night conforms to the recommendation of 55 dBA and 45 dBA respectively set out by the WHO, World Bank and IFC for a residential area. While the developmental character is rural, sound levels measured indicate higher rating levels. This however is due to faunal noise and the site can be considered naturally quiet.
- ***MBN01***: Measured daytime data indicate sound levels typical of an area with an *"Urban noise district"* (55 dBA day). Night-time values were very high and additional measurements are required to allow an opinion on the long term night-time rating levels of this location. Similarly, measured $L_{Aeq,f}$ levels during the day conformed to the recommendation of 55 dBA and 45 dBA respectively set out by the WHO, World Bank and IFC for a residential area with night-time levels exceeded. Although the area have a rural developmental character ambient sound levels are far higher than expected. Considering the developmental character and the data collected at other measurement locations the source of the night-time noises were faunal (very close to the microphone).

Equivalent sound levels varied from location to location, with all locations experiencing noisy single events at times that impact on the measured data (both L_{Aeq} and L_{A90}). L_{A90} levels indicate an area with potential to be quiet at certain times, in general the ambient soundscape had consistent noise in the area. Night-time measurements were particularly higher than the day-time measurements, relating to increased faunal activity due to the spring (mating) season.

A summary of the SANS 10103:2008 noise districts are provided in Table 31.

Table 31: Summary of noise district rating levels

Point name	Noise district rating based on L_{Aeq} measurement data (Day / Night)	Noise district rating based on all data and character of area	Existing ambient sound levels conforming to international recommended levels? (day / night)
GBN01	Urban /urban	Urban	Yes/yes
GBN02	Urban /urban	Urban	Yes/yes
GBN03	Urban /urban	Urban	Yes/yes
GBN04	Urban /urban	Urban	Yes/yes
MBN01	Urban/ -	Urban	Yes/no

It is recommended that the project consider the guideline levels for residential use as set by international institutions such as WHO, World Bank and IFC for residential areas. Seasonal changes in ambient sound levels must be considered as well as spectral character, especially in areas where the sound levels may be exceeded due to the activities of the proposed mine.

Receptor type	One hour L_{Aeq} (dBA)	
	Daytime 07:00 - 22:00	Night-time 22:00 – 07:00
Residential; institutional; educational	55	45
Industrial; commercial	70	70

1.2.11 VISUAL ASSESSMENT

1.2.11.1 Aesthetics

The topography of the Generaal Project varies greatly throughout the MRA area. The western MRA area is essentially flat, at an average elevation of 650 mamsl becoming irregular plains with relief as you move eastwards. The eastern portion of the MRA area is characterised by hills and ridges with low lying mountains to the south of the MRA area. The Mutamba River traverses the MRA area and flows into the Nzhelele River just north of the Nzhelele Dam and Nature Reserve. The greater Kuduland Conservancy is located on the eastern boundary of the MRA area and the Nzhelele Nature Reserve to the south.

The proposed Generaal Project is located within the Savannah biome, characterized by a grassy ground layer and a distinct upper layer of woody plants (trees and shrubs). Where this upper layer is near the ground (low growing) the vegetation may be referred to as Shrubveld, where it is tall and dense, as Woodland, and the intermediate stages are locally known as Bushveld (BGIS, 2011).

The shrub-tree layer may vary from 1 to 20 m in height, but in the Generaal Project area typically varies from 3 to 7 m. As a result of the lack of sufficient rainfall, which prevents the upper (tree and shrub) layer from dominating, coupled with fires and grazing, the grass layer is dominant in the MRA area. Figure 49 indicates the topography of the Generaal Project area.

1.2.11.2 Visual Character of the Area

The majority of the area is still natural and utilised for grazing, cattle ranching and game farming. The proposed Makhado Colliery Project is located to the south of the project area and the N1 and various provincial roads traverse the MRA area. A number of communities occur to the south of the MRA area.

The landscape within the visual catchment of the MRA area is dominated by the Soutpansberg, which ranges more than 1000 m above the valley floor of the Mutamba River. The mountain provides a highly scenic visual resource in the area. Views of the Soutpansberg are complimented by large areas of undisturbed natural vegetation and low population density. The combination of these features lends a unique wilderness character to the area.

The visual quality of the landscape is high. The contrast of high mountains and flatland, combined with views of game and natural vegetation, as can be seen on the photograph in Figure 48, create scenes that are unique and not widely found. The existence of residential villages, agricultural fields and isolated buildings in the area do not distract from the scenic value of the region, as these are easily absorbed by the landscape at large.

The tourism and hunting sector relies heavily on the rural peaceful character of the area to market their establishments. The D745 and various other gravel roads contribute to the dust pollution in the area. The N1 and the R525 to Tshipise carries sufficient traffic to impact on the ambient sound levels a distance away from the roads.

Figure 48: Photo of view from Generaal Project in a southern direction over the Soutpansberg

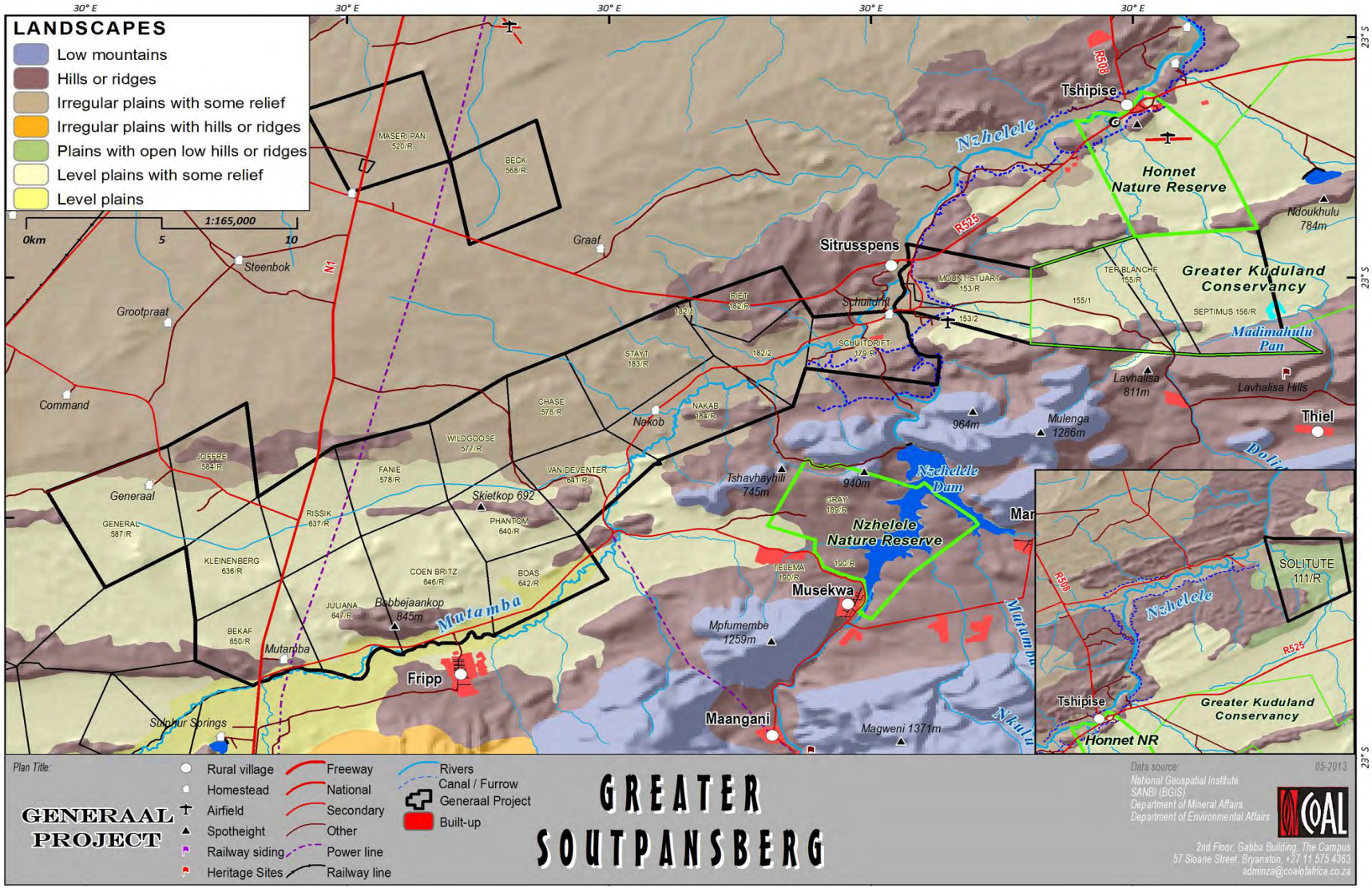


Figure 49: Topography map indicating location of hills and ridges

1.3 ENVIRONMENTAL ASPECTS THAT MAY REQUIRE PROTECTION OR REMEDIATION

1.3.1 SENSITIVE LANDSCAPES

1.3.1.1 River Systems

River systems are always considered to be ecologically sensitive, and are thus given a very high (No-Go) sensitivity. This is due to the unique habitats they provide and support for several flora and fauna species. The river systems provide migration corridors for many species. River systems are particularly important due to the water transport and associated biological, economic, health and cultural values. The provision of clean and healthy water to people, agriculture and natural biological systems is of utmost importance in this arid region.

Based on the findings of the aquatic and surface water specialist studies the Mutamba River is seen to be a water stressed system with the degree of water stress increasing in a downstream direction. Some recovery of the system does however occur in the lower reaches but impacts on the aquatic ecology of the lower reaches of the system are still considered to be likely. The Mutamba River can be considered to be a system of reduced EIS in relation to the Nzhelele River due to the limited provision of refugia and in the local area and the limited support it provides to the aquatic ecology of the area. The system is however deemed important in terms of the provision of services to the terrestrial fauna of the area as well as fair significance from a socio-cultural point of view. It is deemed essential that all effort is made to ensure that impacts on the Mutamba River as a result of the proposed Generaal Project are minimised.

The Nzhelele River can be considered to be a system of high aquatic Ecological Importance and Sensitivity due to the provision of refugia and in the local area and the support it provides to the aquatic ecology of the area. The system is also deemed important in terms of the provision of services to the terrestrial fauna, such as the provision of drinking water of the area as well as a high significance from a socio-cultural point of view, with special mention of water provision for agriculture. It is deemed essential that all effort is made to ensure that impacts on the Nzhelele River as a result of the proposed Generaal Project are minimised.

The following is recommended:

- No mining development can be supported within the 1:100 year flood-line on both sides of the rivers. A further buffer zone will be needed to protect the major rivers from effects of mining, especially from pollution and erosion;
- Care should be taken that no erosion takes place along the river banks;
- The rivers and river bank areas should be included in an open space plan, where the indigenous vegetation is protected and no development allowed; and
- All alien woody species on the river banks should be removed and controlled.

1.3.1.2 Wetland Systems

Legislative requirements were used to determine the extent of buffer zone required for each group of wetland systems depending on whether a group is considered wetland/riparian habitat or not:

- Due to the ephemeral nature of the drainage lines, not all drainage lines could be considered riparian habitat as defined by NWA No 36 of 1998. Therefore, distinction was made between drainage lines with riparian zones and drainage lines without riparian zones. Smaller drainage lines with riparian zones are defined as watercourses. If any activities are to take place within 100 meters or the 1:100 year flood lines exemption terms of Regulation GN 704 of the NWA, 1998 needs to be obtained. Section 21 of the NWA as well as General Notice No. 1199 of 2009 as it relates to the NWA will also apply and therefore a Water Use License will be required.
- Smaller drainage lines without riparian zones are not considered wetlands but are still defined as watercourses. If any activities are to take place with the 1:100 year flood line exemption terms of Regulation GN 704 of the NWA, 1998 needs to be obtained, however Section 21 of the NWA as well as General Notice No. 1199 of 2009 as it relates to the NWA does not apply and therefore no Water Use Licence will be required.

Based on the findings of the aquatic assessments and ecological sensitivity of the wetland systems, it is recommended that the project should be designed and operated on the basis that no mining activities should take place within 100m from the edge of the 1:100 year flood-line of the major drainage lines, i.e. Mutamba and Nzhelele Rivers.

1.3.2 FORMAL CONSERVATION INITIATIVES IN THE REGION

1.3.2.1 Vhembe Biosphere Reserve

Biosphere reserves are protected environments which are important for conservation and sustainable utilization of natural resources. They are building blocks for bio-regional planning and economic development. Biosphere reserves are community driven initiatives assisted by government departments or agencies. Biosphere reserves are important ecosystems designated as protected areas by the United Nations Education, Science and Cultural Organization (UNESCO).

The objectives of a Biosphere Reserve are to (LEDET, 2008):

- Preserve special bio-diverse environments for future generations;
- Create and encourage a balance between conservation and economic development;
- Place a priority on encouraging local communities to become involved and to become direct beneficiaries of the benefits flowing from a Biosphere; and
- Establish a social contract between all stakeholders and create an integrated ownership and management structure.

Worldwide Biospheres all have three distinct zones:

- A legally constituted ***Core area*** or areas devoted to long-term protection, according to the conservation objectives of the Biosphere Reserve;
- A ***Buffer zone*** or zones clearly identified and surrounding or contiguous to the core areas, where only activities compatible with the conservation objectives can take place; and
- An outer ***Transition area*** where sustainable resource management practices are promoted and developed.

Limpopo Province has three Biosphere Reserves namely the Waterberg Biosphere Reserve (WBR), the Kruger to Canyon Biosphere (K2C) and Vhembe Biosphere Reserve (VBR).

Figure 50 shows the VBR with its core areas and buffer zones. The Generaal Project falls within the boundary of the VBR, and the Mount Stuart Section infringes on the buffer zone associated with the Nwanedi core area (Honnet Nature Reserve and Greater Kuduland Conservancy).

1.3.2.2 Protected Areas

Figure 50 shows both the formal and informal protected areas within the VBR boundary (SANBI BGIS, 2013). Protected areas in the vicinity of the site include:

- Bergtop Nature Reserve to the West;
- Goro Game reserve to the West;
- Musina Nature Reserve to the North;
- Nzhelele Nature Reserve to the South;
- Honnet Nature Reserve directly to the North;
- Greater Kuduland Nature Reserve to the East, with some overlap;
- Nwanedi Nature Reserve to the East;
- Studholme Nature Reserve to the South;
- Hangklip State Forest to the South-West;
- Happy Rest Nature Reserve to the West;
- Roodewal State Forest to the South;
- Entabeni State Forest to the South; and
- Langjan Nature reserve to the West.

Protected areas that will be affected or that are directly adjacent to the site include Honnet Nature Reserve and the Greater Kuduland Conservancy (Mount Stuart Section).

The Generaal Project area falls outside the Priority Area 1 {North Eastern Escarpment} for conservation as determined by the National Biodiversity Assessment (NBA) as contemplated in the National Protected Area Expansion Strategy (LEDET, 2008).

1.3.2.3 Avifauna

1.3.2.3.1 Ground Hornbill research and conservation project

At present Southern Ground Hornbills are considered 'vulnerable' and a protected species under TOPS regulations (2007) but their numbers are still declining. Over 70% of this species natural habitat has been lost due to farming / agriculture and cattle over the past 50 years. Indirect poisoning, indirect trapping and snaring, loss of large nesting trees, the trade in exotic birds, an increase in ancient cultural uses and electrocution on power transformer boxes are some reasons provided for the decline in numbers.

The Mabula Ground Hornbill Research and Conservation Project are addressing these issues by:

- Harvesting and hand-rearing of second hatched chicks which die of starvation in the nests.
- Re-introduction and augmentation of non-viable groups in the wild.
- Provision of artificial nests for wild groups without nests.
- Research on behaviour and other important unanswered questions.
- Awareness Campaigns to educate the general public regarding:
    - unintentional poisoning;
    - trade in ground hornbills; and
    - secondary trapping and snaring.

In conjunction with the Musina Game Study Group, artificial nest boxes are being supplied to compensate for the lack of suitable nesting trees in the Musina area.

1.3.2.3.2 Cape Vulture

The Blouberg Mountains (extension of the Soutpansberg Mountain Range) is home to the largest breeding colony of Cape Vultures in the world. Furthermore 'Vulture Mountain' on the farm Buffelspoort 222 IS is in close proximity to the south of the Soutpansberg Mountain. They are attracted to this area due to the height and topography of the mountain, together with the food offered by the surrounding game farms. Cape vultures may have a 300 km foraging area surrounding their roosting sites.

The Cape Vulture is a scavenger of animal carcasses, and relies on leftover food from kills made by large predators (lions, leopards, etc). This bird also feeds off animals that have died from natural causes. Thus vultures are natures' way of controlling animal carcasses. This bird has adapted to a life of flying extensive distances for food. As the proposed mining area falls within the birds feeding grounds, the large game will be removed due to the selling of the farms they inhabit. This will result in a decrease of food for the Cape Vulture.

Cape Vultures are SA's only endemic vulture species and is listed as a TOPS regulated species as well as CITES I. It is classified as vulnerable by the International Union for Conservation of Nature and Natural Resources ("IUCN") and is species of special concern for South Africa.

Figure 50: Protected areas and conservation initiatives within the Vhembe Biosphere Reserve

1.4 DESCRIPTION OF LAND USE, CULTURAL AND HERITAGE ASPECTS AND INFRASTRUCTURE

1.4.1 LAND USE ACTIVITIES ON SITE AND NEIGHBOURING PROPERTIES

1.4.1.1 Rural Communities

Four villages are located to the south of the proposed Generaal Project area, namely Mudimeli on the farm Fripp 645 MS, south of the Generaal Section, and Makushu, Mosholombe and DoliDoli to the south of the Mount Stuart Section. The villages are provided with water from boreholes and from the Nzhelele Water Supply Scheme. Other villages are located in the broader area as indicated in Figure 6. Also refer to Section 1.1.2.

1.4.1.2 Socio-Economic Activities

The study area is defined in the figure below. The MRA area is included in the baseline SEIA on a broader level, where the mining footprint area and surrounding area is done in more detail.

The socio-economic activities in the area are mixed between intensive irrigated agriculture, hunting and tourism.

Some preliminary facilities, structures and activities have been identified as being sensitive from a socio-economic point of view. These may be influenced by environmental factors, with a secondary socio-economic impact. The facilities, structures and activities have been identified utilising aerial photography and satellite imagery.

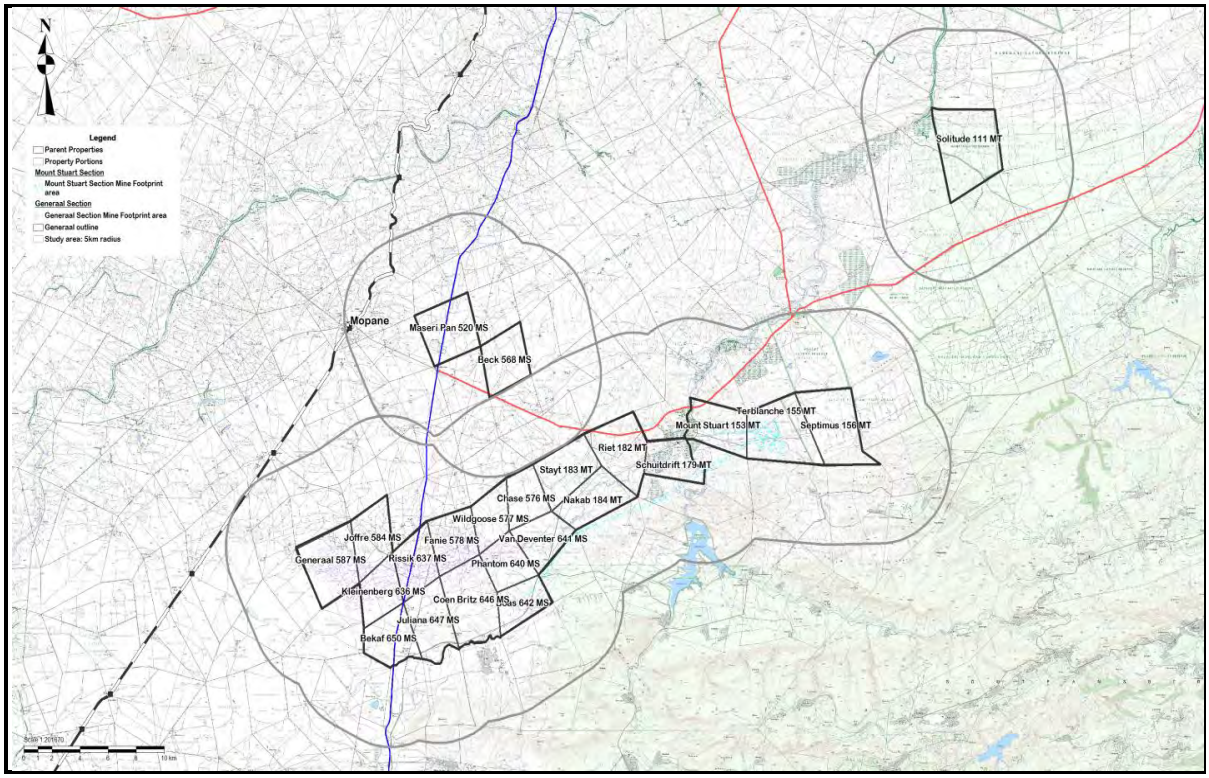


Figure 51: Socio-economic study area

1.4.1.2.1 Agricultural activities

The intensive irrigated agricultural activities are focused along the Nzhelele River and Nzhelele dam Irrigation Scheme. The land use in the Generaal Section of the Generaal Project is predominantly hunting, game farming and ecotourism. The Mount Stuart Section has portions of intensive agriculture, and areas to the east are utilised for conservation, hunting and ecotourism. The significance of the intensive agricultural area is utilised for predominantly citrus production and is known as a winter citrus production area for both local and export markets. Some of the properties are also focused on mixed farming, with a mixture of livestock, game and irrigated agriculture. A number of pack houses for citrus are operational in the region, with the largest probably being Alicedale Estates situated to the north of the Mount Stuart Section.

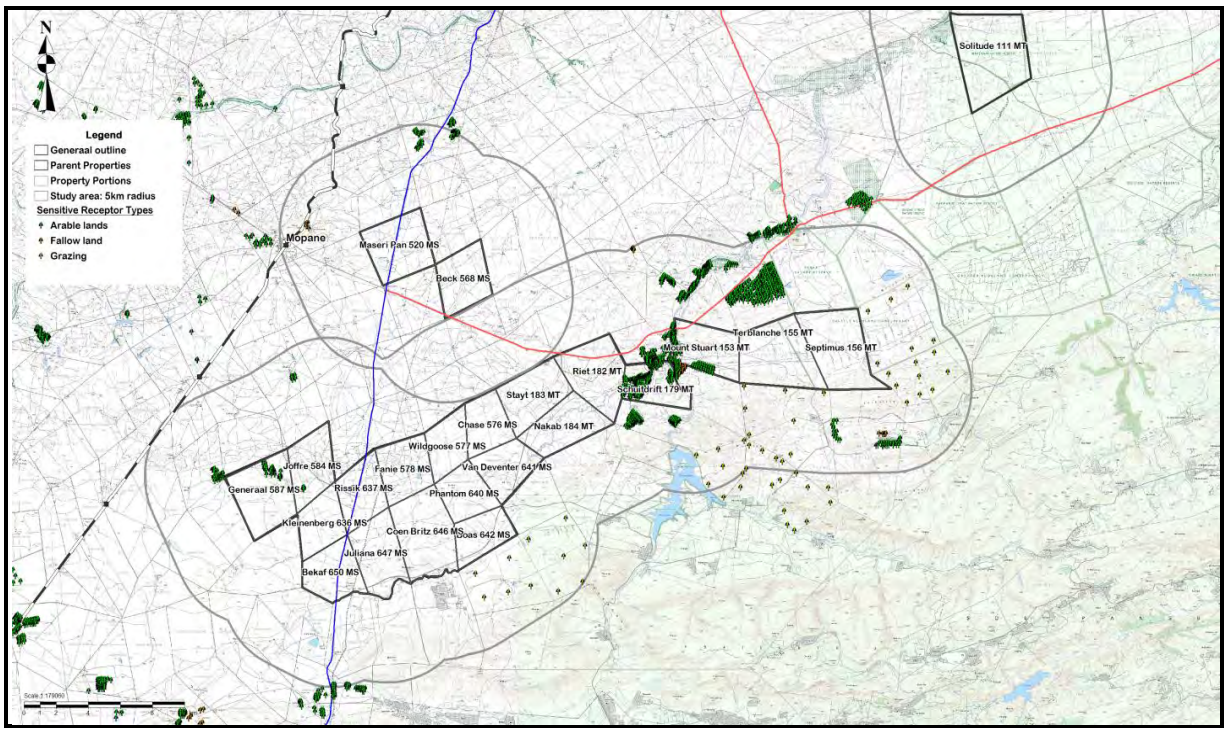


Figure 52: Detected agricultural activities

1.4.1.2.2 Hunting activities

Hunting, game trading and Ecotourism is an established socio-economic driver in the area. There are a number of properties utilized for trophy (for local and foreign tourists) and biltong hunting with ecotourism spin-off activities. The figure below indicates where hunting camps and other game activities could be determined via aerial photography.

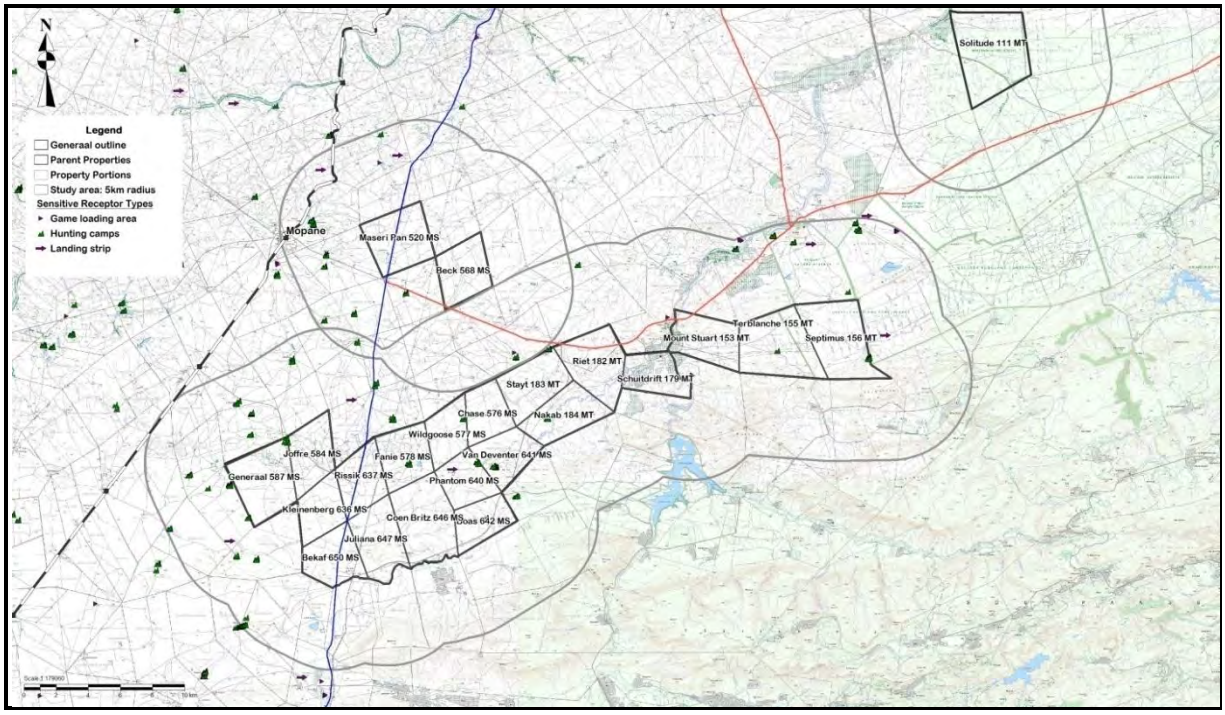


Figure 53: Hunting Facilities and/or Activities

1.4.1.2.3 Residential, business and other structures

The location of all structures, houses, institutional buildings such as schools, post offices, etc is important in the evaluation of their susceptibility to nuisance, noise, visual and air quality impacts. Changes to the sense of place and ambiance of the area have an impact on the socio-economic environment. Housing, labour houses and other structures are scattered throughout the area, as can be seen in the figure below.

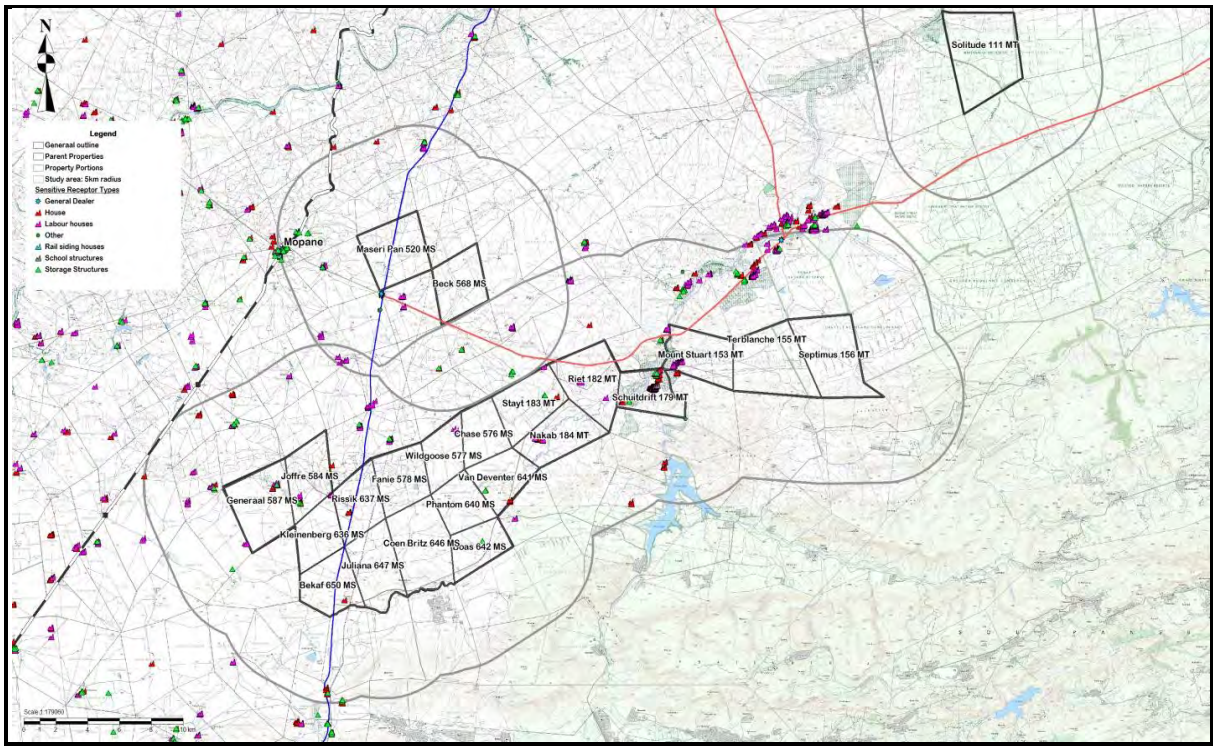


Figure 54: Houses, labour houses and other structures

1.4.1.2.4 Water use and infrastructure

The area is known locally to be water scarce therefore livelihoods in the project area largely rely on water sources to be able to sustain their socio-economic activities. Surface and groundwater is captured in dams for utilization on the various properties. In collaboration with the surface and groundwater specialists the water resources utilized and the purpose will be determined to evaluate the secondary socio-economic dependencies on water use in the area.

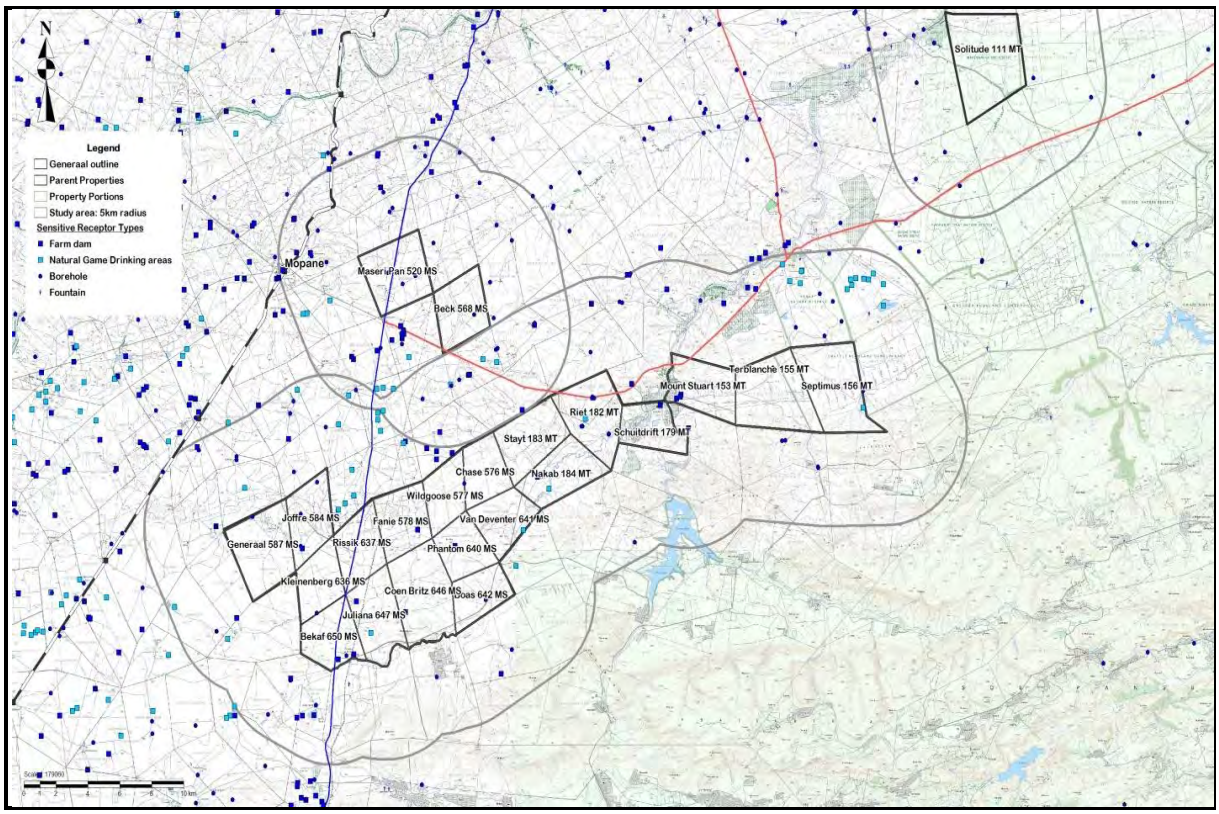


Figure 55: Water sources and infrastructure

1.4.2 CULTURAL AND HERITAGE RESOURCES

1.4.2.1 Theoretical Framework

The following is an outline of the cultural sequence in South Africa and some heritage concepts that form the theoretical framework for understanding typologies of heritage resources in South Africa.

1.4.2.1.1 The Stone Age culture

South Africa's human history and heritage span more than 3 million years. Hominid sites and their fossil remains are largely confined to dolomite caves on the highveld in Gauteng, Limpopo and Northwest Provinces (Deacon & Lancaster, 1986). The Stone Age which dates back more than 1 million years marks a more diagnostic appearance of the cultural sequence divided into three epochs, the Early, Middle and Late Stone Ages. Stone and bone implements manifest the technology of the period and fall into distinct typologies indicating chronological development. Material evidence of human activities is easily detectable in caves, rock-shelters and riverside sites, and very rarely seen in open country. The Late Stone Age is also associated with the execution of paintings mostly in rock shelters and caves.

Early Stone Age

The Early Stone Age marks the earliest appearance of stone artefacts about 1.4 million years ago. Such tools bore a consistent shape such as the pear-shaped hand axe, cleavers and core tools (Deacon & Deacon, 1999). These tools, which have been called Acheulian after a site in France, were probably used to butcher large animals such as elephants, rhinoceros and hippopotamus that had died from natural causes. Acheulian artefacts are usually found near sites where they were manufactured and thus in close proximity to the raw material or at butchering sites. The early hunters are classified as hominids meaning that they have not evolved to the present human form.

Middle Stone Age (MSA)

The Middle Stone Age (MSA), which appeared 100 000 years ago, is marked by the introduction of a new tool kit which included prepared cores, parallel-sided blades and triangular points hafted to make spears. By then men had become skilful hunters, especially of large grazers such as wildebeest, hartebeest and eland. It is also believed that by then, men had evolved to become anatomically modern. Caves were used for shelter suggesting permanent or semi-permanent settlement. Furthermore there is archaeological evidence from caves indicating that people had mastered the art of making fire. These were two remarkable steps in cultural advancement (Deacon &Deacon, 1999).

Later Stone Age (LSA)

By the beginning of the LSA, humans were classified as *Homo sapiens* which refer to the modern physical form and thinking capabilities. Several behavioural traits are exhibited, such as rock art and purposeful burials with ornaments, became a regular practice. The practitioners of the Rock Art are definitely the ancestors of the San and sites abound in the whole of South Africa. LSA technology is characterised by microlithic scrapers and segments made from very fine-grained rock. Spear hunting

probably continued, but LSA people also hunted small game with bows and poisoned arrows. Because of poor preservation, open sites are usually of less value than rock shelters.

1.4.2.1.2 The Iron Age culture

The Iron Age culture, which supplanted the Stone Age at least 2000 years ago, is associated with the introduction of farming and the use of several metals and pottery. Scholars have analyzed existing archaeological evidence using various models the earliest attempts of which arrived at the conclusion that a sudden synchronized appearance of these technologies occurred in South Africa, indeed in the whole region of Eastern and Southern Africa suggesting a fairly rapid movement of people (Phillipson, 2005). Overall, since these people are indigenous to Africa, current theoretical positions are in support of a gradual "expansion" or "spread" (rather than a migration in the strict sense) of populations of speakers of Bantu languages from a source or sources in the north. Pottery, even though broken into shards has a high survival rate, and has been a handy means for characterizing and identifying archaeological traditions within the broad Iron-using culture and to further isolate geographical variations, which have been called facies (Evers, 1988). Ceramic classifications rely largely on shape and decoration similarities and variations. Coupled with radiocarbon dates, which have been obtained at several sites, it has been possible to reconstruct a picture of the chronological and spatial development of Iron Age traditions.

Early Iron Age

Metalworking represents a new technology not found among the Stone Age hunters. As mixed farmers, they practiced agriculture and kept domestic animals such as cattle, sheep, goats and chicken. There is however increasing evidence that sheep might have moved into the area much earlier than the Iron Age.

According to Huffman (2007) there were two streams of Early Iron Age (EIA) expansion converging in South Africa, one originating in east Africa which has been called the Urewe-Kwale Tradition (or the eastern stream) and another from the west spreading through Zambia and Angola called and the Kalundu Tradition (or western stream).

Urewe Tradition spawned the following facies:

- Matola (Eastern Seaboard)
- Mzonjani facies (Broederstroom) AD 450 – 750)

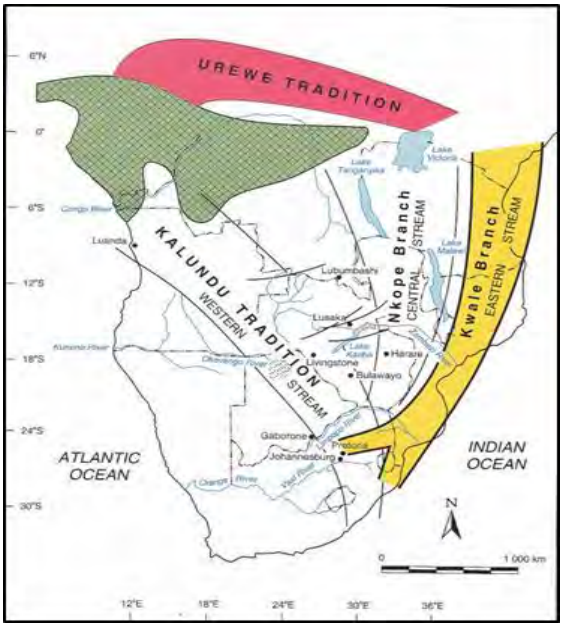
Kalundu Tradition spawned the following facies:

- Benfica Sub-branch:
    - Bambata facies AD 150 – 650
- Happy Rest Sub-branch:
    - Happy Rest facies AD 500 – 750
    - Malapati facies AD 750 – 1030

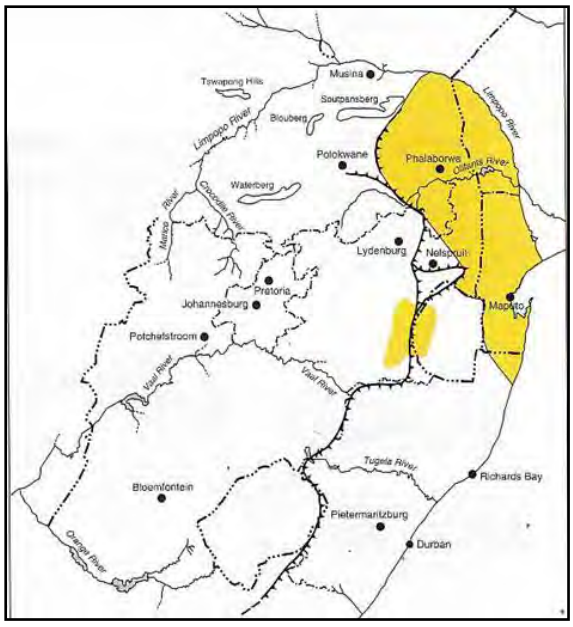
Late Iron Age (LIA)

Around the turn of the first Millennium AD, archaeologists have noticed the growing importance of cattle in the economy of farmers as houses and grain bins were arranged around a central area for

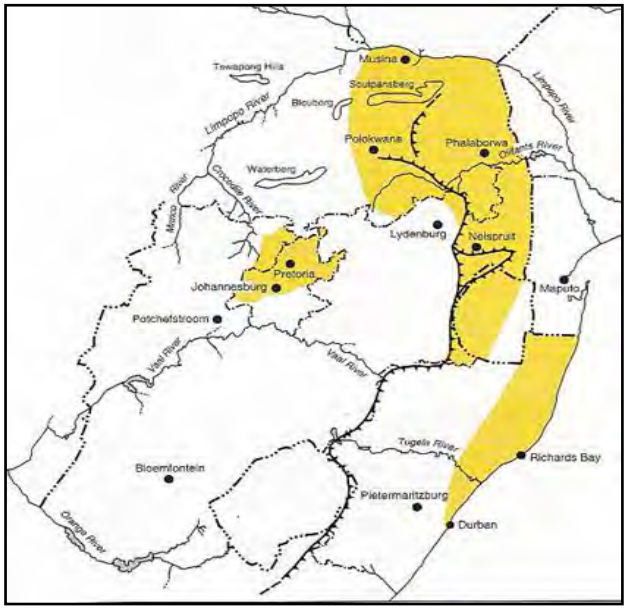
cattle. This settlement behaviour dubbed the 'Central Cattle Pattern' commonly occurs in South Africa, with sites usually sited near water and good soils that could be cultivated with an iron hoe. The growing importance of cattle in defining social and economic rank is seen at K2 at the confluence of the Shashi and Limpopo Rivers. Subsequently and close by at Mapungubwe World Heritage Site cultural landscape (approximately 100km from the Project area) further transformation in the spatial organisation of settlements occurred where the "Central Cattle Pattern" changed into the Zimbabwe Pattern which defines political elites.



A: Spread of the Kalundu & Urewe Traditions in Southern Africa (Huffman 2007: 122)



B: Matola (Silver Leaves) Facies of the Urewe-Kwale Tradition (Huffman 2007: 123)



C: Broederstroom facies (later than Matola) (Huffman 2007: 127)

Various factors contributed to these cultural and settlement changes, but important was the surplus wealth from the East Coast Gold and Ivory trade and the intensive cultivation of the Limpopo flood plains. From about 1300 AD, there is evidence of Sotho-Tswana settlement in the area north of the Soutpansberg. They are recognised by their distinctive pottery, known after the farm Icon where the pottery was first found. After 1400 AD, there appear to have been movements from across the Limpopo River introducing the Zimbabwe-Khami culture. The relationship between the Venda and Khami is a subject of on-going debate and research (Nemaheni, pers. com). There appear to be three chronological layers representing intrusions by the Ngona, Lembethu/Mbedzi/Thavhatsindi and Singo groups, possibly all coming from across the Limpopo River in that order. There are two stonewalled sites in the Project Areas, namely Verdun and Machema, which have been confirmed. Both ruins fall within the Mapungubwe-Thulamela-Dzata continuum. Dzata, which dates to the 18th century, appears to be the youngest of the Zimbabwe type settlements is located approximately 50km to the east of the Project area.

Various LIA facies have been identified on the basis of pottery typology and radiocarbon dates.

- Moloko (Sotho-Tswana) Branch
- Icon facies AD 1300 – 1500: This pottery is associated with the first Sotho Tswana people entering the country.
- Eiland facies AD 1000 – 1300
- Mapungubwe facies AD 1250 – 1300
- Mutamba facies AD 1250 – 1450
- Khami facies AD 1430 – 1680
- Thavhatshena facies AD 1450 – 1600
- Letaba facies AD 1600 – present

Letaba pottery is associated with modern day Venda people and can be found in any Venda village.

Around the turn of the first millennium AD, Archaeologists have noticed the growing importance of cattle in the economy of farmers as houses and grain bins were arranged around a central area with a settlement, designed for cattle. This settlement configuration, dubbed the “Central Cattle Pattern” commonly occurs in South Africa, with sites usually sited near water and good soils that could be cultivated with an iron hoe. The growing importance of cattle in defining social and economic rank is seen at Bambandyanalo (K2) at the confluence of the Shashe and Limpopo Rivers. Subsequently and nearby at Mapungubwe (ca 80km from the Project Area)further transformation in the spatial organisation of settlements occurred where the “Central Cattle Pattern” changed into the Zimbabwe Pattern which defines political elites (Huffman 2007).

Various factors contributed to these cultural and settlement changes, but important was the surplus wealth from the East Coast. From about 1300 AD, there is evidence of Venda, and Northern Sotho settlement in the area north of the Soutpansberg. They are recognised by their distinctive pottery, known after the farm Icon where the pottery was first found. After 1400 AD, there appears to have been movement from across the Limpopo River introducing the Zimbabwe-Khami culture. Early Venda history is a subject of on-going debate and research (Nemaheni, pers. com).There appears to be three chronological layers representing intrusions by the Ngona, Lembethu/Mbedzi/Thavhatsindi and Singo groups, possibly all coming from across the Limpopo River in that order.

There are several ruins in the vicinity of the Generaal Project area. The substantial ruins on Verdun Farm are 15km from the project area. They were proclaimed a National Monument in 1938 under the National Monument Commission Act. It became ranked Grade 2 Provincial Heritage Site under the National Heritage Resources Act, (No 25: 1999). The ruins are associated with early Venda chiefly settlement. According to legend, the ruins are the remains of the home of the Venda Chief Matshokotike, dating to the early eighteenth century. The strong walls of the Khoro, or council-chamber, have a typical chief's chair. Behind the chair on the opposite side of the walls is a short piece of wall with check patterns.

Machema Ruins is 30km west of the Project area. The site is also associated with the early Venda, typologically belonging to the Khami group as exemplified by check pattern and bi-chrome effect of alternating course of black stones (schist) and brown sandstones. They are associated with the Machema people said to have been subordinated to a higher political order at Mapungubwe.

Dzata Ruins in Dzanani Communal area 25km south-east of the Project Area, form an important architectural continuum with Mapungubwe. It dates to the 18th and appears to be the youngest of the Zimbabwe type settlements.

Five small stonewalled sites have been confirmed in the Chapudi Project area, which indicates a presence of the Mapungubwe-Thulamela-Dzata cultural continuum in the larger area.

1.4.2.1.3 Other heritage concepts

Historical Archaeology

The frame of archaeological application is extended to cover the historical period. Archaeological evidence can be used to complement the large corpus of historical and oral data. One archaeologist has noted that one of the rulesof historical archaeology "is that documentary and archaeological data are kept distinct to avoid circular arguments as one is tested against the other". In other words written and oral documents are seen as independent sources of data.

The coming of the Voortrekkers in the area and the introduction of commercial farming in the 19th and early 20th centuries has a strong archaeological footprint in the Generaal Project Area. We have noted a prevalence of house remains associated with pioneer commercial farmers and shifting semi-permanent dwellings of farm workers. Several graves both with inscriptions and "anonymous" mostly associated with pioneer farmers or their workers were also recorded. Thus the Archaeology of the historical and industrial periods brings forth new terminology – Historical Archaeology and Industrial Archaeology - to denote emerging sub-disciplines which find relevant application to this study, even if to complement the corpus of written records (Pikirayi 1993).

Cultural Landscapes

Over the past twenty years a territorial approach to heritage has shifted emphasis from sites to the recognition of broad territorial attributes of heritage. Within the international discourse which has ensued, a genre of heritage called Cultural Landscapes has emerged. Article 47 of the Operational Guidelines for the Implementation of the World Heritage Convention (2005) defines Cultural Landscapes as:

Cultural landscapes are cultural properties that represent the "combined works of nature and of man" designated in Article 1 of the World Heritage Convention. They are illustrative of the evolution of human society and settlement over time, under the influence of the physical constraints and/or opportunities presented by their natural environment and of successive social, economic and cultural forces, both external and internal.

Broadly, the Generaal Project area, which is approximately 80 km Southeast of Mapungubwe, may be considered as part of the Greater Mapungubwe Cultural Landscape. The following genres of cultural landscapes have been encountered in the Generaal Project area:

Organically evolved cultural landscapes result from an initial social, economic, administrative, and/or religious imperative and have developed its present form by association with and in response to its natural environment. Such landscapes reflect that process of evolution in their form and component features. They fall into two sub-categories:

- A relict (or fossil) landscape is one in which an evolutionary process came to an end at sometime in the past, either abruptly or over a period. Its significant distinguishing features are, however, still visible in material form; and
- A continuing landscape is one which retains an active social role in contemporary society closely associated with the traditional way of life, and in which the evolutionary process is still in progress. At the same time it exhibits significant material evidence of its evolution over time.

Associative cultural landscapes have powerful religious, artistic or cultural associations of the natural element rather than material cultural evidence, which may be insignificant or even absent.

Intangible Cultural Heritage

The elevation of Intangible Cultural Heritage has evolved out of a post-colonial discourse largely nurtured in the developing world. South Africa has participated actively in the debates which culminated in the UNESCO Intangible Heritage Convention passed in 2003.

The "intangible cultural heritage" means the practices, representations, expressions, knowledge, skills – as well as the instruments, objects, artefacts and cultural spaces associated there with – that communities, groups and, in some cases, individuals recognize as part of their cultural heritage. This intangible cultural heritage, transmitted from generation to generation, is constantly recreated by communities and groups in response to their environment, their interaction with nature and their history, and provides them with a sense of identity and continuity, thus promoting respect for cultural diversity and human creativity.

Intangible values give meaning to heritage sites.

1.4.2.2 Results

1.4.2.2.1 Current conservation status of heritage resources in the project area

The Generaal Project area is under various land use systems including commercial farming (cattle ranching, game farming and plantation irrigation). While it is noted that archaeological sites under

irrigation fields have been disturbed, these new activities create a cultural landscape layer of heritage value. Cattle and game farming are practised and we note that archaeological sites tend to remain stable under such activities. The Generaal Area still retains good natural woodlands some of which are fine examples of forest product harvest cultural landscapes.

1.4.2.2.2 National and Provincial heritage sites (Monuments)

There are no proclaimed Grade 1 sites in the Generaal Project area. According to the South African Heritage Resources Agency (SAHRA) the largest Baobab Tree in the Vhembe District which is located near Tshipise, ca 10km east of the Project area has been proclaimed a National Monument (Grade 1) under the NHRA, 25 of 1999: South African Heritage Resource Agency Identification (SAHRA ID) 9/2/240/0003. There are many Baobab trees in the project area as the fieldwork results attest. Only 3 baobab sites have been selected and illustrated in the Catalogue (Annexure II of the HIA) to highlight their heritage significance.

1.4.2.2.3 Summary data on heritage resources

Forty-eight (48) heritage sites have been recorded under 7 typologies as follow:

	Heritage Typology	Quantity/Description
1	Grave Sites	12
2	Stone Age Archaeological Sites	1
3	Later Iron Age Archaeological Sites	8
4	Later Iron Age Stonewalled Sites	1
5	Buildings more >60yrs old	4
6	Sites of the commercial farming period (historical archaeology)	16
7	Cultural Landscapes (forest products)	6
TOTAL NUMBER OF SITES		**48**

A ranking system has been used to isolate sites that will need attention before or during the operational phase of the project. Seventeen (17) heritage sites have been prioritized under Categories 1 and 2 as deserving the highest attention before or during the operation phase of the project.

	Ranking	Explanation	No of sites
1	Very high	12 burials (Section 36 of NHRA) require stakeholder consultations before relocation or other mitigation measures are considered. 1stonewalled site (ruins) have high cultural and architectural significance; these must not be disturbed	13
2	High	Substantial/rare archaeological deposits (3 sites) and an ancient fountain (1 site). These siterequires mitigation	4
3	Medium	Archaeological sites (2); Farm buildings (10 sites); Cultural landscapes (Mopani, citrus) (6);They may require mitigation.	18
4	Low	Heritage sites deemed of less importance. These are mostly sites with pottery but belonging to the relatively recent commercial farming period. Decisions on mitigation will be made by a heritage expert including options of destruction with or without salvage	13
		TOTAL	**48**

The conclusions from the HIA are that:

- Seventeen (17) heritage sites have been prioritized under Categories 1 and 2 as deserving the highest attention before or during the operation phase of the project. These sites are one (1) site of the Zimbabwe Tradition, twelve (12) grave sites, one (1) Stone Age Site and three (3) Iron Age sites, which may require consultation with local communities and other stakeholders before any action on them is considered.
- Eighteen (18) heritage sites are considered to be of medium significance. These include 5 cultural landscapes exemplifying non-timber forest product exploitation.
- Thirteen (13) sites are considered to be of less importance. As they have been recorded as minimum requirement, they may be disposed of with or without salvage.

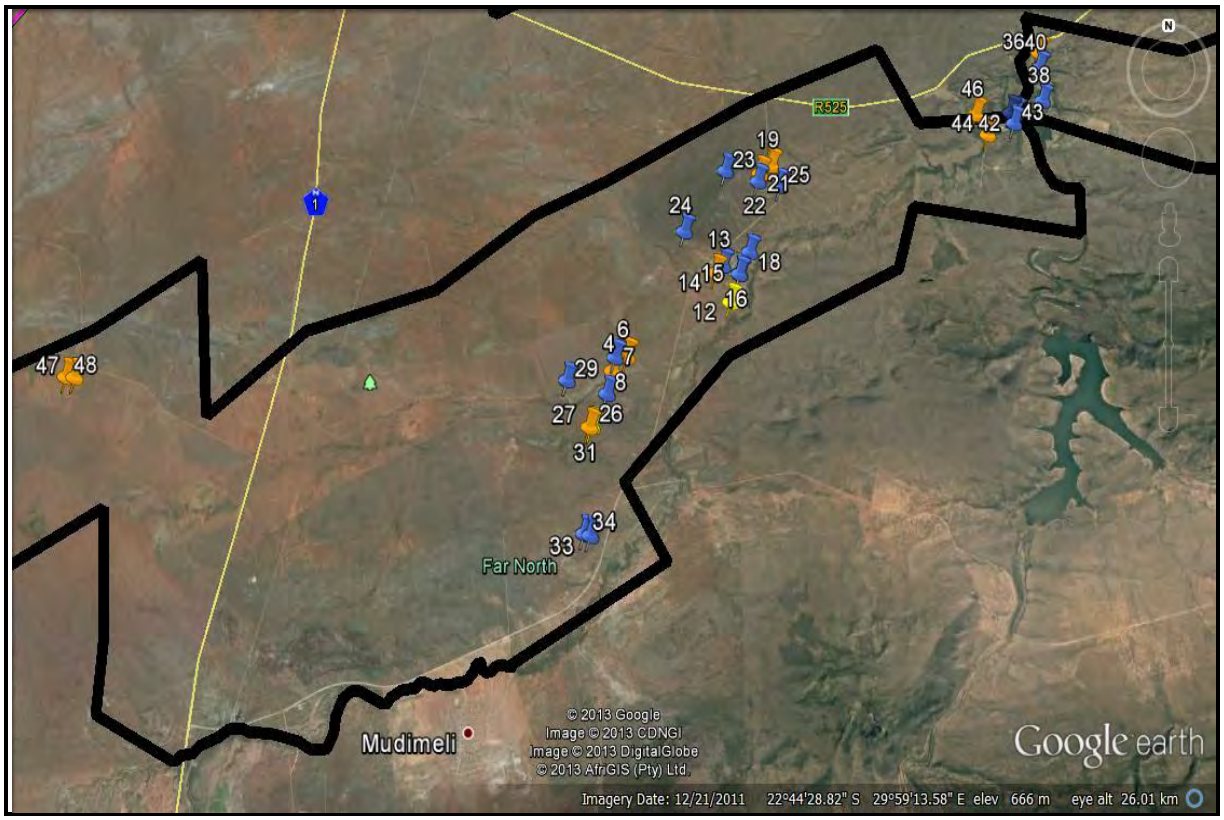


Figure 56: Map of the area showing the location of Categories 1, 2 & 3 heritage sites

1.4.3 INFRASTRUCTURE (BUILT ENVIRONMENT)

The Generaal Project is situated in the magisterial district of Vhembe, in the Limpopo Province, approximately 35 km north of the Makhado Town in the Makhado and Musina Local Municipal areas. Musina is situated approximately 70 km to the north – refer to Figure 2. Musina and Makhado are connected by well developed road infrastructure.

The Generaal Project is well situated with respect to major infrastructure, including rail, road and power. The N1 national road pass through the MRA area (Generaal Section) with the R525 (Tshipise road) running to the north of the project area in a west-east direction. Both of these roads carry sufficient traffic to impact on the ambient sound levels a distance away from these roads.

The Makhado-Musina railway line runs in a north-south direction to the west of the Generaal Project area. Eskom grid power lines are located parallel to the N1 and are situated 6 km east of the farm Cavan 508 MS at their closest point.

The Mount Stuart Section is accessed along the R525 running east towards Tshipise. The R525 is a surfaced road. Approximately 16 km from the N1, at a T-junction to the south, the road leads to the mine access intersection. The access road is approximately 6 km long and runs in an easterly direction. The access road to the mining site will have a gravel wearing surface.

The existing access road to Mopane traverses across the Generaal West Pit. The existing intersection with the N1 will be moved approximately 1.2 km south and the road relocated to run along the N1 in a northerly direction past the coal reserve from where it will turn westwards to tie up with the existing Huntleigh road. Access to the Generaal Project site is by way of this new intersection with the N1. The access to the Generaal East Pit is from the West Pit across the N1 by means of an underpass. The access road to the mining site will have a gravel wearing surface.

1.5 SENSITIVE RECEPTOR MAP

A sensitive receptor for the purpose of this study is defined as a person or place where involuntary exposure to pollutants released by the proposed project could take place. Receptors surrounding the proposed site were identified from a site visit and through satellite imagery (Figure 57). They are as follows:

- Neighbouring communities.
- Farm houses, guesthouses, lodges and local residences on farms.
- Businesses and resorts.
- Schools and clinics located within the vicinity of the Generaal Project area.
- Other infrastructure (pack houses, dams, boreholes, windmills, etc.).

Other sensitive receptors within the area would be the local fauna and flora. It has been identified that dust may result in sickness and associated lung disease for wildlife and human which will arise as a result of mining operations.

The current land use activities and sensitive receptors within and surrounding the Generaal Project area is discussed in detail in Sections 4.4 and 4.5 of the SEIA (ANNEX-9).

1.6 SPECIALIST STUDIES

A number of specialist studies were performed for the Generaal Project, in line with the Plan of Study presented in the Scoping Report for the Generaal Project, August 2013. These are attached as Annexures as listed below.

Annexure	Aspect	Independent Consultant
ANNEX-1	Soils, Land Use & Capability	Gudani Consulting - EcoSoil Consortium
ANNEX-2	Surface Water	WSM Leshika Consulting (Pty) Ltd
ANNEX-3	Groundwater	WSM Leshika Consulting (Pty) Ltd
ANNEX-4	Biodiversity	Phaki Phakanani Environmental Consultants
ANNEX-5	Aquatic Systems	Scientific Aquatic Services
ANNEX-6	Ambient Noise	Gudani Consulting
ANNEX-7	Air Quality	Royal Haskoning DHV
ANNEX-8	Heritage Resources	Mbofho Consulting and Projects
ANNEX-9	Socio-Economic Aspects	Naledi Development Restructured (Pty) Ltd
ANNEX-10	Macro-Economic Aspects	Mosaka Economic Consultants cc

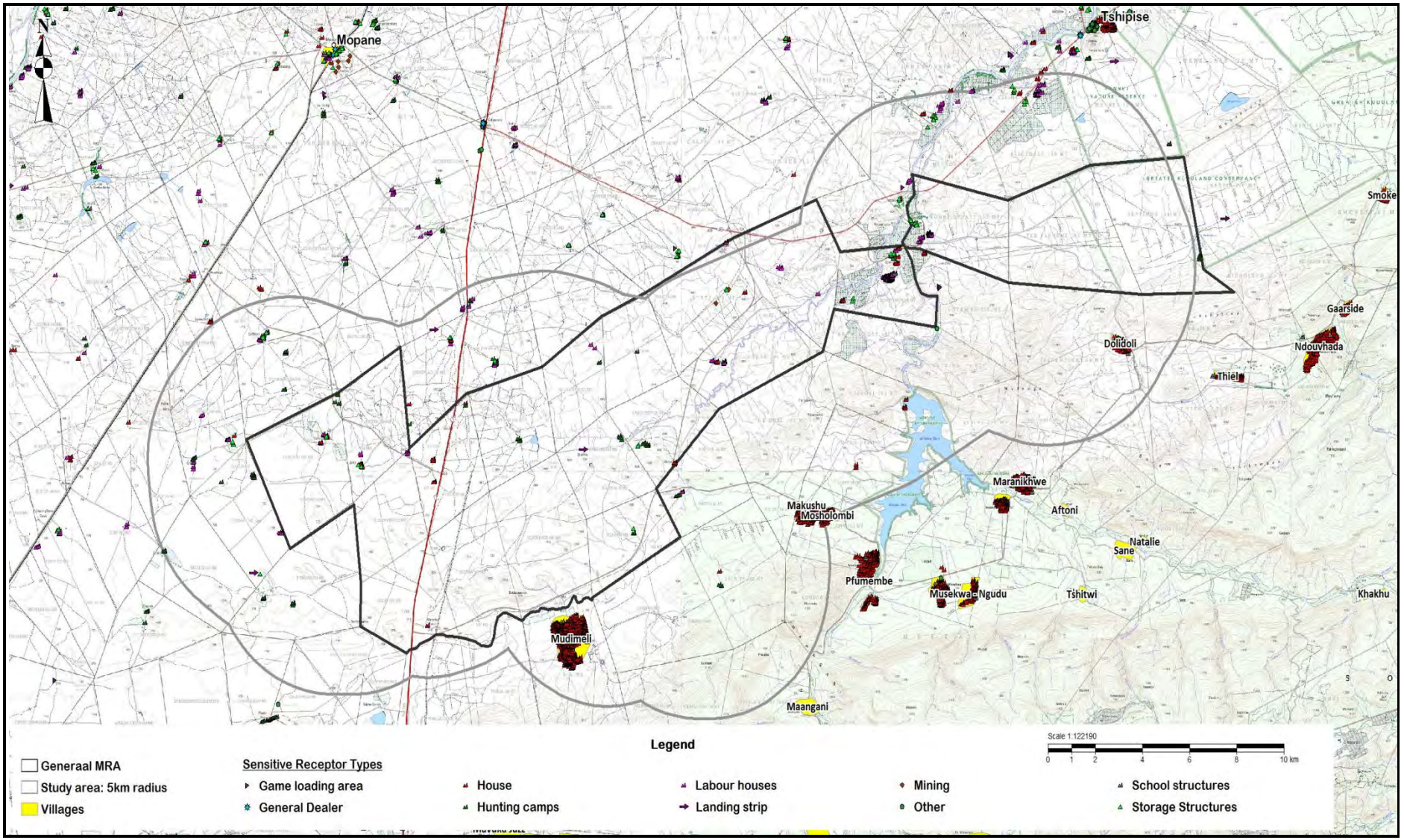


Figure 57: Sensitive receptor map for the Generaal Project

2 PROPOSED MINING OPERATION

2.1 MINERAL TO BE MINED

Two sections are planned for the Generaal Project, namely the Generaal and Mount Stuart Sections, and have the potential to produce good quality hard coking coal and a domestic thermal coal product.

The current planning is that construction and mining will commence at the Mount Stuart Section first where the coking coal yields are the highest. It is expected that mining operations at the Generaal Section will only commence much later (in terms of current data towards 2032) as capacity in infrastructure is developed. The Mount Stuart Section will be mined at 1.4 Mtpa (for 25 years), whilst the Generaal Section will be mined at 1.7 Mtpa, therefore the life of mine is expected to exceed 30 years.

The coal seams vary in depth from surface from a minimum of less than 50m in the South to a maximum of almost 900m for the Seam Bottom Lower (SBL) in the North. It is estimated that the Generaal Section is in most instances mineable to a depth of 200 m through open cut methods. Conventional truck and shovel mining will be employed for overburden stripping and coal extraction at this section. The Mount Stuart Section resource allows for an underground mining method to a depth of 900m.

The Soutpansberg Coalfield is situated north of the Soutpansberg Mountain Range in the Limpopo Province stretches for ± 190km from Waterpoort in the west to the Kruger National Park in the east. The Soutpansberg Coalfield can be divided into 3 separate coal fields i.e. the Mopane Coalfield, the Tshipise Coalfield and the Pafuri Coalfield. The Pafuri Coalfield terminates at the northern limit of the Kruger National Park in the east and is in exploration phase of development.

The Mopane and Tshipise Coal fields are host to the Makhado Project as well as the GSP projects, including the proposed Generaal Project – refer to Figure 58.

The regional geology consists of 3 main lithological groups, i.e. the Limpopo Mobile Belt, the Soutpansberg Group and the Karoo Sequence rocks:

- The ***Limpopo Mobile Belt*** (LMB); forms the gneissic basement on which the overlying strata (Soutpansberg Group and the Karoo Sequence) was deposited. The LMB rocks are the metamorphic expression of the collision and welding together of the Kaapvaal craton and the Zimbabwe craton. The LMB has a long and complex history of deformation occurring from 3200 Ma (million years) to 2000 Ma. The LMB gneisses are made up of inter-cratonic sediments and volcanics, deformed and metamorphosed to granulite facies and intruded and by granite bodies which have themselves been metamorphosed to varying degrees. The rift fault systems controlling the various basins, in which the Soutpansberg and Karroo strata have been preserved, are major zones of crustal weakness preferentially re-activated during periods of tectonic instability over time.
- The ***Soutpansberg/Waterberg Group*** strata were deposited into rift basins controlled by these major fault systems between 1900 Ma and 1600 Ma. The strata consist of basaltic

lavas, arenites and shales attaining a maximum preserved thickness of 5000m. Dips can vary from 20° to 80° to the north.

- The ***Karoo Sequence*** strata were deposited on LMB basement and/or Soutpansberg Grp. strata between 300 – 180 Ma. Karoo deposits are preserved in the same reactivated rift basins and are often terminated against major east-west trending faults on their northern margins. The dips are between 3° and 20° to the north with coal located at the base of the sequence. The nature of the coal deposits changes from a multi-seam coal-mudstone association (7 seams) approximately 40m thick in the west (Mopane Coalfield), to two thick seams in the east (Pafuri Coalfield in the Tshikondeni area).

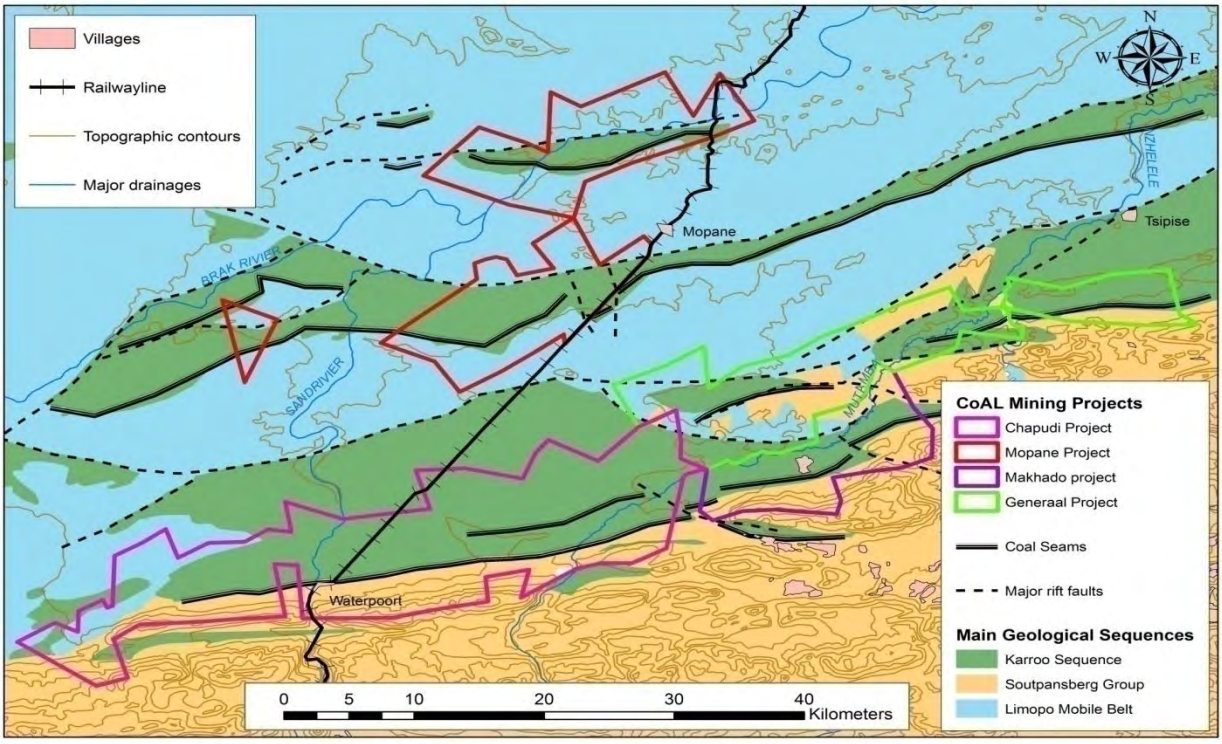


Figure 58: Regional Geology of CoAL Mining Projects within the Soutpansberg Coalfield

The Mount Stuart Section represents an isolated and up faulted block of Karoo age sediments, which lies approximately 6 km to the north of the Tshipise South Basin in which the Makhado Project occurs. The Karoo strata represented in the project area is underlain by the 10 m thick conglomerate-diamictite of the Tshidzi Formation, which can be correlated to the glacial Dwyka tillite in the Main Karoo Basin. The basal unit is overlain by the 190m thick succession of alternating black shale, micaceous sandstone, siltstones and inter-bedded coal seams of the Madzaringwe Formation.

The Mount Stuart Section resource allows for an underground mining method to a depth of 900m and is planned to be a mechanised mine laid out on a bord-and-pillar design using continuous miners and shuttle cars. It is envisaged that the coal will be treated though its own dedicated processing plant, but dispatched through the Makhado Rapid Load-out Terminal (RLT) situated on the farm Boas 642 MS. The product will be transported from the Mount Stuart Section to the RLT via conveyor.

The Generaal Section represents a 20 km long, east-west striking, up-faulted block within the northern part of the Waterpoort Basin, immediately north of the Makhado Project. The coal bearing Mikabeni Formation is present within the northern parts of the project area, and contains a thick (20m – 30m) package of heavily stone banded coal units. Within this package, three "cleaner" coal seams have been identified with average thicknesses of 2.9m – 3.9m. Dips in the area are generally between 4º - 5º, although the central portion of the block is associated with steeper dips.

The average overall coking yield in the Generaal Section is around 17% and the average middling yield is around 38%, which renders a total yield of round about 55% on the coal in Generaal area.

The Generaal Section will be mined by the total extraction open pit mining method, up to a depth of approximately 200 m. The open pit will be mined through conventional truck and shovel. The Generaal Section will make extensive use of infrastructure at the Makhado Colliery Project, including its processing plant and rail loading facility.

2.2 EXTENT OF THE OPERATION

The Generaal Section footprint covers an area of 1 554 ha and the Mount Stuart Section footprint covers an area of 118 ha for mining and infrastructure development.

The major infrastructure items were designed and positioned to accommodate mining layouts at both Sections, access to stockpiles, location of the processing plants, and environmental requirements. Other mine infrastructure includes:

- Access and on-site haul roads;
- Topsoil stockpiles and berms;
- Overburden (carbonaceous and non-carbonaceous) stockpiles;
- ROM coal storage area;
- Associated conveyors from the ROM storage areas to the processing plant(s);
- Associated conveyors from the processing plant(s) to the product storage areas;
- Product stockpile areas;
- Carbonaceous discards stockpile at Mount Stuart Section;
- Storm water management infrastructure (i.e. clean & dirty water run-off);
- On-site water management and reticulation systems;
- Wastewater (sewage) treatment plant;
- Bulk electricity supply infrastructure;
- Bulk water supply infrastructure; and
- Offices, vehicle support structures and stores.

The overall mining and infrastructure layout in relation to the MRA footprint is shown in Figure 59. The mining and infrastructure layouts for the Mount Stuart and Generaal Sections are shown in Figure 60 and Figure 61 respectively.

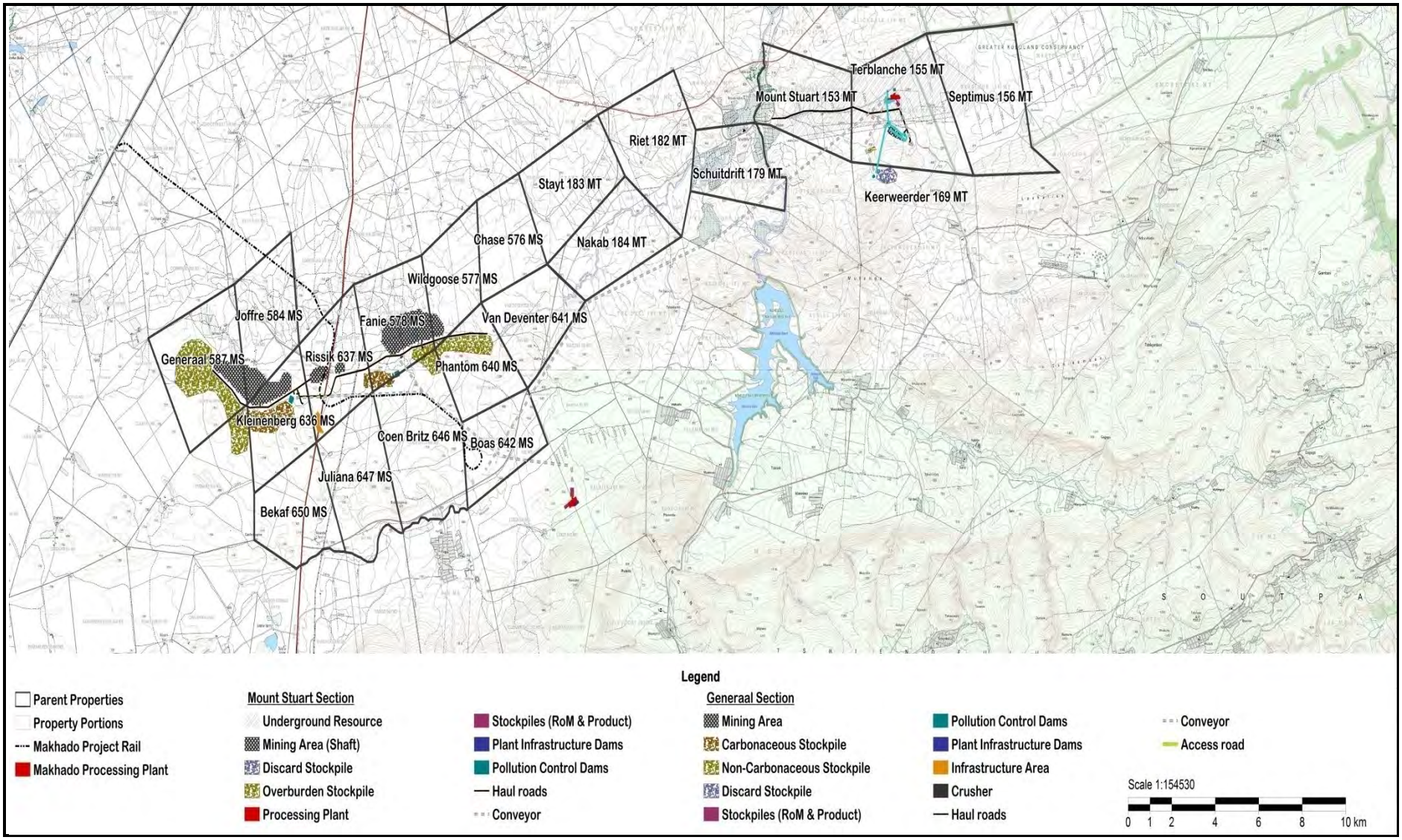


Figure 59: Mining and infrastructure layout for Generaal Project

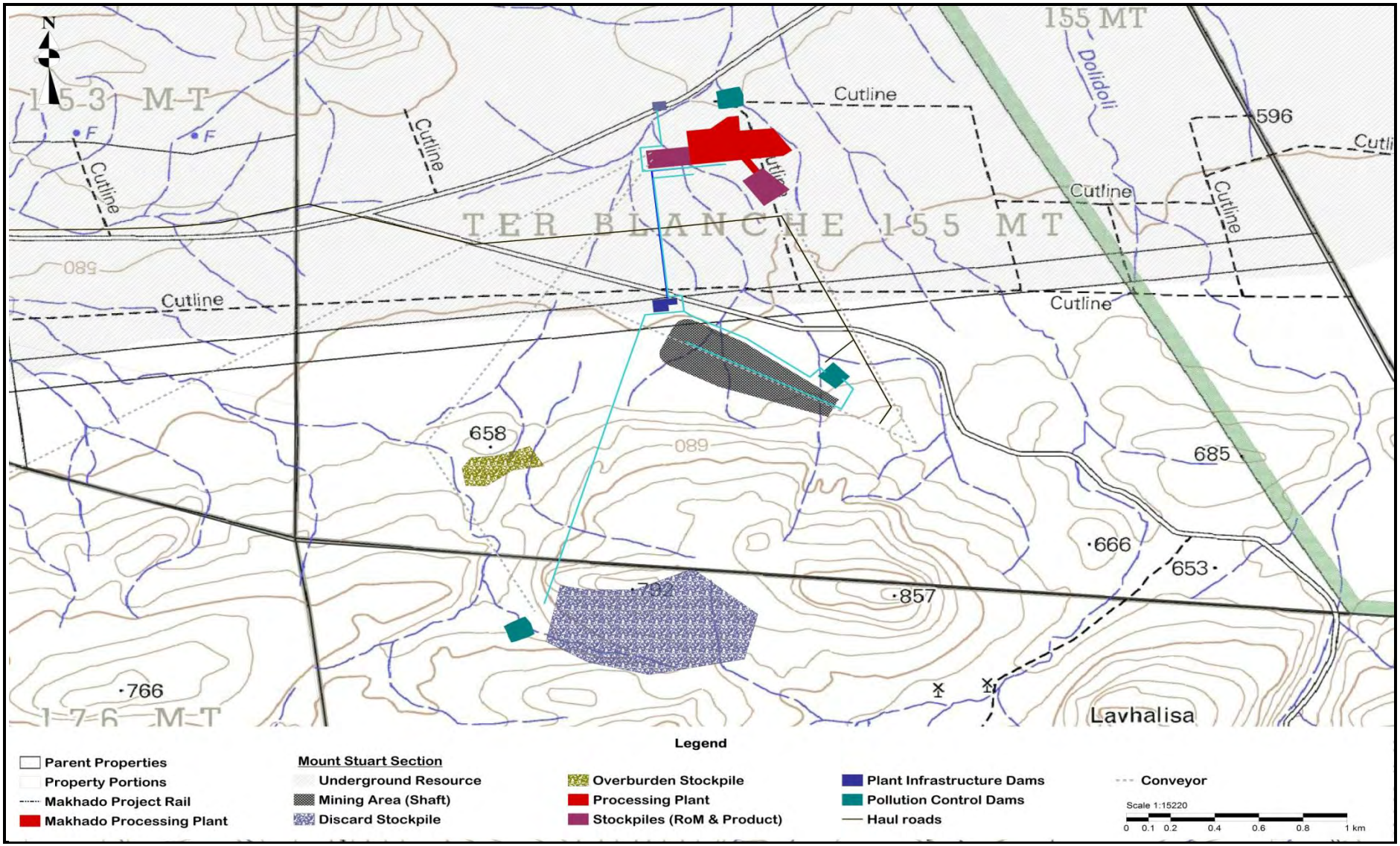


Figure 60: Mount Stuart Section - Mine and infrastructure layout plan

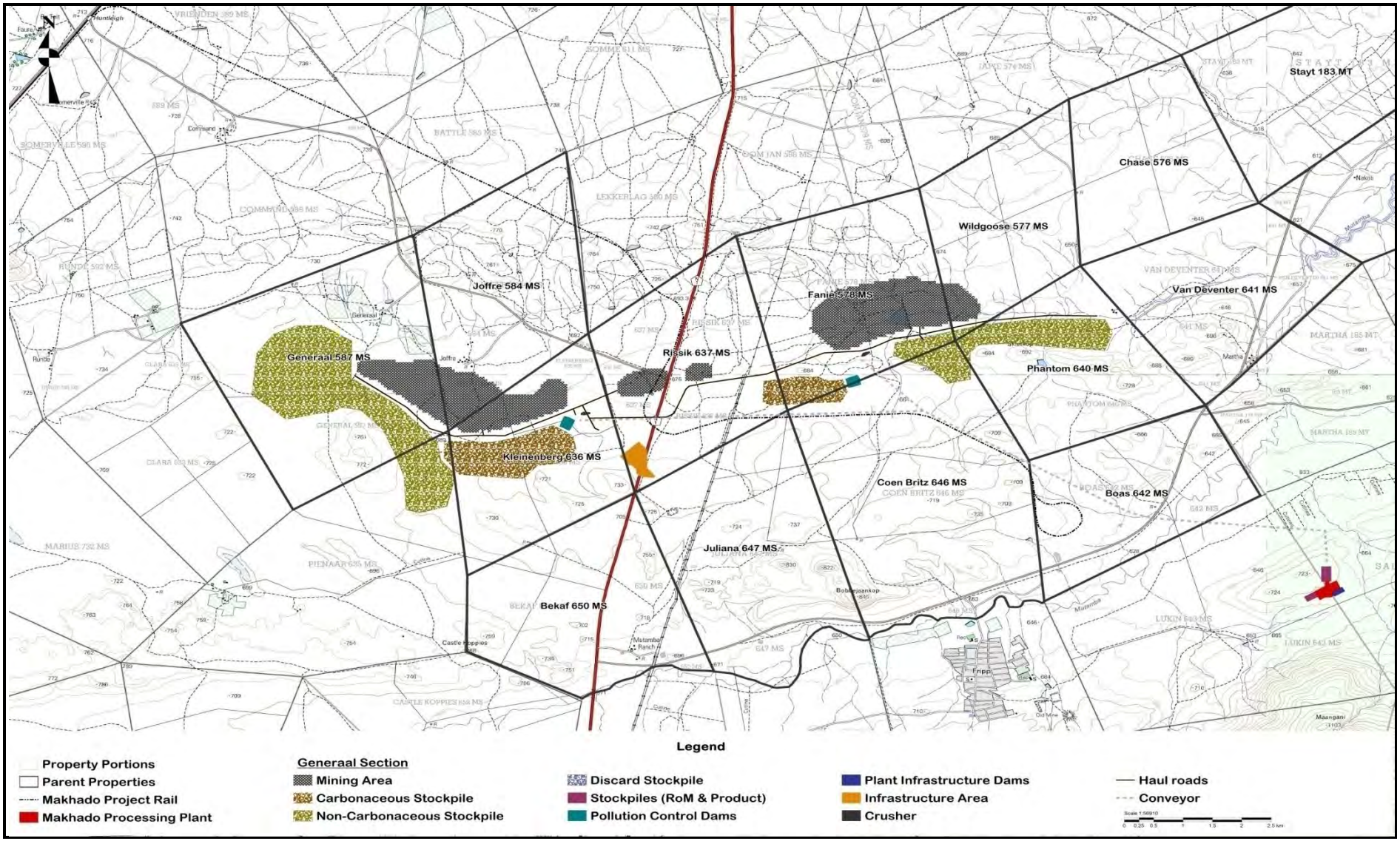


Figure 61: Generaal Section - Mine and infrastructure layout plan

2.3 MINING OPERATIONS

2.3.1 MINING METHODOLOGY

2.3.1.1 Mount Stuart Section

The Mount Stuart Section is planned to be an underground, mechanised mine laid out on a bord-and-pillar design using continuous miners and shuttle cars.

Once the box-cut has been developed and the coal extracted from the box-cut, the portal and entrance into the underground reserves can be established. Access will commence by developing three adits into virgin ground from the portal position. The purposes of these 3 adits are: two for in-take airways i.e. conveyance and tramming, whilst the other will be used for return airways. Bord-and-pillar mining method is normally proposed for dipping coal seams. This entails the mining of rooms (bords) leaving pillars intact as a primary support to support the immediate roof. Secondary support will be used in the form of roof bolts and any other support means as and when required into the immediate roof of the bords mined. The width of the pillars to be left intact is dictated mainly by the following factors:

- The depth below surface;
- Immediate roof competency (inputs from a geotechnical specialist);
- The mining height; and
- Width of the board.

To maintain optimal extraction of the resource, pillars left behind could be partially extracted towards the end of a panel being mined or towards the end of the LOM following specialised geotechnical guidelines. Due to the thickness of the parting between the two seams designated to be mined, it is envisaged that the two seams can be super imposed. This implies that the layout of the lower seam is to be as close as practical possible to the layout of the upper seam. This layout will also be dependent on specialised recommendations of a geotechnical engineer with further studies and will mainly rely on the thickness and the competency of the parting in between. Figure 62 below illustrates a typical bord-and-pillar layout.

Coal can be extracted as follow:

- Conventionally: This entails a mining cycle of drilling, charging and blasting, cleaning and support the immediate roof. With the cleaning process broken coal will be conveyed by means of load haul dumpers (“LHDs”) to either a feeder breaker where the coal will be crushed in order to convey it to either a bunker or stockpile in close proximity of the processing plant; and
- Mechanised: This entails a mining cycle of cutting and loading the coal by means of a continuous miner and supporting the roof. Coal will then be conveyed by means of electrical or battery driven shuttle cars to a feeder breaker from where it will be crushed in order to convey it to either a bunker or stockpile in close proximity to the processing plant.

A mechanised mining method was chosen for the Mount Stuart Section.

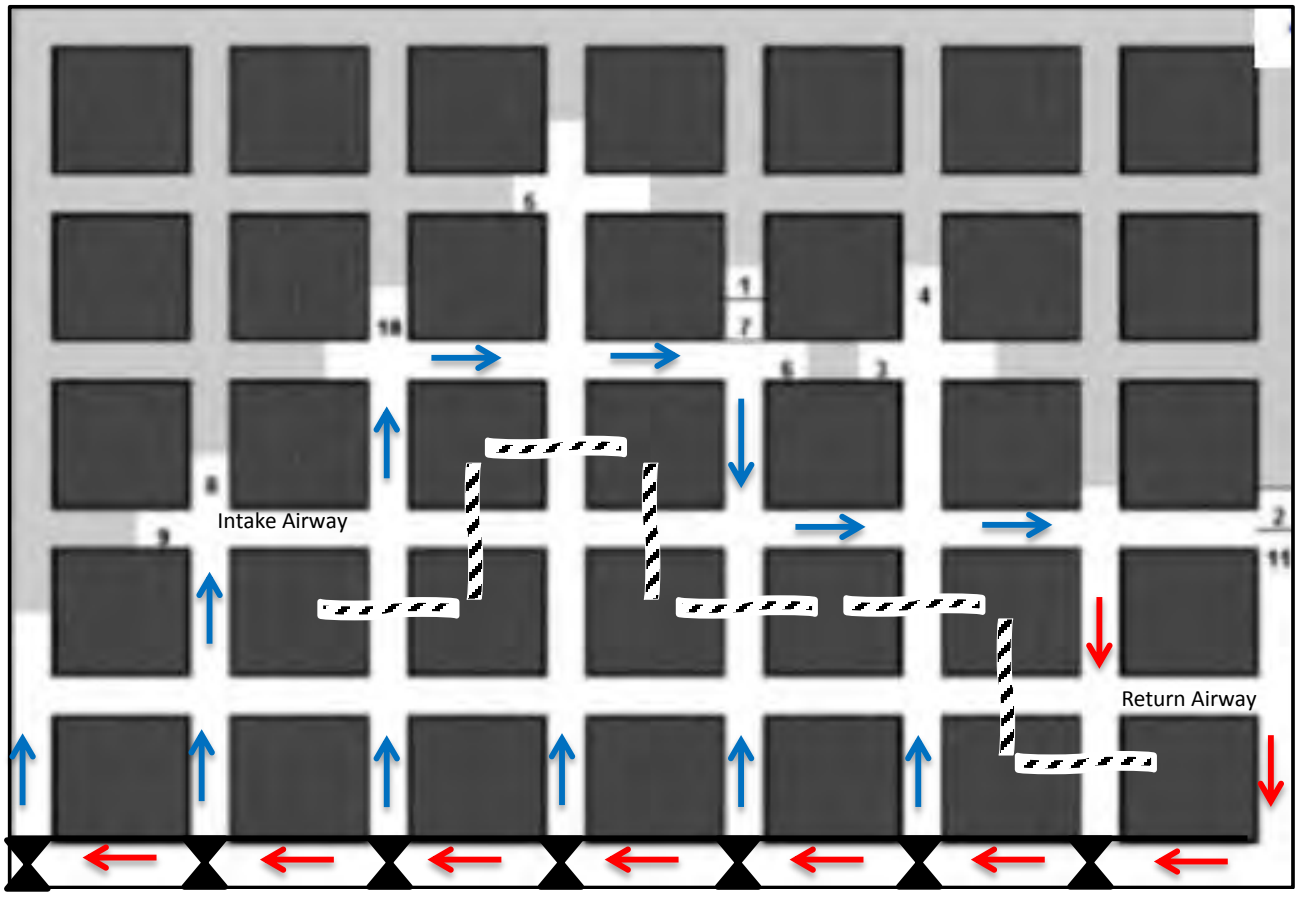


Figure 62: Bord-and-Pillar layout

2.3.1.2 Generaal Section

The type of mining method that will be employed at the Generaal Section is a total extraction open pit mining method. The open pit will be mined through conventional truck and shovel.

The process for mining method involves stripping, drilling, blasting, loading and hauling of overburden to the waste dumped and ROM stockpile or processing plant area. Drilling and blasting are undertaken by pneumatic or hydraulic crawler mounted drills using commercial, emulsion type explosives delivered on site by an explosives manufacturer. Loading and hauling are done by means of shovels and/or front-end loaders into off-road haul trucks for hauling to the primary crusher or waste dump on site.

Ramps will be from 20m to 30m at 1:10 gradients and operating lift height as specified in the design for each pit component. Coal will be mined with a conventional truck and shovel operation. Coal is modelled to be mined by excavators with a capacity of 1400bcm/h. Interburden units are modelled to be mined by excavators with a capacity of 1500bcm/h. Overburden units are modelled to be mined by excavators with a capacity of 1650bcm/h.

A fleet of trucks at 220 ton payload has been allocated for waste movement. Coal mining and reject haulage has been modelled with a fleet of trucks at 150 ton payload. The scheduled waste demand to meet a 3Mt/a coal product production rate is such that 1 coal excavator is required with 3 interburden excavators and 2 Overburden excavators. The fleet will be exclusively diesel powered

2.3.1.2.1 Mining sequence

The mining sequence in the open pit environment is illustrated in Figure 63. Open pit terminology is illustrated in Figure 64.

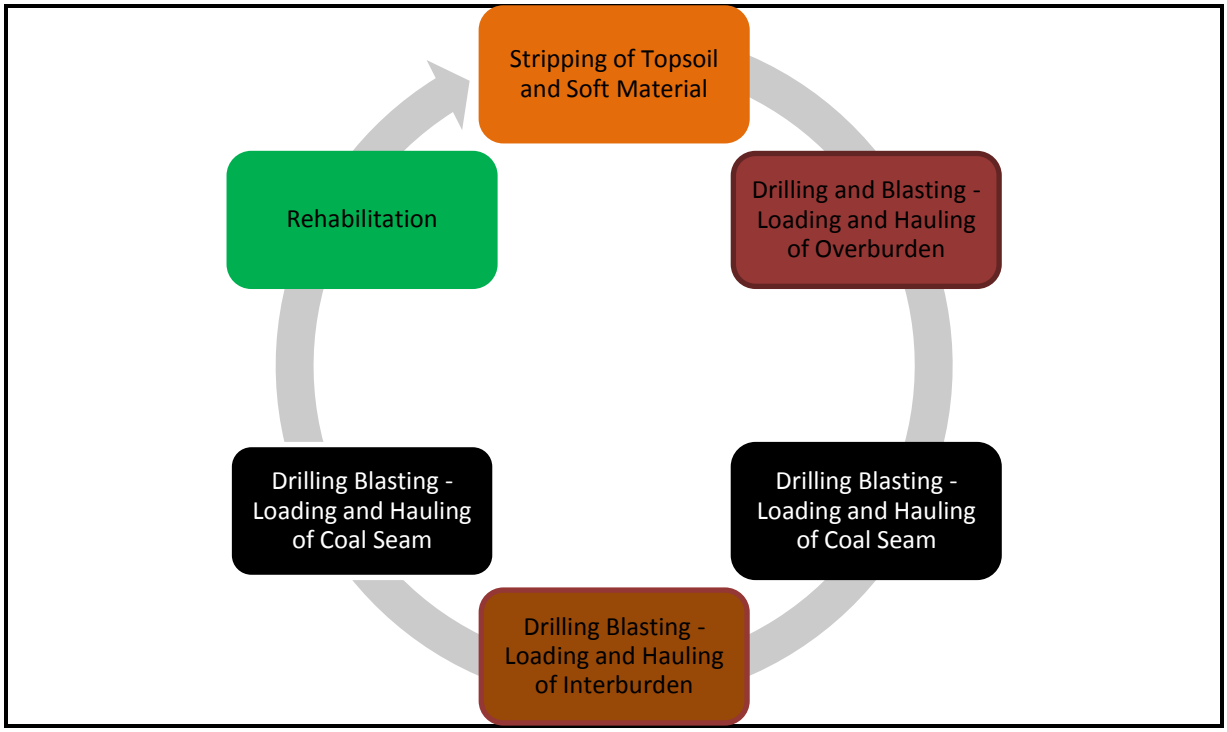


Figure 63: Typical mining sequence

2.3.1.2.2 Drilling and blasting

- Drilling of blast holes by pneumatic or hydraulic crawler mounted drills;
- Blasting with commercial, emulsion type explosives delivered on site by an explosives manufacturer by means of an explosives delivery truck;
- Slope angles to be as per design; and
- Vertical benches as per design.

Figure 65 illustrates a typical layout of how the overburden and interburden drilling and blasting would be conducted.

2.3.1.2.3 Loading and hauling

- Loading and hauling are done by means of shovels and/or front-end loaders into off-road haul trucks for hauling to the primary crusher or waste dump on site;
- Ramps will be from 20m to 30m at 1:10 gradients; and
- Operating lift height as specified in the design.

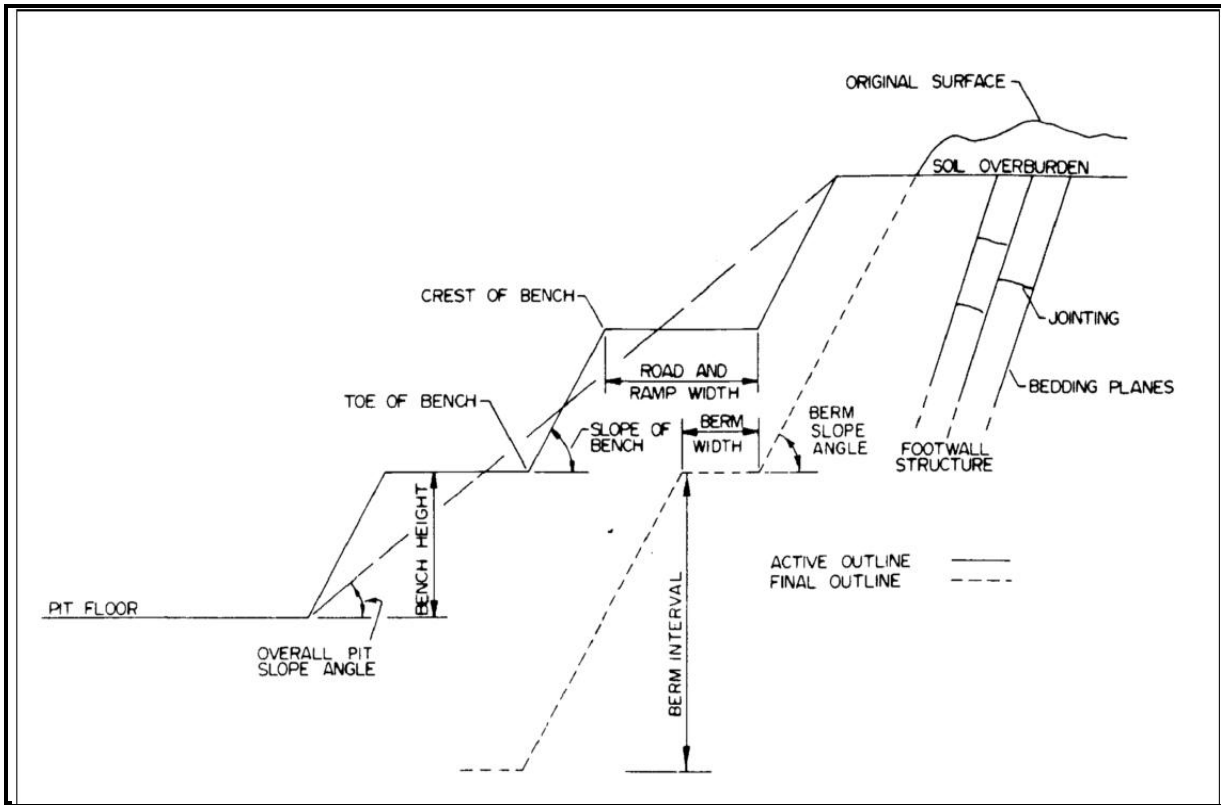


Figure 64: Open pit mining cross section layout

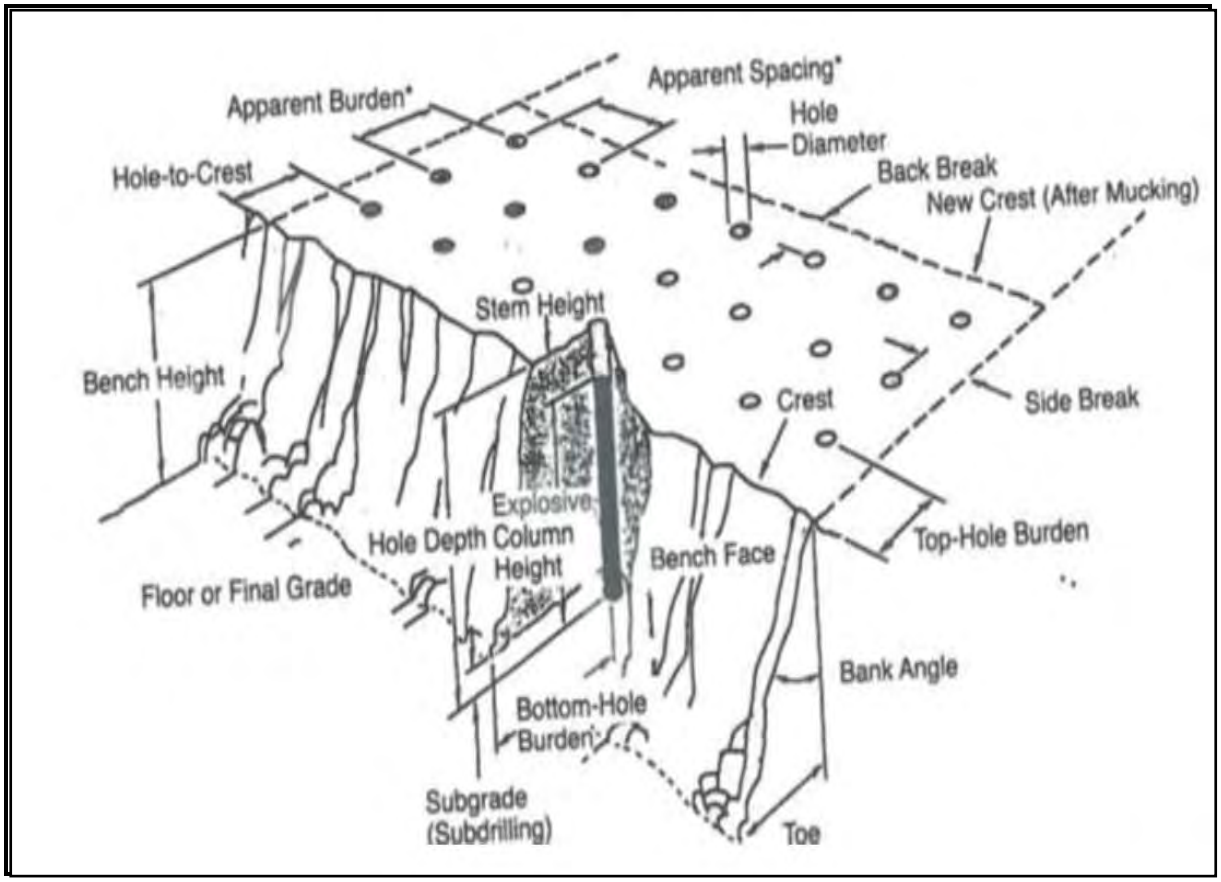


Figure 65: Schematic drilling and blasting pattern

2.3.2 MINING SCHEDULE

2.3.2.1 Mount Stuart Section

The estimated coal production at a rate of 2.0 Mtpa is 20 years with the start date assumed to be 2019. Figure 66 indicates the total ROM production for the two mineable seams (SBU – Seam Bottom Upper and SM – Seam Middle) with the combined saleable product.

2.3.2.2 Generaal Section

The schedule runs over a period of approximately 14 years at a ROM production rate of 3 Mtpa excluding the ramp down phase in the 14th year. The waste volumes to be mined are at approximately 19 Mtpa on steady state and that includes the waste tonnages from the interburden. The LOM production schedule with the relevant product types is illustrated in Figure 67.

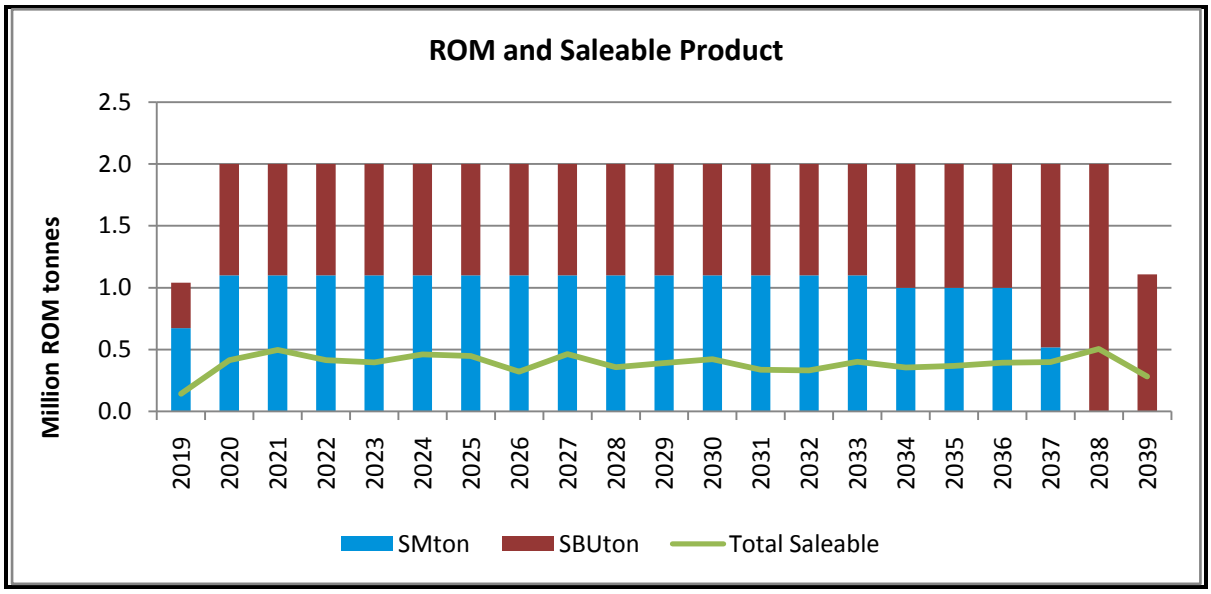


Figure 66: Mount Stuart Section - ROM and saleable product

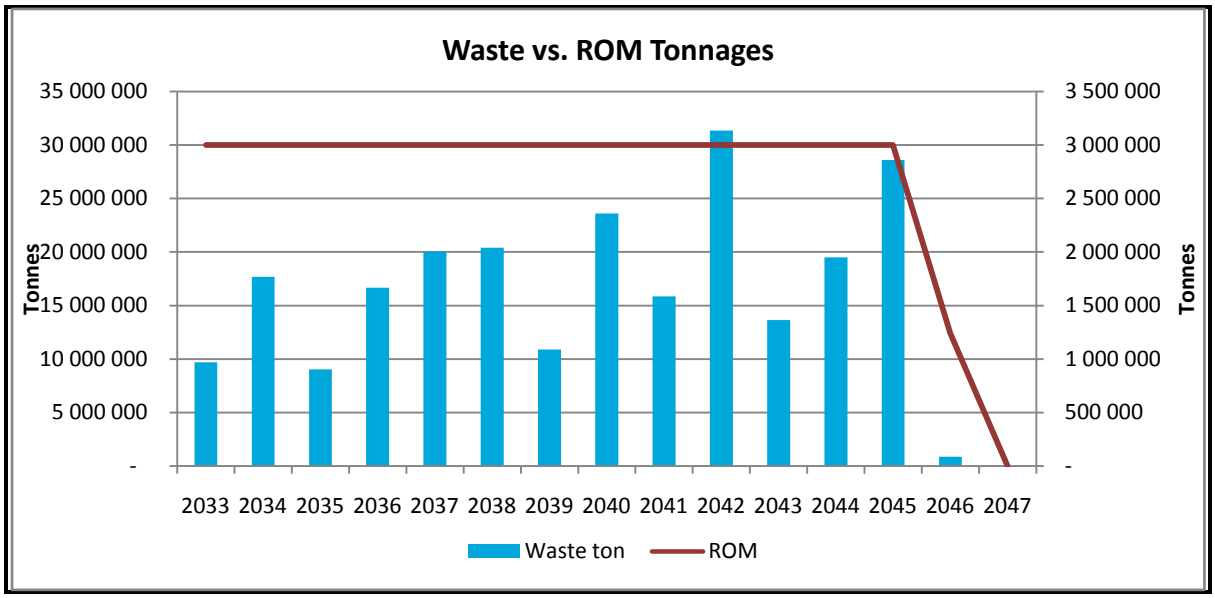


Figure 67: Generaal Section - LOM production profile

2.3.3 COAL PROCESSING

No processing plant will be required on the Generaal Section, since coal will be transported by overland conveyor to the Makhado Colliery processing plant. The Mount Stuart Section will have its own plant and clean coal will be transported by overland conveyor to the Makhado Rapid Load-out Terminal (RLT) for dispatching.

2.3.3.1 Design Overview

The Mount Stuart Section will be developed as an underground mine supplying 2 Mtpa ROM for processing. The proposed Coal Handling and Processing Plant (CHPP) is selected on the basis of using concepts that ensure efficient and effective beneficiation of Mount Stuart coals at the required quality within reasonable capital and operating costs. The technologies selected are well proven in the coal industry.

The colliery washing plants will produce two products namely a middlings product with an ash content of 30% and a coking product with an ash content of 10%. The processing plants will therefore use the following technologies:

- Two-stage crushing of raw coal using double roll crushers in a primary and secondary configuration to reduce coal from nominally 450mm to produce a plant feed product (50 x 1mm)
- Two-stage dense medium separation (DMS) for coarse coal (50 x 1mm) beneficiation using cyclone separators to produce a coking and middlings product
- Two-stage of up-flow classification for recovery of fine coal (1 x 0.3mm) using reflux classifiers to produce a coking and middlings product
- Two-stage flotation using micro-bubble and conventional mechanical technologies for the recovery of ultra-fine coking coal (-0.3mm) product

The selection of dense medium cyclones allows for the treatment of raw coal with large variation in yield that will be treated during the proposed life of the mine. The use of two-stage reflux classifiers in the fines circuit improves the overall yield of the middlings product. The combination of different technologies in the flotation circuit improves the efficiency of separation of coking coal from ultra fine particles. The coarse products will be dewatered by centrifuges while the fines will be dewatered by filtration.

Fine tails will be dewatered using a thickener followed by tailings filtration before being discharged on a common discard conveyor feeding the discard dump. The development of the discard dump will be done in phases and will be compacted and the sides of the dump soil clad to reduce the risk of heating or spontaneous combustion.

The CHPP capacities have been aligned with the mining and distribution concepts deemed appropriate for the successful exploitation of Mount Stuart coals.

2.3.3.2 Process Plant Key Design Features

The plant feed size is reduced to -50mm to ensure that high quality coal is liberated and effectively beneficiated using DMS, fines recovery and flotation processing technologies. The rotary breaker is used to ensure that any competent shale is removed from plant feed upfront as discard before feeding the process plant.

The coal shall be extracted from the ROM stockpile, at a controlled rate, via vibrating feeders beneath the stockpile. The use of feeders will allow for blending of the coal by drawing material from different areas of the stockpile to keep the plant yield as consistent as possible.

The plant uses a two stage DMS that allows for simultaneous production of a coking product of high value and a middlings product. The HG DMS cyclone will operate with a medium RD of 1.8 and medium to ore ratio of 3.5 to 1 to ensure efficient separation of coal in the cyclone. The LG DMS cyclone will operate with a medium RD of 1.3 and medium to ore ratio of 3.5 to 1 to ensure efficient separation of coal in the cyclone. The desliming screens will be fitted with 1 x 8.8mm slotted panels with a cut point of 1mm to ensure effecting sizing of coal and to reduce the blinding of panels with fines. The circuit can handle a feed size of 0.8mm to allow for a decrease in bottom size feed to the DMS should this plant be found to be more efficient than the reflux classifier on the fines fraction of -1+0.8mm. Pulping water and spray water is added on the screen to ensure efficient separation of fines from the coarse DMS feed.

The reflux classifiers have been selected instead of spirals due to its ability to cut at lower densities. This allows for recovery of a -1+0.3mm coking product with a targeted ash content of 10%. The reflux units will be supplied with probes that allow for monitoring and control of the cut point for efficient operation. The RC2020 reflux classifier has a maximum feed rate of 69tph and can treat particles with a size range of -2+0.25mm. This unit therefore gives flexibility to change the feed top size from 0.8 – 2mm to increase the proportion of feed reporting to the fines circuit should the unit be found to be more efficient than the DMS in the recovery of finer coking coal Added benefits of these units over spirals is that they use less footprint for a similar tonnage and can cut at an RD as low as 1.40 compared to spirals that typically cut at 1.70.

The floatation circuit uses a combination of micro-bubble flotation and conventional mechanical flotation for the processing of ultra-fines. The selected micro-bubble cells are Jameson units which have proven higher organic efficiencies. The Jameson cells have a smaller footprint than mechanical cells and do not require any power for operation. Mechanical cells will be used as scavengers and also to reduce residual frother in the flotation tailings stream as excessive frother leads to the formation of froth on top of the thickener and other process tanks in the plant.

The concentrate filtration plant does not include a concentrate thickener ahead of dewatering as the design of the concentrate filter feed tank ensures sufficient froth breaking before feeding the concentrate filter. The use of a tailings filter ensures that most of the water is recovered and re-used in the plant and as such no slimes disposal facilities are required for discarding fine tailings. The fine tailings will be disposed off with coarse discard.

The use of centrifuges on coarse and fine products allows for maximum recovery of process water in the plant. This reduces the amount of raw make-up water required by the plant thus improving water use efficiencies.

The plant chutes, bins, tanks and other areas prone to abrasive and impact wear will be adequately lined to withstand high wear rates. Lining will typically consist of VRN 400 steel liners, high density alumina tiles, epoxy lining, rubber lining and use of HDPE pipes.

Instrumentation in the plant will ensure effective operation of process units within optimum operating parameters. This allows for monitoring and control of process units to ensure efficient product recovery by the CHPP coupled with automatic sampling, feed rate measurement and use of weighbridges to form the backbone of the metallurgical accounting system. Instrumentation will mainly consist of mass meters, nuclear density meters, level transmitters, level probes, pressure transmitters, flow meters and automatic samplers. A SCADA system will be used in the process control room to ensure effective process management.

2.3.3.3 Product Handling

The coarse coking product (-50+1mm) from the LG DMS plant, fine coking product from the fines circuit (-1+0.3mm) and product filter cake from the product cake stockpile (-0.3mm) are transported to the 500t product silo via a 750mm wide common product conveyor. The conveyor is fitted with a mass meter and an automatic sampler for metallurgical accounting purposes.

The product is withdrawn from the silo using a belt feeder that discharges onto common overland conveyors to transport final product to the Makhado RLT. The product silo has an overspill chute which feeds an emergency stockpile when the silo is full. The emergency stockpile has an additional 4,000 t holding capacity and the product from the emergency stockpile can be reloaded onto the overland product conveyor by means of a re-load conveyor that is fed using front-end loaders.

The coarse middlings (-50+1mm) from the LG DMS plant and the fine middling from the fines circuit (-1+0.3mm) are transported to the 500t middlings silo via a 750mm wide common middlings conveyor. The conveyor is fitted with a mass meter and an automatic sampler for metallurgical accounting purposes.

The middlings silo feeds the common overland conveyors via vibrating feeders to transport middlings to the RLT. The common overland conveyors can only carry one product at a time to the RLT. The middlings silo has an overspill chute which feeds an emergency stockpile when the silo is full. The emergency stockpile has an additional 4,000 t holding capacity and the middlings from the emergency stockpile can be reloaded onto the overland product conveyor by means of a re-load conveyor that is fed using front-end loader.

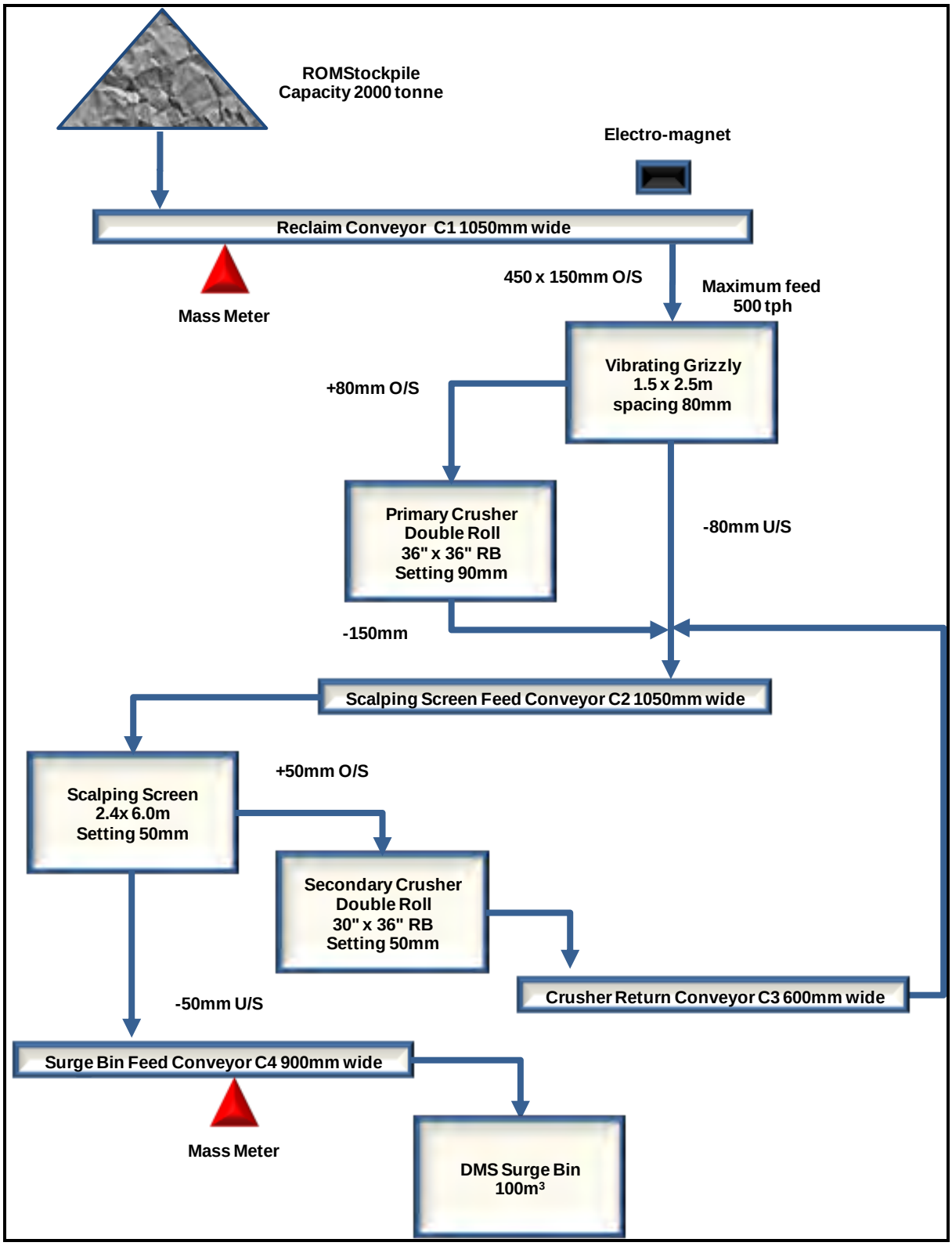


Figure 68: Mount Stuart Section – block flow diagram ROM Handling

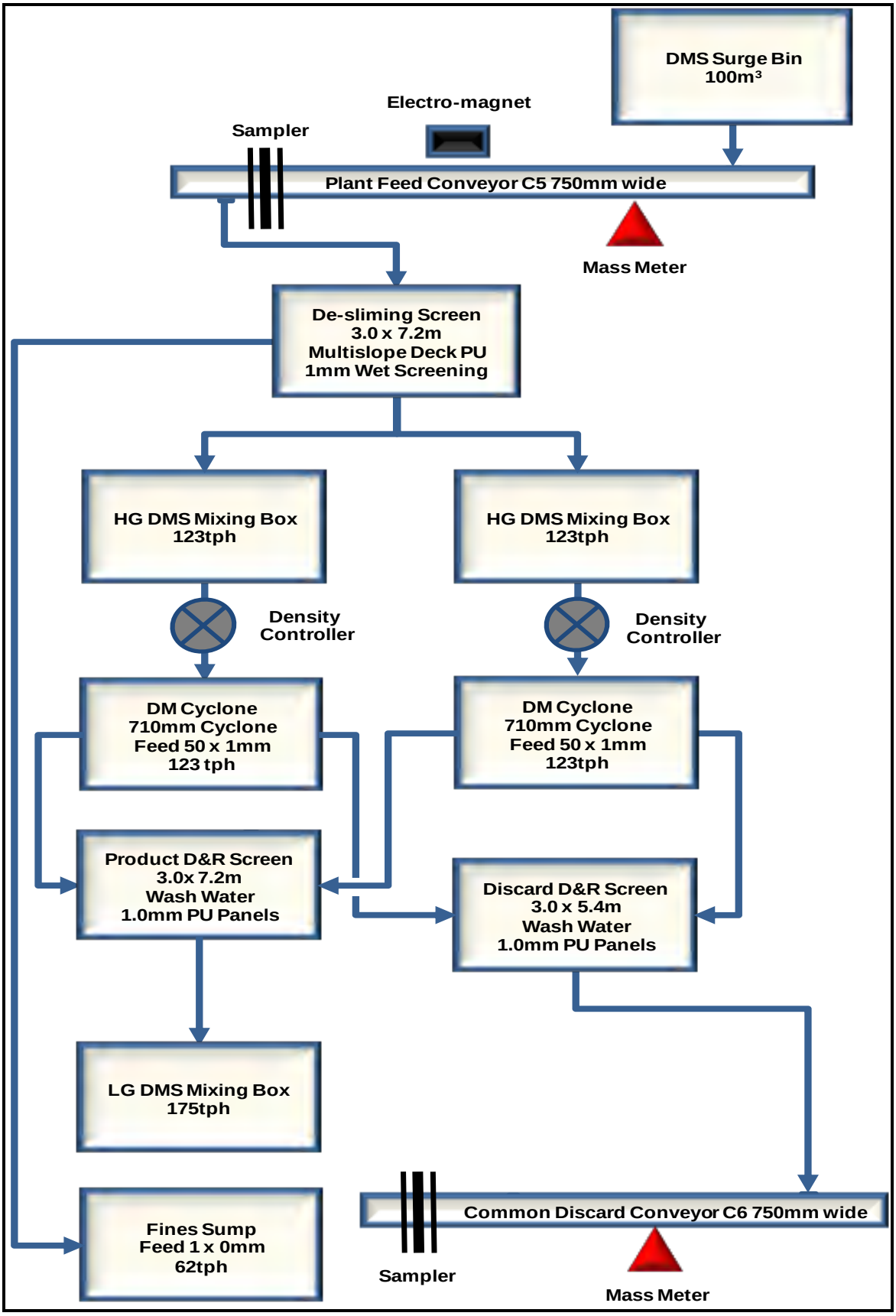


Figure 69: Mount Stuart Section – block flow diagram HG DMS

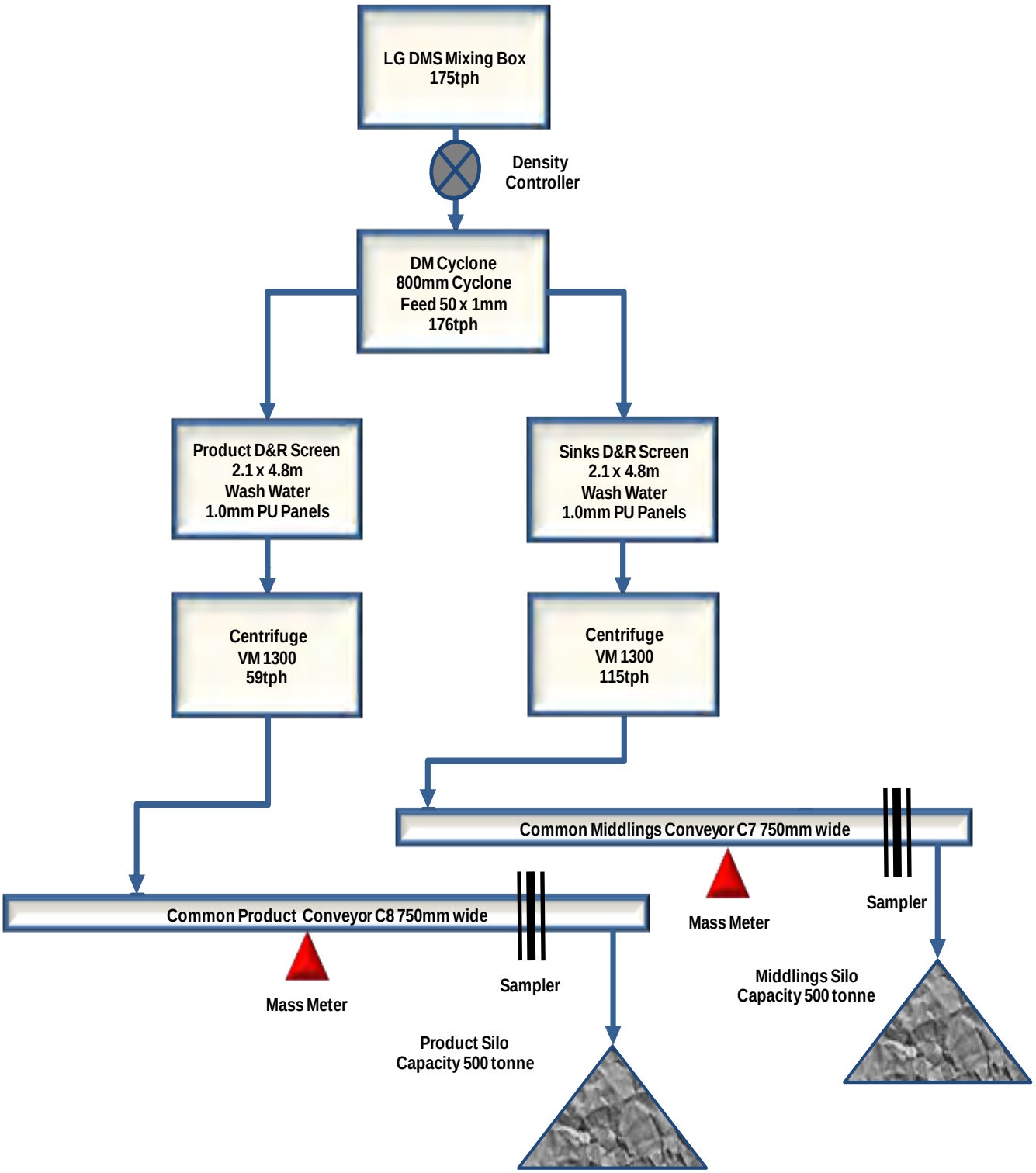


Figure 70: Mount Stuart Section – block flow diagram LG DMS

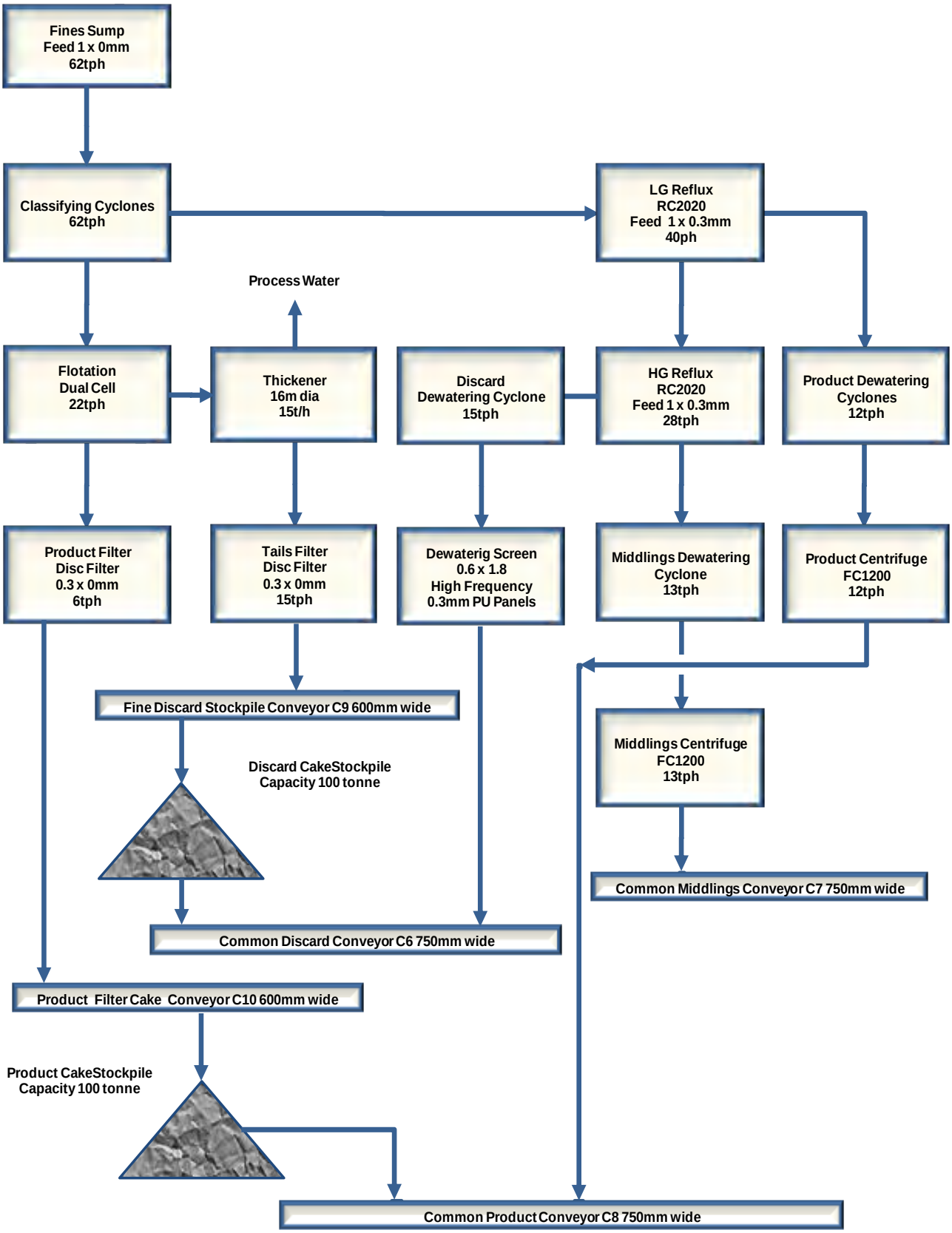


Figure 71: Mount Stuart Section – block flow diagram Fines Plant

2.3.4 MINE INFRASTRUCTURE

The mine infrastructure areas (MIA) comprise all the facilities, roads, services and systems required for the mine to operate optimally. The individual mining sections will be provided with workshops and other necessary infrastructure required for the mining operation, such as personnel support structures, vehicle support structures, water management structures and management and monitoring systems. Buildings will include management offices, production offices, change house, medical and fire fighting facility, shift changing facility, security and access control, training centre, control room and contractors accommodation camp.

The major infrastructure items were designed and positioned to accommodate mining layouts at both pits, access to stockpiles, location of the CHPP, and environmental requirements (including the management of dirty and clean water and protection of water courses and rivers).

A layout of the mine infrastructure for the Mount Stuart and Generaal Sections are shown in Figure 60 and Figure 61 respectively.

2.3.4.1 Mount Stuart Section

The Mount Stuart Mine is designated as an underground mine. As such the mine does not require substantial surface infrastructure to support the mining of the resources. However, the Mount Stuart Section will have its own CHPP and clean coal will be transported by overland conveyor to the Makhado RLT. Due to the long hauling distance a conveyor will be utilised to transport the coal product from the washing plant to the Makhado RLT.

2.3.4.1.1 Access road

The Mount Stuart mining site is accessed along the R525 running east towards Tshipise. The R525 is a surfaced road. Approximately 16 km from the N1, at a T-junction to the south, the road leads to the mine access intersection. The access road is approximately 6 km long and runs in an easterly direction. The access road to the mining site will have a gravel wearing surface.

2.3.4.1.2 Mining roads

The mine is an underground mine and therefore the surface service roads are not extensive. The necessary roads lead to the plant, mine infrastructure, conveyors and the inclined shaft and also to the stockpiles.

Service roads will be constructed gravel roads and provide ease of access to areas travelled by light mining vehicles and delivery trucks.

2.3.4.2 Generaal Section

The Generaal East and West Pits will share common mine infrastructure comprising of workshops and vehicle support infrastructure located at the West Pit.

The ROM hauled from the pits will be crushed in close proximity to the pits before transported to the CHPP at Makhado Colliery located to the south east of the Generaal Section.

Due to the long hauling distance a conveyor will be utilised to transport the ROM from the West Pit to the East Pit and from there to the Makhado CHPP.

2.3.4.2.1 Access road

The existing access road to Mopane traverses across the Generaal West Pit. The existing intersection with the N1 will be moved approximately 1.2 km south and the road relocated to run along the N1 in a northerly direction past the coal reserve from where it will turn westwards to tie up with the existing Huntleigh road. Access to the Generaal Project site is by way of this new intersection with the N1. The access to the Generaal East Pit is from the West Pit across the N1 by means of an underpass. The access road to the mining site will have a gravel wearing surface.

2.3.4.2.2 Mining roads

Haul roads and service roads will link the West and the East Pits, the stockpile areas and the infrastructure areas on the east and west sides of the N1 respectively. Haul roads have been planned to be 30m wide with gravel surfaces to meet the requirements of the hauling fleet.

Service roads will be constructed gravel roads and provide ease of access to remote areas for light mining vehicles. These roads are separate from the haul roads in order to separate light mine traffic from the heavy traffic (haul trucks) as a site safety measure.

The service roads will also cross the N1 by means of an underpass adjacent to the haul road underpass.

2.3.4.3 Storm Water Management

Water is a scarce commodity and every effort has been made in the design of the water management systems to conserve and reuse as much water as possible. A water management strategy will be implemented on the Generaal Project to address the following salient issues:

- Water uses and users, with a particular focus on consumption rates;
- Engineering design basis for the water reticulation and distribution systems required to provide water to all the infrastructure, mining and beneficiation operations;
- Effluent management, including sewage treatment and disposal;
- Engineering design basis for the clean water diversion system; and
- Engineering design basis for the dirty water collection and management systems, including flood protection.

Clean storm water run-off along the various small water courses will be diverted around the proposed infrastructure, the mining pits and dump areas. These storm water drains and deflection berms have been positioned along the southern boundaries of the proposed mining pits to collect and convey clean water into the closest natural river course. Dirty water such as storm water run-off from the various terraces and plant area is captured and conveyed along lined channels towards the various dirty water dams positioned around the site. All water polluted on site as well as run-off from the carbonaceous dumps as well as seepage under carbonaceous dumps is retained and re-cycled on site. A detail water management strategy will be developed and implemented for the Generaal Project.

2.3.4.3.1 Clean water run-off

Clean storm water run-off along the various small watercourses will be diverted around the proposed infrastructure, the mining pits and dump areas. These storm water drains and deflection berms have been positioned along the southern boundaries of the proposed mining pits to collect and convey clean water into the closest natural river course.

2.3.4.3.2 Dirty water run-off

Dirty water such as storm water run-off from the various terraces and plant area is captured and conveyed along lined channels towards the various dirty water dams positioned around the site. All water polluted on site as well as run-off from the carbonaceous stockpiles and seepage under carbonaceous stockpiles is retained and re-cycled on site.

2.3.5 BULK POWER SUPPLY

The lengthy Eskom Tabor and Spencer 132 kV Distribution networks stretching 200 km from Polokwane to 50 km away from the Musina border-post result in low voltages and thermal constraints during transformation and line contingencies. The expected Tabor and Spencer 132 kV load growth is located 100 km north of Tabor and 70 km from Spencer - generally the area in which the Generaal Project resides - therefore, the Transmission outreach constraint will cap load growth.

The Polokwane Customer Load Network (CLN), including the Tabor and Spencer power corridor, remains susceptible to voltage instability and is the weakest part of the Northern Grid network due to being operated beyond its reliability power transfer limit. Eskom Transmission Division plan to strengthen the Northern Grid in the areas north of the Soutpansberg with a new 400 kV power line between the Tabor Main Transmission Substation and the newly approved Bokmakirie (Nzhelele) Substation.

Eskom is accordingly establishing additional Distribution and Transmission assets to cater for load north of the Soutpansberg, including the Bokmakirie Distribution Station and the 4x250 MVA 400/132 kV Nzhelele Main Transmission Station (MTS). The proposed network solution meets the 10 year Distribution load requirements in the Tabor and Spencer network area and it is also informed by the 20 year Transmission and Distribution load forecast in meeting the Transmission 20 year plan.

The Generaal Project requires an electrical supply capability of 32 MVA:

Operation	Electrical Capacity (MVA)	Year
Mount Stuart	27	2018
Generaal (N1 West)	5	2032
Total	32	

An Eskom connection can only be established once the Nzhelele / Bokmakirie 400/132 kV Main transmission Station has been commissioned - this is planned for 2017/8.

The Generaal Project electrical supply will be taken from the 132 kV network and transformed to 11kV/550/400/230V. The exact supply configuration is yet to be determined and the least environmental impact solution will be followed. The project team has evaluated the possible supply options and has identified a direct supply from Nzhelele / Bokmakirie 400/132 kV Main transmission Station – refer to Figure 72.

A 132/11 kV substation will be established at each of the mining operations. Power factor correction equipment will be installed at each of the 132/11kV substations to reduce the amount of reactive power required from Eskom and to improve the voltage regulation over the 11kV/550/400/230V distribution networks.

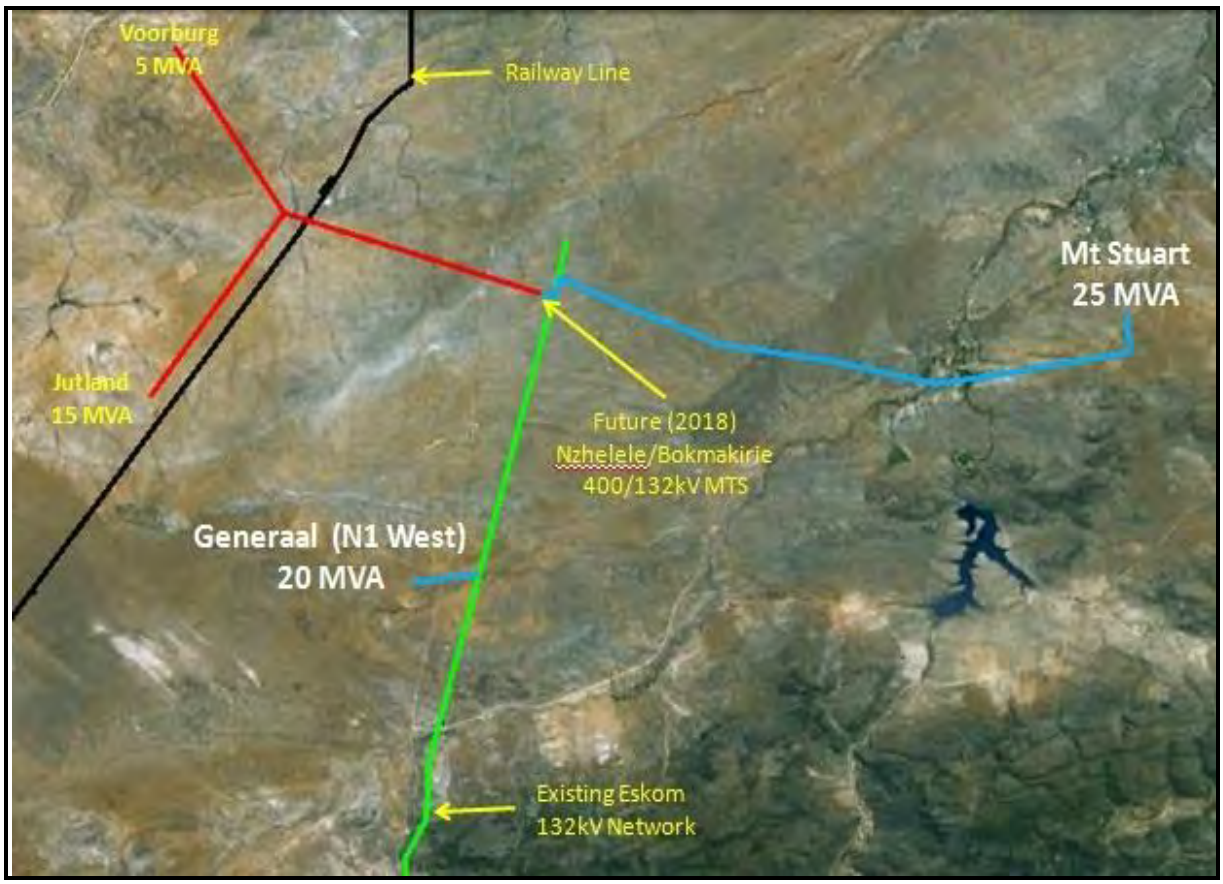


Figure 72: Probable 132kV line route to supply the Generaal Project

2.3.6 BULK WATER

The water requirement estimate for the Generaal Project indicates that a maximum of 11 000 m³/day of water is required at the mining peak.

The water supply to the mine will come from the following sources:

- Groundwater (boreholes and seepage into the mining pits);
- Storm water run-off impounded on site;
- An external water source piped to site;
- Sewage effluent released from Makhado Town; and
- Abstraction from the Nzhelele Dam (buy-out of existing rights).

Storm water run-off on site is seasonal and, although it will be utilised, it is not a constant water supply and has therefore not been included in the water-supply chain.

The investigation into the most cost-effective source for water supply to the Generaal Project has yet to be completed. This will be finalized during the Feasibility Phase of the project

2.3.7 LOGISTICS

The primary domestic destination for coking coal is located at ArcelorMittal, Vanderbijlpark. The primary domestic location for middlings coal is Eskom's Tutuka, Majuba, Camden and Grootvlei Power Stations in Mpumalanga Province.

As indicated above, no processing plant will be required on the Generaal Section, since coal will be transported by overland conveyor to the Makhado Colliery processing plant, from where the product will be dispatched via the Makhado RLT situated on the farm Boas 642 MS with a railway link to Huntleigh where it links up with the TFR main line.

The Mount Stuart Section will have its own CHPP and clean coal will be transported by overland conveyor to the Makhado RLT for dispatching.

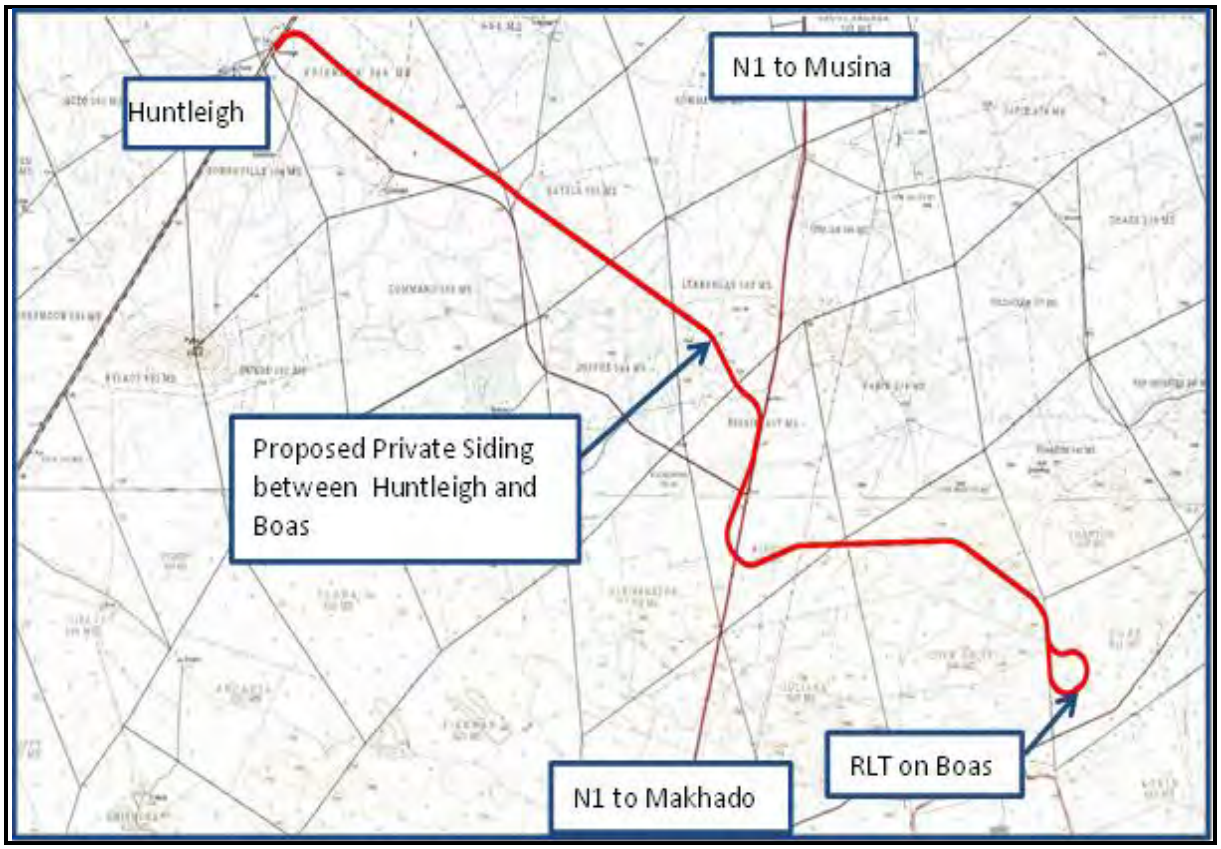


Figure 73: Rail link between farm Boas 642 MS and Huntleigh as proposed for the Makhado Project

2.4 MINE RESIDUE MANAGEMENT

2.4.1 MINING (INDUSTRIAL) WASTE

Mine residue stockpiles are required to accommodate mining overburden, partings and plant discards on the mine surface. Mine residue stockpiles are categorised as topsoil stockpiles, non-carbonaceous stockpiles and carbonaceous stockpiles.

2.4.1.1 Carbonaceous and Non-Carbonaceous Stockpiles

Design philosophy is based on the requirement to minimise the volume and surface area required for stockpiling by starting in-pit backfilling as soon as possible during the mining operation as double handling of the material is costly.

At the Generaal Section (opencast) it is envisaged that the dumping of material on the surface will be required for a period of three years after which the material mined from the pit will be returned to the pit minimising the fill material during the rehabilitation process.

Being an underground mine, the Mount Stuart Section will require surface stockpiles for its carbonaceous discard / slurry from the CHPP, as well as an overburden dump associated with the inclined shaft excavated material. Discard stockpiles will be placed according to accepted practice and procedures

2.4.1.2 Topsoil Stockpiles

Topsoil will be stripped from the pit mining areas, roads and terrace areas and will be placed as close as possible to the point of stripping. The topsoil will be used as fill material, for the construction of berms and also be placed between the discards to act as isolating material. Topsoil will also be used as capping material during final rehabilitation of the stockpiles.

2.4.2 NON-MINING WASTE

The following waste types will be generated during the course of the project:

- Domestic waste
- Hazardous waste
- Fluorescent tubes
- Glass
- Plastics
- Chemicals
- Medical waste
- Scrap metal
- Used oil/diesel/greases
- Building rubble (construction & demolition activities)
- Used tyres
- Old explosives

The different waste streams will be segregated and disposed of in appropriate designated receptacles. An approved, registered waste contractor will be appointed by the mine to manage the waste generation and safe disposal thereof. No landfill site will be established on the Generaal Project site. The waste removed will be either treated through the composting station, recycled through the Waste Transfer Station (WTS) and the remainder will be disposed through landfill at appropriate registered landfill sites.

No waste will be disposed of or buried on site, or in any other location that is not a licensed waste disposal site.

2.4.3 SEWAGE EFFLUENT

Sewage effluent will be managed as follow:

- An appropriate sewage treatment plant will be designed and constructed for the Generaal Project. The final treatment system will be selected during the Feasibility Phase and the necessary authorization applied for.
- As a minimum, treatment will adhere to the General Standards and chemical dosing will be applied for final effluent disinfection (chlorine contact basin).
- Treated effluent will be re-used in the processing plant.
- No sewage disposal will be allowed on site.

2.5 LIST OF MAIN MINING ACTIONS, ACTIVITIES OR PROCESSES

Below a summary of the main activities / processes and their associated activities.

Main activities / processes	Associated activities
Opencast mining	Underground mining (Mount Stuart Section) • Portal (incline shaft) area • Ventilation shafts Opencast mining pits (Generaal Section) • Generaal East Pit • Generaal West Pit • ROM crushing and screening In-pit / underground water management • sumps • pumping systems
Processing plant & infrastructure	Beneficiation Plant (Mount Stuart Section) • Plant stockpiles • Plant infrastructure • Clean water storage tanks • Dirty water holding dams • Silt traps / dirty water canals Mine Infrastructure Areas • Workshops • Wash-bay • Bulk hydrocarbon facilities Offices Communication Structures Explosive magazine Stores Waste Collection Area
On-site conveyance of ROM & product	Haul roads / service roads / conveyors • River crossings / culverts
Mine residue / waste management	Carbonaceous / discards stockpiles Non-carbonaceous stockpiles Topsoil stockpiles / berms In-pit disposal Waste management (general / hazardous)
Off-site product transport	Rapid Load-out Terminal (RLT) Balloon railway siding
On mine water	Dirty and Clean Storm Water systems • Dirty water surge dams • Diversion and protection berms and channels • River diversions / storm water berms and channels Potable water plant Dirty and potable water pipelines Sewage treatment plant

2.6 APPLICABLE LEGISLATION

The legal frameworks within which the mining development, transport options and associated infrastructure aspects operate is complex and include many acts, associated regulations, standards, principle, guidelines, conventions and treaties on an international, national, provincial and local level. The main legal frameworks that require compliance in terms of Environmental and Water Use Authorisation are:

- Act No. 28 of 2002: Mineral and Petroleum Resources Development Act (MPRDA)
- Act No. 107 of 1998: National Environmental Management Act (NEMA)
- Act No. 36 of 1998: National Water Act (NWA)

Other legislative frameworks applicable to a development of this nature include:

- Act No. 25 of 1999: National Heritage Resources Act (NHRA)
- Act No. 10 of 2004: NEMA: Biodiversity Act (NEMBA)
- Act No. 43 of 1983: Conservation of Agricultural Resources Act (CARA)
- Act No. 84 of 1998: National Forests Act (NFA)
- Act No. 7 of 2003: Limpopo Environmental Management Act (LEMA)
- Act No. 39 of 2004: National Environmental Management: Air Quality Act (AQA)
- Act No. 57 of 2008: National Environmental Management: Protected Areas Act
- Act No. 59 of 2008: National Environmental Management: Waste Act (NEMWA)
- Act No. 101 of 1998: National Veld and Forest Fire Act
- Act No. 15 of 1973: Hazardous Substances Act
- GN No. R.527 of 23 April 2004: Mineral and Petroleum Resources Development Regulations
- GN No. 704 of 4 June 1999: Regulation on use of water for mining and related activities aimed at the protection of water resources
- GN No. R.544, R.545 and R.546 of 18 June 2010: NEMA: EIA Regulations
- GN No. 718 of 3 July 2009: NEMWA: Waste Management Activities
- GN No. 248 of 31 March 2010: AQA: Atmospheric Emissions Activities
- GN No. R.152 of 2007: NEMBA: Threatened or Protected Species (TOPS) Regulations

It is important to note that the approach for the Generaal Project is to first apply for a NOMR and follow the required Regulations in conducting the EIA and compile an EMP in terms of the MPRDA. Once this process is completed and the applicant has obtained further detail in respect of its planned development, the applications for environmental authorisation in terms of the NEMA and an IWUL in terms of the NWA will be conducted as separate processes. Refer to Table 32 for a high-level assessment of the listed activities (NEMA) and water uses (NWA) that may potentially be triggered by the Generaal Project.

The purpose of this document is to address the requirements of the MPRDA only. However, it is important to note that the construction and mining activities cannot commence without compliance to all the legislative requirements and before all the necessary permits / licenses are issued by the regulating authoritie.

Table 32: Activity-based legal requirement assessment (high-level) for Generaal Project

ACTIVITY	NEMA/NEMWA	NWA
Opencast and Underground Mining		
- Generaal Section (o/c) - Mount Stuart Section (u/g)	GNR 545 – A15: *Physical alteration of undeveloped, vacant or derelict land for residential, retail, commercial, recreational, industrial or institutional use where the total area to be transformed is 20 hectares or more.*	S21(c)&(i) – impeding / altering of water courses S21(g) – dust suppression
- In-pit / underground water management - {sumps / pumping}		S21(a)&(j) – Dewatering of pits / underground workings S21(g) – Disposing of waste / water containing waste
- Storm water management - {river diversions / berms}	GN544 – A11: *The construction of (i) canals; (ii) channels; (iii) bridges; (iv) dams; (v) weirs; (vi) bulk storm water outlet structures; (vii) marinas; (viii) jetties exceeding 50 square metres in size; (ix) slipways exceeding 50 square metres in size; (x) buildings exceeding 50 square metres in size; or (xi) infrastructure or structures covering 50 square metres or more, where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.*	S21(c)&(i) – impeding / altering of water courses
Beneficiation plant and infrastructure areas		
- Access / haul roads	GN544 – A22: *The construction of a road, outside urban areas, (i) with a reserve wider than 13.5 meters or, (ii) where no reserve exists where the road is wider than 8 metres, or (iii) for which an environmental authorisation was obtained for the route determination in terms of activity 5 in Government Notice 387 of 2006 or activity 18 in Notice 545 of 2010.*	S21(g) – dust suppression
- Stream crossings - {bridges, pipelines, roads}	GN544 – A11: T*he construction of (i) canals; (ii) channels; (iii) bridges; (iv) dams; (v) weirs; (vi) bulk storm water outlet structures; (vii) marinas; (viii) jetties exceeding 50 square metres in size; (ix) slipways exceeding 50 square metres in size; (x) buildings exceeding 50 square metres in size; or (xi) infrastructure or structures covering 50 square metres or more, where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.*	S21(c)&(i) – impeding / altering of water courses
	GN544 – A18: *The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock from (i) a watercourse; (ii) the sea; (iii) the seashore; (iv) the littoral active zone, an estuary or a distance of 100 metres inland of the high-*	S21(c)&(i) – impeding / altering of water courses

ACTIVITY	NEMA/NEMWA	NWA
	water mark of the sea or an estuary, whichever distance is the greater.	
- Infrastructure area, workshops	GNR 545 – A15: *Physical alteration of undeveloped, vacant or derelict land for residential, retail, commercial, recreational, industrial or institutional use where the total area to be transformed is 20 hectares or more.*	S21(g) – Disposing of waste / water containing waste
- Plant stockpiles		S21(g) – Disposing of waste / water containing waste
- Clean water storage tanks	*GN546 – A2: The construction of reservoirs for bulk water supply with a capacity of more than 250 cubic metres.*	S21(b) – Storage of water
- Dirty water dams	GNR 545 – A19: *The construction of a dam, where the highest part of the dam wall, as measured from the outside toe of the wall to the highest part of the wall, is 5 metres or higher or where the high-water mark of the dam covers an area of 10 hectares or more.*	S21(a)&(g) – Disposing of waste / water containing waste
- Bulk hydrocarbon facilities	GN545 – A3: *The construction of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of more than 500 cubic metres.*	
- Sewage plant (effluent)	*GN718 – Category B(7): The treatment of effluent, wastewater or sewage with an annual throughput capacity of 15,000 cubic meters or more.*	S21(e) – controlled activities (irrigation with waste water) S21(g) – Disposing of waste / water containing waste
Conveyance of ROM & product (on site)		
- Haul / service roads	GNR 544 – A22: *The construction of a road, outside urban areas, (i) with a reserve wider than 13.5 meters or, (ii) where no reserve exists where the road is wider than 8 metres, or (iii) for which an environmental authorisation was obtained for the route determination in terms of activity 5 in Government Notice 387 of 2006 or activity 18 in Notice 545 of 2010.*	S21(g) – dust suppression
- Stream crossings / culverts - {roads, pipelines, conveyors}	GNR 544 – A11: *The construction of (i) canals; (ii) channels; (iii) bridges; (iv) dams; (v) weirs; (vi) bulk storm water outlet structures; (vii) marinas; (viii) jetties exceeding 50 square metres in size; (ix) slipways exceeding 50 square metres in size; (x) buildings exceeding 50 square metres in size; or (xi) infrastructure or structures covering 50 square metres or more, where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.*	S21(c)&(i) – impeding / altering of water courses
Mine residue management		
- Overburden stockpiles - Discards stockpile	GNR 545 – A15: *Physical alteration of undeveloped, vacant or derelict land for residential, retail, commercial, recreational, industrial or institutional use where the total area to be transformed is 20 hectares or more.*	S21(g) – Disposing of waste / water containing waste

ACTIVITY	NEMA/NEMWA	NWA
- In-pit disposal / rehabilitation		S21(g) – Disposing of waste / water containing waste
- General / hazardous waste	N/A – off-site disposal	
Product transport		
- Conveyor from Mount Stuart to Boas RLT - {stream crossings}	GN544 – A11: T*he construction of (i) canals; (ii) channels; (iii) bridges; (iv) dams; (v) weirs; (vi) bulk storm water outlet structures; (vii) marinas; (viii) jetties exceeding 50 square metres in size; (ix) slipways exceeding 50 square metres in size; (x) buildings exceeding 50 square metres in size; or (xi) infrastructure or structures covering 50 square metres or more, where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.*	
	GN544 – A18: *The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock from (i) a watercourse; (ii) the sea; (iii) the seashore; (iv) the littoral active zone, an estuary or a distance of 100 metres inland of the high-water mark of the sea or an estuary, whichever distance is the greater.*	S21(c)&(i) – impeding / altering of water courses

2.7 IMPLEMENTATION SCHEDULE

From the date of granting of the mining right (anticipated to be in 2014) further feasibility and final design studies will be undertaken and construction will commence at the Mount Stuart Section in 2018 and production will commence in 2019. The Generaal Section is due to commence actual production only in 2034, that is, at the end of the life of the Makhado Colliery, of which it is an extension.

The project schedule over the next 10 years is shown in Figure 74.

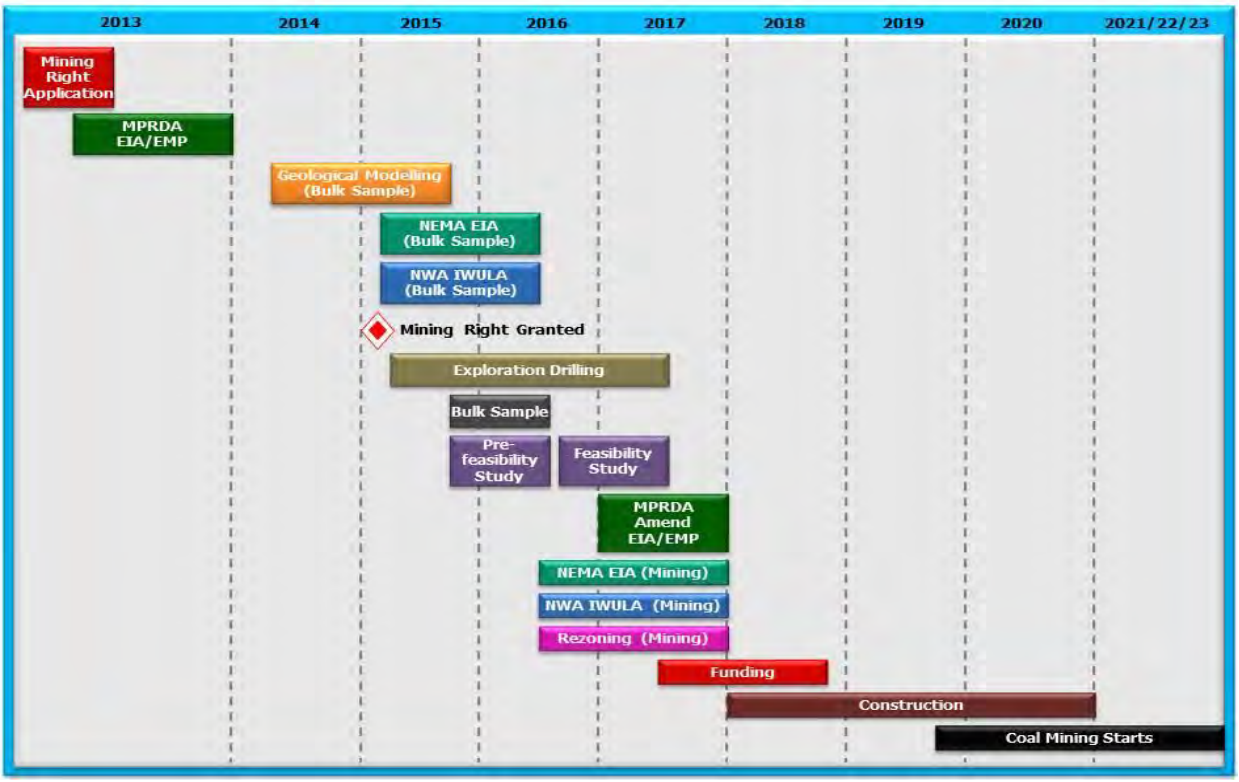


Figure 74: Project schedule for Generaal Project over the next 10 years

3 DESCRIPTION OF POTENTIAL IMPACTS ASSOCIATED WITH ACTIVITY

3.1 LIST OF POTENTIAL IMPACTS

Table 33 lists the potential environmental impacts for each of the main mining activities, processes and activities associated with the Generaal Project. These are described in more detail in the following sections.

Table 33: List of potential environmental impacts for the Generaal Project

Activity	Environmental Aspect	Potential Impact
All activities	**Biodiversity / Land Use & Capability**	Surface disturbance of approximately 1,700 hectares for the purpose of mining and infrastructure development over the LOM will lead to impacts on the soil, land use and land capability, natural vegetation and fauna
All activities	**Waste management**	Poor waste management could lead to environmental impacts
		Poor sewage management could impact on water resources
All activities	**Bulk water**	Impact on water stressed catchment - fully allocated
All activities	**Bulk electricity**	Further impact on over-allocated electricity reticulation system
All activities	**Heritage resources**	Destruction of heritage & cultural resources as a result of mining and associated infrastructure (including linear activities)
All activities	**Sense of place**	Impact on conservation value of the region
Opencast mining (Generaal Section)	**Soils / Land Use & Capability**	Potential hard setting of soils post-reclamation
		Subsidence of rehabilitated areas
Opencast mining (Generaal Section)	**Surface water**	Impact on non-perennial streams cutting through mining areas leading to decrease in runoff
		Impact on 1:100 year flood-line of the Mutamba River
		Impact on wetland areas and aquatic ecosystems
		Increased sedimentation into the river systems due to uncontrolled surface run-off
		Potential impact on in-stream habitat and riverine vegetation as a result of decrease in runoff
		Impact of long-term decant on water quality
Opencast mining (Generaal Section	**Groundwater**	Dewatering of aquifer as a result of mining, resulting in drying up of boreholes and springs
		Impact on surrounding vegetation as a result of dewatering and subsequent recovery
		Decrease in regional water quality due to seepage from rehabilitated pits
		Migration of pollution plume after full recovery of groundwater levels (prior to decant)
Opencast mining (Generaal Section)	**Air Quality**	Dust impact caused by vehicle movement
		Dust impact caused by blasting activities
		Dust impact caused by materials handling
		Methane emissions leading to air quality impacts
Opencast mining (Generaal Section	**Noise**	Elevated noise levels caused by mining operation, dewatering (pumping) and blasting activities

Activity	Environmental Aspect	Potential Impact
Opencast mining (Generaal Section)	**Visual / Aesthetics**	The mining will have a negative on the aesthetics / sense of place
Opencast mining (Generaal Section)	**Blasting**	Impact on the communities and sensitive receptors as a result of blasting
Underground mining (Mount Stuart Section)	**Soils / Land Use & Capability**	Soil impacts as a result of poor hydrocarbon management and spillages
		Surface disturbance caused by infrastructure
Underground mining (Mount Stuart Section)	**Surface water**	Impact on non-perennial streams cutting through proposed incline shaft area, leading to decrease in runoff
		Increased sedimentation into the river systems due to uncontrolled surface run-off
Underground mining (Mount Stuart Section)	**Groundwater**	Dewatering of aquifer as a result of mining, resulting in drying up of boreholes and springs
		Impact on surrounding vegetation as a result of dewatering and subsequent recovery
Underground mining (Mount Stuart Section)	**Air quality**	Air quality impacts associated with ventilation shafts
		Methane emissions leading to air quality impacts
Underground mining (Mount Stuart Section)	**Noise**	Noise impact (especially during the night) as a result of the ventilation system / extractor fans
Underground mining (Mount Stuart Section)	**Visual / aesthetics**	The shaft complexes will have a negative on the aesthetics / sense of place
Processing plant / infrastructure areas	**Soils / Land Use & Capability**	Soil impacts as a result of poor hydrocarbon management and spillages
		Surface disturbance caused by infrastructure
Processing plant / infrastructure areas	**Surface water**	Water quantity impact due to decreased surface runoff
		Water quality impact on Mutamba and Nzhelele Rivers
		Water quality impacts as a result of poor hydrocarbon management and spillages
		Impact on wetland areas and aquatic ecosystems
Processing plant / infrastructure areas	**Groundwater**	Water quality impacts due to infiltration of dirty water from the plant and infrastructure areas
Processing plant / infrastructure areas	**Air quality**	Air quality impacts associated with processing activities and movement of vehicles
		Dust impact caused by crushing and screening operations
Processing plant / infrastructure areas	**Noise**	Elevated noise levels caused by crushing and processing activities
Processing plant / infrastructure areas	**Visual / aesthetics**	Processing plant will have a visual impact as a result of high buildings
Processing plant / infrastructure areas	**Lighting**	Sky glow effect will have an impact on the sense of place at night
		Impact on invertebrates
On-site conveyance of ROM and product	**Air Quality**	On-site conveyance will increase the ambient air quality
On-site conveyance of ROM and product	**Surface water**	Stream crossings (road and conveyor) could potentially impact on the stream flow and lead to stream flow reductions downstream
		Spillages along conveyors/roads could impact on water quality
On-site conveyance of ROM and product	**Noise**	Elevated noise levels caused by trucking and conveying activities

Activity	Environmental Aspect	Potential Impact
On-site conveyance of ROM and product	**Soils / Land Use & Capability**	Surface disturbance caused by infrastructure
Mine residue stockpiles	**Groundwater**	Impact of carbonaceous stockpiles on groundwater resources
Mine residue stockpiles	**Surface water**	Impact on non-perennial streams cutting through mining areas leading to decrease in runoff
		Impact on wetland areas and aquatic ecosystems
		Increased sedimentation in drainage lines due to uncontrolled surface run-off and erosion
		Water quality impacts as a result of dirty water runoff / seepage from carbonaceous stockpiles
Mine residue stockpiles	**Visual / Aesthetics**	Large stockpiles will impact on the landscape
Mine residue stockpiles	**Air quality**	Increase dust emissions as a result of stockpiles
Mine residue stockpiles	**Noise**	Noise from stockpile construction leading to the main contributing factors to the noise at the sensitive receptors, especially at night-time
Off-site conveyance of product - conveyor system between Mount Stuart & Generaal	**Safety**	Road / conveyor crossings could lead to safety risks to road users
Off-site conveyance of product - conveyor system between Mount Stuart & Generaal	**Surface water**	Stream crossings where culverts may concentrate flow, leading to enhanced flow velocities and associated erosion problems
		Potential for water quality impacts due to dirty runoff and spillages along the conveyor
Off-site conveyance of product - conveyor system between Mount Stuart & Generaal	**Noise**	Increase of ambient noise levels along the conveyor route
Off-site conveyance of product - conveyor system between Mount Stuart & Generaal	**Air quality**	Increase of dust emissions along the conveyor route
Off-site conveyance of product - conveyor system between Mount Stuart & Generaal	**Biodiversity**	Land units will be divided into smaller units which may not be ecologically viable
		Potential impact on protected flora species identified along the route
		Creation of additional corridors which could lead to increased poaching
		Killing of animals crossing the conveyor
Rail link to main TFR railway line	**Safety**	Road / rail crossings could lead to safety risks to road users
Rail link to main TFR railway line	**Surface water**	Stream crossings where culverts may concentrate flow, leading to enhanced flow velocities and associated erosion problems
Rail link to main TFR railway line	**Surface water**	Potential for water quality impacts due to dirty runoff and spillages along the rail link
Rail link to main TFR railway line	**Noise**	Increase of ambient noise levels along the rail route

Activity	Environmental Aspect	Potential Impact
Rail link to main TFR railway line	**Air quality**	Increase of dust emissions along the rail link
Rail link to main TFR railway line	**Biodiversity**	Land units will be divided into smaller units which may not be ecologically viable
		Potential impact on protected flora species identified along the route
		Creation of additional corridors which could lead to increased poaching
		Killing of animals crossing the rail line
Off-site conveyance of product by truck (in emergencies)	**Safety**	Road transport of product will impact on the traffic along the route, safety risk to road users
Off-site conveyance of product by truck (in emergencies)	**Biodiversity**	Killing of animals and avifauna on the roads, especially nocturnal animals/birds
Off-site conveyance of product by truck (in emergencies)	**Surface water**	Potential for water quality impacts due to spillages and dirty runoff into the streams
Off-site conveyance of product by truck (in emergencies)	**Air quality**	Material and product loss from trucks
Off-site conveyance of product by truck (in emergencies)	**Noise**	Increase of ambient noise levels along the route

3.1.1 SOILS, LAND USE AND LAND CAPABILITY

The impacts identified for the soils, land capability and land use are considered collectively as all of these facets are inter-related and inter-dependant, and so the impact to the soil depth and land capability distribution includes all other facets e.g. opencast, plant infrastructure areas and stockpile areas will be the same.

Opencast mining results in total destruction (before mitigation) of the various facets of the following:

- Soils (i.e. slope, depth, order of horizons, organic carbon, microbial activity, fertility, perched water table, hydrology and relative compaction);
- Land capability (i.e. capability class and distribution) – land capability is downgraded; and
- Land use.

Areas that will be totally to largely altered by mining related activities include the sites of the various features/facilities in the infrastructure areas, the overburden stockpiles and the haul/access roads.

Areas that will only be partially altered by mining related activities include the conveyors, power lines, gravel service roads and temporary 'topsoil' stockpiles.

3.1.1.1 Post-Mining Land Capability

Post-mining land capability may be considered from two different perspectives, namely according to:

- The Chamber of Mines post-mining land capability requirements; and
- The land capability potential (i.e. potential land-use).

3.1.1.1.1 Land capability requirements

Rehabilitate to the Chamber of Mines (and Government Regulation R537) post-mining capability class standards. This scenario must represent at least equivalent (or increased) post-mining arable and grazing capability class percentages, relative to the pre-mining state. The aforementioned indicates a commitment by the mine to rehabilitate the post-mining land capability to the recommended standard.

3.1.1.1.2 Land capability potential (i.e. potential land use)

Soil is a living ecological entity, therefore it is unlikely that rehabilitated post-mining arable capability class areas in the totally and totally - largely altered (and rehabilitated) areas may be successfully cultivated in the post-mining state, this being due to both a lowered production potential of the soils.

The lowered potential land capability could be attributed to the following:

Compaction, Consistency and Hard Setting

Soil compaction and hard setting can be attributed to the total destruction of soil structure in the stripping and redressing operations.

Consistency is the degree of cohesion or adhesion within the soil mass, or its resistance to deformation or rupture. given the above, soil consistence (in the area) appears to be directly related to soil texture and soil structure, whereby heavier textures and increasing grades of structure lead to increasing levels of hardness in the dry state.

Hard-setting of a cultivated soil involves slumping, a process of compaction that occurs without the application of an external load. Hard-setting involves the collapse of the aggregate structure during and after wetting, and a hardening without re-structuring during drying. This can be attributed to a decline in microbial activity, loss of organic carbon and subsoil material lying on the surface.

Mitigation measures such as suitable crops, the leaching of the soil to reduce the exchangeable sodium percentage, fertilizer applications to correct nutritional imbalances, mulching and organic matter, increasing irrigation water salinity, soil stabilizers, soil moisture, and suitable 'topsoiling' materials will be discussed.

These recommendations will be made in order that only high to moderate quality 'topsoiling' material will be replaced on the immediate surface during rehabilitation operations, thereby providing an acceptable medium for the growth of vegetative cover.

Subsidence

In the opencast and infrastructure areas, the pre-mining/pre-disturbance grade (slope), slope shape, contours and drainage density (not necessarily pattern) should be implemented where possible, at all times bearing in mind the critical erosion slopes (which will be calculated from the soil erodibility nomograph of Wischmeier, Johnson and Cross, 1971) for the various broad soil groups/phases which occur. This will be done by surface re-grading. Concave (rather than convex) slopes should be maximized wherever possible, while the creation of undulating 'basin and ridge' topography with frequent blind hollows should be avoided.

Limited surface subsidence of rehabilitated 'topsoiled' areas within the various pit footprints is likely to occur, this being caused by the settling of the spoil over time. Should a differential settling of the spoil occur, then this settling may lead to an interruption to the free-drainage of water, and thus the localized ponding of water. Furthermore localized soil erosion may occur upslope of the same area due to the slope change and slower infiltration rates as previously discussed. Such areas must similarly be re-graded (re-sloped), 'topsoiled' and re-vegetated in order to re-establish a free-draining final topography. Thus limited 'topsoil' (stockpiles) must be held in reserve for use in repair work during the operational, closure and post-closure phases of the mine.

3.1.1.2 Other Potential Impacts

Other impacts include the following:

- Alteration of the topography (changed slope shape, slope grade, drainage distribution, drainage density, and increased soil erosion);
- Alteration of soil horizons (decreased permeability, decreased moisture holding capacity, increased susceptibility to erosion, reduced fertility, and decreased levels of plant growth);
- Alteration of sub-surface layers; and
- Soil pollution.

3.1.2 BIODIVERSITY

3.1.2.1 Vegetation

The following impacts to vegetation and flora are expected as a result of the proposed mining activity, although additional impacts may be identified during future site assessments:

- Loss of vegetation
- Loss of floral species of special concern
- Increased risk of alien invasion
- Increased risk of soil erosion
- Disruptions to ecological corridors and loss of biodiversity conservation areas
- Aridification of the area as a result of mine de-watering

3.1.2.1.1 Loss of vegetation and habitat

The mining activity will result in the removal of vegetation from the mining footprint. This could result in permanent or temporary loss of habitat for both dependant and localised floral and faunal species. Furthermore, it could result in loss of intact vegetation and habitat for populations of localised and endemic species.

Figure 75 shows the vegetation communities in relation to the proposed mining activities. In general the proposed activities occur in areas of moderate sensitivity; however some sensitive areas (ridges, riverine systems are encroached upon by the opencast / stockpile areas (Generaal Section) and some linear activities.

The riverine forest and floodplains are important dry season refuge areas for many faunal species in their natural state. It is also a centre of floral diversity. Some of these areas, however, are degraded and overgrazed. The Mutamba River does provide a (limited) source of water, while the deeper alluvial soils may provide better forage than areas inland of the riparian zone. Any impacts on the sensitive aquatic ecosystems, regardless of the source, need to be avoided.

Impacts on this system include erosion, deforestation through flooding, habitat loss and degradation and the associated impacts on faunal and floral diversity, dewatering, water abstraction as well as increased sedimentation. Continued impacts on the riverine ecosystems may also ultimately reduce the capacity of this system to absorb dramatic flooding events.

3.1.2.1.2 Loss of floral and faunal species of special concern

Removal of natural vegetation in the areas where opencast mining will take place will influence various listed protected species. Listed protected species will be damaged or destroyed during construction or operation of the mine, which could have an impact on the population and survival of the species.

There are potentially a number of listed and legally protected species that could occur in the area, and whose habitat will be affected by the various mining activities – refer to Table 13. Many of these may not be present, but due to seasonal sampling constraints (many species are dormant or a positive identification is not possible during the winter months), their presence/absence could not be confirmed, especially herbaceous and bulbous species. Flora species of concern that were noted to be present include, amongst other, are the following:

- *Acacia erioloba* (Camel Thorn)
- *Adansonia digitata* (Baobab)
- *Adenium multiflorum* (Impala Lily)
- *Boscia albitrunca* (Shepherd's Tree)
- *Combretum imberbe* (Leadwood Tree)
- *Euphorbia aeruginosa*
- *Philenoptera violacea* (Apple-leaf)
- *Sclerocarya birrea subsp. caffra* (Marula)
- *Spirostachys africana* (Tamboti)

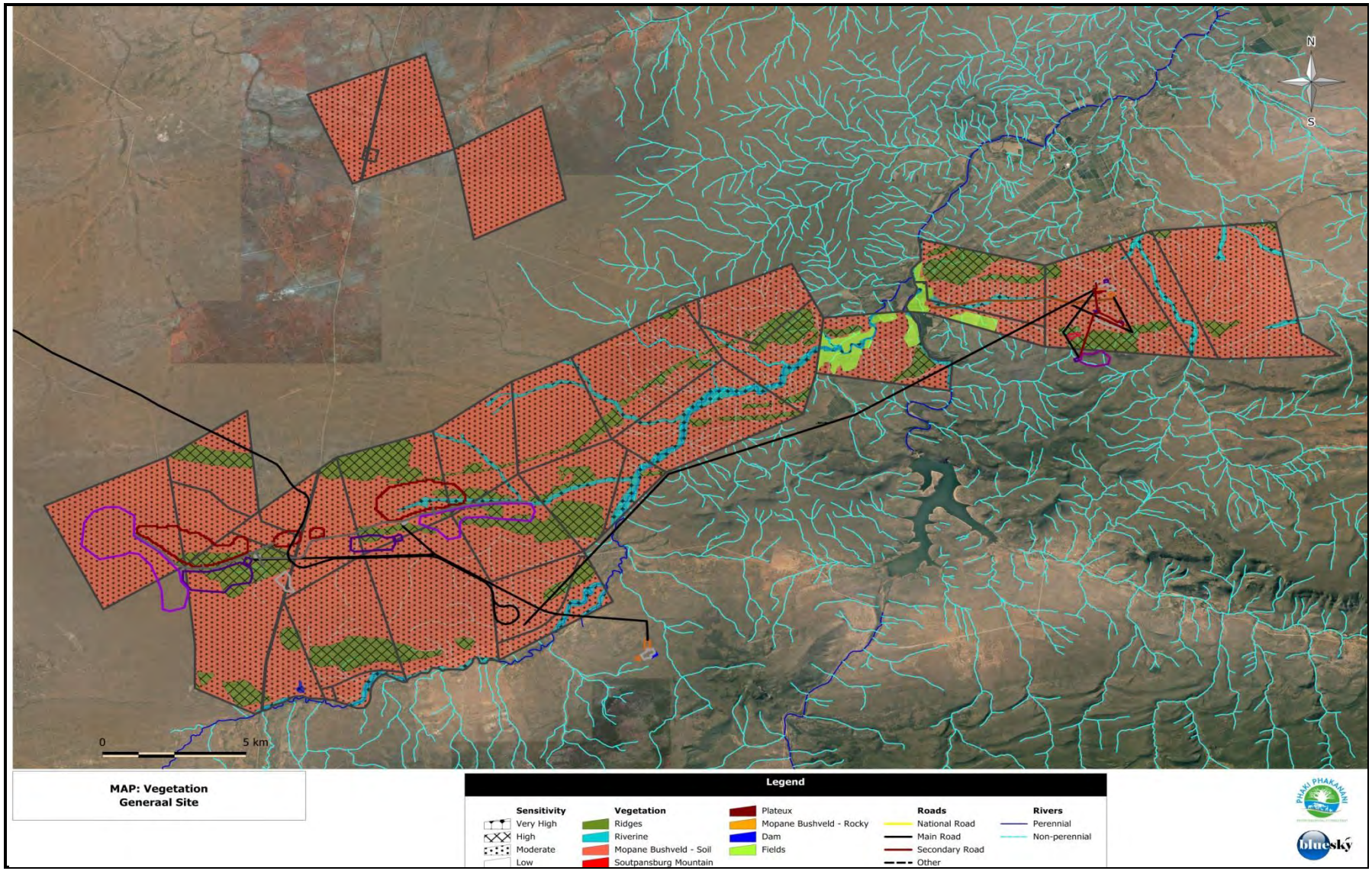


Figure 75: Vegetation communities and sensitivity mapping in relation to the proposed mining activities

Different species, or categories of species, have different legal requirements in terms of actions that need to be taken and permit requirements will determine the actions that need to be taken in order to protect such species.

Potential impacts include:

- Destroy or damage of protected species.
- Influence on specific species population numbers and survival.

3.1.2.1.3 Increased risk of alien invasion

Disturbances relating to mining activities and post mining rehabilitation may increase the risk of localised infestations of alien species in disturbed areas. This could either be in the form of introduced new species or the spread of existing species. Measures to reduce this risk will be assessed and appropriate recommended provided

3.1.2.1.4 Increased risk of soil erosion

Disturbances relating to mining activities and post mining rehabilitation may increase the risk of soil erosion in disturbed areas. This could both be as a result of loss of vegetation cover, or altered drainage patterns and storm-water runoff. Measures to reduce this risk will be assessed and appropriate recommended provided

3.1.2.1.5 Disruption of ecological corridors and loss of biodiversity conservation areas

Large scale mining activities may result in the permanent or temporary disruption of important faunal and floral ecological corridors. Important faunal movement corridors may be disrupted, which could affect the population and survival of these species, as well as associated floral species as a result of disrupted pollination and seed dispersal mechanisms.

3.1.2.1.6 Aridification of the area as a result of mine dewatering

The groundwater model showed that significant drawdown northwards for more than 25 km as the impacts from the Generaal, Chapudi, Mopane and Makhado Projects are cumulative and overlap (refer to Section 3.1.5 below).

Impacts of mining could be significant, including:

- Reductions in water available for abstraction and discharge i.e. lower borehole yields or drying up of boreholes and springs in the radius of influence.
- Contamination of aquifers downstream of the mining and infrastructure areas due to seepage from the rehabilitated pits and underground workings, discard dumps, stock piles and dirty water dams.
- A reduction in water available for evapotranspiration. Groundwater dependant floral species around springs and seeps could be affected as the water table drops. Riverine vegetation is mostly sustained from surface flows and water stored in the alluvial deposits, however shallow groundwater may be important during extended dry periods.

3.1.2.2 Fauna

In relation to the proposed mine development, certain impacts have been identified within the study area. After looking at the habitats and the associated faunal communities, the impacts have been rated both with and without recommended mitigation and management measures. Impacts are rated for the full life cycle of the proposed mine and cumulative effects have been taken into account. The following impacts were identified:

- Limited Food availability for Cape Vulture
- Habitat destruction
- Fragmentation of habitats
- Faunal mortality through mining operations
- Habitat creation (negative)

3.1.2.2.1 Limited food availability for Cape Vulture

The Blouberg Mountains (extension of the Soutpansberg Mountain Range) is home to the largest breeding colony of Cape Vultures in the world. Furthermore 'Vulture Mountain' on the farm Buffelspoort 222 IS is in close proximity to the South. They are attracted to this area due to the height and topography of the mountain, together with the food offered by the surrounding game farms. Cape vultures may have a 300 km foraging area surrounding their roosting sites.

The Cape Vulture is a scavenger of animal carcasses, and relies on leftover food from kills made by large predators (lions, leopards, etc). This bird also feeds off animals that have died from natural causes. Thus vultures are natures' way of controlling animal carcasses. This bird has adapted to a life of flying extensive distances for food. As the proposed mining area falls within the birds feeding grounds, the large game will be removed due to the selling of the farms they inhabit. This will result in a decrease of food for the Cape Vulture.

3.1.2.2.2 Habitat destruction

Mining activities involve permanently disturbing the terrestrial faunal environment. The top soil will be removed together with the vegetation habitats, thus destroying the entire area which is subjected to the mining operation. The mining activities will destroy existing habitats. Habitat destruction leads to the displacement of fauna.

3.1.2.2.3 Fragmentation of habitats

Even though certain areas will remain unaffected by the proposed mining operations, these small habitats may become isolated. Thus the ecological continuity will be disrupted by the proposed mining activities. Individual faunal species (within the proposed mining site) are generally familiar with their surroundings.

For example, tortoises know their home ranges, and other animals (such as caracal) are familiar with their territories and feeding grounds. Certain amphibian species may only make use of water sources for breeding (tadpoles) and spend the rest of their life-cycle away from water. During breeding times, these amphibians could be prevented from gaining access to water. Precocial bird species (such as guinea fowl) could be affected due to the disruption in the continuity of the ecological

corridor, up until the flight feathers are fully developed. Precocial chicks are flightless and vulnerable to predators and mining (such as trenches and piled rocks) may trap chicks when being pursued chase, thus increasing chick mortality unnaturally.

Mining activities (such as stock piling between faunal habitats) may alter critical behaviours, traits and survival technique, due to alteration, manipulation or destruction of the numerous corridors present within the proposed mining site. Certain faunal species may utilize specific corridors to gain for flight (escape) and to gain access to foraging and breeding areas. Since animals are creatures of habit, they are likely to get trapped or killed by new structures place inside their habitats if they are not familiar with the placement thereof.

3.1.2.2.4 Faunal mortality through mining operations

Frequent truck/vehicle road activity (in the proposed site) will result in mortality of vertebrates and invertebrates. Reptiles frequent open sandy/rocky areas to searching for food, bask in the sun during the day, or simply traversing through. Amphibians may cross over the mining area to reach wetlands from aestivation areas. Rain is a key factor influencing amphibians, as (in times of rainfall) amphibians are at their most mobile and vulnerable. These factors all contribute to the above fauna being subjected to this impact.

Working machinery, blasting and conveyer belts, are additional factors which may contribute to faunal mortalities. It is likely that large birds (during flight) will collide into erected power lines/electrical cables or be electrocuted while roosting on said cables.

3.1.2.2.5 Habitat creation (negative)

Mining activities not only leads to habitat destruction, but can often create alternative habitats. However, habitat creation may indirectly lead to negative impacts. In this case, the creation of habitats often alters the natural balance for certain faunal species. Small crevices between rocks in stockpiles may lead to chambers which make excellent micro habitats for bees to set up a hive, bats to roost and reptiles to take up residence.

Loosely compacted rubble and stones stockpiled within the site may indirectly provide habitats for reptiles. Lizards and diurnal snakes will bask on the warm ground surface and retreat into this man-made habitat. Thus due to this artificial habitat, there will likely be an increase of reptiles near roads and stock piles, however temporary. Snakes are likely to use these artificial habitats as breeding grounds and lay their eggs between the stored materials (for example, the Natal Green Snake). Although not gregarious, this species is often found in large numbers within a relatively small area.

Temporary water accumulation after rains may occur in mined areas, and this offers temporary habitats for frogs and toad. These animals may be harmed by vehicle and machinery activity.

Birds such as swifts and swallows build mud nests under structures (such as bridges), thus if bridges are constructed, potential habitats are created. Large non-vegetated rock faces (mine pits) are likely to be created as a result of the proposed mining activities, which could offer breeding habitats for bee-eaters and certain owls. This can result in the harming of birds.

3.1.3 AQUATIC ENVIRONMENT

3.1.3.1 Loss of In-stream Flow, Aquatic Refugia and Flow Dependent Taxa

The Nzhelele River, Mutamba River, Dolidoli River and to a lesser degree the other systems in the vicinity of the Proposed Generaal Project are water stressed. The Nzhelele River, Mutamba River systems are extensively utilised for the abstraction of water for the production of citrus and vegetable crops. These water uses lead to the lower sections of the Mutamba Rivers being dry along most of its length and few refuge pools for aquatic biota occur in these lower areas. Any impact on in-stream flow will therefore be significant and can have a significant impact on the Nzhelele and Mutamba River Ecology. In addition many of the drainage lines in the area have well established riparian zones. In particular mention is made of the Dolidoli River as well as some smaller systems.

In terms of aquatic and riparian zone ecology in the vicinity of the project area the Nzhelele and Mutamba Rivers are the most significant and require the most attention when considering impacts on reduced in-stream flow and aquatic refugia and the loss of flow dependent taxa.

The remainder of the project area is very dry and no other systems were identified in which aquatic biota occurred except in artificial impoundments where a more permanent supply of surface water occurs. The artificial impoundments support low abundances of tolerant aquatic taxa and wetland vegetation.

Mean annual runoff (MAR) from the Project site into the water courses of the area are anticipated to be primarily affected by the following:

- Direct rainfall in the opencast pits. Rain falling directly into the pits will collect in a sump at the bottom of the pit/s and thus be polluted. This water may be recycled for use, or evaporated in dirty water dams, thereby decreasing the MAR reaching the surrounding river systems;
- Runoff from stockpiles. Rain falling directly onto the 'dirty' stockpiles will either seep into the stockpile or runoff the sides of the stockpile. Any runoff or horizontal seepage from the stockpile will be captured in control dams or a leaching system for water quality control reasons, and thus subsequently be prevented to discharge to tributaries and into the surrounding larger river systems;
- Concentration of flow when runoff is intercepted by canals. The canal system will intercept runoff that would otherwise have flowed naturally over the ground surface until reaching a defined watercourse. Vegetation and surface topography, particularly in flatter areas, would in the natural state have encouraged interception and infiltration. Once water has been intercepted by a canal however, no further interception or infiltration is likely until the canal discharges the flow into a surrounding river systems), the concentration of flow would still discourage interception and infiltration. There is thus likely to be a marginal increase in MAR resulting from the construction of the canal system. Stream flow regulation and recharge and a change in flow rates will however occur.

A substantial increase to the peak flow of flood events in the Mutamba River could cause erosion and change in channel character and dimensions, destroy riverine vegetation, alter bed roughness and cause eroded sediment to be deposited downstream.

It is expected that project activities will cause a change to peak flows in the river system downstream of the project site, due to the following factors:

- Change in surface coverage. Development of the Project area will change the surface coverage in some areas from vegetated soil to buildings, hardened gravel roads, paved areas (parking), and compacted earth. These new surface types will allow considerably less infiltration into the ground (typically 0-20%) as compared to the natural surface (typically 60-70%), resulting in more surface runoff following storms and consequently higher peak flow rates.
- Capture of runoff and capture of rainfall in the 'dirty' area would lower in-stream flow in the receiving environment.
- Canalisation of runoff. Intercepting runoff from the hillslopes above the opencast pits and canalising the flow could reduce the amount of time that water would take to reach the surrounding river systems. This is due to the decreased friction on the water associated with concentrated flow in a concrete lined canal as opposed to sheet flow on the hill slopes, and the consequently lower flow velocities.

In technical terms, the time of concentration would be reduced, reducing the time of concentration results in higher peak flow rates. This effect is dependent on the design of the canalisation system, as increasing the length of flow paths, and implementing other detention measures, could negate this effect.

A cut off canal system is required to separate unpolluted ('clean') and polluted ('dirty') water, which is a positive intervention. However, intercepting the tributaries that flow from the water divide across the mining areas, and redirecting them via canals around the pits, will starve those same water courses of water along their reach between the point of interception and the surrounding larger river systems.

Furthermore, if the canals only extend as far as to route water around the outer edge of the opencast pits, then concentrated volumes of water will be discharged at point locations on the hill slopes leading to altered surface and subterranean hydrology.

All the above factors are likely to lead to altered riverine recharge flood peaks and a general loss of runoff volumes successfully reaching the surrounding larger river systems as well as the other major drainage systems in the area which in turn lead to the loss of aquatic biota such as fish and aquatic macro-invertebrates which rely on the presence of surface water as well as the riparian zone which relies on base flows as well as recharge by larger rainfall events.

3.1.3.2 Impacts on Water Quality Affecting Aquatic Ecology

3.1.3.2.1 Increased sediment load

In the natural state of the project site, vegetation cover causes friction to rainfall run-off, that reduces flow velocities and consequently shear forces between the water and the ground surface, resulting in the ground surface remaining intact and not being eroded away. If for any reason flow velocities are increased, there is potential for increased erosion to occur.

Increased erosion of disturbed surfaces means that the run-off contains a higher silt or sediment load, which is discharged to the surrounding river systems. A component of this sediment load is particles fine enough to remain in suspension, 'clouding' or 'muddying' the water.

The extent of this effect can be quantified by measuring a water quality parameter, suspended solids. If there are too many suspended solids in the water this can negatively affect biological life. In addition, a changed sediment load could have similar morphological effects to the river as changing peak flow rates, such as changes in channel character or dimensions and changes to bed roughness. Severe sediment deposition in the surrounding river systems could lead to reduced surface flows in the system with a larger volume of water moving through a thickened sand layer. All of these changes could potentially affect biological life.

The following activities are likely to cause an increase in flow velocities, or directly increase erosion:

- Stripping (vegetation clearance) of mining areas prior to excavation of pits;
- Construction of hard-standing areas that increase run-off volumes, including roads, buildings and paved areas;
- Canalisation of run-off, particularly if canals do not discharge directly into the major water courses; and
- Construction activities that loosen the ground surface.

Furthermore, if run-off from the stockpiles is uncontrolled, such run-off would likely contain a high sediment load due to the fine particles in the waste product resulting from the ore crushing process. It can thus be stated that without any mitigation measures, the sediment load in the larger watercourses will increase as a result of mining activities associated with this Project.

3.1.3.2.2 Impaired water quality due to pollutants discharged from processing plant

Waste water from the coal ore beneficiation process would contain pollutants in excess of the target water quality ranges for the water uses of the receiving water body and discharge of this would impact negatively on the surface water quality. A further consideration is the run-off of pollutants from the process plant area following rainfall, due to the activities within that area.

3.1.3.2.3 Impaired water quality due to pollutants in run-off from stockpiles

It is likely that run-off from the stockpiles will have a different chemical composition to natural run-off. In this event it is best practice to keep 'dirty' water from stockpile run-off separate from 'clean' water from natural run-off.

3.1.3.2.4 Impaired water quality due to pollutants in water discharged from opencast pits

Overflow of water (decant), whether surface or ground, from the pits could release pollutants to the surface water environment if geochemical testing indicates a possible acid mine drainage or other water quality issue.

3.1.3.2.5 Impaired water quality due to petrochemical spills

Fuel or oil spills from vehicles could contaminate surface water resources. Leakages, spills or run-off from vehicle wash bays, workshop facilities, fuel depots or storage facilities of potentially polluting substances could contaminate surface water resources.

3.1.3.2.6 Heavy metal contamination

Increase in metal concentrations is commonly associated with tillage and blasting of the upper crust of the earth's surface. This releases metals into the associated surface and ground water systems (NSS, 2009). Under alkaline conditions, most of the metals remain biologically unavailable, however in the presence of acid mine drainage the metal-speciation changes and they become available (Bonta et al., 1993). This may alter the species composition of the aquatic biota inhabiting the river, in the vicinity of and downstream of the proposed development.

3.1.3.3 Loss of Aquatic Habitat

Habitat destruction is the alteration of a natural habitat to the point that it is rendered unfit to support the species dependent upon it as their home territory. Many organisms previously using the area are displaced or destroyed, reducing biodiversity. Globally modification of habitats for agriculture is the chief cause of such habitat loss. Other causes of habitat destruction include surface mining, deforestation, slash-and-burn practices and urban development. Habitat destruction is presently ranked as the most significant cause of species extinction worldwide. Additional causes of habitat destruction include water pollution, introduction of alien species, overgrazing and overfishing.

Riverine systems and particularly ephemeral riverine systems or river systems that have very low flows as part of their annual hydrological cycles are particularly susceptible to changes in habitat condition. The proposed mining activity of the Generaal Project has significant potential to lead to habitat loss and/or alteration of the aquatic and riparian resources on the study area.

3.1.3.4 Loss of Aquatic Biodiversity and Sensitive Taxa

Aquatic resources in the area can be considered scarce and in addition to being scarce are generally exposed to significant water stress. The aquatic resources in the direct vicinity of the project area are of limited importance to in-stream biodiversity. There is however the potential for the mining operations to affect the Nzhelele River which supports a diverse aquatic macro-invertebrate community and a well-established fish community. On a national scale the system is also considered to be of importance since the lower sections of the Sand River are considered a FEPA system and a Fish FEPA support system and the Nzhelele River and associated drainage systems form part of this catchment.

The aquatic ecology of the area can potentially be impacted by further reductions in in-stream flow, altered water quality and habitat loss.

3.1.3.5 Loss of Wetland and Riparian Habitat

The main land use constitutes game farming and to a lesser extent crop cultivation. As a result, overall landscape and vegetation transformation in the vicinity of water courses and depressions, within the study area, are considered to be low. Consequently, all features presently provide niche habitat for wetland and aquatic faunal and floral species within a water stressed region.

The ephemeral nature of smaller drainage lines does limit the ability for these features to provide optimum conditions for the formation of an extensive riparian zone. Therefore, larger tree species with root systems that can subtract water from deeper within the soil during winter months such as *Faedherbia albida* and *Xanthocercis zambesiaca* (Nyala) and fig species were restricted to river systems such as the Mutamba and Nzhelele Rivers as well as some of the larger ephemeral drainage lines in the area. None the less, the smaller drainage lines do provide habitat for species such as *Combretum imberbe* (leadwood) (protected in accordance to the National Forests Act (Act No 84 of 1998 as amended September 2008).

Surface water that would provide habitat for aquatic species as well as drinking water for terrestrial wildlife, was also concentrated on the Nzhelele and Mutamba Rivers. Some of the more ephemeral pans in the area are also likely to be of some importance in surface water provision to the faunal communities of the area.

Loss or impact on wetland and riparian habitat would result in loss of niche habitat for various faunal and floral species within a water stressed region. Due to the sandy nature of the soil it is deemed likely that it would be difficult to rehabilitate wetland and riparian habitat to resemble these unique habitat units presently within the study area.

3.1.3.6 Changes to Wetland Ecological and Socio-cultural Service Provision

To determine feature specific importance in terms of function and service provision, the Nzhelele River, Mutamba River, smaller drainage lines as well as pans and wetland depressions were assessed separately. Following the assessment, all features are considered of intermediate importance in terms of function and service provision, with the highest scores calculated for water provision biodiversity, tourism and recreation.

Loss or impact on wetland and riparian habitat would reduce a features importance in terms of function and service provision. Although deemed possible to reduce impact in terms of changes to ecological and socio-cultural service provision it is doubtful that the level of importance could be reinstated after mine closure, unless all allocated 100m buffer zones are kept strictly off limits to any mining related activity, including general infrastructure and that water abstraction are kept to a minimum and there is no formation of a cone of dewatering which may be created through the opencast mining methods which affects the base flows in the aquifers of the Nzhelele and Mutamba River systems.

3.1.4 SURFACE WATER

The surface water impacts of the Project can be divided into two aspects, namely:

- Impacts on surface water quantity
- Impacts on surface water quality

It should however be kept in mind that water quality is naturally linked to water quantity due to the fact that changes in water quantity are likely to affect the dilution of pollutants.

3.1.4.1 Impacts on Quantity

3.1.4.1.1 Impact on mean annual run-off to major rivers

Mean annual run-off (MAR) from the Project site into the major rivers (Mutamba and Nzhelele) is anticipated to be primarily affected by the following:

- Direct rainfall in the opencast pits. Rain falling directly into the pits will collect in a sump at the bottom of the pit/s and thus be polluted. This water may be recycled for use, or evaporated in dirty water dams, thereby decreasing the MAR.
- Run-off from stockpiles. Rain falling directly onto the 'dirty' stockpiles will either seep into the stockpile or run-off from the sides of the stockpile. Any run-off or horizontal seepage from the stockpile will be captured in control dams or a leaching system for water quality control reasons, and thus subsequently be prevented to discharge to tributaries and into the major rivers.
- Concentration of flow when run-off is intercepted by canals. The canal system will intercept run-off that would otherwise have flowed naturally over the ground surface until reaching a defined watercourse. Vegetation and surface topography, particularly in flatter areas, would in the natural state have encouraged interception and infiltration.
- Once water has been intercepted by a canal however, no further interception or infiltration is likely until the canal discharges the flow into a watercourse. Even once discharged back into a watercourse, the concentration of flow would still discourage interception and infiltration. There is thus likely to be a marginal increase in MAR resulting from the construction of the canal system.

The total reduction in runoff shown in Table 34, Table 35 and Table 36 for the Mutamba River and Nzhelele River is for the worst case scenario at the end of the life of the mine, assuming that no rehabilitation of the pits has been done and the carbonaceous dumps and plant areas retain polluted runoff.

The Generaal Section falls within the Mutamba River Basin and the cumulated impact has a reduction in annual runoff of 136 364 m^3/annum, or 0.20% of the MAR of the downstream quaternary catchment A80F. With the actual cumulated runoff in the Mutamba River expected to be smaller than the naturalized runoff due to upstream water use, the actual impact would be a larger percentage. In the absence of flow gauges in the river, a more reliable estimate cannot be made of this quantity.

Table 34: Estimated impact of the Generaal Section on surface water runoff in quaternary catchment area A80F

DESCRIPTION	AFFECTED AREA (ha)	% OF SITE AREA	RUNOFF INTERCEPTED* (m^3/a)	% OF MAR ON A80F
Opencast mining (all pits)	595	29.7	40 784	0.059
Plant dirty water area, plus haul roads	1 034	51.6	70 915	0.103
Carbonaceous dump area	360	18.0	24 666	0.036
TOTAL FOR SITE	1 988	99.2	136 364	0.199

* Based on 6.86 mm runoff, the average for A80F

A small part of the Mount Stuart Section falls within the Nzhelele River Basin, the cumulated impact has a reduction in annual runoff of 2 908 m^3/annum, or 0.004% of the MAR of the downstream quaternary catchment A80F.

Table 35: Estimated impact of the Mount Stuart Section on surface water runoff in quaternary catchment area A80F

DESCRIPTION	AFFECTED AREA (ha)	% OF SITE AREA	RUNOFF INTERCEPTED* (m^3/a)	% OF MAR ON A80F
Opencast mining (all pits)	0	0.0	0	0.000
Plant dirty water area, plus haul roads	42	2.1	2 908	0.004
Carbonaceous dump area	0	0.0	0	0.000
TOTAL FOR SITE	42	2.1	2 908	0.004

* Based on 6.86 mm runoff, the average for A80F

The remainder of the Mount Stuart Section falls within the A80G quaternary catchment. The cumulated impact on the Nzhelele River also has a reduction in annual runoff of 10 165 m^3/annum, or 0.022% of the MAR of the downstream quaternary catchment A80G.

Table 36: Estimated impact of the Mount Stuart Section on surface water runoff in quaternary catchment area A80G

DESCRIPTION	AFFECTED AREA (ha)	% OF SITE AREA	RUNOFF INTERCEPTED* (m^3/a)	% OF MAR ON A80F
Opencast mining (all pits)	18	0.9	820	0.002
Plant dirty water area, plus haul roads	201	10.0	9 345	0.020
Carbonaceous dump area	0	0.0	0	0.000
TOTAL FOR SITE	219	10.9	10 165	0.022

* Based on 4.65 mm runoff, the average for A80G

The actual cumulated runoffs in both the Mutamba River as well as the Nzhelele River is expected to be smaller than the naturalized runoff due to upstream water use, the actual impact would be a larger percentage. In the absence of flow gauges in the river, a more reliable estimate cannot be made of this quantity.

3.1.4.1.2 Change to peak flow rates in the major rivers during flood conditions

A substantial increase to the peak flow of flood events in the rivers could cause erosion and change in channel character and dimensions, destroy riverine vegetation, alter bed roughness and cause eroded sediment to be deposited downstream.

It is expected that Project activities will cause a change to peak flows in the receiving rivers downstream of the Project site, due to the following factors:

- Change in surface coverage. Development of the Project area will change the surface coverage in some areas from vegetated soil to buildings, hardened gravel roads, paved areas (parking), and compacted earth. These new surface types will allow somewhat less infiltration into the soil, resulting in more surface run-off following storms and consequently higher local peak flow rates.
- Capture of run-off. Capture of rainfall in the 'dirty' area would lower peak flow rates.
- Canalisation of run-off. Intercepting run-off from the hill-slopes above the opencast pits and canalising the flow could reduce the amount of time that water would take to reach the major rivers. This is due to the decreased friction on the water associated with concentrated flow in a concrete-lined canal as opposed to sheet flow on the hill slopes, and the consequently lower flow velocities. In technical terms, the time of concentration would be reduced, reducing the time of concentration results in higher peak flow rates. This effect is dependent on the design of the canalisation system, as increasing the length of flow paths, and implementing other detention measures, could negate this effect.

3.1.4.1.3 Drying up of tributaries and establishment of new watercourse due to canalisation

A cut-off canal system is required to separate unpolluted ('clean') and polluted ('dirty') water, which is a positive intervention. However, intercepting the tributaries that flow from the water divide across the mining areas, and redirecting them via canals around the pits, will starve those same water courses of water along their reach between the point of interception and the major rivers.

Furthermore, if the canals only extend as far as to route water around the outer edge of the opencast pits, then concentrated volumes of water will be discharged at point locations on the hill slopes. Also, the soils most susceptible for erosion are those where sandy topsoil overlies more clayey, usually structured subsoil.

When considered together, this information suggests that the soils on the hill slopes are particularly prone to erosion. Hence rather than dispersing out over the surface, the concentrated flow at the canal discharge points would erode gulleys into the soil and carry silt into the major rivers, impacting on water quality.

3.1.4.2 Impacts on Quality

The philosophy supporting the following section of the report is that if all constituents in the cumulative discharge from the Project site are within the applicable target water quality ranges, then the Project activities will not contribute significantly to an unacceptable cumulative impact.

The converse of this statement is not necessarily true, as different activities within the catchment may discharge different pollutants at different concentrations, and the dilution effect may mean that a constituent that is out of the target water quality range in the cumulative discharge from the Project site is within the target water quality range when the discharge is combined with the major rivers flow itself.

However the Precautionary Principle requires that a conservative approach be taken, in this case to account for possible discharge of pollutants by future activities in the river catchment, and therefore the dilution effect of the major rivers cannot be relied upon.

3.1.4.2.1 Increased sediment load in the major rivers

In the natural state of the project site, vegetation cover causes friction to rainfall run-off, that reduces flow velocities and consequently shear forces between the water and the ground surface, resulting in the ground surface remaining intact and not being eroded away. If for any reason flow velocities are increased, there is potential for increased erosion to occur.

Increased erosion means that the run-off contains a higher silt or sediment load, which is discharged to the major rivers. A component of this sediment load is particles fine enough to remain in suspension, 'clouding' or 'muddying' the water.

The extent of this effect can be quantified by measuring a water quality parameter, viz. suspended solids. If there are too many suspended solids in the water this can negatively affect biological life.

In addition, a changed sediment load could have similar morphological effects to the river as changing peak flow rates, such as changes in channel character or dimensions and changes to bed roughness. All of these changes could potentially affect biological life.

The following activities are likely to cause an increase in flow velocities, or directly increase erosion:

- Stripping (vegetation clearance) of mining areas prior to excavation of pits;
- Construction of hard-standing areas that increase run-off volumes, including roads, buildings and paved areas;
- Canalisation of run-off, particularly if canals do not discharge directly into the major rivers; and
- Construction activities that loosen the ground surface.

Furthermore, if run-off from the stockpiles is uncontrolled, such run-off would likely contain a high sediment load due to the fine particles in the waste product resulting from the ore crushing process.

It can thus be stated that without any mitigation measures, the sediment load in the major rivers will increase as a result of mining activities associated with this Project.

3.1.4.2.2 Impaired water quality due to pollutants discharged from processing plant

Wastewater from the coal ore beneficiation process would contain pollutants in excess of the target water quality ranges for the water uses of the receiving water body and discharge of this would impact negatively on the surface water quality. A further consideration is the run-off of pollutants from the process plant area following rainfall, due to the activities within that area.

3.1.4.2.3 Impaired water quality due to pollutants run-off from stockpiles

It is likely that run-off from the stockpiles will have a different chemical composition to natural run-off. In this event it is best practice to keep 'dirty' water from stockpile run-off separate from 'clean' water from natural run-off.

3.1.4.2.4 Impaired water quality due to pollutants in water discharged from opencast pits

Overflow of water (decant), whether surface or ground, from the pits could release pollutants to the surface water environment if geochemical testing indicates a possible acid mine drainage or other water quality issue.

3.1.4.2.5 Impaired water quality due to petrochemical spills

Fuel or oil spills from vehicles could contaminate surface water resources. Leakages, spills or run-off from vehicle wash bays, workshop facilities, fuel depots or storage facilities of potentially polluting substances could contaminate surface water resources.

3.1.4.3 Generalized Mitigation Measures

- Diversion of streams and drainage lines: The water quality of re-routed streams should be maintained by preventing scour of bed material, thereby minimising turbidity during flood conditions. Lining of the canals and/or energy dissipating structures may be required at steep slopes.
- Impact of the proposed mining development on surface water runoff quantity: The area of the open pits should be kept as small as possible to minimize the reduction in runoff.
- Impact of the proposed mining development on surface water runoff quality: By adhering to the requirements of GN 704 and implementing a design along the guidelines provided in the Best Practice Guidelines, the water quality will not be polluted by mining activities. However, care should be taken in the mining development phase to restrict the clearing of land to the minimum required. In this phase, while erosion control measures are being implemented, the highest risk of erosion damage occurs. This will lead to high turbidity levels and increased sediment in the drainage lines and streams.
- In the event of major floods causing failure of the system, the dilution effect may minimise the impact.
- Other types of failures should be prevented by proper management and maintenance of the system.
- Impact of the dirty water areas on water quality: By adhering to the requirements of GN 704 and following the best practice guidelines, as would be required in the licensing application, dirty water is contained and water available after evaporation losses will be re-used.
- In case of accidental spillages, especially of hydro carbons and of coal, specialized equipment should be available on site to mop up the pollutants before irreversible damage is caused. Else, specialized contractors may be used to fulfill this function.
- Off-setting the loss of wetlands: The creation of small impoundments at the head of stream diversions, where appropriate, may be considered. These low structures (earth or gabion embankments) will lower the approach velocity and contain sediment, thereby delivering

relatively clean water at acceptable velocities into the canal system. In time wetlands will be formed behind the embankments.

- Impact of surface water use: At this stage of the investigations, the large-scale development of a surface water source for use by the mine does not appear feasible. Therefore surface water use would be limited to the direct rainfall on open pits, increased evaporation loss and a small quantity to be stored for use in the dirty water area control dam.
- Limiting erosion at drainage structures, e.g. design and install appropriate outlet structures to retard the flow velocity.

The Storm Water Management Plan described in the EMP (Section 2) Paragraph 2.3 describes the expected localized impacts and mitigation requirements at the Generaal Project to ensure that the surface water impacts are minimized.

3.1.5 GROUNDWATER

Mining can impact on groundwater by the cone of dewatering that forms from removal of inflows into the pit as it is deepened and by contamination of groundwater due to mining activities.

A numerical model was generated in order to quantify the impact of the proposed mine on the groundwater in the study area, and to determine inflows into the mine workings. Since many mines will be operated in conjunction, it was necessary to model a large area to determine cumulative impacts. The Makhado Colliery will be in operation before the Generaal Project, and will impact on water levels. In addition, the Mopane and Chapudi Projects will overlap with the Generaal Project, hence all the projects must be considered in conjunction.

The USGS MODFLOW2000 Finite Difference groundwater model was used in the US Department of Defense GMS 9.0 (Groundwater Modelling System) interface to simulate and plot groundwater flow.

The construction and calibration of the regional numerical model is discussed in detail in the Groundwater Specialist Report (ANNEX-3, WSM Leshika 2013) and is not repeated here.

3.1.5.1 Groundwater Inflows

The impacts of mining on the regional water balance are shown in Figure 76.

Evapotranspiration from riverine areas is impacted and decreases from 47.8 Ml/d to 46.4 Ml/d. This reduction occurs largely along the river channels and the springs and seeps along the foot of the Soutpansberg Mountains, where drawdown of the water level reduces the availability of shallow groundwater.

Abstraction of groundwater for existing users is reduced from 14.5 Ml/d to a minimum of 14.1. Due to the way that the model has been set up i.e. 2 layers of 200m thickness each, losses from abstraction may be significantly more, as in the model, boreholes can abstract water down to 200m, which is not the real situation.

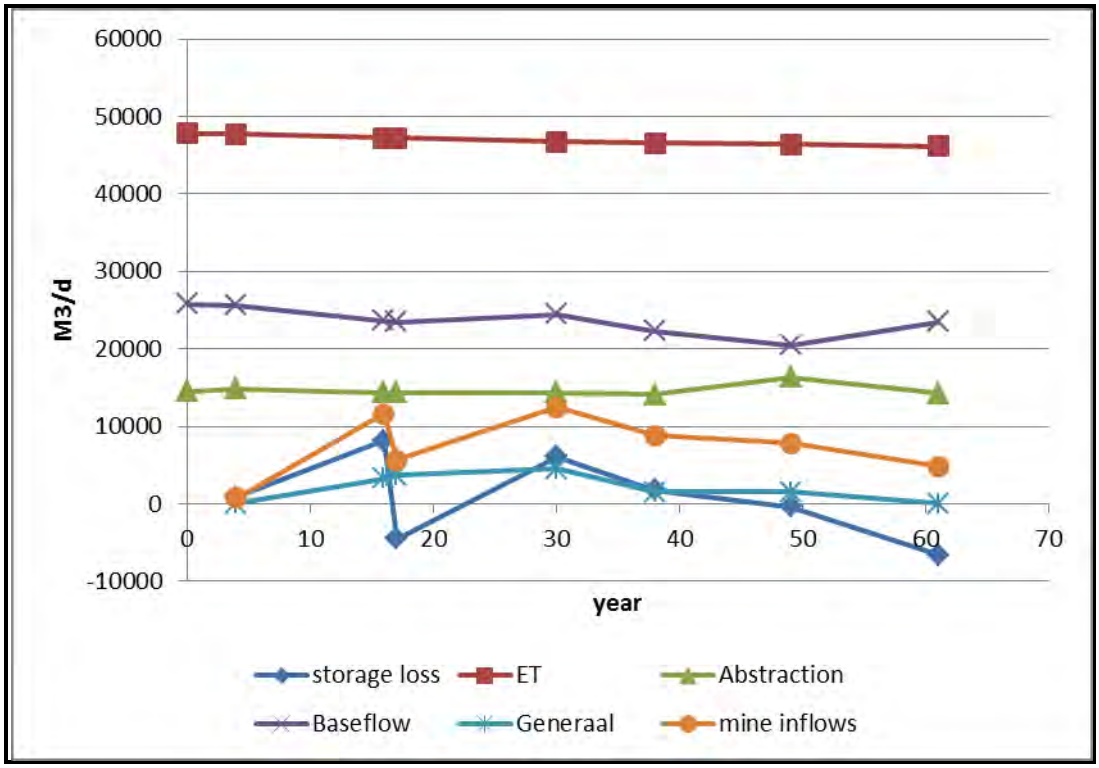


Figure 76: Mine abstraction and impact on the aquifer

The bulk of inflows into the pits and to boreholes originate from storage losses from the aquifer, which rises to 8.1 Ml/day by the end of the life of mine of Makhado. They subsequently decline due to the refilling of Makhado and the closure of Mount Stuart Section (underground mine) and Wildebeesthoek Section (Chapudi Project). Inflows into mines peak at 12.4 Ml/d when all mines except Makhado are in operation, then decline to 8.7 Ml/d by the end of the life of the Mopane Project. During the peak inflows, 4.4 Ml/d are inflows into the Generaal Project sections. Inflows into Generaal decline to 1.5 Ml/d after the closure of the Mount Stuart Section.

Mine inflows exclude direct rainfall into mine workings, and surface runoff which is not diverted. This is because such inflows are not part of the average daily inflow, and occur only during storm events, which are highly variable. Post mining, recharge to the pits is included in the water balance, since this volume will not be removed as storm water and will replenish the pits.

3.1.5.1.1 Inflows into Mount Stuart and Generaal Sections

Inflows into Mount Stuart Section increase to 4.7 Ml/d in mining year 21, 16 years after the mine starts, which were simulated assuming a progressive deepening of the mine floor. Subsequently, due to significant dewatering, inflows decline.

Inflows into Generaal Section remain low since it is in the dewatered zone created by Makhado. Inflows increase to 1.7 Ml/d by year 37, just before the end of the life of mine (Figure 77).

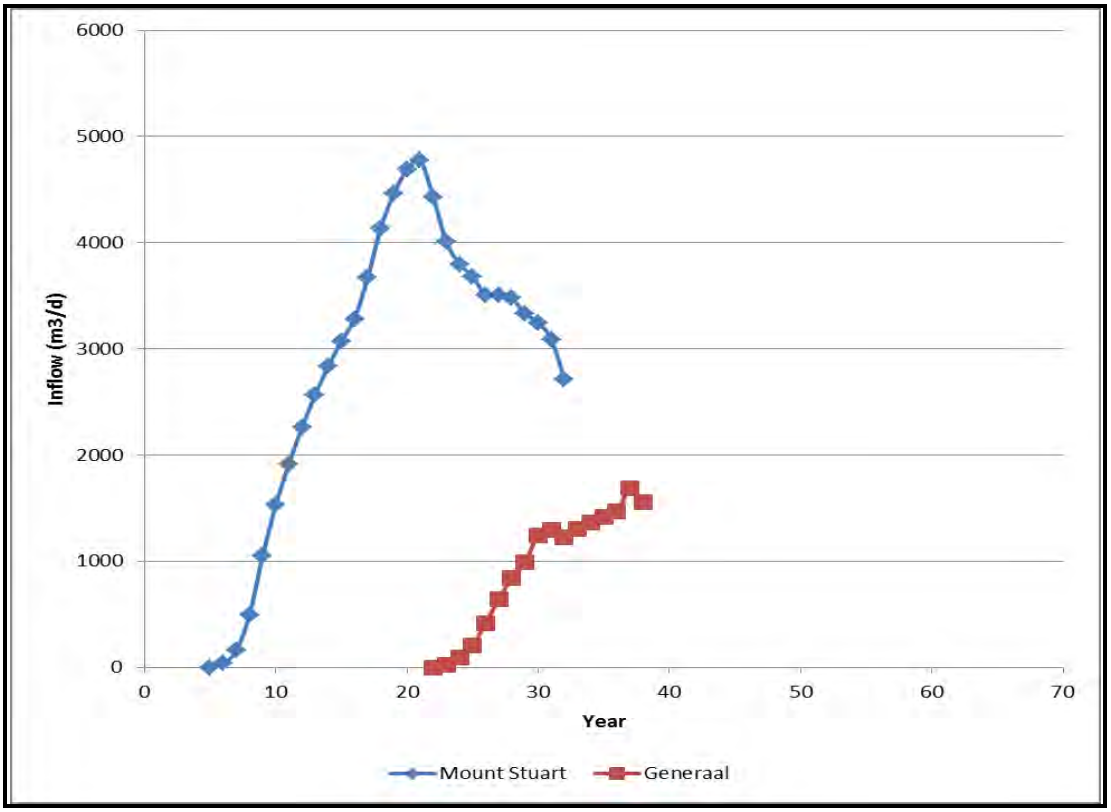


Figure 77: Inflows into the Generaal open pits

3.1.5.2 Cumulative Drawdown

Drawdown is the measure of water level decline taken from a bases point, in this case prior to commencement of mining i.e. year 2013. Drawdown of the water level after mining commences is shown for various periods of time in Figure 78 to Figure 81.

Significant drawdown in water level occurs around the Mount Stuart Section by year 16, 12 years after the start of mine, due to the depth of underground operations. Due to the drawdown in water levels the flow at the Tshipise Hot Water Spring some 5 km north of the mine is expected to be affected and could dry up.

By mining year 38, 8 years after the life of mine of the Mount Stuart Section, water levels will have recovered to within 30-40 m of the static water level around the Mount Stuart Section but drawdowns of over 100 m will exist around the Generaal Section. Drawdown at Generaal Section remains at over 100m over the life of mining operations to year 61.

Additional to the villages affected by Makhado mine i.e. Mudimeli, Mukushu and Pfumembe, the water supply to the villages of Doli Doli, Ndouvhada, Gaarside and Smokey could be affected as they are within the drawdown cone.

By mining year 61, the end of life of all mines, significant drawdown occurs northwards for more than 25 km as the impacts from the Generaal, Chapudi, Mopane and Makhado Projects are cumulative and overlap.

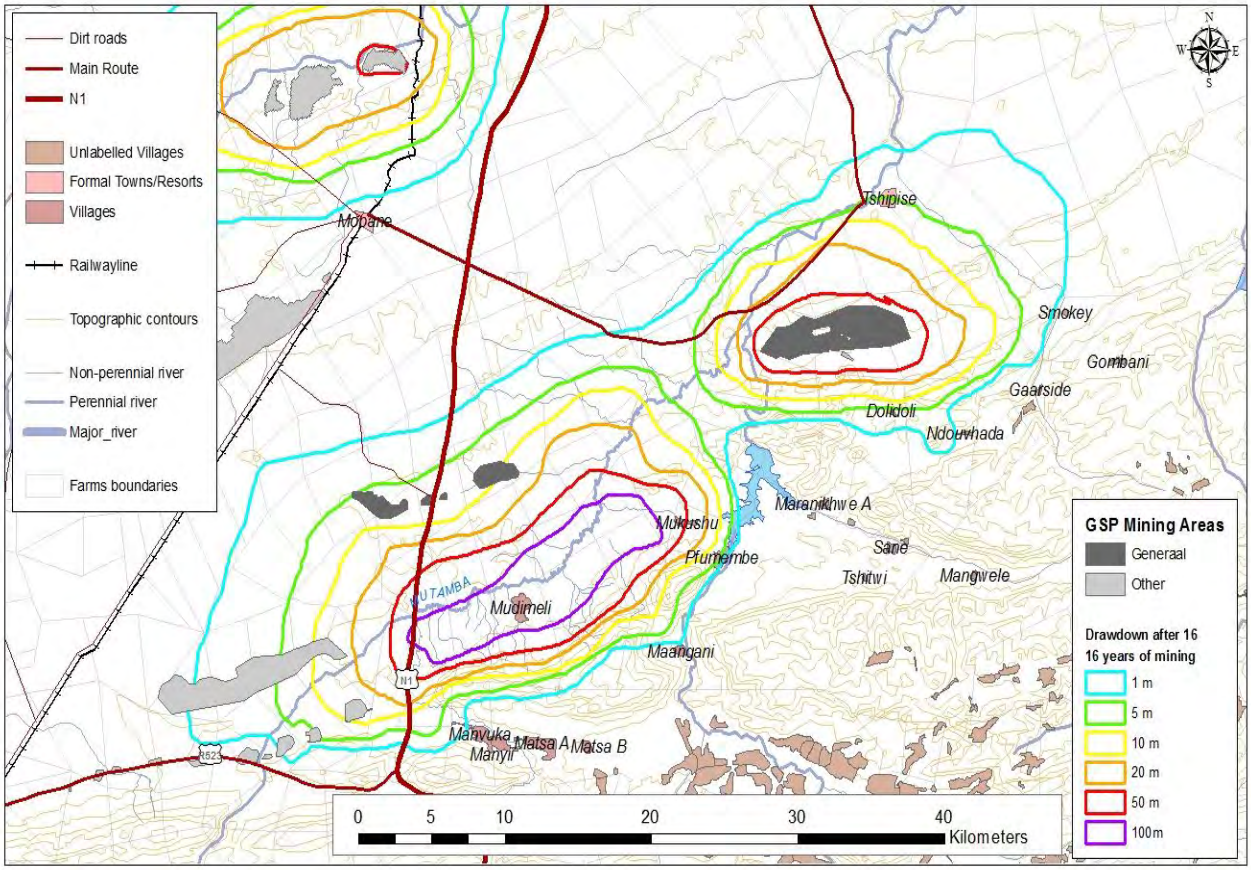


Figure 78: Cumulative drawdown in Year 16

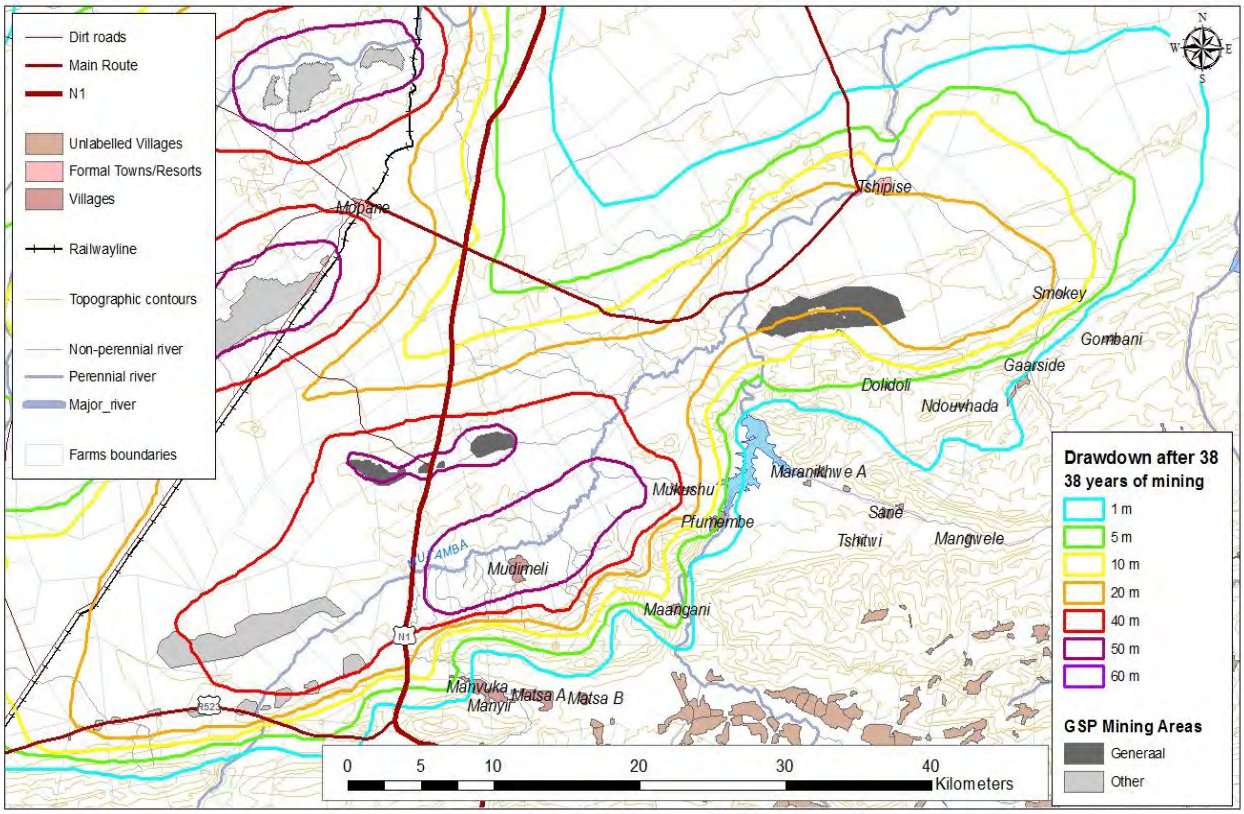


Figure 79: Cumulative drawdown in Year 38

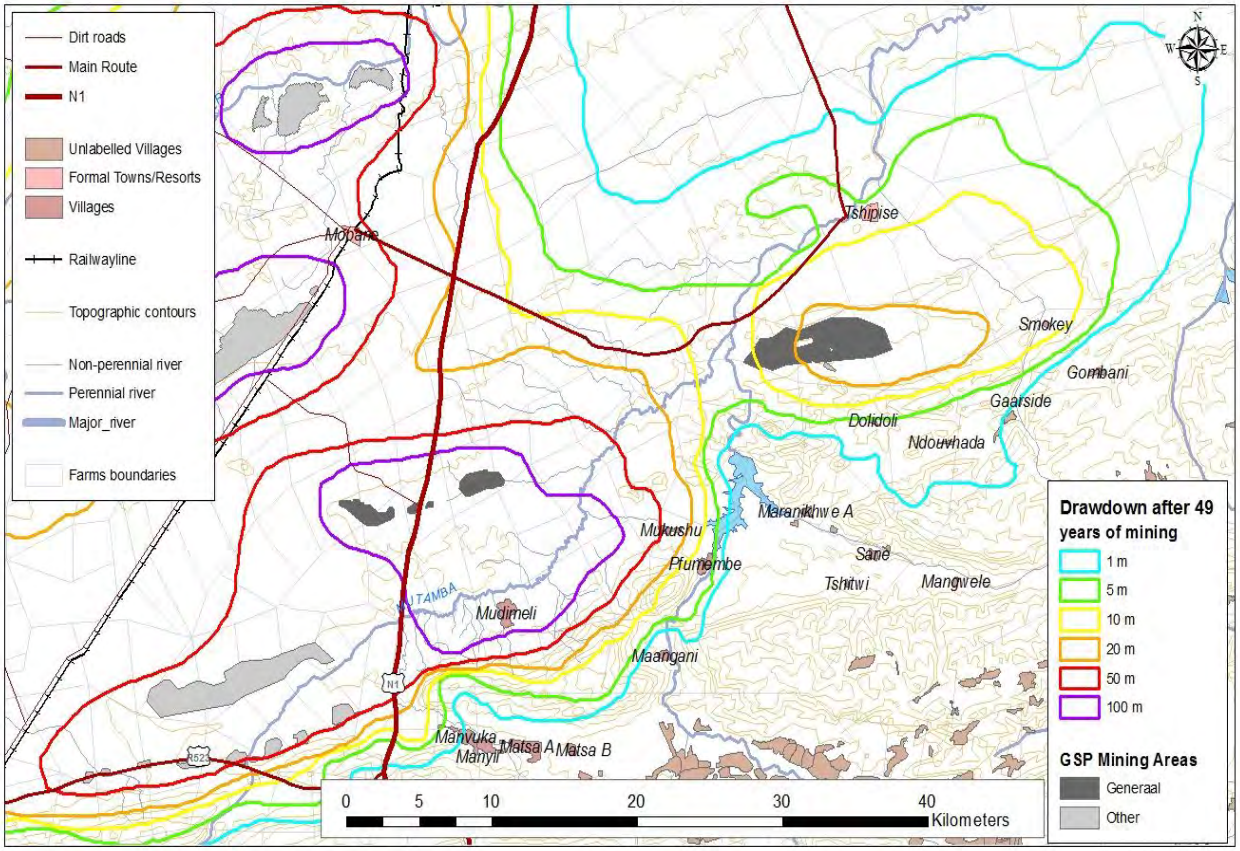


Figure 80: Cumulative drawdown in Year 49

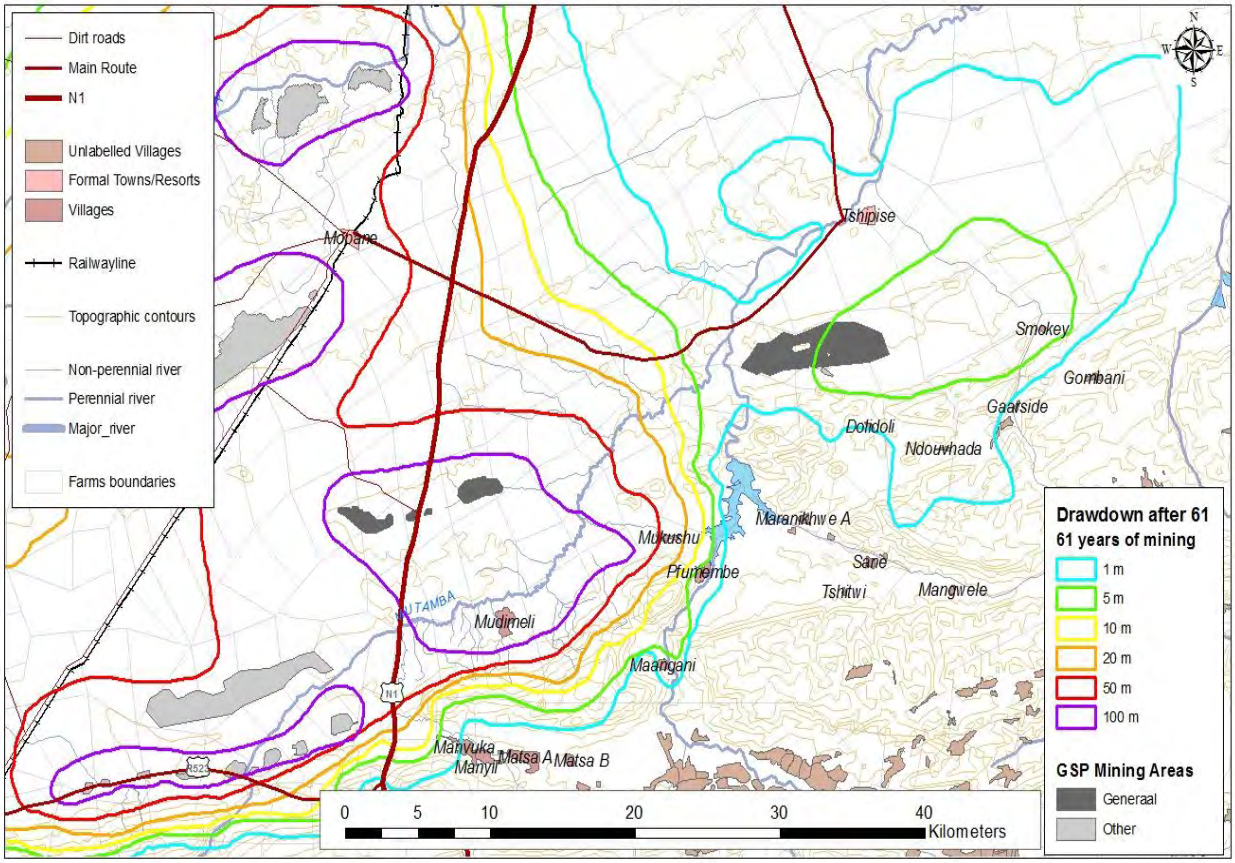


Figure 81: Cumulative drawdown in Year 61

3.1.5.3 Groundwater Impact Assessment for Generaal Project

Mining at Generaal will involve open cast mining along extended open cuts down to 200m below surface at the Generaal Section and underground mining up to 900m (only modelled down to 400m) below surface at the Mount Stuart Section.

Groundwater flow will be intersected by the pits and underground workings when below the water table. The water flowing into the pits will need to be pumped out (dewatered) for safe mining operations to continue. The water pumped from the pits will be used on the mine for process water in the plant and dust suppression. The dewatering will result in a lowering of the water table (cone of depression) around the mine pits and underground section, extending for up to 25 km north-eastwards of Generaal Project at the life of mine. This is because water is taken mostly from aquifer storage, as recharge in the area is low and unable to sustain the dewatering.

The east-west striking faults such as the Tshipise and Klein Tshipise faults are far more transmissive resulting that the cone of depression is elongated along their axis. Due to the radius of influence of the dewatering cone the Tshipise Hot Water Spring which is some 5 km north of the Mount Stuart Section is expected to be affected and could stop flowing. Further boreholes yields at the villages of Doli Doli, Ndouvhada, Gaarside and Smokey could also be affected as they lie within the drawdown cone.

Impacts of mining could be significant. These, in order of significance, include:

- Reductions in water available for abstraction and discharge i.e. lower borehole yields or drying up of boreholes and springs in the area of influence.
- Contamination of aquifers downstream of the mining and infrastructure areas due to seepage from the rehabilitated pits and underground workings, discard dumps, stock piles and dirty water dams.
- A reduction in water available for evapotranspiration. Groundwater dependant floral species around springs and seeps could be affected as the water table drops. Riverine vegetation is mostly sustained from surface flows and water stored in the alluvial deposits, however shallow groundwater may be important during extended dry periods.

3.1.6 SENSITIVE LANDSCAPES

3.1.6.1 Conservation Initiatives / Protected Areas

The Generaal Project falls within the boundary of the VBR and the Mount Stuart Section infringes on the buffer zone associated with the Nwanedi core area (Honnet Nature Reserve and Greater Kuduland Conservancy. Because of the large scale of a biosphere, various developments can be accommodated in the biosphere concept and the development of a coalmine within the borders of a biosphere can be accommodated. The sensitivity of environments and zone will determine the allowable activities in the VBR, which will determine if the mine is in compliance with VBR stipulations.

Protected areas in the vicinity of the site include:

- Bergtop Nature Reserve to the West;
- Goro Game reserve to the West;
- Musina Nature Reserve to the North;
- Nzhelele Nature Reserve to the South;
- Honnet Nature Reserve directly to the North;
- Greater Kuduland Nature Reserve to the East, with some overlap;
- Nwanedi Nature Reserve to the East;
- Studholme Nature Reserve to the South;
- Hangklip State Forest to the South-West;
- Happy Rest Nature Reserve to the West;
- Roodewal State Forest to the South;
- Entabeni State Forest to the South; and
- Langjan Nature reserve to the West.

Protected areas that will be affected or that are directly adjacent to the site include Honnet Nature Reserve and the Greater Kuduland Conservancy (Mount Stuart Section).

Because of the remoteness of the areas, the main impacts will probably be through aspects such as ambience and character of the environment and wilderness quality (sense of place) through visibility, noise, air quality (dust), light etc. In addition, species that occur within the protected areas, but that is not restricted to its boundaries through fences (e.g. birds), might be influenced through a loss in habitat for feeding, nesting etc.

Potential impacts can be summarized as follow:

- Impact on protected species (fauna and flora).
- Loss in habitat and habitat quality for certain (migration) species.
- Change the ambience and character of the environment.
- Decrease the experience of the Soutpansberg and the VBR as an eco-tourist destination.
- Direct and indirect impact on protected areas and VBR buffer zone.

3.2 CUMULATIVE IMPACTS

The Generaal Project forms part of the Greater Soutpansberg Project (GSP) situated to the north of the Soutpansberg in the Limpopo Province. Figure 1 depicts the locality of the various GSP projects, from which it is evident that they are within close vicinity of each other, all situated within the A80F and A71J, K & L quaternary catchments. Future operations planned for the Greater Soutpansberg area (MbeuYashu / CoAL only) are:

- Makhado Colliery (in decision-making phase)
- Mopane Project (NOMR application submitted)
- Chapudi Project (NOMR application submitted)
- Generaal Project (NOMR application submitted)

The total surface area associated with these NOMR applications is approximately 100 500 hectares.

The cumulative impacts of the high risk environmental aspects associated with the Greater Soutpansberg Project are summarized below.

Aspect	Unit of measurement	Makhado	Mopane	Chapudi	Generaal	Total
NOMR application area	hectares	7 635	24 703	40 792	27 306	100 436
Surface disturbance / vegetation clearance (over 60 years of mining, ignoring continuous rehabilitation)	hectares	3 800	3 500	7 575	1 672	16 547
% of NOMR application area	%	50	14	19	6	16.5
Maximum bulk water requirements (make-up water at full production in 2035 at current mining schedule)	m^3/day	5 200	7 600	11 000	11 000	34 800
Groundwater Impact - area of drawdown influence	km^2	300	inclusive	inclusive	inclusive	3 600
Direct employment opportunities (at full production, inclusive of all sections)	persons	1 106	917	1 834	984	4 841
Impact on existing employment (estimate)	persons	370	128	412	41	951

TBD: Still under investigation as part of the Generaal EIA specialist investigations.

The most significant cumulative impact is associated with the groundwater drawdown. The groundwater modeling indicate that the impacts from the Makhado, Mopane, Generaal and Chapudi Projects are cumulative and overlap, and drawdown occurs for a radius of up to 25 km at the end of the life of the mines. The area of drawdown influence is in the order of 3 600 km^2.

The Nzhelele River and Sand River, and to a lesser degree the Mutamba River, are important systems with these systems providing potable water as well as large volumes of water for the irrigation of crops to the north of the Soutpansberg mountain range. The irrigation of the crops is critical to their success and the crops produced can be considered to be of high significance as the crops are produced in winter when areas further to the south cannot produce food for the South African consumer. Prior to any large scale mining in the area both these systems can already be considered to be stressed from a water supply point of view. According to DWA (2004), the Nzhelele River is a water stressed region and therefore, the implementation of the ecological Reserve may require compulsory licensing to deal with the over-allocation to the irrigation sector.

The Sand River system has been identified as a FEPA river system and an upstream support area for a fish FEPA and is therefore considered important in fish conservation. For these reasons caution must be used in decision making in the area with regards to any activity which may affect water supply in the Nzhelele and Mutamba River systems which are major tributaries of this system.

As part of the Greater Soutpansberg Project three large-scale mining operations are proposed which include the Mopane Project, the Chapudi Project and the Generaal Project. The activities of the Chapudi and Generaal Projects are likely to contribute to the cumulative impact on the Mutamba River as well as the cumulative impact on the Nzhelele River.

There will also be a cumulative impact on the Sand River system from both the Chapudi and the Mopane Projects with both systems likely to have similar types of impacts on the Sand River system. The combined impact of both these projects along with the Generaal Project is likely to affect the water supply and possibly the water quality in the lower reaches of the Sand River which in turn will affect the habitat available in the system as well as the availability of refuge pools in periods of low flow and an impact on aquatic and riparian community diversity sensitivity and abundance is likely to occur.

For these reasons extreme caution and care should take place throughout the entire life cycle of these three projects, should they proceed, in order to ensure that the impact on the Sand River system as well as the Nzhelele River system with special mention of the Mutamba River and other ephemeral systems in the area with riparian vegetation is minimised to levels which would ensure an ongoing acceptable level of functioning and biodiversity in these systems and ensure the implementation of the ecological reserve.

The cumulative impacts on Particular Matter (air quality) arising from the operational activities of the Mopane, Chapudi and Generaal Projects (as scheduled currently) is discussed in Section 5.1.1.3 below. The cumulative impact for PM_{10} of 90 µg/m^3 falls below the South African <u>daily</u> standard of 120 µg/m^3. However, when compared against the standards to be implemented in January 2015, the predicted concentration is above the 75 µg/m^3 standard. Mitigation measures should be implemented to maintain the PM concentration below the standards.

The cumulative worst case annual impact for PM_{10} from all mines is estimated at 40 µg/m^3, which falls below the South African <u>annual</u> standard of 50 µg/m^3. However it is recommended that proposed mitigation measure should be implemented at the start of operations in order to maintain

within the limits. The mine contributing the most to the Particulate Matter emission is the Chapudi Project.

The other socio-economic cumulative impacts have been addressed in detail in the SEIA (Naledi, 2013) and are not repeated here. Refer to ANNEX-9.

The main conclusion arising from the SEIA assessment is that should all the Greater Soutpansberg Projects and other planned mining developments in the region be implemented at the same time and development cannot be staggered, the following cumulative socio-economic impacts and benefits are envisaged:

- Cumulative socio-economic impacts:
    - Additional influx of people into the area, thereby adding to congestion and pressure on local infrastructure and services.
    - Compounded impact on the area's sense of place, this in turn may cause a decline in tourism and hunting related activities in the surrounding area.
    - Impact on land use and availability for ecotourism and hunting.
- Cumulative socio-economic benefits:
    - Combined increased in local economic growth and employment.
    - Combined increase in local procurement opportunities causing local business to expand to fill the demand for goods and services.
    - Additional contribution to government tax, balance of payments and national growth.

Given the scale of mining planned in the region and if there is a lack of a concerted action by key stakeholders including government, local stakeholders and industry, there is a high likelihood that significant environmental and socio-economic impacts will occur in the area. It is therefore recommended that development be staggered in the area to optimise the sustainability of the long-term benefits and mitigate the environmental and socio-economic impacts.

3.3 POTENTIAL FOR ACID MINE DRAINAGE

No Geochemical study for the Generaal Project has as yet been undertaken. As part of the Makhado Project a geochemical study, which included laboratory tests and hydro-geochemical modeling of the area as well as the tailings facility was conducted to determine the impact of this activity on the area. This study has been used to determine the potential impacts for the adjacent Generaal Project.

The current design of mining operations involves excavation of overburden, coal-associated minerals and coal. The overburden will be stored in above-ground waste rock dumps and the carbonaceous material associated with the coal will be stored in lined facilities. The main objective in storing the carbonaceous material in lined facilities is to prevent hazardous chemicals from leaching into the regional groundwater systems.

Contaminant release from coal mining sites is usually associated with elevated sulphur in the various waste rocks. The frequency distribution of sulphur in the coal beds at Makhado is such that the vast majority of sulphur concentrations centres around 1.0% to 1.2% by mass rock. Samples were taken from borehole cores at Makhado and subjected to geochemical analysis to qualify potential risk posed by leachate from the rocks.

X-ray fluorescence (XRF) studies suggested silica and coal as major constituents of the sampled minerals. In high abundance were calcium, iron and aluminium. The presence of iron in high abundance is indicative of pyrite content of minerals and thus a potential risk to water resource by leachates derived from reaction of pyrite with oxygen. The presence of calcium and aluminium suggest carbonate and clay materials may neutralise products of oxidation of pyrite, diminishing risk of pollution of water resources.

Mineralogical investigations by X-ray diffraction (XRD) confirmed the presence of pyrite (less than 1 %) in borehole core samples from Makhado. Also confirmed were high concentrations of calcite and clay minerals. The possibility therefore exist that acid and metals released by pyrite oxidation may be neutralised by the associated carbonate and clay minerals in the host rock formations.

Acid-base accounting results indicated the potential for net acid formation in rocks potentially excavated by coal mining at Makhado. There are indications that chemical reactions forming potential leachates are relatively fast, which could mean that any risks would be encountered in the short term (years to decades) as opposed to longer term (decades to centuries).The acid base accounting experiments suggested that clays contribute spurious neutralisation potential to ABA results. This in turn suggests that less actual neutralising capacity may be affected by excavated minerals than that indicated by acid-base accounting methods.

Based on uncertainty in measured neutralising capacity of minerals sampled at Makhado, short-term leach tests were undertaken. The leach tests used in this study were the Acid Rain leach test and the Toxicity Characteristic Leach Test (TCLP), considered by the South African Department of Water Affairs as significant indicators of risks due to leaching by waste rock dumps. Elements were leached that were above the DWA guideline limits in all combinations of Acid Rain and TCLP, Domestic Use and Aquatic Ecosystems guidelines, suggesting that materials potentially emitted by mining operations at Makhado could constitute a risk in terms of legislative limits.

Laboratory kinetic tests in the form of humidity cell leach followed to reduce uncertainty in prediction of contaminant release from Makhado. The test was used to characterise the time-dependent release of elements from rock samples from Makhado. The humidity test results indicated the potential to exceed the DWA guideline limits by leaching from the rock samples analysed. Chemical factors of greatest concern are pH and the concentrations of iron, manganese, lead, zinc, aluminium, selenium and copper.

As the geochemical test methods failed to conclude no risk due to leachates potentially emerging from the Makhado mining operations, hydro-geochemical modelling was employed to further refine understanding of the geochemical processes at the Makhado site under hypothesised scenarios. A hydro-geochemical model (PhreeqC) was constructed of the reactive outer layers of a waste rock dump consisting of overburden and carboniferous material at the Makhado mine site.

A system diagram was constructed as the conceptual model of the chemical aspects of the waste rock dump. One main scenario, which was evaluated in this study, is the backfilling operations after a section was completely mined out. A sulphate load to the mining area was determined on the principle of a worst-case scenario in which 10% of the annual rainwater (400 mm/a) percolated through the 250 meter deep backfilled zone into the local aquifer system. It was also assumed that the whole mining area (5 km x 1 km) would react in a similar manner and that all leachate would reach the monitoring areas where it could reach equilibrium with an oxidizing environment. The last step was done to evaluate the maximum available sulphate leachate which could be produced in the area.

A geochemical model was constructed which consisted of three basic stages. Firstly, rain water infiltrates the waste facility and transports oxygen to the deeper levels. Subsequently, the percolated water reacts with the mineral ensemble to produce the leachate. Finally, the leachate is allowed to enter an environment and equilibrate with the atmosphere to produce the maximum number of oxidised species. It is assumed that 10 mmol of oxygen infiltrates the waste site per day and is constant throughout the year. From this worst case scenario a daily load, over the 500 hectare area was calculated to be in the order of 853 kg of sulphate. In general a sulphate load over this area would be in the order of 3500 kg. However, since the host rock formation has neutralising minerals and the concentration of sulphides present in the subsurface is less than 1.5% the value is representative of the mining region.

Considering all the hydro-geochemical factors in the region, based on the worst case scenario of the modelling at Makhado Project, the Generaal Project would have an impact from leachate. However, with the correct impoundment facilities and monitoring plans, these impacts can be mitigated.

4 ALTERNATIVE LAND USE OR DEVELOPMENTS THAT MAY BE AFFECTED

4.1 CURRENT LAND USE

The current land uses / economic activities in the region include:

- Live Stock Farming
  - Commercial Cattle
- Game Farming
  - Live Sales
  - Hunting, sub-divided into "Trophy" and "Biltong"
    - Trophy hunting including services like professional hunter, skinner, tracker, etc.
    - Biltong hunting including the services of trackers, skinners, etc.
  - Hunting Accommodation
- Eco- and Holiday Tourism
- Irrigation

Refer to Section 1.2.4 and Section 7 of this report for more detail in this regard.

4.2 ALTERNATIVE LAND USE OPTIONS

Shallow soils and surface rock are present throughout the study area. Only approximately 3 282 ha (14%) of the surveyed area has soils deeper than 75cm that can be regarded as good for crop production.

Although there are areas of deep soils, these soils are marginal for dry-land crop production as a result of low rainfall, high temperatures (high evapotranspiration), susceptibility to soil compaction and wind erosion potential. These soils are however suitable for irrigation when rainfall permits or when high quality water for irrigation is available and is classified as class III agricultural potential.

Only 324 ha in the project area are presently under cultivation (156 ha dry land and 168 ha irrigated). Water for irrigation purposes is drawn directly from the Nzhelele Dam; limited groundwater resources are of suitable water quality for irrigation.

The majority of the Generaal Project area is presently covered with low density woody species and is dominated by Mopane shrub field. Present land use of these shallow soils is cattle and game farming; however, carrying capacity is questionable due to poor soil fertility (erosion susceptibility, shallow soils, and surface rock) and poor climatic conditions.

Other potential land uses include eco-tourism and rural housing development.

Refer to Section 1.2.3 of this report as well as the Soil Specialist report (ANNEX-1) for detail description of the land capability of the project area.

4.3 DEVELOPMENT ALTERNATIVES – CONCEPT STUDY

A number of alternative options have been evaluated during the concept mine design. A high-level qualitative risk assessment was performed to determine the most preferred option from an environmental perspective.

4.3.1 MINE INFRASTRUCTURE

Initially 2 mining layout options were developed for the Generaal Section, of which were then compared and the more favourable option taken forward to the costing and submission stage. Refer to Figure 82 and Figure 83 below showing the two mining pits in relation to the rail line and the national road (N1) from where access to the mines will be gained via a new intersection on the N1. A third option was also considered as described below.

The following factors were taken into considerations during the process where the alternatives were compared:

- Distance of product to be transported to the nearest rail link (in this instance Huntleigh Station);
- Mode of transport i.e. rail versus conveyor (for environmental reasons road transport was not considered);
- Topography and water courses (the N1 divides the mining pit into two);
- Sharing of facilities amongst the two mining pits;
- Positioning of carbonaceous and non-carbonaceous dumps, discards and topsoil dumps in relation to the mining pit;
- Discard dumps in relation to the plant/infrastructure position and layout;
- Positioning and orientation of infrastructure and layouts of haul roads, access roads, rail access routes and conveyor routes;
- Traffic movement around the plant and mine infrastructure areas; and
- Natural streams and drainage channels for discharge of clean and capture of polluted storm water run-off. A comparison of Option 1 and Option 2 is given below.

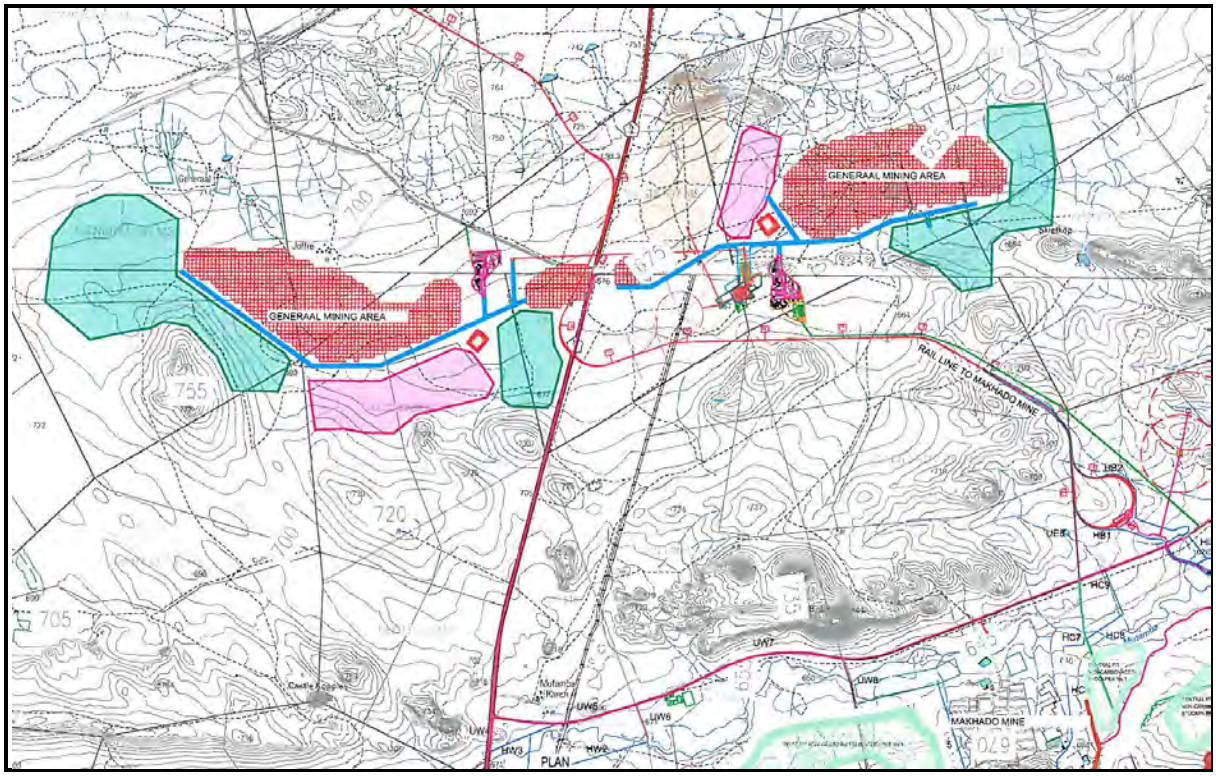


Figure 82: Generaal Section - Option 1 Layout

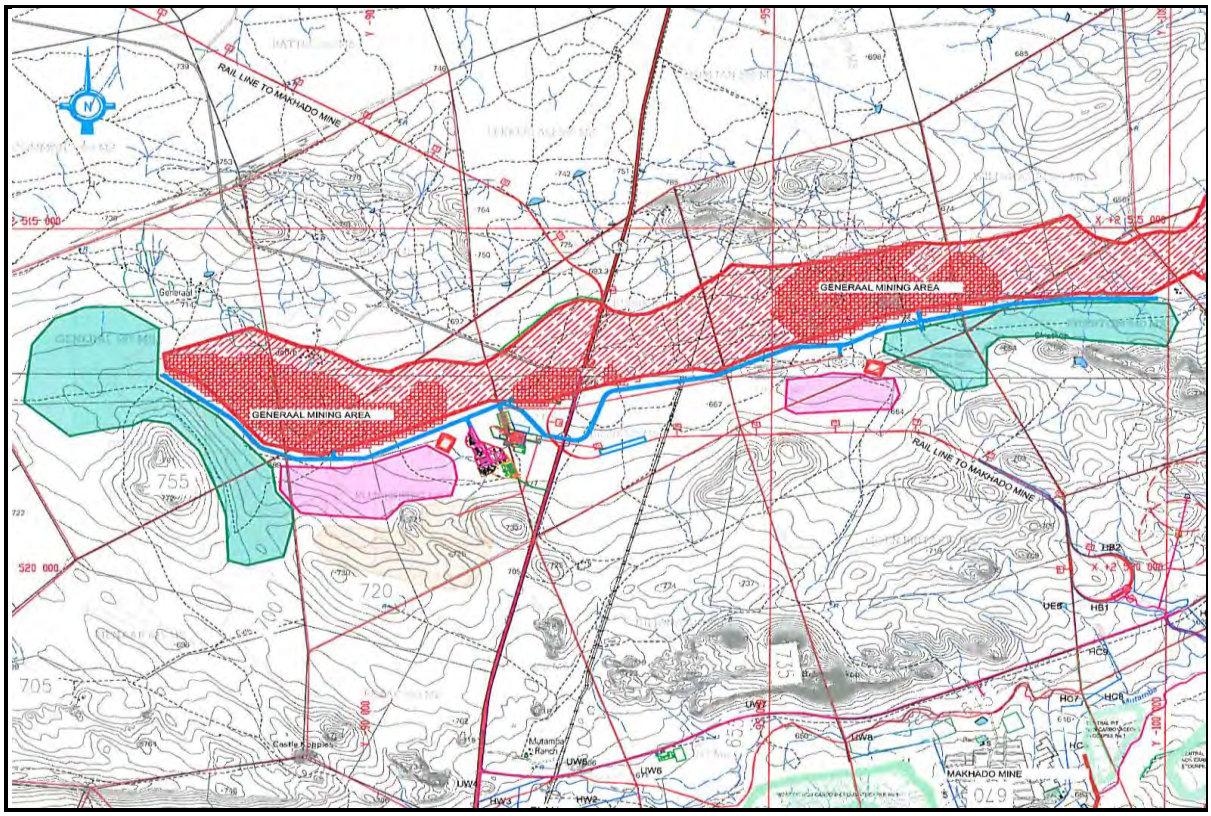


Figure 83: Generaal Section - Option 2 Layout

4.3.1.1 Option 1: Processing Plant at Generaal Section East

This option considered the mining of the Generaal Section East and West pits as two separate entities each with independent infrastructure; however the shared coal processing plant is located at the East Pit.

4.3.1.1.1 Generaal Section East

Generaal Section East lies to the east of the N1 National Highway. The main variables for this option are as follows:

- Positioning of the residue dumps;
- Positioning of the plant and infrastructure on site;
- Transport of product to the rail siding.

The positioning of the residue dumps are dictated by the coal reserves below the surface as well as the N1 national highway which runs in a north-south direction and splits coal reserves into two. As the coal reserves dips from south to north the dumps should ideally be positioned to the south of the pits. There are however hills south of the pit and the plant infrastructure which does not allow all the dumps to be placed on the southern edge of the pit. The dumps have therefore been positioned as close to the mining pits as possible but also around the east and west sides of the pit.

The position of the plant and infrastructure area was chosen in order to be accessible by road and rail. The Makhado rail line runs to the south of the east pit and is the obvious choice for rail transportation of the product. Access to the mining site is provided by an intersection on the N1 national road.

From the processing plant the product will be transferred by a conveyor to a rapid load-out facility (RLT) on a rail loop which joins the Makhado rail line to the Huntleigh station. The conveyor and rail runs are short and therefore cost effective.

4.3.1.1.2 Generaal Section West

Generaal Section West lies adjacent but west of the east pit and the N1 highway. The mine residue dumps have been placed to the south of the mining pits as far as possible due to the south-north dip of the coal reserves. The access road to the mining site is once more directly off the N1 from the same intersection as the east pit. Due to the close proximity of the east and west pits only a single processing plant was considered (positioned at the east pit). Therefore a conveyor has been provided from the west pit tip to transport the product to the east-pit processing plant.

Under option 1 as described both the mining pits (East and west) have their own infrastructure facilities however they share a common processing plant. In order to make the mine more cost effective a second option, Option 2 was considered where the mining infrastructure is also shared.

4.3.1.2 Option 2: Combined Mining Facilities

The combined mining option, as opposed to the individual mining options explored the advantages of the two mining pits sharing common facilities such as:

- Processing plant;
- Infrastructure such as change house, managers offices etc;
- Cheaper load out facility;
- Balancing coal production between the two pits; and
- Explosives magazine etc.

As the mining plan dictates that mining will start on the west pit, the processing plant was positioned at the west pit. The RLT facility has been replaced by a front end loader operation which is cheaper but had to be placed on the east side of the N1 due to the curvature of the rail line. Product will be railed from here by utilising the Makhado rail lilne to Huntleigh station.

As the vehicle maintenance facilities will be shared, a haul road crossing underneath the N1 has become necessary. A conveyor has been provided from the east tip to transport product to the wasing plant at the west tip. Alternatively ROM could be transported by road to the west tip for processing although the haul distance becomes relatively long.

Site access is by means of an intersection off the N1 to the west pit from where a service road follows the haul road all the way to the east pit.

4.3.1.3 Option 3: Utilising Makhado Processing Plant

The final option that was considered was to use the existing Makhado processing plant for coal washing. The rationale for this option is as follows:

- Generaal Section will only come on line by the time that Makhado reaches the end of life of mine;
- The washing plant could therefore be used for washing of the Generaal product;
- There will be no cost in establishing a new processing plant at Generaal although the ROM will have to be conveyed over a distance to Makhado;
- The Makhado RLT and rail facilities could be used as it eliminates the requirement for such facilities at Generaal mine;
- There is an existing bulk water supply to the Makhado plant;
- There will be substantial cost savings.

The infrastructure layout is shown in Figure 84. ROM will be transported from the west pit by conveyor crossing the N1 National Road by means of an underpass and linking up with the ROM conveyor from the east pit ROM tip. From here a single conveyor will transport ROM to the washing plant at Makhado. Product will be conveyed to the RLT as before for the Makhado plant.

Due to the many advantages offered as listed above and the fact that Makhado Colliery will be nearing the end of life of mine with Generaal Section starting up this option has been adopted as the preferred option.

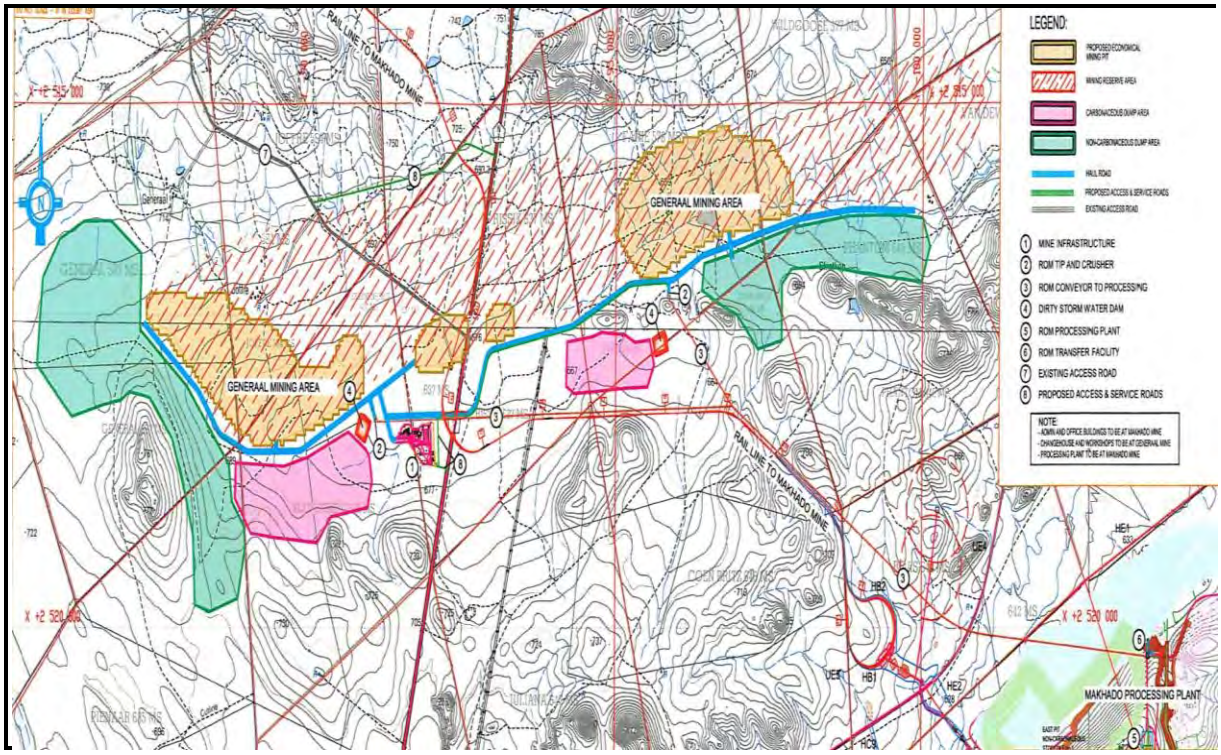


Figure 84: Generaal Section - Option 3 Layout

4.3.2 PRODUCT TRANSPORT

Different options were evaluated by the project team in terms of the locality, land ownership, mineral rights, environmental impacts, plant location and estimated capital costs.

A balloon siding with a RLT on the farm Boas 642 MS has been determined as the preferred option in collaboration with the project team and has therefore been taken forward to concept study stage.

The balloon siding on the farm Boas 642 MS is also shared with the Makhado Colliery Project and ROM product will be transported by means of conveyor belts to the plant at Makhado where the rail infrastructure will be used for the dispatch of product from the Mount Stuart and Generaal Sections.

Factors underpinning this decision to proceed with a RLT on the farm Boas 642 MS connected by a railway siding to Huntleigh railway station:

- The low long term operational cost for the coal transport from plant to port is achieved when replacing the road haul leg, with its expensive road over road crossings and access ramps, with a 24.5 km dedicated rail siding;
- Long-term rail costs are significantly lower than road costs, when upgrading and ongoing maintenance costs are taken into account;
- Economies of scale are achieved even at the currently expected long term average throughput of 2.9 Mtpa including ramp up volume as other mines come on stream;
- A railway has lower environmental impact when measured against a road haul option, under prevailing road and rural community conditions;

- A railway option largely internalizes the externalities associated with transport in the form of congestion, accidents, air pollution, carbon footprint, noise (the marginal difference between road and rail) and nuisance, which are not passed on to the community at large;
- The effect of approximately 505 x 34t road vehicle trips per day (empty and loaded leg) is effectively removed as a source of ongoing community conflict, significant traffic hazard, noise and nuisance in a very confined rural environment;
- While a railway line will not be without its impacts, the dramatically lower level of intrusion into the fabric of public life allows due attention to be paid to those issues which do indeed materialize;
- With the proposed being a direct link and loading site at the farm Boas, opposed to a loading site at Huntleigh, providing a seamless transition from loading siding to direct link to TFR mainline network at Huntleigh; and
- Better environmental management of loading activities is possible, due to the provision of a RLT.

4.3.3 MINE RESIDUE MANAGEMENT

4.3.3.1 Slurry Management

Two options were evaluated:

- Surface slurry ponds
- Inclusion of filter press within the system

The inclusion of a filter press within the process would facilitate increased recycling of water, reduce the risk of spillages and acid-mine drainage and limit the impact on air quality as the residue will be consolidated. Thus, even though this would mean a higher capital cost input, from an environmental perspective this is the preferred option.

4.3.3.2 Discard Management

Three options were evaluated for the management of the mine residue (discard and slurry) associated with the proposed project. Two surface facilities were looked at, namely surface discard dumps and slurry facilities and a co-disposal facility catering for both. The third option that was evaluated is in-pit disposal of mine residue during rehabilitation of the opencast pits.

From a groundwater perspective, the in-pit disposal is the option that would (potentially) cause the least impact owing to the fact that the residue could be placed at the bottom of the pit, allowing the residue to be inundated with water. This would reduce the potential for oxidation and the formation of acid-mine drainage.

In-pit disposal would also facilitate a free-draining final profile which from a visual and end-land use perspective is the preferred option. Surface residue facilities would have a huge visual impact as well as long-term maintenance issues.

Due to constraints in the mining schedule and the bulking factor of the overburden, a combination of surface and in-pit disposal will be employed at the Generaal Section. For the Mount Stuart Section, being an underground mine, surface disposal is necessary.

4.4 DEVELOPMENT ALTERNATIVES – FEASIBILITY STUDY

The following alternative options were proposed by stakeholders during the various engagement sessions and will be investigated further during the Feasibility Phase of the project:

- Infrastructure and stockpiles must be placed in such a way that it does not impact on Marula / Sandveld vegetation areas, as these areas offer the best grazing. Mountainous area is not such good grazing areas. For this reason the discard stockpile at Mount Stuart Section was moved since the Scoping Report as the previously proposed position was considered good grazing area.
- If stockpiles are placed at the foot of the mountain it can be landscaped and revegetated to become part of the mountain.
- Also consider placing the stockpiles further to the south behind the mountainous area.
- Processing plant should be placed as far as possible from Honnet and Kuduland to reduce sense of place impacts.
- Alignment of all linear activities (conveyors) with existing road / power line servitudes and/or fence lines.

Based on the outcome of the EIA, the following will be further investigated during the Feasibility Phase:

- The re-positioning / re-alignment of the mine infrastructure and stockpiles to ensure that no activities (mining or ancillary) take place within 100m from the edge of the 1:100 year flood-line of the major drainage lines, i.e. Mutamba and Nzhelele Rivers.
- The mining schedule will be optimized (phased-in / staggered) in order to minimise the impact on groundwater drawdown on a regional basis.

5 POTENTIAL SOCIAL AND CULTURAL IMPACTS

5.1 SOCIO-ECONOMIC ENVIRONMENT

5.1.1 AIR QUALITY

Dispersion modelling simulations were undertaken by Royal HaskoningDHV (ANNEX-7) to determine the potential air quality impacts associated with the proposed activities. These impacts are reflected as isopleths plots. The isopleths plots reflect the gridded contours (lines of equal concentration) of zones of impact at various distances from the contributing sources. The patterns generated by the contours are representative of the maximum predicted ground level concentrations for the averaging period being represented. The impact assessment for the Generaal Project is based on two scenarios namely; scenario 1 which assess the impacts arising from the construction activities on site and scenario 2 which assess the LOM (life of mine) activities. Cumulative impacts were also modelled to determine the impacts arising from the simultaneous mining operations from the Mopane, Chapudi and Generaal Projects.

5.1.1.1 Construction Impacts

Construction is a source of dust emission which has a temporary impact on the local air quality. Infrastructure and road construction are the two types of construction activity with high emission potentials. The emissions associated with mining and road construction can be associated with land clearing, drilling, blasting, ground excavation and construction of the mining facilities. The dust emissions vary from day to day and depend on the level of activity, specific operation and the prevailing meteorological conditions (USEPA, 1996).

The temporary nature of construction activities is what distinguishes it from other fugitive sources present within the locality. Emissions from construction activities are expected to have a definitive start and end period and will vary depending on the various construction phases. In contrast to other fugitive sources, here the emissions occur in a steady state or follow a discernible pattern. The quantity of dust emissions from construction activities is proportional to the area of land under construction (USEPA, 1996).

The impact on air quality and air pollution of fugitive dust is dependent on the quantity and drift potential of the dust particles (USEPA, 1996). Large particles settle out near the source causing a local nuisance problem. Fine particles can be dispersed over much greater distances. Fugitive dust may have significant adverse impacts such as reduced visibility, soiling of buildings and materials, reduced growth and production in vegetation and may affect sensitive areas and aesthetics. Fugitive dust can also adversely affect human health.

The following components of the environment which may be impacted upon during the Generaal Project construction phase:

- The ambient air quality;
- Local residents, farms and neighbouring communities;
- Mine employees; and
- The surrounding environment and possible the fauna and flora.

A quantitative assessment of the construction impacts was based on the activities carried out in the respective mining pits. Emission rates were calculated based on the USEPA heavy construction emission factors. Construction activities will commence at Mount Stuart Section where the coking coal yields are the highest. Mining operations at the Generaal Section will commence much later as capacity in infrastructure is developed.

Table 37 below represents the daily and annual concentration (µg/m^3) of PM_{10} anticipated to be released during construction activities. Based on Figure 85 and Figure 86 illustrated below, the maximum predicted annual and daily ground level concentration of PM_{10} falls below the annual and daily South African standard of 120 µg/m^3 and 50 µg/m^3 respectively.

Table 37: Maximum predicted ambient ground level concentration (µg/m^3) of Particulate Matter during the construction phase of the Generaal Project

Source	Maximum predicted ground level Concentration of PM_{10} (µg/m^3)	Ambient air quality standard (µg/m^3)	Fraction of the standard (%)
Daily			
Cumulative construction impacts	4.0E-01	120	<1
Annual			
Cumulative construction impacts	9.0E-02	50	<1

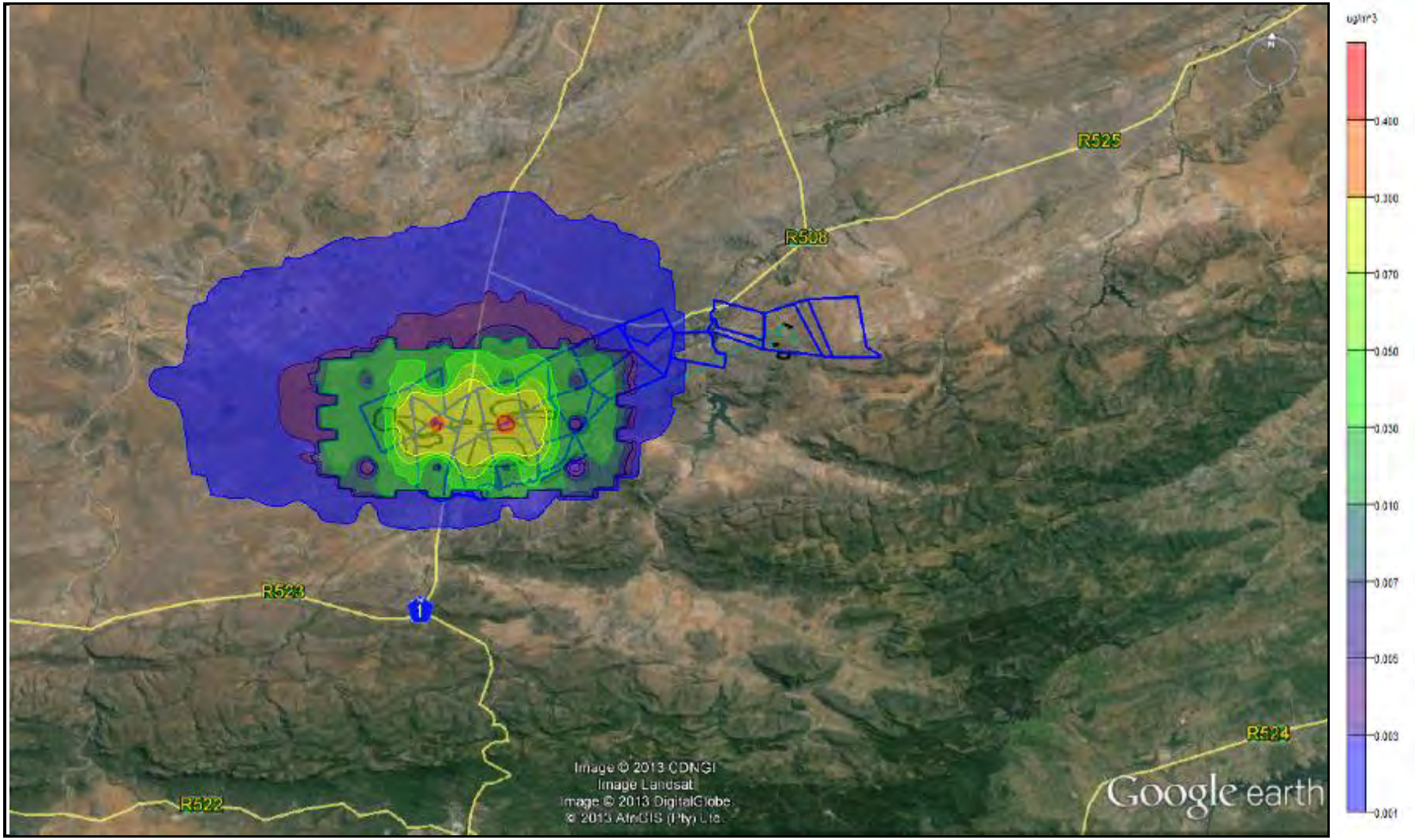


Figure 85: Maximum predicted daily concentration (µg/m^3) of Particulate Matter during construction activities

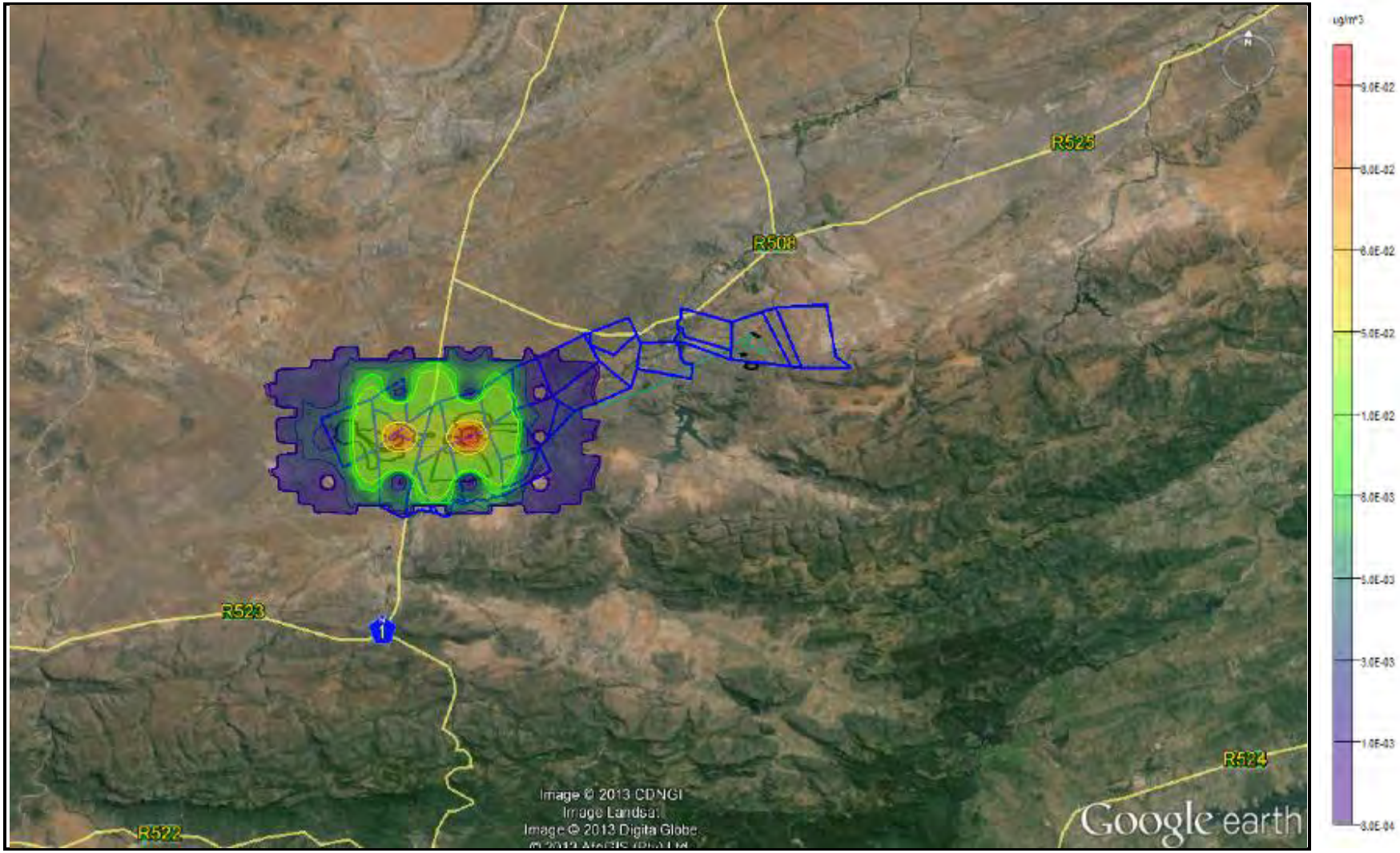


Figure 86: Maximum predicted annual concentration (µg/m^3) of Particulate Matter during construction activities

5.1.1.2 Operational Impacts

This section of the report aims to deal with the air quality impacts associated with the proposed mining activities scheduled to commence at the Mount Stuart section which will be mined at 1.4 Mtpa for a period of 25 years and then at the Generaal section which will mined at a rate of 1.7 Mtpa.

The details regarding source characteristic were extrapolated from site layout plans. Sources which were evaluated in this assessment are:

- Coal processing (storage piles, crushing and screening activities);
- Open cast mining activities (drilling, blasting, bulldozing, tipping and materials handling activities); and
- Wind erosion from exposed surfaces.

Table 38 below indicates the maximum predicted daily ground level concentration of PM_{10} during the operational phase at the Generaal Project area. The cumulative impact of 40 µg/m^3 falls below the South African annual standard of 120 µg/m^3 (Figure 87). When compared against the standards to be implemented in 2015, the predicted concentration falls below the 75 µg/m^3 standard.

The highest contributor to the emission of particulate matter within the Generaal Project area is the Generaal mining pit. Minimum emission rate are anticipated to be released from the respective stockpiles.

Table 38: Maximum predicted daily ground level concentration for PM_{10} during the operation conditions at the Generaal Project

Source	Maximum predicted ground level Concentration of PM_{10} (µg/m^3)	Ambient air quality standard (µg/m^3)	Fraction of the standard (%)
Mining pit	40	120	10
Stockpiles	3	120	2.5
Generaal Section	40	120	10
Mount Stuart Section	3.0E-01	120	<1
Cumulative Impacts	40	120	10

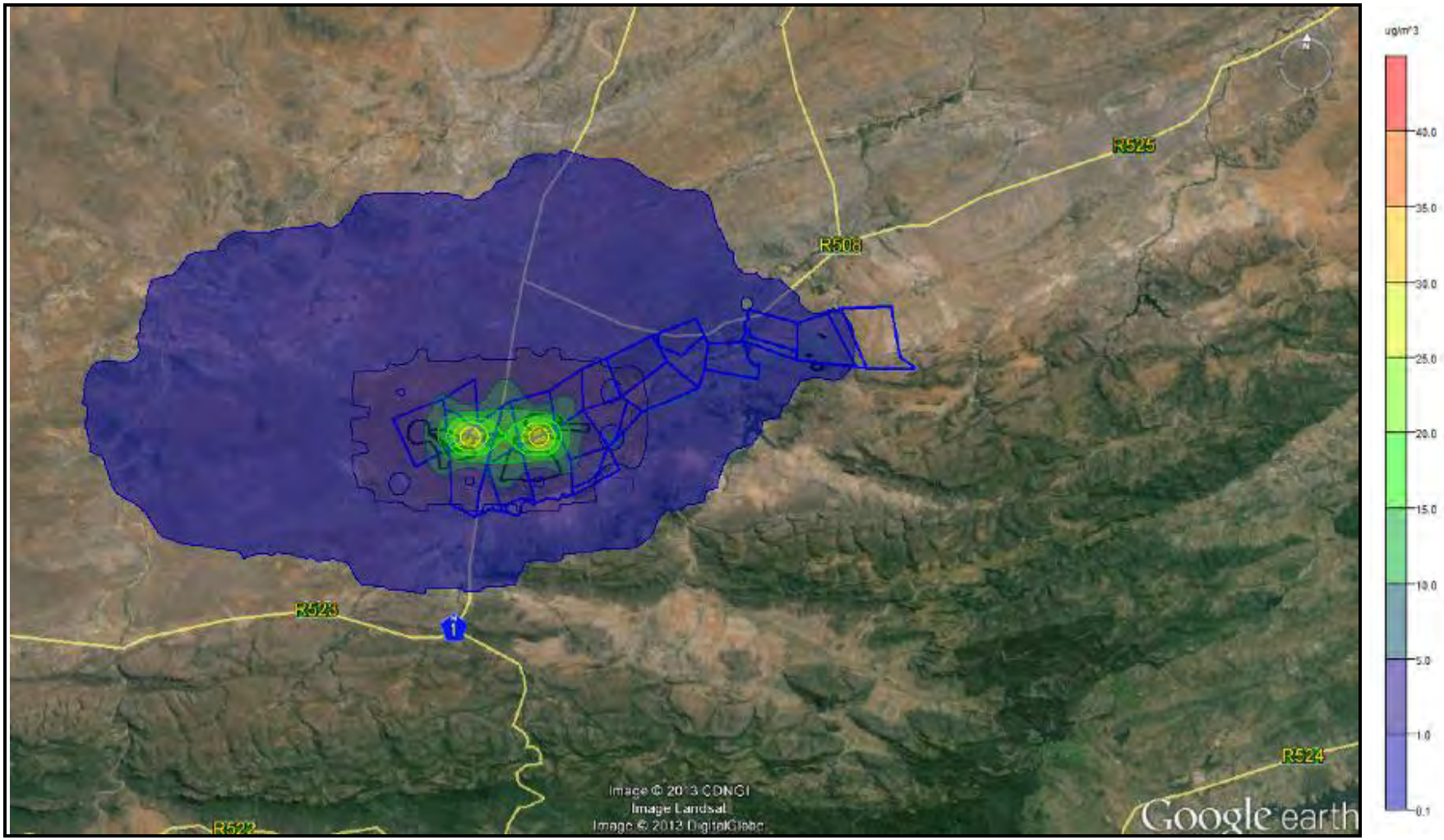


Figure 87: Maximum predicted daily ground level concentration (µg/m^3) of Particulate Matter during operational phase at the Generaal Project

Table 39 below indicates the maximum predicted annual ground level concentration of Particulate Matter at the Generaal Project area (Figure 88). The cumulative impact of 10 µg/m^3 falls below the annual South African standard 50 µg/m^3 for Particulate matter. The highest contributor of particulate matter is mainly from the Generaal mining pit calculated at 9 µg/m^3.

Table 39: Maximum predicted annual ground level concentration for PM_{10} during the operation conditions at the Generaal Project

Source	Maximum predicted ground level Concentration of PM_{10} (µg/m^3)	Ambient air quality standard (µg/m^3)	Fraction of the standard (%)
Mining pit	9	50	18
Stockpiles	6.0E-01	50	1.2
Generaal Section	10	50	20
Mount Stuart Section	4E-02	50	<1
Cumulative Impacts	10	50	20

The blasting activities were modelled separate as blasting is carried out at an average of 3 times per week during intervals of approximately 10 minutes. Figure 89, Figure 90 and Figure 91 illustrates the impact arising from blasting activities at the Generaal project area. The daily and annual predicted concentration for blasting activities falls below the South African standard of 120 µg/m^3 and 50 µg/m^3 respectively.

Blasting is not a continuous activity and is limited to a maximum of three times a week, thus the initial impact from blasting activities is relatively high with the annual concentration being a minimum.

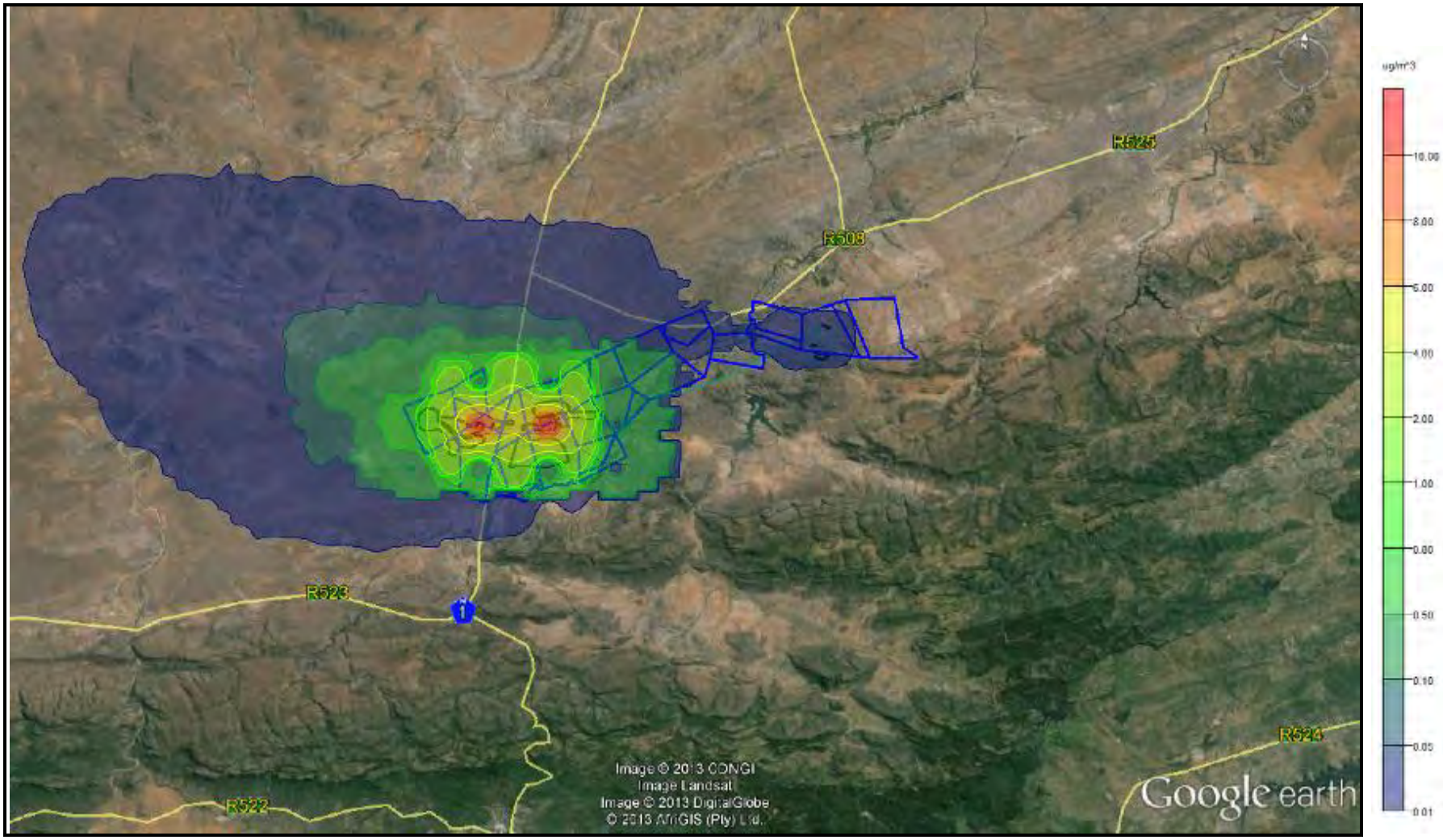


Figure 88: Maximum predicted annual ground level concentration (µg/m^3) of Particulate Matter during operational phase at the Generaal Project

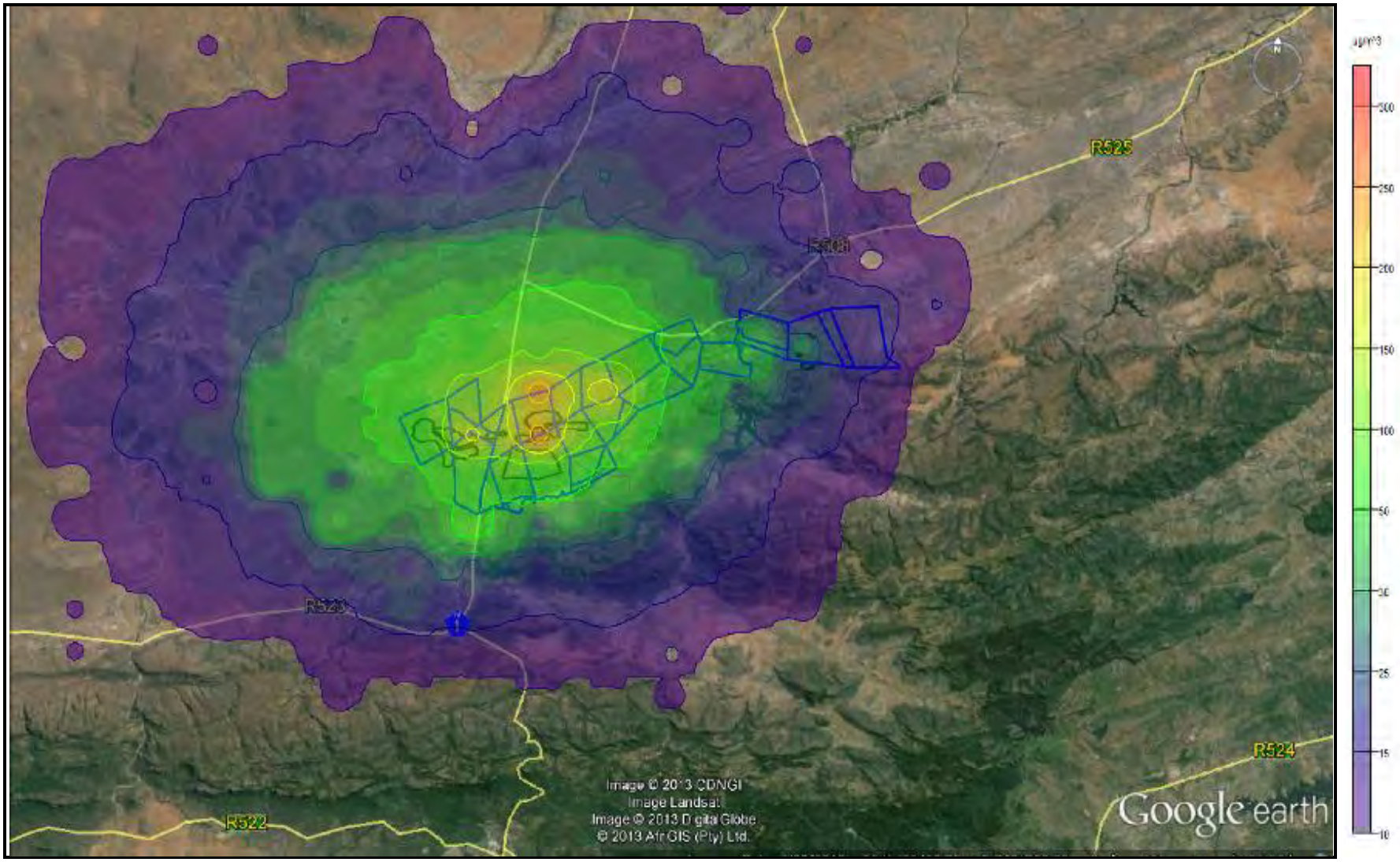


Figure 89: Maximum predicted hourly concentration (µg/m^3) of Particulate Matter from blasting activities at the Generaal Project

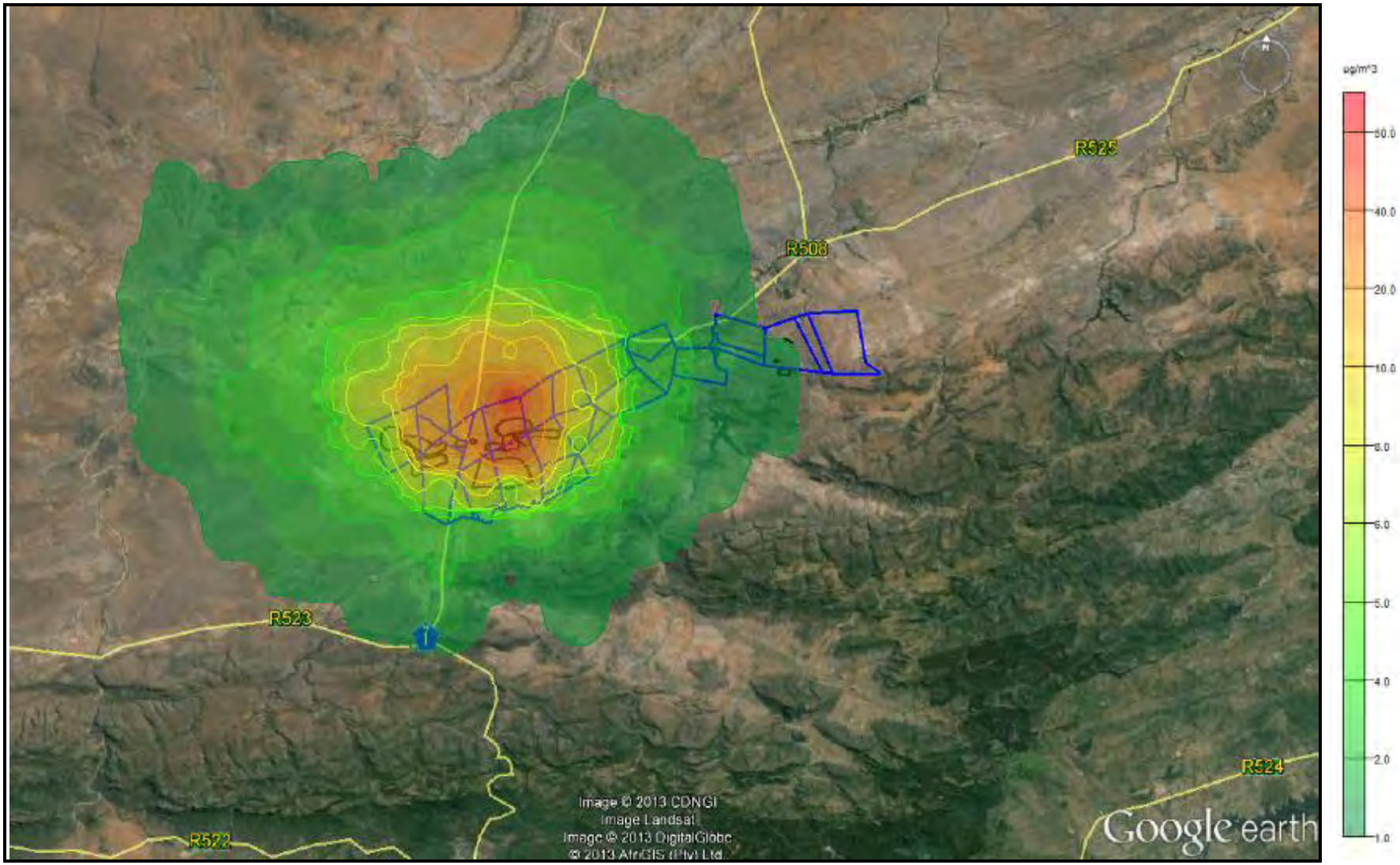


Figure 90: Maximum predicted ground level daily concentration (µg/m^3) of Particulate Matter from blasting activities at the Generaal Project

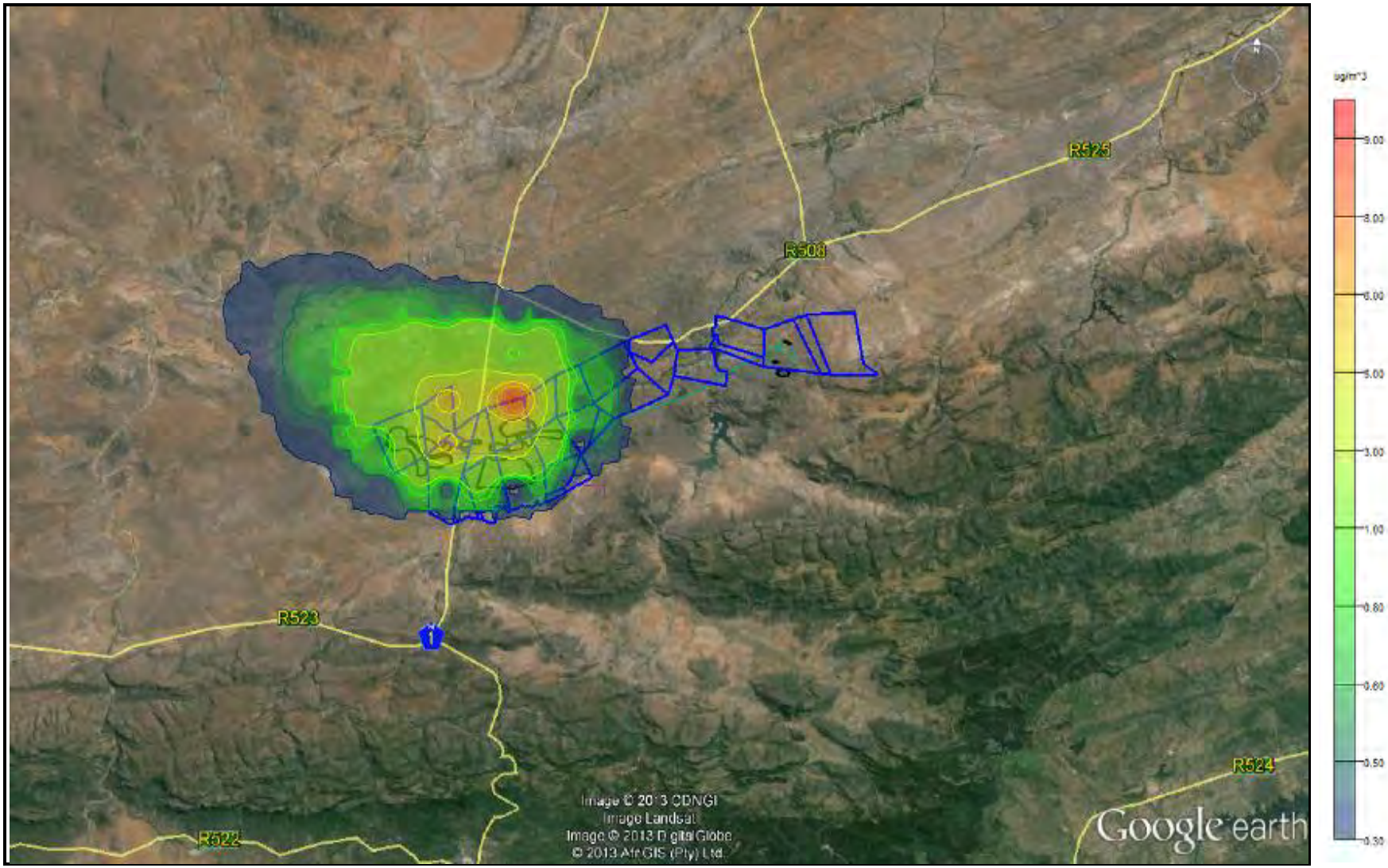


Figure 91: Maximum predicted annual ground level concentration (µg/m^3) of Particulate Matter from blasting activities at the Generaal Project

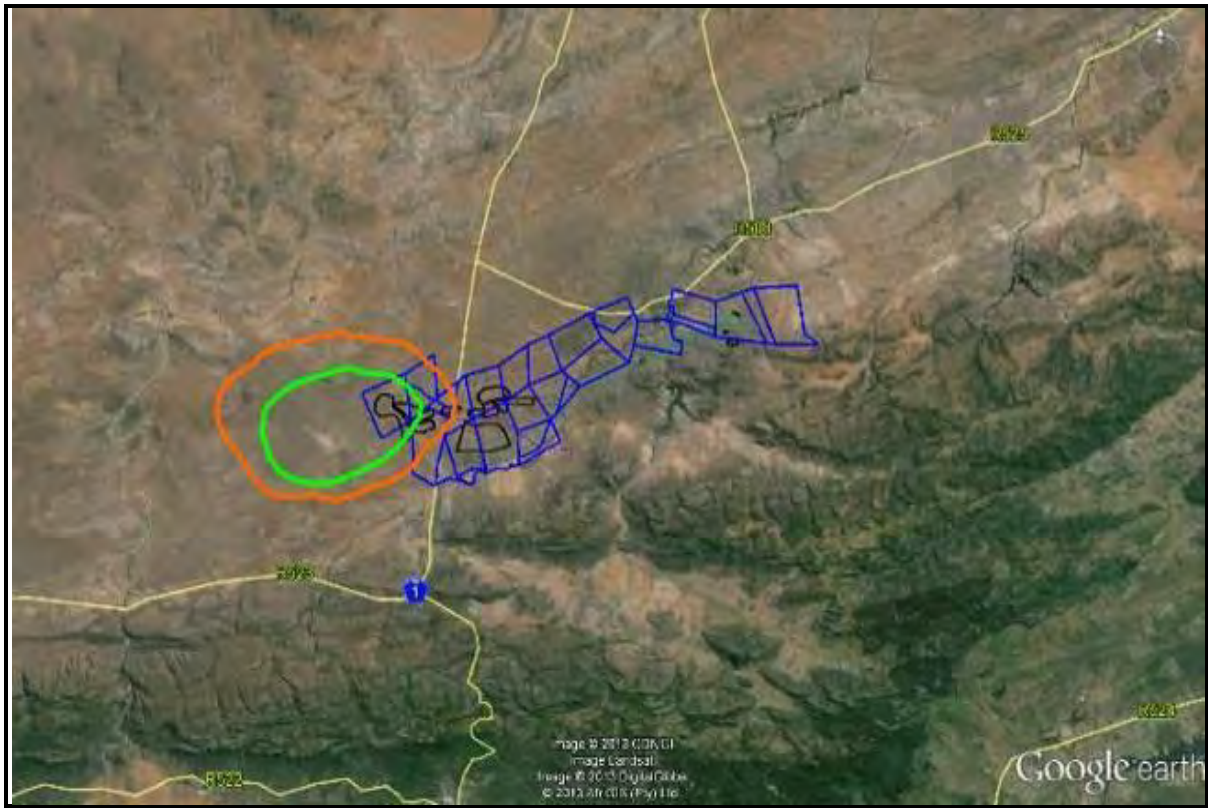


Figure 92: Dust fallout impacts recorded during the operational phases of the Generaal Project

{Orange: 300 mg/m^2/day, Green: 600 mg/m^2/day}

Figure 92 above illustrates the dispersion potential of the predicted dust fallout impacts arising from the operational phase at the Generaal project area. Majority of the dust impacts arise from the Generaal Section mining pit. Majority of dust fallout impacts extends from the mining pit area and surrounding stockpiles. Minimum emissions are released from the conveyor operations. Very low dust fallout concentrations are expected to arise from the Mount Stuart Section operations.

When comparing the modelled results to monitored ambient data of August 2010 – April 2013, the average dust fallout results was 390 mg/m^2/day compared to the modelled data of 300 mg/m^2/day. Higher dust concentrations are expected to arise during the winter months (July – August). Increase in mining activity will result in an increase in the dust fallout rate.

5.1.1.3 Cumulative Impacts

This section of the report aims to deals with the cumulative impacts arising from the operational activities of the Mopane, Chapudi and Generaal Projects.

Figure 93 and Figure 94 below illustrates the daily and annual cumulative impacts respectively. The cumulative impact of 90 µg/m^3 falls below the South African daily standard of 120 µg/m^3. When compared against the standards to be implemented in January 2015, the predicted concentration is above the 75 µg/m^3 standard. Mitigation measures should be implemented to maintain Particulate Matter concentration below the standards.

The cumulative worst case annual impact from all mines is estimated at 40 µg/m^3, which falls below the South African annual standard of 50 µg/m^3. However it is recommended that proposed mitigation measure should be implemented at the start of operations in order to maintain within the limits.

The mine contributing the most to the particulate matter emission is the Chapudi Project.

Table 40: Maximum predicted ground level concentration (µg/m^3) of PM_{10} from all operating mines

Source	Maximum predicted ground level Concentration of PM_{10} (µg/m^3)	Ambient air quality standard (µg/m^3)	Fraction of the standard (%)
Daily			
All mines	90	120	75
Annual			
All mines	40	50	80

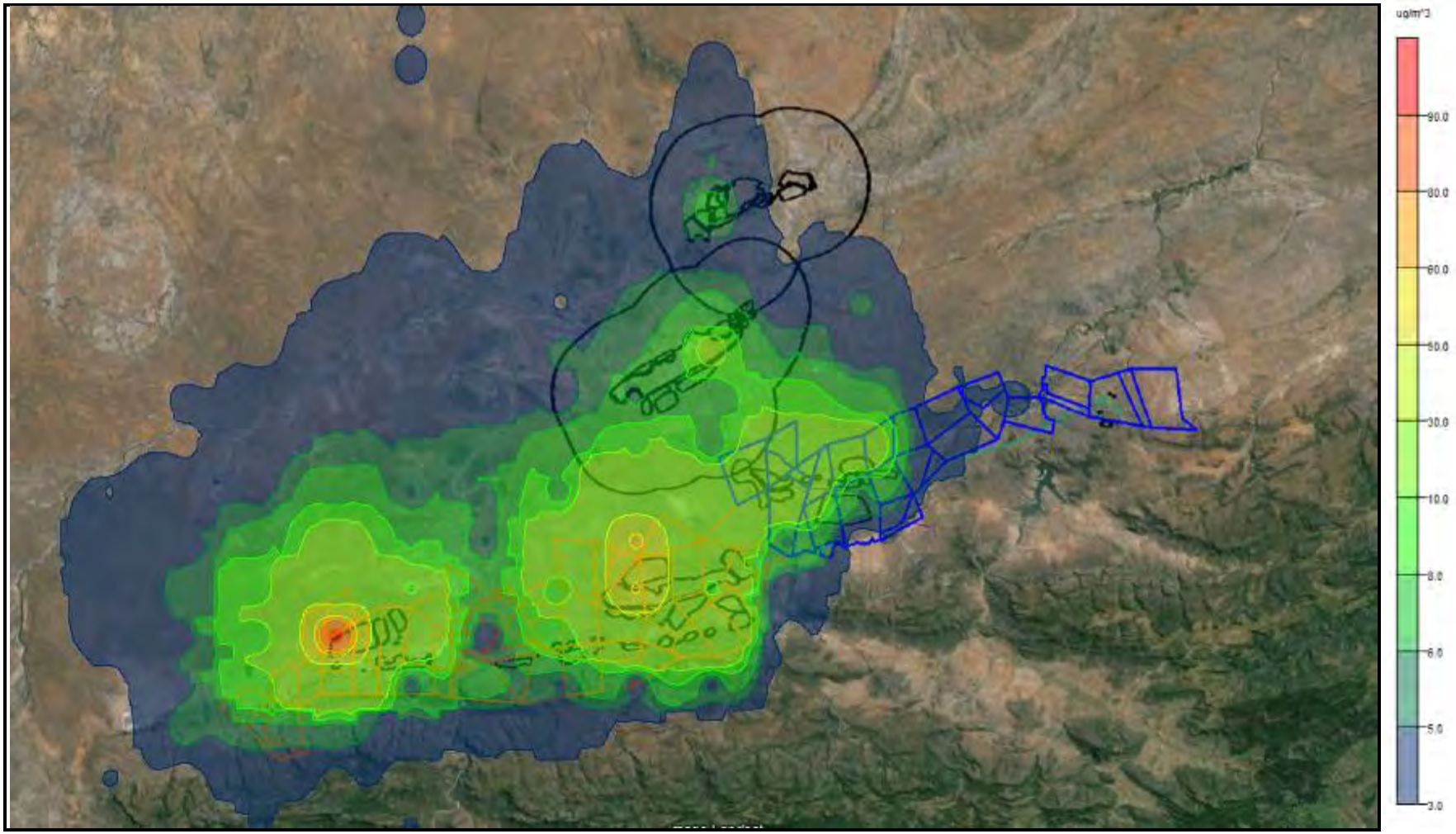


Figure 93: Maximum predicted daily ground level concentration (µg/m^3) of Particulate Matter from the Mopane, Chapudi and Generaal Project areas

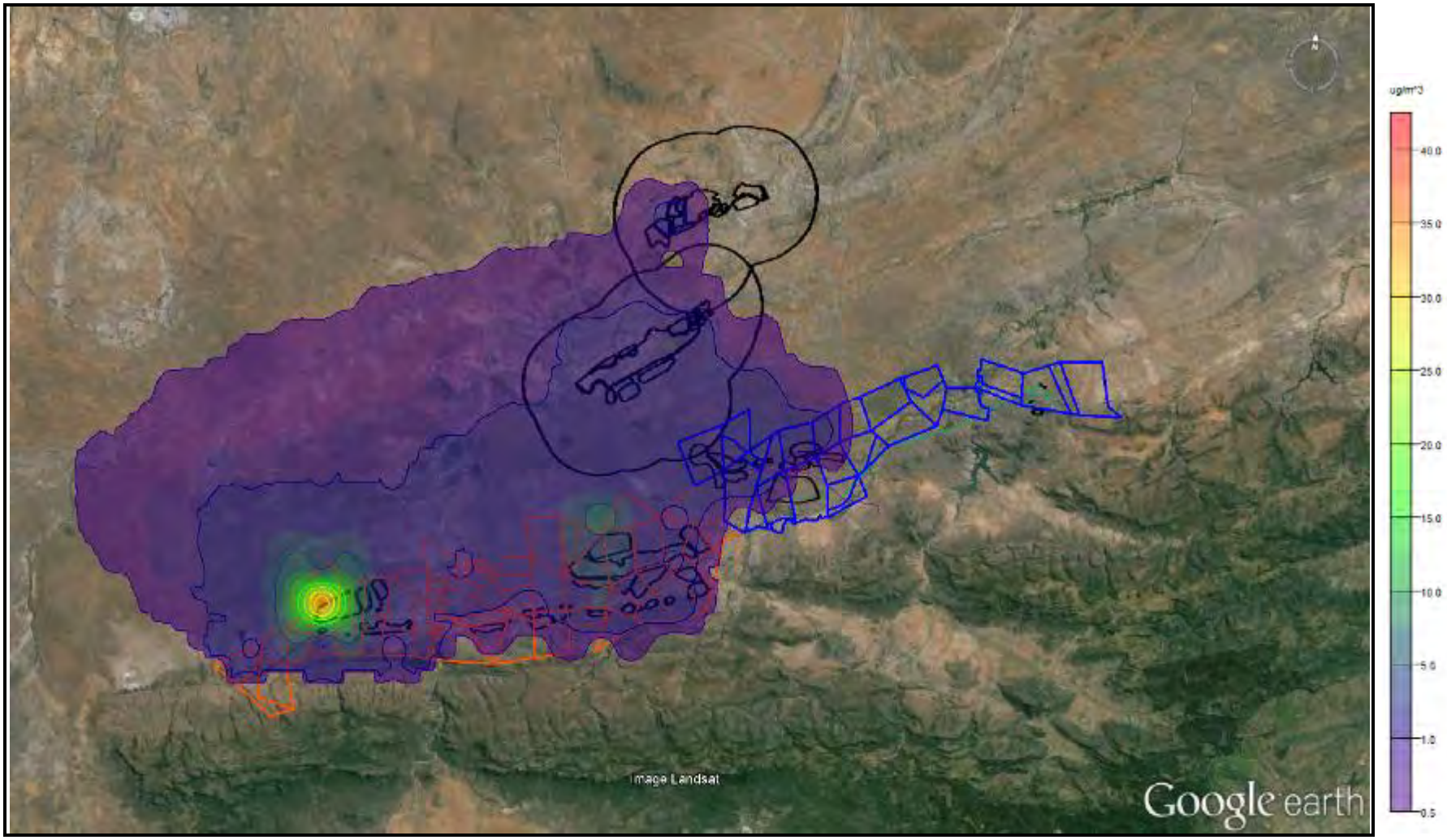


Figure 94: Maximum predicted annual ground level concentration (µg/m^3) of Particulate Matter from the Mopane, Chapudi and Generaal Project areas

5.1.1.4 Decommissioning Impacts

The decommissioning phase is associated with activities related to the demolition of infrastructure and the rehabilitation of disturbed areas. The total rehabilitation will ensure that the total area will be a free draining covered with topsoil and grassed. The following activities are associated with the decommissioning phase (US-EPA, 1996):

- Existing buildings and structures demolished, rubble removed and the area levelled;
- Remaining exposed excavated areas filled and levelled using overburden recovered from stockpiles;
- Topsoil replaced using topsoil recovered from stockpiles; and
- Land and permanent waste piles prepared for re-vegetation.

Possible sources of fugitive dust emission during the closure and post-closure phase include:

- Smoothing of stockpiles by bulldozer;
- Grading of sites;
- Transport and dumping of overburden for filling;
- Infrastructure demolition;
- Infrastructure rubble piles;
- Transport and dumping of building rubble;
- Transport and dumping of topsoil; and
- Preparation of soil for re-vegetation – ploughing and addition of fertiliser, compost etc.

Exposed soil is often prone to erosion by water. The erodability of soil depends on the amount of rainfall and its intensity, soil type and structure, slope of the terrain and the amount of vegetation cover (Brady, 1974). Re-vegetation of exposed areas for long-term dust and water erosion control is commonly used and is the most cost-effective option. Plant roots bind the soil, and vegetation cover breaks the impact of falling raindrops, thus preventing wind and water erosion. Plants used for revegetation should be indigenous to the area, hardy, fast-growing, nitrogen-fixing, provide high plant cover, be adapted to growing on exposed and disturbed soil (pioneer plants) and should easily be propagated by seed or cuttings.

5.1.1.5 Methane Emissions

The first emissions released from coal production are methane. Methane is a powerful heat trapping gas and is the second contributor to global warming after Carbon dioxide. Methane is non toxic to humans but is of concern in terms of its explosive potential and its impact on the global climate. Methane is one of the most significant greenhouse gases and is 21 times stronger than carbon dioxide (Campbell, 1996).

Methane is produced during coalification (process of coal formation). Only a fraction remains trapped under pressure within the coal seams and surrounding strata. The trapped methane is released during mining when the coal seams are fractured. Methane released in this fashion will escape into the mine works and eventually diffuse into the atmosphere (Irving and Tailakov, 2000).

The amount of coal released during mining depends on a number of factors, the most important of which is the coal rank, seam depth and method of mining. As coal rank increases so does the amount of methane produced. At surface mines, methane escapes from newly exposed coal faces /surfaces as well as from areas of coal rubble created by blasting operations. Methane is also present in the overburden which breaks down during the mining process and the underlying strata can be fractured due to the removal of overburden. Methane emission per ton of coal is much lower from surface than underground mining as the gas content is lower with shallow seams (Irving and Tailakov, 2000).

5.1.2 AMBIENT NOISE

The noise emissions from various sources, as defined by the project, were calculated in detail by Gudani Consulting (ANNEX-6) using the sound propagation models described by SANS 10357 and checked with the ISO 9613-2 model.

The following were considered:

- The octave band sound pressure emission levels of processes and equipment;
- The distance of the receivers from the noise sources;
- The impact of atmospheric absorption;
- The meteorological conditions in terms of Pasquill stability;
- The operational details of the proposed project, such as projected areas where activities will be taking place;
- A barrier where berms, high walls, spoil or discard dumps are expected around open cast or stockpile areas;
- Topographical layout; and
- Acoustical characteristics of the ground. 50% soft ground conditions were modelled, as the area where the mining activity would be taking place is well vegetated and sufficiently uneven to allow the consideration of soft ground conditions. This is because the use of hard ground conditions could represent a too precautionary situation.

5.1.2.1 Construction Phase

Daytime (06:00 – 22:00) and night-time (22:00 – 06:00) operations were assessed. Most critical investigational times would be the night-time hours when a quiet environment is desired (at night for sleeping, weekends etc.).

Only opencast and stockpile construction was assessed as other construction processes (road and plant infrastructure development) is relatively short-term in comparison to the lengthy opencast site clearance and box-cut development phase. As it is unsure if the developer intends on constructing the facility during the night-time hours, it is assumed that open cast site clearances will take place over the 24 hour day and night periods.

Calculations are based on a worst-case scenario and will not be relevant for all times during the construction phase and may only be relevant when construction activities occur near a receptor.

Stockpiles, berms and barriers will be constructed during this phase. This material will be re-used to close the open pits for rehabilitation purpose after mining.

5.1.2.1.1 Investigated worst-case construction scenarios - Day and Night-times

Road Traffic: Traffic on the haul roads from open cast pits calculated as – 10 vehicles p/h on a single continuous non-paved road, heavy vehicles was calculated as 50% of vehicles. Traffic calculated at constant speed of 60 km/h.

Construction of Opencast/Stockpile Areas: Construction processes assessed included:

- A worst-case scenario was assessed whereby the most significant noisy equipment during construction takes place as feasibly close as possible to receptors, while still remaining on the project footprint; and
- Site preparations and other construction processes at pits and stockpiles are defined in Section 2 of the noise impact specialist report (ANNEX-6), with construction localities illustrated in Figure 95.

Existing Ambient Contributors and Acoustical Factors: The following ambient soundscape factors were considered:

- Distance from receiver to noise source considered. Receptors are regarded at a 2 meters height in relation to the ground surface;
- The existing ambient soundscape as defined in Chapter 2 of this report;
- Intervening ground conditions of a medium ground nature, i.e. some flora etc. (50% hard ground conditions); and
- Activities functioning during wind-still conditions, in good sound propagation conditions (20°C and 80% humidity).

5.1.2.1.2 Results

Figure 96 illustrates the resulting conceptual night-time worst-case peak noise climate around the proposed development. These figure contours are illustrated from 40 dBA upwards (SANS 10103:2008 Rating level referencing), with contours illustrated in 5 dBA intervals. These figures indicate a $L_{Req,1\,h}$ value with no tone or impulse corrections. Only a night-time map is displayed.

Calculated levels will exceed the Equator Principle IFC guideline, SANS10103:2008 Rating or ambient soundscape by a measurable value during both daytime and nighttime hours. Activities at a receptors' dwelling, as well noise sources of significance (N1 road traffic) may screen noise levels during certain times of the day.

Construction processes are normally short to medium term in operational period and the impact is considered to be of medium significance.

The potential operations near buildings and facilities where a natural or quiet period is required, e.g. religious, educational and health care and hospitality facilities (game lodges) needs to be considered.

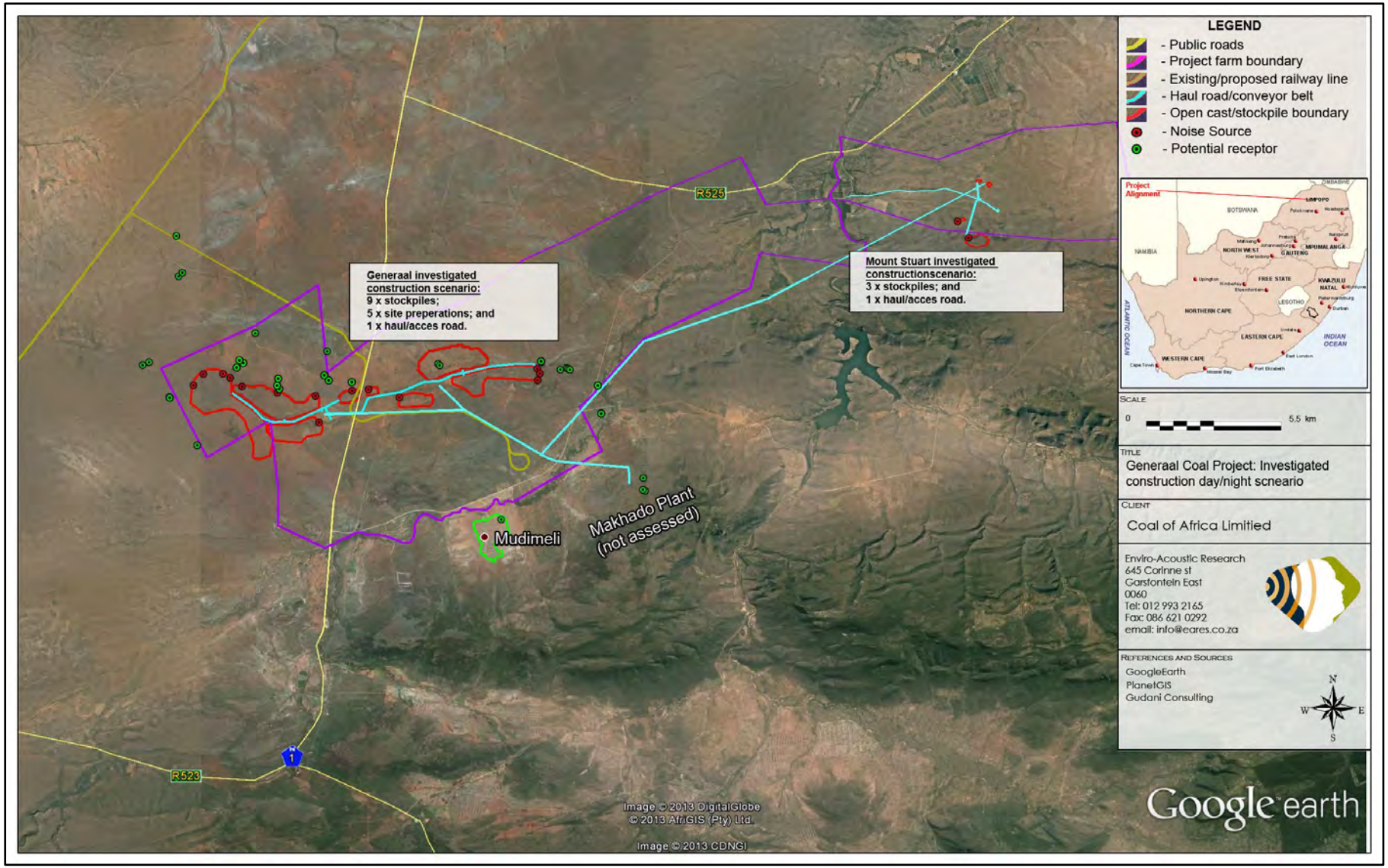


Figure 95: Investigated construction scenario as modelled for the day/night time period – worst case

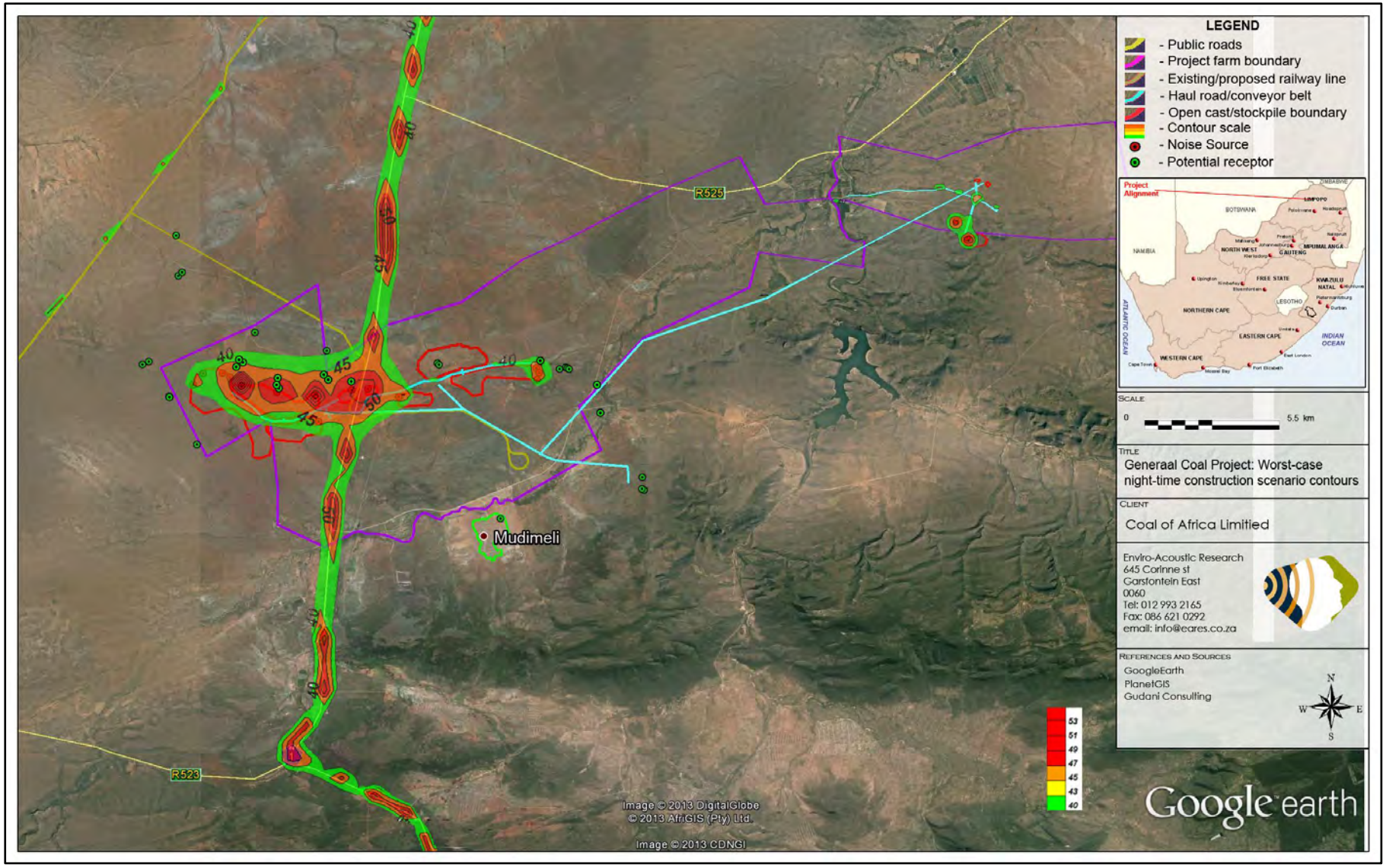


Figure 96: Projected construction Noise Rating Levels in contours of sound levels

5.1.2.2 Operational Phase

Calculations for the operational phase are based on a worst-case scenario and will not be relevant for all times of the operation phase (not a moment in time, but the potential extent of noise rating levels during the operational phase). No screening corrections were considered (such as the cladding or enclosing of crushers and screens). Opencast pit operations took into consideration a conceptual 10 m berm/barrier around it.

5.1.2.2.1 Investigated worst-case operational scenarios - Day and Night-times

Haul Road Traffic: Traffic on the haul roads calculated as – 174 vehicles p/h (delivering to stockpiles and dumps) travelling on a single non-paved continuous road, all heavy vehicles. Traffic calculated at constant speed of 60 km/h. The Articulated Dump Trucks (ADT) volumes used on haul roads was calculated from available information sourced in the specialist report.

Colliery Infrastructure: Colliery infrastructure and modus operandi is defined in the noise specialist report, with assessed scenario localities illustrated in Figure 97.

Opencast "truck and shovel" Method and Stockpile Management: It is expected that berms and barriers will be implemented during the construction phase from spoils, discards, hards, softs etc. Operations of the opencast and stockpile areas took the following into account:

- A worst-case scenario was assessed whereby the most significant noisy equipment during operational phase takes place as close as feasibly possible to receptors, while still remaining on the project footprint;
- A conceptual 10 m barrier/berm constructed during the construction phase from overburden, interburden (hards, softs etc.) was considered as a screen completely enclosing open cast pits and stockpile areas; and

Drilling, excavating, trucks, overburden removal, truck and shovel coal mining, stockpile management and other operational processes are defined in Section 4.3 of the noise specialist report, with assessed scenarios illustrated in Figure 97.

Railway traffic: Based on available information, the operations were assessed taking into account the following acoustical corrections:

- Train lines were split into sections for various corrections. The daytime and night operations of 2 x Class 43 electric locomotives and 100 CCL 8 x 4-axle tread braked wagons per train with 1 (1 delivery, no return) trains a day and night, traveling at 40 km/h;
- Ballast correction (acoustics attenuation due to ballast effect) was considered;
- Intervening ground conditions of a medium ground nature, i.e. (50% hard ground conditions);
- Continuous welded rail (CWR) corrections were considered; and
- Assessment does not consider façade corrections or the row of houses acting as a screen when obstructing a direct line of sight to the railway line. Assessed calculations better illustrate potential noise rating levels at houses directly adjacent or with a direct line of sight to railway lines.

Existing Ambient Contributors and Acoustical Factors: The following ambient soundscape factors were considered:

- Distance from receiver to noise source considered. Receptors are regarded at a 2 meters height in relation to the surrounding environment;
- Existing ambient soundscape contributors as defined in Chapter 2 of this report;
- Intervening ground conditions of a medium ground nature, i.e. some flora etc. (50% hard ground conditions); and
- Activities functioning during wind-still conditions, in good sound propagation conditions (20°C and 80% humidity).

5.1.2.2.2 Results

It must be noted that the impact assessment is quite precautious and a worst-case scenario represents the maximum equivalent (average) noise climate ($L_{Req,1\ h}$) the receptors could be exposed to at some time during the operational phase for the larger project area. The noise rating levels therefore does not represent a moment in time.

Figure 98 illustrates the resulting conceptual night-time worst-case peak noise climates for the Generaal and Mount Stuart sections. These noise ratingcontours are illustrated from 40 dBA upwards (SANS 10103:2008 night-time Zone Sound Level for a suburban area), with contours illustrated in 5 dBA intervals. These figures indicate a $L_{Req,1\ h}$ value with no tone or impulse corrections. Only night-time maps are displayed as daytime projections would not be easily presented.

Calculated levels will exceed the Equator Principle IFC guideline, SANS10103:2008 Rating or ambient soundscape by a measurable value during both daytime and nighttime hours.

Activities at a receptors' dwelling, as well noise sources of significance (N1 road traffic) may screen noise levels during certain times of the day. The implementation of a berm/barrier during the construction phase and around the boundary of open cast pits will assist to screen noise levels.

Tonality from brake squeal may become an annoyance at sections of the railway where momentum needs to be reduced or trains make periodic stops (rail loops etc.). Train hooters and the need for shunting activities near a sensitive receptor will cause noise annoyance during night-times.

The potential operations near buildings and facilities where a natural or quiet period is required, e.g. religious, educational and health care and hospitality facilities (game lodges) needs to be considered.

The impact is considered to be medium (day-time) to high (night-time) and the necessary mitigation measures need to be taken to reduce the noise levels.

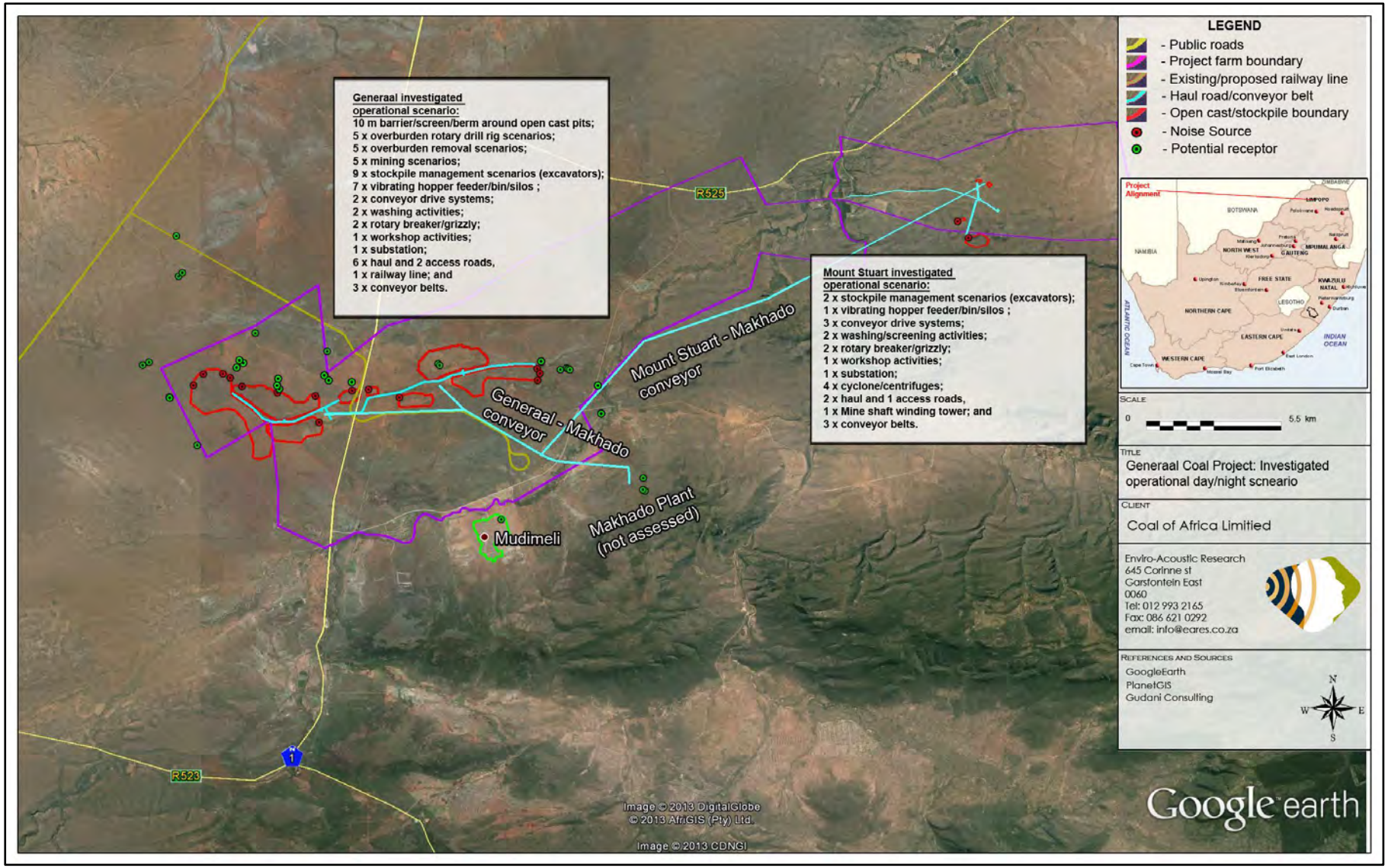


Figure 97: Investigated operational scenario as modelled for the day/night time period – worst case

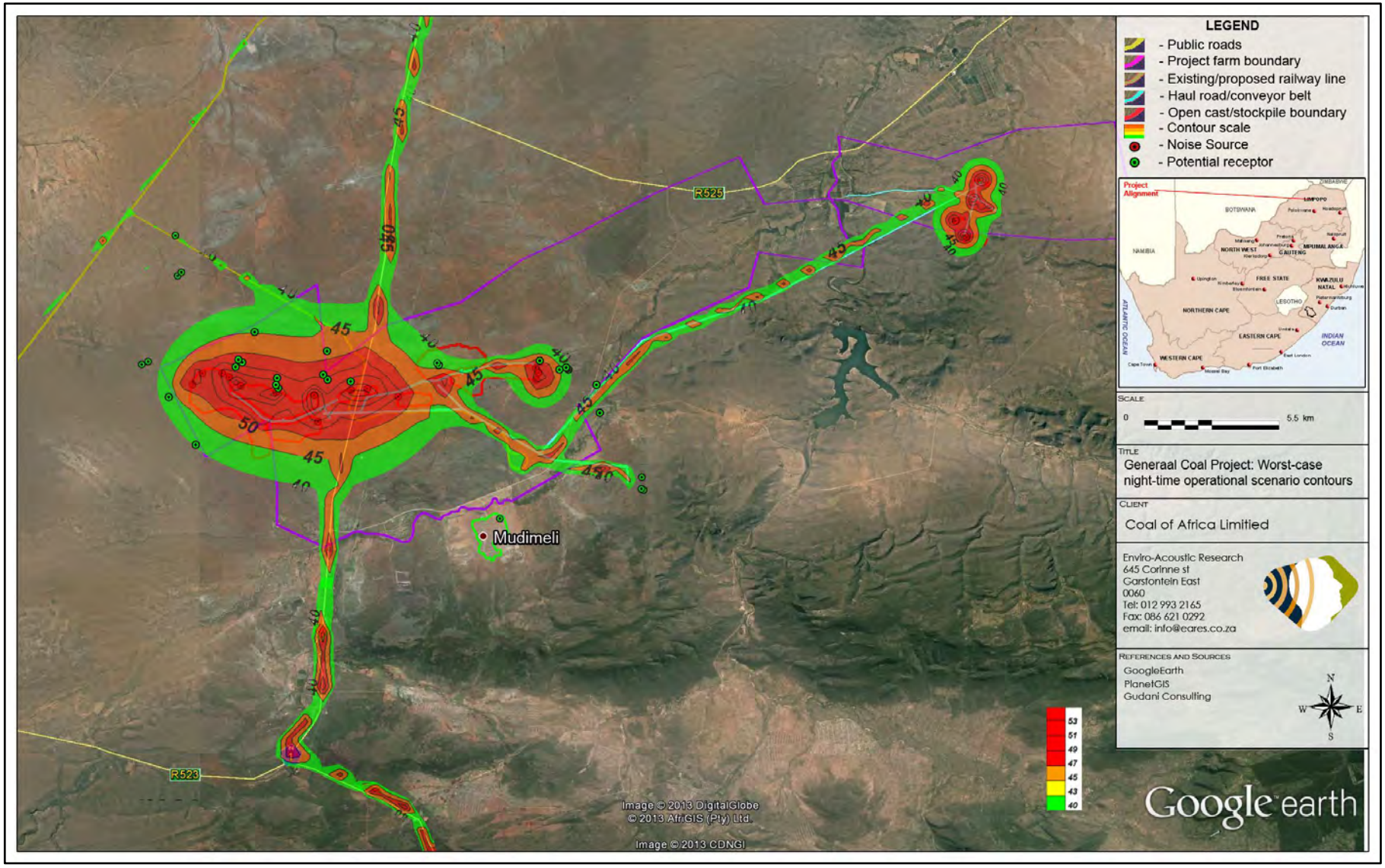


Figure 98: Projected operational Noise Rating Levels in contours of sound levels

5.1.3 VISUAL AND AESTHETIC IMPACT

The aim of the visual assessment is to identify systematically all the potential landscape and visual impacts associated with the mine development to predict and estimate their magnitude. The assessment will cover landscape impacts, which amount to changes in the fabric and character of the landscape and visual impacts, for example, changes in available views of the landscape and the effect the changes will have on sensitive receptors in the area.

The mining development stretches in an east-west direction with the Soutpansberg forming the southern backdrop. The degree to which an object fills a person's central field of vision determines the visual impact it might cause. The visual assessment conducted for the proposed Makhado Colliery Project concluded that the viewshed of viewers within a 6 km radius of the mining development will be impacted the significantly. Moving further away from the mine will lessen the visual impact. A full impact assessment will provide a clearer picture of the impacted areas and sensitive receptors that will be impacted on.

The main concerns in this regard are the following:

The main concerns in this regard are the following:

- The change of the topography by large scale (footprint and height) of the opencast areas, stockpiles and the beneficiation plant and other mining related infrastructure;
- Reflective and bright infrastructure development will alter the visual character of the area;
- Dust pollution due to excessive vegetation and topsoil stripping;
- The dumping and exposure of calcareous materials, the color of which is in sharp contrast with the Soutpansberg mountain range;
- The introduction of industrial activity with associated light pollution;
- The introduction of additional coal transporting vehicles on local gravel roads with an increased rate of recurrence.

5.1.3.1 Visual Exposure

A viewshed analysis conducted from two points in the Generaal Project area for a 50 m high structure reveals that the topography of the area will affect the visibility of the open pits and the infrastructure – refer to Figure 99. The open pits and infrastructure will mostly be visible from elevated positions, especially from places where the viewer is elevated above tree top level. It is anticipated that the stockpiles, due to their large footprint and height and parts of the processing plant will be highly visible as it contrasts in shape and color with the environment.

This impact is expected to be extremely adverse where mining components contrast with diverse views of the Soutpansberg and unspoilt natural vegetation, typically from within game farms, conservancies and other scenic areas.

5.1.3.2 Factors Impacting on the Sense of Place

Apart from visibility of static mine components such as stockpiles and infrastructure, the following secondary effects of mining operations adversely affect the quality of the landscape and the sense of place on a wider scale:

Product Transport: The additional conveyor systems from the Generaal and especially the Mount Stuart Sections, and the increase in rail traffic, will increase the ambient noise levels which will impact on the sense of place and negatively influence sensitive receptors.

Road traffic: Additional transport on the roads in the vicinity of the mine. Apart from the N1 and the R525, these roads mainly carry local traffic. The type of vehicles, which may be regarded as abnormal, invoke extremely negative perceptions from residents and other road users, especially where these are considered to be causing road deterioration, accidents, traffic congestion and dust pollution.

Lighting: It is expected that lighting associated with mining operations will introduce a large degree of light pollution in the rural area and onto the Soutpansberg Mountain range, especially since no other activities of this nature currently exist in the area. This is of particular concern for game farm and lodge owners who host tourists in close proximity to the mine area.

Dust: Dust is an inevitable result of opencast mining and the transportation of coal. Although mitigation measures can be put in place to minimize this, it must still be considered as a possibility which might negatively influence sensitive viewers.

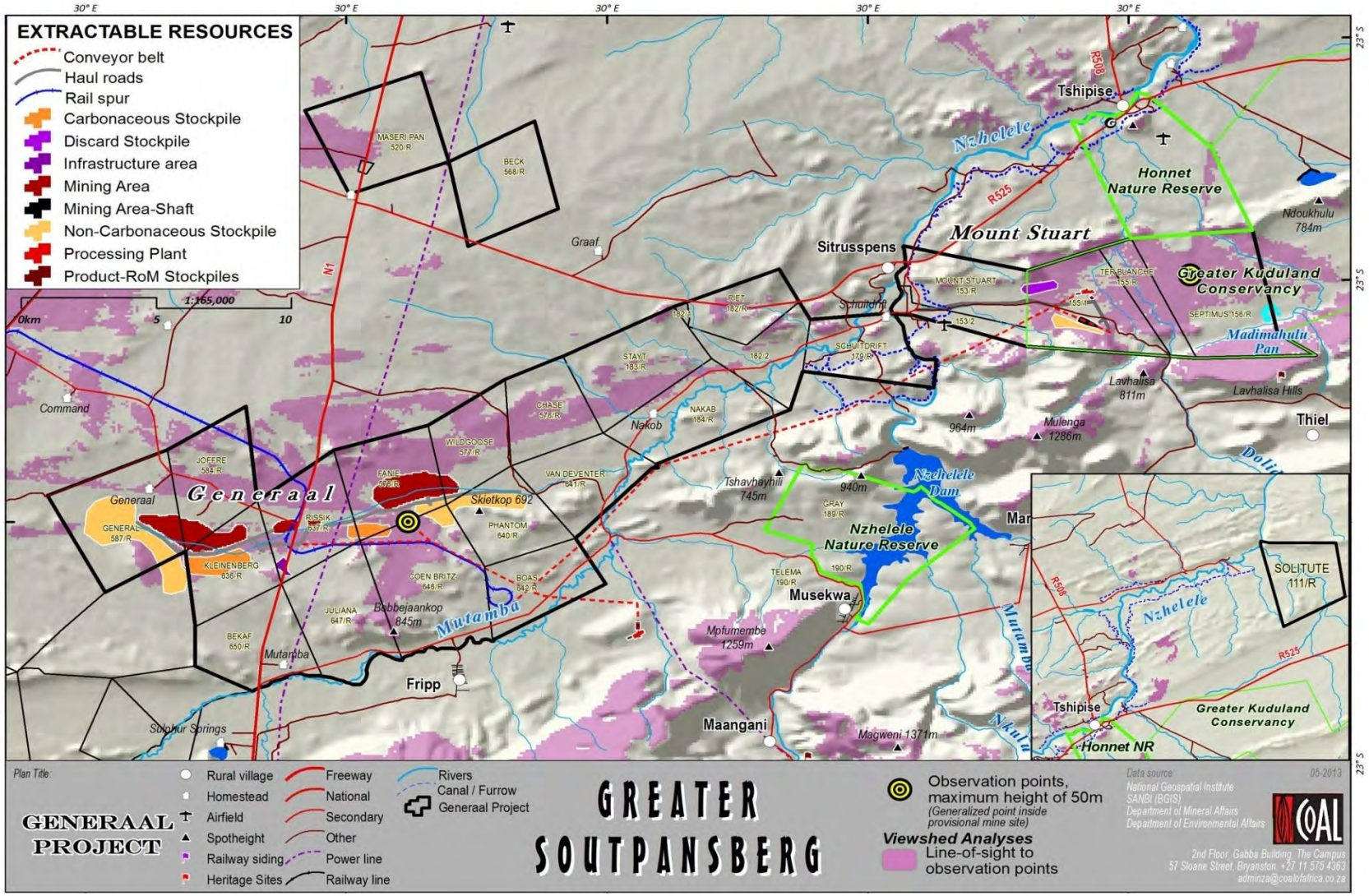


Figure 99: Viewshed analysis for the Generaal Project area

5.1.4 SOCIAL IMPACTS

The anticipated socio-economic impacts of the proposed project are detailed in the SEIA (ANNEX-9) and are summarized below in table format.

Table 41: List of potential socio-economic impacts for the Generaal Project

Social Aspect	Potential Impact
Demographic and Population Impacts	Influx of work seekers into the area
	Influx of construction labour with pressure on services and social structures
	Influx of operational workforce with pressure on services and social structures
	Influx of people and the development of spontaneous settlements near project facilities, in the Waterpoort Town and surrounding areas
	Conflicts arising at the end of construction due to the termination of job opportunities for contractors
Health and Social Wellbeing	Increased chances of the spread of communicable diseases such as HIV/AIDS and STDs linked to influx of predominantly male job-seekers and workers
	Safety and Risk Exposure through an increase in crime
	Safety and Risk Exposure due to an increase in poaching on neighbouring game farming properties
Quality of Living Environment	Change in "sense of place"
	Disruption of Social Networks and decrease in Social Capital
	Perceptions of and Feelings in relation to the project
Family and Community Impacts	Impacts on landowners and labourers
	Change processes and impacts related to daily movement patterns
	Conversion of land use
Institutional/Legal/Political/Equity Impacts	Challenge to local government capacity
	Participation and Consultation in process
	Impact equity
Socio-economic Wellbeing	Increase in South African GDP and Trade Balance
	Increase in provincial and local GDP
	Increase in government revenue
	Increase in employment, income and skills development
	Impact on existing businesses in surrounding areas
	Change in property values
	Decrease of visitors, tourists and hunting parties
	Equity Participation of the Local Communities
	Participation of local business in procurement opportunities
	Decline in South African GDP and Trade Balance at Decommissioning
	Decline in provincial and local GDP at decommissioning
	Decline in government revenue at Decommissioning
	Decline in employment, income and skills development at decommissioning
Vulnerable Group Impacts	Gendered Division of labour
	Potential Infringements on Historically Disadvantaged People's Human Rights

5.2 CULTURAL AND HERITAGE

The nature and scale of impacts of the proposed mining on heritage are summarised in the following table:

	Activity	Potential Impacts
1	Mineral extraction	Stripping of top soil and mineral extraction opencast methods will represent the most extensive excavation of the area and earthmoving. Total destruction of heritage sites.
2	Dumps/stockpiles/discards	Overlaying (and destruction) of heritage sites. Possible graves in the proposed area.
3	Mine infrastructure/plant	Total destruction of heritage resources. Visuals impacts on cultural landscapes.
4	Main access road, rail & conveyor	Total destruction and visual impacts.
5	Emulsion and explosion areas	Destruction, vibration, pollution.

A farm by farm distribution of operational activities is summarised in the table below, together with the number of heritage sites identified on the farms.

	Farm	Mining area	Stockpiles	Plant	Emulsion & explosion	Road, rail & conveyor	Heritage sites
1	Keerweder						2
2	Mount Stuart						6
3	Schuitdrift						6
4	Stayt						7
5	Van de Venter						6
6	Nakab						10
7	Phantom						5
7	Wildgoose						2
7	Boas						2
8	Generaal						2
9	Riet						0
TOTAL							**48**

The area of high impact from mining is roughly a belt running in an east-west axis through the commercial farms Phantom, Wildgoose, Faniel, Coen Britz, Rissik, Kleinberg and Generaal.

The following is a summary of specific threats:

Site No#	Heritage Typology	Farm	Potential Threats
31	Ruins	Phantom	No direct threat. Potential dust pollution
47	Grave	Generaal	Mineral extraction
48	Grave	Generaal	Mineral extraction

Refer to Catalogue of heritage sites (Annexure II of the HIA)

5.3 QUANTIFICATION OF IMPACT ON DIRECTLY AFFECTED PERSONS

This will be affected by the final mining schedule and infrastructure layout plans to be developed during the Feasibility Phase, in line with the numerous recommendations made by the EIA specialists. The final quantification in monetary terms will only be undertaken after completion of the Feasibility Phase.

6 ASSESSMENT AND EVALUATION OF POTENTIAL IMPACTS

Risk is a combination of the probability, or frequency of occurrence of a hazard and the magnitude of the consequence of the occurrence (Nel, 2002). Risk estimation (RE) is concerned with the outcome, or consequences of an intention, taking account of the probability of occurrence and can be expressed as P (probability) x S (severity) = RE. Risk evaluation is concerned with determining significance of the estimated risks and also includes the element of risk perception. Risk assessment combines risk estimation and risk evaluation (Nel, 2002).

The positive and negative impacts were assessed on the basis of issues identified through the public participation process, interviews with key stakeholders and specialist opinion. Identified impacts were categorised in terms of the phase of the proposed project that is expected to give rise to the impacts. The following steps were followed in the assessment of the potential risks:

- Issues that may arise as a result of the proposed development, through planning, construction, operation and decommissioning phases.
- Potential impacts will be identified for each issue and assessed by considering criteria as outlined in the table below.
- Where the potential impacts are perceived as having a high risk or significance, alternatives, preventative and mitigation measures will be recommended.
- The significance of each impact will be determined "without mitigation" and "with mitigation", taking into consideration alternatives, preventative and mitigation measures.

Table 42: Impact Rating methodology

RISK IMPACT METHODOLOGY		
DURATION		
Short term	6 months	1
Construction	36 months	2
Life of project	50 years	3
Post Closure	Post closure or during decommissioning and downscaling	4
Residual	Beyond the project life	5
EXTENT		
Site specific	Site of the proposed development	1
Local	Farm and surrounding farms	2
District	Musina Local Municipality	3
Regional	Vhembe District Municipality	4
Provincial	Limpopo Province	5
National	Republic of South Africa	6
International	Beyond RSA borders	7
PROBABILITY		
Almost Certain	100% probability of occurrence – is expected to occur	5
Likely	99% - 60% probability of occurrence – will probably occur in most circumstances	4
Possible	59% - 16% chance of occurrence – might occur at some time	3
Unlikely	15% - 6% probability of occurrence – could occur at some time	2
Rare	<5% probability of occurrence – may occur in exceptional circumstances	1
SEVERITY		
Critical	Total change in area of direct impact, avoidance or replacement not an option, detrimental effects, huge financial loss	5
Major (High)	> 50% change in area of direct impact, relocation required and possible, extensive injuries, long term loss in capabilities, off-site release with no detrimental effects, major financial implications	4
Moderate	20 – 49% change, medium term loss in capabilities, rehabilitation / restoration / treatment	3

RISK IMPACT METHODOLOGY		
(medium)	required, on-site release with outside assistance, high financial impact	
Minor	10 – 19% change, short term impact that can be absorbed, on-site release, immediate contained, medium financial implications	2
Insignificant (low)	< 10 % change in the area of impact, low financial implications, localised impact, a small percentage of population	1

RISK ESTIMATION (Nel 2002)

RE (Risk Estimation) = P (Probability) X S (Severity)

	SEVERITY				
PROBABILITY	**Insignificant (1)**	**Minor (2)**	**Moderate (3)**	**Major (4)**	**Critical (5)**
Almost certain (5)	L 5	M 10	H 15	VH 20	VH 25
Likely (4)	L 4	M 8	H 12	H 16	VH 20
Possible (3)	L 3	M 6	M 9	H 12	H 15
Unlikely (2)	VL 2	L 4	M 6	M 8	M 10
Rare (1)	VL 1	VL 2	L 3	L 4	L 5

VH	Very High – immediate action required, Countermeasures and management actions to mitigate risk must be implemented immediately, alternatives to be considered	20 – 25
H	High risk – specific management plans required, determine if risk can be reduced by design and management in planning process, if cannot, alternatives to be considered, senior management responsibility	12 – 16
M	Moderate risk – management and monitoring plans required with responsibilities outlined for implementation, middle management responsibility	6 – 10
L	Low risk – management as part of routine requirements	3 – 5
VL	Very Low risk – no management required	1 - 2

Mitigation - The impacts that are generated by the development can be minimised if measures are put in place to reduce them. These measures are mitigation measures to ensure that the development takes into consideration the environment and the impacts that are predicted so that development can co-exist with the environment as a basis for planning.

Determination of Significance; without mitigation - Significance is determined through a synthesis of impact characteristics as described in the above paragraphs. It provides an indication of the importance of the impact in terms of both tangible and intangible characteristics. The significance of the impact "without mitigation" is the prime determinant of the nature and degree of mitigation required.

IMPACT SIGNIFICANCE

IS (Impact Significance) = D (Duration) + E (Extent) + S (Severity) X P (Probability)

Insignificant	The impact is non-existent or insubstantial, is of no or little importance to any stakeholder and can be ignored.
Low	The impact is limited in extent, even if the intensity is major; whatever its probability of occurrence, the impact will not have a significant impact considered in relation to the bigger picture; no major material effect on decisions and is unlikely to require management intervention bearing significant costs.
Moderate	The impact is significant to one or more stakeholders, and its intensity will be medium or high; therefore, the impact may materially affect the decision, and management intervention will be required.
High	The impact could render development options controversial or the entire project unacceptable if it cannot be reduced to acceptable levels; and/or the cost of management intervention will be a significant factor in project decision-making.
Very high	Usually applies to potential benefits arising from projects.

Determination of Significance; with mitigation - Determination of significance refers to the foreseeable significance of the impact after the successful implementation of the necessary mitigation measures.

Table 43: Environmental Impact Risk Matrix

#***ID Abbreviations:*** A – All activities, OC – Opencast mining (Generaal Section), UG – Underground mining (Mount Stuart Section), P – Processing plant / infrastructure areas, ON – On-site conveyance of ROM and product, MR – Mine residue stockpiles, OF – Off-site conveyance of ROM – conveyor system between Mount Stuart and Generaal Sections, RL – Rail link to main TFR railway line, EM – Off-site conveyance of product by truck (in emergencies)

ID#	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
A1	Biodiversity / Land Use & Capability	Surface disturbance of approximately 1,700 hectares for the purpose of mining and infrastructure development over the LOM will lead to impacts on the soil, land use and land capability, natural vegetation and fauna	Negative	High Risk	Moderate Significance	• Development and implementation of a detailed Mine Rehabilitation and Reclamation Plan during the Feasibility Phase. • Concurrent rehabilitation and levelling of opencast pits in line with the Mine Rehabilitation and Reclamation Plan. • Monitoring, auditing and regular review (if required) of the Mine Rehabilitation and Reclamation Plan. • Rehabilitation of infrastructure and other disturbed areas post-mining. • Implementation of Flora Rescue and Relocation Plan prior to any surface disturbances. • Develop species rescue, relocation and re-introduction plan (fauna) with the assistance of specialists in this field. • Develop and implement Biodiversity Action Plan, including avifaunal plan. • Fencing of designated mining and infrastructure areas. • Implementation of biodiversity monitoring. • Close collaboration with the Vhembe Biosphere Reserve in respect of final end land use and sustainable mining. • Participation on a collaborative approach for the development of a Regional Strategic Environmental Impact Assessment (SEIA).	Moderate Risk	Moderate Significance
A2	Waste Management	Poor waste management could lead to environmental impacts	Negative	Moderate Risk	Low Significance	• Implementation and regular review of Waste Management Procedure. • Appoint an approved, registered waste contractor to manage the waste generation and safe disposal thereof. • No waste will be disposed of or buried on site, or in any other location that is not a licensed waste disposal site	Low Risk	Low Significance
A3	Waste Management	Poor sewage management could impact on water resources	Negative	Moderate Risk	Moderate Significance	• Sewage effluent will be treated to General Standards and pumped to the Infrastructure Area storage dams for re-use in the process. No effluent will be discharged to the environment	Low Risk	Low Significance

ID#	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
A4	Bulk Water	Impact on water stressed catchment - fully allocated	Negative	Very High Risk	Moderate Significance	• The bulk water source will be determined during the Feasibility Phase, followed by a detail EIA for the selected option. • Design closed system to ensure optimal recycling of water and minimise water requirements for the mine. • Installation of filter presses to increase water recovery in the process plant.	High Risk	Moderate Significance
A5	Bulk Electricity	Further impact on over-allocated electricity reticulation system	Negative	High Risk	Moderate Significance	• Energy efficient designs such as: o High efficiency motors in plant and workshops o Power Factor Correction o Use VSDs o Use solar power where possible o Install solar geysers at change houses\Optimal building design to make use of ambient light • Energy Policy must govern energy efficient designs such as: power factor correction; lighting designs; cooking and heating - avoid electricity use gas; process efficiency; high efficiency motors; low loss transformers; green building designs; use of solar and heat pumps for water heating. • Implement Energy Management Plan. • Monitor and record energy usage on site. Ongoing improvement in energy consumption should form part of the mine's KPIs.	Moderate Risk	Moderate Significance
A6	Heritage Resources	Destruction of heritage & cultural resources as a result of mining and associated infrastructure (including linear activities)	Negative	Very High Risk	Moderate Significance	• A Heritage Management Plan will be developed during the Feasibility Phase once the mining and infrastructure has been finalised. • Implementation of Heritage Management Plan dealing with the Phase 1B&2 assessments as well as the relocation of burial sites. • National Heritage and Cultural issues will be included in the environmental awareness programme. • Regular monitoring of off-site heritage resources of importance	Moderate Risk	Low Significance
A7	Sense of Place	Impact on conservation value of the region	Negative	High Risk	Moderate Significance	• Identify and implement biodiversity offset programmes in conjunction with the IAPs and authorities, including the Vhembe Biosphere Reserve. • Close collaboration with the Vhembe Biosphere Reserve in respect of final end land use and sustainable mining. • Participation on a collaborative approach for the development of a Regional Strategic Environmental Impact Assessment (SEIA). • Implementation of environmental monitoring programme.	Moderate Risk	Moderate Significance

ID#	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
						• Develop environmental awareness & educational programmes. • Environmental auditing and reporting.		
OC1	Soils / Land Use & Capability	Potential hard setting of soils post reclamation	Negative	Moderate Risk	Moderate Significance	• Soil analyses and amelioration during reclamation	Low Risk	Low Significance
OC2	Soils / Land Use & Capability	Subsidence of rehabilitated areas	Negative	Moderate Risk	Low Significance	• Free-draining profile (as far as practically possible) for rehabilitated areas and ongoing monitoring	Low Risk	Low Significance
OC3	Surface Water	Impact on non-perennial streams cutting through mining areas leading to decrease in runoff	Negative	High Risk	Moderate Significance	• Optimisation of the storm water management plan and positioning of mining pits during the Feasibility Phase. • Diversion of non-perennial streams around opencast areas to minimise decrease in surface runoff. • Rehabilitation concurrent to mining – limit dirty footprint.	Moderate Risk	Moderate Significance
OC4	Surface Water	Impact on 1:100 year flood-line of the Mutamba River	Negative	High Risk	Moderate Significance	• Revise mining and infrastructure footprints during Feasibility Phase to avoid 1:100 flood-lines of the major drainage lines, plus a 100m buffer zone.	Moderate Risk	Low Significance
OC5	Surface Water	Impact on wetland areas and aquatic ecosystems	Negative	High Risk	Moderate Significance	• Maintain a buffer zone of 100 m from the 1:100 year flood-line of major drainage lines to reduce impact on aquatic systems. • Reposition surface infrastructure and stockpiles to avoid drainage lines and sensitive wetlands systems. • Implement aquatic (bio) monitoring. • Create small impoundments at head of stream diversions to limit erosion. This could potentially become artificial wetlands over time. • Identify and implement biodiversity offset programmes (including wetland offsets) in conjunction with the IAPs and authorities, including the Vhembe Biosphere Reserve.	Moderate Risk	Moderate Significance
OC6	Surface Water	Increased sedimentation into the river systems due to uncontrolled surface run-off	Negative	High Risk	Moderate Significance	• Design and install appropriate outlet structures to retard flow velocity. • Construction of energy dissipating structures along steep slopes. • Side slopes of earth berms / canals to be designed to 1:3 and protected & vegetated to prevent erosion.	Moderate Risk	Moderate Significance
OC7	Surface Water	Potential impact on in-stream habitat and riverine vegetation as a result of decrease in runoff	Negative	Moderate Risk	Low Significance	• Implementation of monitoring programme for early detection of impacts (plant moisture stress monitoring). • Diversion of clean storm water runoff around opencast areas to minimise impact of flow within the Mutamba and Nzhelele River catchments.	Moderate Risk	Low Significance

ID#	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
OC8	Surface Water	Impact of long-term decant on water quality	Negative	High Risk	High Significance	• Investigate appropriate management measures over the LOM	High Risk	High Significance
OC9	Groundwater	Dewatering of aquifer as a result of mining, resulting in drying up of boreholes and springs	Negative	Very High Risk	High Significance	• Revision and phasing in of mining schedules during the Feasibility Phase on a regional basis to reduce the radius of influence. The groundwater flow model will be utilized during this exercise to obtain the most feasible option from a groundwater impact perspective. • Implementation of baseline monitoring programme on farms and within communities that are potentially impacted once the mining and infrastructure feasibility studies have been completed. • Provide alternative water sources where appropriate. • Compensation mechanisms need to be developed and agreed with impacted landowners and communities to compensate those who are impacted upon.	Very High Risk	High Significance
OC10	Groundwater	Impact on surrounding vegetation as a result of dewatering and subsequent recovery	Negative	Moderate Risk	Moderate Significance	• Ongoing monitoring of boreholes and springs. • Implementation of monitoring programme for early detection of impacts (plant moisture stress monitoring). • Diversion of clean storm water runoff around opencast areas to minimise impact of flow within the Mutamba and Nzhelele River catchments.	Moderate Risk	Moderate Significance
OC11	Groundwater	Decrease in regional water quality due to seepage from rehabilitated pits	Negative	Moderate Risk	Low Significance	• Potential acid generating horizons will be placed at bottom of pit and submerged below the water table, thereby preventing oxidation. • Rehabilitation will be concurrent with mining, minimising the potential for oxidation of sulphide bearing rocks and controlling the migration of high sulphate leachate. • Exposed residue material will be minimised by direct placement of overburden and topsoil. • Vegetation will be re-established as soon as possible after topsoiling to minimise infiltration of water through residue material. • Implementation of baseline monitoring programme to detect any seepage. • Compensation mechanism to compensate landowners and communities who are impacted upon.	Moderate Risk	Low Significance

ID#	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
OC12	Groundwater	Migration of pollution plume after full recovery of groundwater levels (prior to decant)	Negative	High Risk	Moderate Significance	• Investigate appropriate management measures over the LOM. • Groundwater and geochemical models must be updated on a regular basis (every 5 years) to verify potential for decant.	High Risk	Moderate Significance
OC13	Air Quality	Dust impact caused by vehicle movement	Negative	High Risk	Moderate Significance	• Application of dust suppression measures (surface surfactants) such as Dustex. • Reduce vehicle speed on unpaved roads to limit dust creation.	Low Risk	Low Significance
OC14	Air Quality	Dust impact caused by blasting activities	Negative	High Risk	Moderate Significance	• Develop Blasting Procedure to minimise impacts.	Moderate Risk	Low Significance
OC15	Air Quality	Dust impact caused by materials handling	Negative	High Risk	Moderate Significance	• Reduction of drop height to reduce the dispersion of materials being transferred, and increase in moisture content (water sprays). • Creation of wind breaks in close proximity to storage piles to reduce the potential erosive forces of the wind.	Low Risk	Low Significance
OC16	Air Quality	Methane emissions leading to air quality impacts	Negative	Low Risk	Low Significance	• Ongoing methane monitoring if required.	Low Risk	Low Significance
OC17	Noise	Elevated noise levels caused by mining operation, dewatering (pumping) and blasting activities	Negative	High Risk	Moderate Significance	• Noise attenuation berms (topsoil) on footprint of opencast areas. • Noise suppression devices on heavy vehicles and all noisy plant. • Alternative reverse hooting systems will be implemented to reduce the noise levels. • Low noise generator sets will be used in pit. • Develop air blast control measures. • Blasting limited on regular times, restricted to 08:00-18:00. • All plant, equipment and vehicles to be kept in good repair. • Employees / contractors working in areas where the 8-hour ambient noise levels exceed 85dBA must wear ear protection equipment.	Moderate Risk	Moderate Significance
OC18	Visual / Aesthetics	The mining will have a negative on the aesthetics / sense of place	Negative	High Risk	Moderate Significance	• Berms on footprint of opencast areas to be protected and vegetated to reduce the visual impact. • Avoid the unnecessary removal of vegetation during the operational phase. • Rehabilitation and revegetation will be performed concurrent to mining. • Introduce trees to the landscape at strategic locations (sensitive receptors) to break full exposure of the mine. Further analyses and stakeholder engagement will be required for this commitment.	Moderate Risk	Moderate Significance

ID#	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
OC19	Blasting	Impact on the communities and sensitive receptors as a result of blasting	Negative	High Risk	Moderate Significance	• Develop and implement Blasting Procedure as well as an Evacuation Procedure.	Moderate Risk	Low Significance
UG1	Soils / Land Use & Capability	Soil impacts as a result of poor hydrocarbon management and spillages	Negative	Moderate Risk	Low Significance	• Develop and implement hydrocarbon management procedure. • Reclamation of soils in the event of accidental spillages.	Low Risk	Low Significance
UG2	Soils / Land Use & Capability	Surface disturbance caused by infrastructure	Negative	Moderate Risk	Moderate Significance	• Dismantling of infrastructure. • Final rehabilitation of disturbed areas. • Rehabilitation of dams and storm water drainage.	Low Risk	Low Significance
UG3	Surface Water	Impact on non-perennial streams cutting through proposed incline shaft area, leading to decrease in runoff	Negative	Moderate Risk	Moderate Significance	• Optimisation of the storm water management plan and positioning of the incline shaft during the Feasibility Phase. • Diversion of non-perennial streams around shaft area to minimise decrease in surface runoff. • Rehabilitation concurrent to mining – limit dirty footprint.	Low Risk	Low Significance
UG4	Surface Water	Increased sedimentation into the river systems due to uncontrolled surface run-off	Negative	High Risk	Moderate Significance	• Design and install appropriate outlet structures to retard flow velocity. • Construction of energy dissipating structures along steep slopes. • Side slopes of earth berms / canals to be designed to 1:3 and protected & vegetated to prevent erosion.	Moderate Risk	Moderate Significance
UG5	Groundwater	Dewatering of aquifer as a result of mining, resulting in drying up of boreholes and springs	Negative	Very High Risk	High Significance	• Revision and phasing in of mining schedules during the Feasibility Phase on a regional basis to reduce the radius of influence. The groundwater flow model will be utilized during this exercise to obtain the most feasible option from a groundwater impact perspective. • Implementation of baseline monitoring programme on farms and within communities that are potentially impacted once the mining and infrastructure feasibility studies have been completed. • Provide alternative water sources where appropriate. • Compensation mechanisms need to be developed and agreed with impacted landowners and communities to compensate those who are impacted upon.	Very High Risk	Moderate Significance
UG6	Groundwater	Impact on surrounding vegetation as a result of dewatering and subsequent recovery	Negative	Moderate Risk	Moderate Significance	• Ongoing monitoring of boreholes and springs. • Implementation of monitoring programme for early detection of impacts (plant moisture stress monitoring). • Diversion of clean storm water runoff around opencast areas to minimise impact of flow within the Mutamba and Nzhelele River catchments.	Moderate Risk	Low Significance

ID#	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
UG7	Air Quality	Dust impact associated with ventilation shafts	Negative	Moderate Risk	Moderate Significance	• Dust collection systems in ventilation shafts.	Low Risk	Low Significance
UG8	Air Quality	Methane emissions leading to air quality impacts	Negative	Moderate Risk	Moderate Significance	• Ongoing methane monitoring if required.	Moderate Risk	Moderate Significance
UG9	Noise	Noise impact (especially during the night) as a result of the ventilation system / extractor fans	Negative	High Risk	Moderate Significance	• Cladding of ventilation system / extractor fans - encapsulation in buildings, acoustic covers.	Moderate Risk	Low Significance
UG10	Visual / Aesthetics	The shaft complexes will have a negative on the aesthetics / sense of place	Negative	Moderate Risk	Moderate Significance	• Berms on footprint of opencast areas to be protected and vegetated to reduce the visual impact. • Avoid the unnecessary removal of vegetation during the operational phase. • Rehabilitation and revegetation will be performed concurrent to mining. • Introduce trees to the landscape at strategic locations (sensitive receptors) to break full exposure of the mine. Further analyses and stakeholder engagement will be required for this commitment.	Low Risk	Low Significance
P1	Soils / Land Use & Capability	Soil impacts as a result of poor hydrocarbon management and spillages	Negative	Moderate Risk	Low Significance	• Develop and implement hydrocarbon management procedure. • Reclamation of soils in the event of accidental spillages.	Low Risk	Low Significance
P2	Soils / Land Use & Capability	Surface disturbance caused by infrastructure	Negative	Moderate Risk	Moderate Significance	• Dismantling of infrastructure. • Final rehabilitation of disturbed areas. • Rehabilitation of dams and storm water drainage.	Moderate Risk	Low Significance
P3	Surface Water	Water quantity impact due to decreased surface runoff	Negative	Moderate Risk	Moderate Significance	• Optimisation of the storm water management plan and positioning of infrastructure during the Feasibility Phase. • Separation of clean and dirty water systems (stream diversions) to minimise impact on runoff	Low Risk	Low Significance
P4	Surface Water	Water quality impact on Mutamba and Nzhelele Rivers	Negative	High Risk	Moderate Significance	• Directing and containment of dirty water runoff in dirty water dams and providing silt traps. • Recycling (reuse) of dirty water in process. • The dirty water dam will be designed for the 1:50 year flood-event and HDPE lined to prevent discharges / seepage into the surface water resources.	Low Risk	Low Significance
P5	Surface Water	Water quality impacts as a result of poor hydrocarbon management and spillages	Negative	Moderate Risk	Moderate Significance	• Develop and implement hydrocarbon management procedure. • Bulk facilities to be concrete lined and bunded to capacity of 110%.	Low Risk	Low Significance

ID#	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
P6	Surface Water	Impact on wetland areas and aquatic ecosystems	Negative	High Risk	Moderate Significance	• Maintain a buffer zone of 100 m from the 1:100 year flood-line of major drainage lines to reduce impact on aquatic systems. • Reposition surface infrastructure to avoid drainage lines and sensitive wetlands systems. • Implement aquatic (bio) monitoring.	Moderate Risk	Moderate Significance
P7	Groundwater	Water quality impacts due to infiltration of dirty water from the plant and infrastructure areas	Negative	High Risk	Moderate Significance	• Dirty water dams to be plastic lined to prevent groundwater contamination. • Carbonaceous plant stockpile areas to be appropriately lined with dedicated dirty water drainage from the stockpile to prevent groundwater contamination. • Dirty water canals in the Infrastructure Area to be concrete lined to prevent groundwater contamination.	Moderate Risk	Low Significance
P8	Air Quality	Air quality impacts associated with processing activities and movement of vehicles	Negative	Moderate Risk	Low Significance	• Reduction of drop height to reduce the dispersion of materials being transferred, and increase in moisture content (water sprays). • Plant and access roads to be surfaced or treated with dust palliatives such as Dustex.	Low Risk	Low Significance
P9	Air Quality	Dust impact caused by crushing and screening operations	Negative	Moderate Risk	Moderate Significance	• Introduce dust suppression systems, either in the form of water sprays or cladding in order to reduce the potential emissions. • Reduce vehicle speed on unpaved roads to limit dust creation.	Low Risk	Low Significance
P10	Noise	Elevated noise levels caused by crushing and processing activities	Negative	Moderate Risk	Moderate Significance	• Rubber vulcanised belt – less noisy / vibration. • Cladding of crushing and screening plants and noisy equipment – encapsulation in buildings, acoustic covers, screens or sheds. • Noise suppression devices on heavy vehicles / crushing equipment. • Low noise generator sets will be used in plant. • Employees / contractors working in areas where the 8-hour ambient noise levels exceed 85dBA must wear ear protection equipment.	Moderate Risk	Low Significance
P11	Visual / Aesthetics	Processing plant will have a visual impact as a result of high buildings	Negative	High Risk	Moderate Significance	• Avoid the use of highly reflective material in construction. • Metal surfaces should be painted in natural soft colours (Aloe Green) that would blend in with the environment.	Moderate Risk	Moderate Significance

ID#	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
P12	Lighting	Sky glow effect will have an impact on the sense of place at night	Negative	High Risk	Moderate Significance	• Use specifically designed lighting equipment that minimises the upward spread of light near to and above the horizontal. Care should be taken when selecting luminaries to ensure that appropriate units are chosen and that their location will reduce spill light and glare to a minimum. • Keep glare to a minimum by ensuring that the main beam angle of all lights directed towards any potential observer is not more than 70°. Higher mounting heights allow lower main beam angles, which can assist in reducing glare. In areas with low ambient lighting levels, glare can be very obtrusive and extra care should be taken when positioning and aiming lighting equipment. • Covering of high lighting masts to reduce the glow. • Suppress dust forming to minimise the effect of sky glow during night.	Moderate Risk	Moderate Significance
P13	Lighting	Impact on invertebrates	Negative	Moderate Risk	Moderate Significance	• Long-wavelength light sources should be used, e.g. low-pressure sodium vapour lights.	Moderate Risk	Low Significance
ON1	Air Quality	On-site conveyance will increase the ambient air quality	Negative	Moderate Risk	Moderate Significance	• Application of dust suppression (Dustex) on internal haul roads. • Surfacing of access road and main haul roads. • Water sprays at stockpiles and transfer points. • Water misters will be installed at strategic points at the transfer points along the conveyor in order to abate dust emission. • Vehicle speed on unpaved roads limited to prevent dust creation. • Conveyor design to include 'dogsheeting' on top and along the prevailing wind direction sides to minimise dust generation. • Use of appropriate plant operation and material handling techniques, good maintenance and housekeeping. Therefore the implement measures to minimise the generation and dispersion of dust and surface disturbances. • Employ latest technology to reduce vehicle exhaust gas emissions.	Low Risk	Low Significance
ON2	Surface Water	Stream crossings (road and conveyor) could potentially impact on the stream flow and lead to stream flow reductions downstream	Negative	Moderate Risk	Moderate Significance	• Design crossings for 1:20 year flood to minimise effect of damming of water upstream. • No permanent retention of water in river at crossings Avoid sensitive wetland systems as far as possible.	Low Risk	Low Significance
ON3	Surface Water	Spillages along conveyors/roads could impact on water quality	Negative	Moderate Risk	Moderate Significance	• Regular inspections will be implemented for early detection of spillages. Cleaning up of any spillages that may have occurred. • All conveyors to be fully enclosed for zero spillage over all stream	Moderate Risk	Low Significance

ID#	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
						crossings. • Conveyors covered to deflect rain water away from conveyor belt. • Installation of primary and secondary scrapers ensures that there is continuous contact between the scrapers and the belt which will prevent spillages on the return belt.		
ON4	Noise	Elevated noise levels caused by trucking and conveying activities	Negative	High Risk	Moderate Significance	• Rubber vulcanised belt – less noisy / vibration. • Maintenance of vehicles. • All equipment selection to fall in line with permissible noise dBA. • During the selection of the main components and equipment of the proposed undertaking as a whole, installation of alternative low-noise generating makes and models will be considered. • Noise suppression devices on heavy vehicles / conveying equipment.	Moderate Risk	Moderate Significance
ON5	Soils / Land Use & Capability	Surface disturbance caused by infrastructure	Negative	Low Risk	Low Significance	• Dismantling of infrastructure. • Final rehabilitation of disturbed areas and storm water drainage.	Low Risk	Low Significance
MR1	Groundwater	Impact of carbonaceous stockpiles on groundwater resources	Negative	High Risk	Moderate Significance	• Carbonaceous stockpiles to be appropriately lined with a sub-surface drainage system. • Stockpiles to be compacted, properly capped and revegetated to reduce recharge. • Stockpiles slopes to be designed such to increase runoff whilst preventing erosion. • Carbonaceous stockpiles to be disposed in-pit as far as possible at closure to minimise final footprint of surface carbonaceous stockpiles.	Moderate Risk	Low Significance
MR2	Surface Water	Impact on non-perennial streams cutting through mining areas leading to decrease in runoff	Negative	Moderate Risk	Moderate Significance	• Optimisation of the storm water management plan and re-positioning of stockpiles during the Feasibility Phase. • Diversion of non-perennial streams around stockpile areas to minimise decrease in surface runoff.	Low Risk	Low Significance
MR3	Surface Water	Impact on wetland areas and aquatic ecosystems	Negative	High Risk	Moderate Significance	• Maintain a buffer zone of 100 m from the 1:100 year flood-line of major drainage lines to reduce impact on aquatic systems. • Reposition stockpiles to avoid drainage lines and sensitive wetlands systems. • Implement aquatic (bio) monitoring.	Moderate Risk	Moderate Significance
MR4	Surface Water	Increased sedimentation in drainage lines due to uncontrolled surface run-	Negative	Moderate Risk	Moderate Significance	• Side slopes of stockpiles to be protected and vegetated to prevent erosion. • Construction of energy dissipating structures along steep slopes.	Low Risk	Low Significance

ID#	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
		off and erosion						
MR5	Surface Water	Water quality impacts as a result of dirty water runoff / seepage from carbonaceous stockpiles	Negative	High Risk	Moderate Significance	• Dirty water / seepage to be collected in lined facility and recycled to dirty water dams for use in process.	Moderate Risk	Moderate Significance
MR6	Visual / Aesthetics	Large stockpiles will impact on the landscape	Negative	High Risk	Moderate Significance	• In-pit disposal as far as possible. • Stockpiles to be protected and vegetated to reduce visual impact. • Landscaping of stockpiles to minimise impact – avoid straight lines and design contoured stockpiles that represent the natural lines of the existing topography.	Moderate Risk	Moderate Significance
MR7	Air Quality	Increase dust emissions as a result of stockpiles	Negative	Moderate Risk	Moderate Significance	• Compaction by heavy vehicles used for stockpile operations. • Stockpiles to be vegetated to reduce dust emissions.	Moderate Risk	Low Significance
MR8	Noise	Noise from stockpile construction leading to the main contributing factors to the noise at the sensitive receptors, especially at night-time	Negative	High Risk	Moderate Significance	• Noise suppression devices on heavy vehicles / crushing equipment. • Alternative reverse hooting systems will be implemented to reduce the noise levels.	Moderate Risk	Moderate Significance
OF1	Safety	Road / conveyor crossings could lead to safety risks to road users	Negative	Moderate Risk	Moderate Significance	• Appropriate crossings (under or over-passes) will be designed to illuminate the safety risks. • The conveyor route will be fenced off to prevent people and animals from going onto or across the conveyor.	Moderate Risk	Low Significance
OF2	Surface Water	Stream crossings where culverts may concentrate flow, leading to enhanced flow velocities and associated erosion problems	Negative	Moderate Risk	Moderate Significance	• Design crossings for 1:20 year flood to minimise effect of damming of water upstream. No permanent retention of water in river at crossings. • Construct the necessary erosion control measures at these crossings to reduce the impact. • Avoid sensitive wetland systems as far as possible.	Low Risk	Low Significance
OF3	Surface Water	Potential for water quality impacts due to dirty runoff and spillages along the conveyor	Negative	Moderate Risk	Moderate Significance	• Regular inspections will be implemented for early detection of spillages. Cleaning up of any spillages that may have occurred. • All conveyors to be fully enclosed for zero spillage over all stream crossings. • Conveyors covered to deflect rain water away from conveyor belt. • Installation of primary and secondary scrapers ensures that there is continuous contact between the scrapers and the belt which	Moderate Risk	Moderate Significance

ID#	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
						will prevent spillages on the return belt.		
OF4	Noise	Increase of ambient noise levels along the conveyor route	Negative	Moderate Risk	Moderate Significance	• Cladding of conveyor drives and other noisy equipment – encapsulation in buildings, acoustic covers, screens or sheds. • Rubber vulcanised belt – less noisy / vibration. • Noise suppression devices on conveying equipment.	Moderate Risk	Low Significance
OF5	Air Quality	Increase of dust emissions along the conveyor route	Negative	Moderate Risk	Moderate Significance	• Dust fallout monitoring points will be established along the conveyor route to detect an increase in emissions. • Regular inspections will be done along the conveyor route to detect and clean any spillages from the conveyor.	Moderate Risk	Moderate Significance
OF6	Biodiversity	Land units will be divided into smaller units which may not be ecologically viable	Negative	High Risk	Moderate Significance	• Re-route conveyor to align with existing disturbed corridors, i.e. road & power line servitudes, fences. This will be finalised during the Feasibility Phase. • Animal crossings (underpasses) will be created along the conveyor for animals and domestic livestock, if the route cannot feasibly be re-routed.	Low Risk	Low Significance
OF7	Biodiversity	Potential impact on protected flora species identified along the route	Negative	Moderate Risk	Low Significance	• The conveyor route will be diverted to prevent specific protected species, e.g. baobabs, impala lilies. • Where possible, the species that cannot be avoided will be rescued and relocated as per the Rescue & Relocation Plan.	Low Risk	Low Significance
OF8	Biodiversity	Creation of additional corridors which could lead to increased poaching	Negative	Moderate Risk	Low Significance	• Establishment of an anti-poaching unit in conjunction with adjacent landowners and communities. • Fencing (game fence) of the conveyor for safety and access control.	Moderate Risk	Low Significance
OF9	Biodiversity	Killing of animals crossing the conveyor	Negative	Moderate Risk	Moderate Significance	• The conveyor will be fenced off to prevent animals from going onto the conveyor system.	Low Risk	Low Significance
RL1	Safety	Road / rail crossings could lead to safety risks to road users	Negative	High Risk	Moderate Significance	• Appropriate crossings (under or over-passes) will be designed to illuminate the safety risks. • The rail link will be fenced off to prevent people and animals from going onto or across the railway line.	Moderate Risk	Low Significance

ID#	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
RL2	Surface Water	Stream crossings where culverts may concentrate flow, leading to enhanced flow velocities and associated erosion problems	Negative	Moderate Risk	Moderate Significance	• Design crossings according to TFR standards - design flow rate 1:50 year flood event - to minimise effect of damming of water upstream. No permanent retention of water in river at crossings. • Construct the necessary erosion control measures at these crossings to reduce the impact. • Avoid sensitive wetland systems as far as possible.	Low Risk	Low Significance
RL3	Surface Water	Potential for water quality impacts due to dirty runoff and spillages along the rail link	Negative	Moderate Risk	Moderate Significance	• Regular inspections will be implemented for early detection of spillages. Cleaning up of any spillages that may have occurred.	Moderate Risk	Moderate Significance
RL4	Noise	Increase of ambient noise levels along the rail route	Negative	Moderate Risk	Moderate Significance	• Rail line to be flush-welded to reduce noise. • Diesel locomotives to operate at slower speed along the rail link. • Noise attenuation berms should be constructed at sensitive receptors closest to the rail link in cooperation with the landowners and/or communities.	Moderate Risk	Low Significance
RL5	Air Quality	Increase of dust emissions along the rail link	Negative	Moderate Risk	Moderate Significance	• Dust fallout monitoring points will be established along the rail link to detect an increase in emissions. • Regular inspections will be done along the rail route to detect and clean any spillages that could lead to increased dust levels. • Use of low sulphur grade fuels.	Moderate Risk	Moderate Significance
RL6	Biodiversity	Land units will be divided into smaller units which may not be ecologically viable	Negative	High Risk	Moderate Significance	• Align rail link with existing disturbed corridors, i.e. roads, fence lines. This will be finalised during the Feasibility Phase. • Animal crossings (underpasses or level-crossings with cattle grid) will be created along the rail link for animals and domestic livestock.	Low Risk	Low Significance
RL7	Biodiversity	Potential impact on protected flora species identified along the route	Negative	Moderate Risk	Low Significance	• The rail route will be diverted to prevent specific protected species, e.g. baobabs, impala lilies. • Where possible, the species that cannot be avoided will be rescued and relocated as per the Rescue & Relocation Plan.	Low Risk	Low Significance
RL8	Biodiversity	Creation of additional corridors which could lead to increased poaching	Negative	Moderate Risk	Low Significance	• Establishment of an anti-poaching unit in conjunction with adjacent landowners and communities. • Fencing (game fence) of the rail link for safety and access control.	Moderate Risk	Low Significance
RL9	Biodiversity	Killing of animals crossing the rail line	Negative	Moderate Risk	Moderate Significance	• The rail link will be fenced off to prevent animals from going onto the track. • Animal crossings (underpasses or level-crossings with cattle grid) will be created along the rail link for animals and domestic livestock.	Low Risk	Low Significance

ID#	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
EM1	Safety	Road transport of product will impact on the traffic along the route, safety risk to road users	Negative	High Risk	Moderate Significance	• Implementation of Community Safety and Traffic Management Procedure, including: o Upgrading of road intersections. o Other traffic calming measures identified during the LOM. o Maintaining vehicle speeds. o Covering of vehicles when in motion, both for loaded and unloaded vehicles. o Switching on head lights of trucks. • Due notification to the surrounding landowners and communities in the event of emergency trucking. • Implement a Traffic Awareness Programme within the surrounding communities.	Moderate Risk	Moderate Significance
EM2	Biodiversity	Killing of animals and avifauna on the roads, especially nocturnal animals/birds	Negative	Moderate Risk	Moderate Significance	• Maintaining vehicle speeds. • Trucking during daylight hours only. • Implement an Environmental Awareness Programme for trucking contractor.	Moderate Risk	Moderate Significance
EM3	Surface Water	Potential for water quality impacts due to spillages and dirty runoff into the streams	Negative	Moderate Risk	Moderate Significance	• Regular inspections will be done along the route to detect and clean any spillages from the trucks. • Emergency procedure to be developed and implemented in the event of any spillage / accident along the route. • Covering of vehicles when in motion, both for loaded and unloaded vehicles.	Moderate Risk	Moderate Significance
EM4	Air Quality	Material and product loss from trucks	Negative	Moderate Risk	Moderate Significance	• Gravel roads to be surfaced or treated with dust palliatives such as Dustex. • Covering of vehicles when in motion, both for loaded and unloaded vehicles. • Regular inspections will be done along the route to detect and clean any spillages from the trucks.	Low Risk	Low Significance
EM5	Noise	Increase of ambient noise levels along the route	Negative	Low Risk	Low Significance	• Noise suppression devices on transport trucks. • Trucking during daylight hours only.	Low Risk	Low Significance

Table 44: Social Impact Risk Matrix

Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
Demographic and Population Impacts	Influx of work seekers into the area	Negative	Moderate Risk	Moderate Significance	• Optimise the use of local labour as far as possible. Establishing early on skills development programmes in the local area will support to possibility of finding skilled people locally • Development and Implementation of an Influx and Land use Management Plan • Develop a code of conduct with which contractors and their employees must comply. The code should deal with the interaction with local communities and substance abuse among other things. • Develop a Stakeholder Engagement Plan (SEP) which clarifies the principles of engagement with community and other stakeholders, sets in place appropriate liaison forums (a community forum is recommended), and describes the grievance management procedure to be adopted by the Generaal Project. Establishment of a local labour recruitment committee to monitor recruitment procedures and results • Communicate through media the recruitment procedures and priorities to discourage work seekers from outside the area	Low Risk	Low Significance

Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
Demographic and Population Impacts	Influx of construction labour with pressure on services and social structures	Negative	Moderate Risk	Moderate Significance	• Facilitate the provision of housing and associated infrastructure. Establishment of a construction accommodation camp to house those employees that cannot be sourced from the local community due to a lack of skills • Optimise the use of local labour as far as possible. Establishing early on skills development programmes in the local area will support to possibility of finding skilled people locally • Development and Implementation of an Influx and Land use Management Plan • Develop a code of conduct with which contractors and their employees must comply. The code should deal with the interaction with local communities and substance abuse among other things. • Develop a Stakeholder Engagement Plan (SEP) which clarifies the principles of engagement with community and other stakeholders, sets in place appropriate liaison forums (a community forum is recommended), and describes the grievance management procedure to be adopted by the Generaal Project. Establishment of a local labour recruitment committee to monitor recruitment procedures and results • Develop and communicate a clear and concise employment and recruitment policy to prevent opportunistic job seekers from settling in the area. • Implementation of a programme of STD and HIV/AIDS screening, counselling and (where possible) treatment.	Low Risk	Low Significance

Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
Demographic and Population Impacts	Influx of operational workforce with pressure on services and social structures	Negative	Moderate Risk	Moderate Significance	• Contribution towards the provision of housing, infrastructure and services for operational staff. The establishment of partnerships with other private sector stakeholders, government authorities and civil society organisations to integrate planning around the provision of services and infrastructure, and to ensure that Mine inputs in this context compliment initiatives led by other players, especially the local and district municipality. • Development and Implementation of an Influx and Land use Management Plan • Optimise the use of local labour as far as possible. Establishing early on skills development programmes in the local area will support to possibility of finding skilled people locally • Induction of contractors and workforce with regard to their code of conduct in the local communities • Develop and communicate a clear and concise employment and recruitment policy to prevent opportunistic job seekers from settling in the area. • Implementation of a programme of STD and HIV/AIDS screening, counselling and (where possible) treatment. • Continuous assessment and monitoring of infrastructure and services capacity in focal points (assessment every 5 years) • Determine scale of assistance required at focal points and enter into an agreement with the municipality • Establish a development, infrastructure and service monitoring forum with the municipality to continuously assess and monitor capacity, determine assistance required and oversee implementation	Low Risk	Low Significance

Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
Demographic and Population Impacts	Influx of people and the development of spontaneous settlements near project facilities, in the Waterpoort Town and surrounding areas	Negative	High Risk	Moderate Significance	• Develop a Community Development Plan which addresses issues relating to provision of housing for the workforce through on-going communication and engagement between the mine and local authorities for implementation of this plan. • Develop and adoption of an Influx Management Plan in consultation with the local government that outlines proactive management measures to discourage and manage influx, outlines and refines relevant stakeholders and their roles and responsibilities and the way in which each role-player intends to manage influx and spontaneous settlements. • Support the compilation of a development master plan, in cooperation with relevant local and regional authorities for the Musina and Makhado areas, whereby new development areas for workers' and new arrivals' accommodation will be catered for and duly planned • Support local government capacity for integrated development planning. • Develop and communicate a clear and concise employment and recruitment policy to prevent opportunistic job seekers from settling in the area. • Continuous assessment and monitoring of infrastructure and services capacity in focal points (assessment every 5 years) • Determine scale of assistance required at focal points and enter into an agreement with the municipality • Establish a development, infrastructure and service monitoring forum with the municipality to continuously assess and monitor capacity, determine assistance required and oversee implementation	Moderate Risk	Low Significance

Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
Demographic and Population Impacts	Conflicts arising at the end of construction due to the termination of job opportunities for contractors	Negative	High Risk	Moderate Significance	• Investigate the possibility of transferring labour from one operation to another – depending on the phasing of the projects • Develop the MbeuYashu grievance procedure to capture and address grievances arising due to retrenchments and downscaling. • Ensure compliance with all applicable Labour Regulations of South Africa • Consider compliance with Best Practice , i.e. IFC's Performance Standard 2 "Labour and Working Conditions" • Monitoring of all contractors and sub-contractors for compliance with the above standards, with contractually-established financial sanctions for observed non-compliances • Communicate the termination conditions to the communication structure established • Communicate the termination conditions to all employees – including contractors and sub-contractors	Moderate Risk	Low Significance
Health and Social Wellbeing	Increased chances of the spread of communicable diseases such as HIV/AIDS and STDs linked to influx of predominantly male job-seekers and workers	Negative	High Risk	Moderate Significance	• Develop a comprehensive HIV/AIDS and STD program to employees through employee wellness programmes which should include prevention, voluntary counselling for HIV testing, as well as anti-retroviral treatment for employees. • Develop a Community Health Action Plan which focuses on HIV/AIDS, tuberculosis. • Repeated awareness campaigns that is focused beyond employees and includes contractors and the communities near project facilities	Moderate Risk	Moderate Significance

Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
Health and Social Wellbeing	Safety and Risk Exposure through an increase in crime	Negative	Moderate Risk	Low Significance	• Increased security on mine premises • Construction and permanent workers are identified and marked with clear identifiable clothing • Code of Conduct to form part of induction of new workers with a clear statement and procedure regarding access, conduct and identification. All construction workers should wear clothing marked (and reflective vests) with the logo of the construction firm/contractor or sub-contractor as well as identification cards that cannot be easily forged, so that they can be easily recognized as being legitimate. • Workers to be screened including criminal background checks. • Properly constructed and secured fences can control access to construction sites. Implementing strict access control of the project site and specifically the contractors workforce camp. • Workers should be urged to recognize and report suspicious activity and signs of burglary and be informed of crime prevention measures that they themselves can take. • Employment of local people on the mine to improve the poverty levels in the host and neighbouring communities • MbeuYashu to liaise with existing community policing forums and project security to properly secure the project area and surrounding area • Investigate the implementation of an anti-poaching unit in collaboration with local stakeholders, policing forums and police	Low Risk	Low Significance

Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
Health and Social Wellbeing	Safety and Risk Exposure due to an increase in poaching on neighbouring game farming properties	Negative	Moderate Risk	Low Significance	• Establishment of an anti-poaching unit available to adjacent land owners, and establishing a security forum in collaboration with these land owners. Land owners are to be actively involved in the selection of the contracting company employed to conduct anti-poaching in the area. • Increased security measures (fencing, access control and monitoring) on mine premises. Properly constructed and secured fences can control access to construction sites. Implementing strict access control of the project site and the contractors workforce camp. Curfew times to be established in accommodation areas. Construction workers accommodated on mine are identified and marked with clear identifiable clothing • Code of Conduct to form part of induction of new workers with a clear statement and procedure regarding access, conduct and identification. All construction workers should wear clothing marked (and reflective vests) with the logo of the construction firm/contractor or sub-contractor as well as identification cards that cannot be easily forged, so that they can be easily recognized as being legitimate. • Workers to be screened including criminal background checks. • Employment of local people on the mine to improve the poverty levels in the local communities	Low Risk	Low Significance

Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
Quality of Living Environment	Change in "sense of place"	Negative	High Risk	Moderate Significance	• Regular and effective engagement with stakeholders through the SEP. • An effective grievance management procedure managed within the framework of the SEP. Grievance mechanisms must be in place throughout the life of the mine, including for a determined period post-closure, to address any impact for affected communities. • Implementation of traffic management measures Implementation of insulation and mitigation measures for noise • Implementation of visual barriers and other mitigation measures as recommended in the visual study • Colour schemes must complement the local environment. • Minimising disturbance to vegetated areas outside the critical development areas where possible • Revegetation/rehabilitation of disturbed sites in parallel with development • Successful mitigation interventions can reduce the intensity of the impact to at least moderate and ultimately moderate-low levels. If grievances are addressed adequately, and communication and engagement is effective affected communities may be able to adjust more easily to the changes.	Moderate Risk	Low Significance
Quality of Living Environment	Disruption of Social Networks and decrease in Social Capital	Negative	Moderate Risk	Low Significance	• Employment of local people already part of the community. • Code of conduct to form part of induction for all new workers • Grievance Procedure within the local communities	Low Risk	Low Significance
Quality of Living Environment	Perceptions of and Feelings in relation to the project	Negative	High Risk	Moderate Significance	• Establish on-going Consultative Forums with concerned groups to air concerns, find possible mitigation measures for their perceived impacts, solutions to co-existence and monitor implementation and effectiveness of mitigation measures • Continuous communication with all stakeholders providing information on anticipated impacts and planned mitigation measures	Moderate Risk	Low Significance

Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
Family and Community Impacts	Impacts on land owner and labourers	Negative	Very High Risk	Moderate Significance	• Development of a land acquisition and lease policy defining the negotiation process to minimize the feelings of uncertainty • Financial compensation of affected property owners/tenants, employees and their families in terms of the relevant legislation. • Displacement of workers and their dependents requires an equitable policy, principles, financial guidelines and clarification of operational approaches. • Land Acquisition, lease and compensation agreements reached with affected landowners that include arrangements and measures for labour tenants	Moderate Risk	Low Significance
Family and Community Impacts	Change processes and impacts related to daily movement patterns	Negative	Moderate Risk	Moderate Significance	• The project description defines that no hauling will take place along existing farm roads or regional / national roads. It is planned that the run-of-mine (ROM) coal will be transported for short distances by truck, on the in-pit haul roads to the crushing and screening facilities. The crushed and screened ROM product will be transported to the coal beneficiation plant at the Infrastructure Hub via conveyor. It is further planned that the product will be loaded directly onto trains at the Rail Load-out Terminal situated at the Infrastructure Hub which links up with the existingMusina-Makhado railway line. • Therefore only supplier light-vehicles and employee busses will disrupt movement patterns, these will stabilize once the mine is fully operational	Low Risk	Low Significance
Family and Community Impacts	Conversion of land use	Negative	High Risk	Moderate Significance	• Acquisition and or leasing of directly impacted land • Fair compensation negotiated and agreed with land owners that will lose agricultural land • Continuous consultation with landowners discussing co-existence and feasibility • Educate landowners in terms of their rights and responsibilities prior to the construction phase • Assist landowners in identifying ways to adapt their land uses, to the benefit of both the landowner and MbeuYashu • Implement a consultation programme with regional stakeholders in the development of a closure plan and rehabilitation programme • Determine the regional needs and characteristics to ensure post	Moderate Risk	Low Significance

Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
					mining use of land enhances the regional characteristics		
Institutional/Legal/Political/Equity Impacts	Challenge to local government capacity	Negative	Moderate Risk	Low Significance	• Intensive engagement between MbeuYashu / CoAL and the municipality well in advance of construction. In this context the responsibilities of local government should be well understood, and potential problems defined and addressed as early as possible. • Establishment of a limited and time-bound municipal support function. MbeuYashu / CoAL should contribute funding and appropriate technical resources. The participation of other major mines and industries in the area should be promoted by both MbeuYashu / CoAL and the local municipality.	Low Risk	Low Significance
Institutional/Legal/Political/Equity Impacts	Participation and Consultation in process	Negative	Moderate Risk	Low Significance	• Provide transport and/or reimbursement to the Historical Disadvantaged Communities • During the Operational phase, the structures established for participation should have a proper constitution that addresses reimbursement of costs • Arrangement of meetings in proximity to the mine or in affected communities to minimize the distance of directly affected parties to travel Cluster meetings together on the same day or over 2 days to minimize disruption of personal schedules	Low Risk	Low Significance
Institutional/Legal/Political/Equity Impacts	Impact equity	Negative	High Risk	Moderate Significance	• Tax and Profit benefits must be ploughed back into the Local Municipal areas and immediate communities • Employment should be prioritized to local communities • Local beneficiation programmes to be investigated and implemented	Moderate Risk	Low Significance
Socio-economic Wellbeing	Increase in South African GDP and Trade Balance	Positive	High Positive	Moderate Significance	• Procure goods and services from South African suppliers as far as possible. • Procure ancillary services for goods procured abroad, such as installation, customisation and maintenance, from South African companies as far as possible.	Very High Positive	High Significance

Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
Socio-economic Wellbeing	Increase in provincial and local GDP	Positive	High Positive	Moderate Significance	• Procure goods and services from local or provincial suppliers as far as possible. • Procure ancillary services for goods purchased from outside of the Limpopo Province, such as installation, customisation and maintenance, from local or provincial companies as far as possible.	Very High Positve	High Significance
Socio-economic Wellbeing	Increase in government revenue	Positive	High Positive	Moderate Significance	• None	High Positive	Moderate Significance
Socio-economic Wellbeing	Increase in employment, income and skills development	Positive	High Positive	Moderate Significance	• Aim to use local workers as far as possible and formalise this policy in contracts. • Consider implementing labour-intensive rather than capital-intensive work methods wherever possible. • Procure resources from local sources wherever possible. • Establish a database of local people with information on qualifications and skills, utilize this database to develop skills plans and recruit local people. • Implement early on skills development programmes in the areas where most job opportunities will be created, i.e. operators and drivers • Include training for general life skills such as financial management and health. • Implement portable skills development programmes • Design and implement economic development programmes that will assist people being retrenched in sustaining their livelihoods • Establish a future forum with representation from the workforce to discuss potential difficulties and solutions • Implementation of programmes to minimize and mitigate the impact of downscaling and retrenchment	Very High Risk	Moderate Significance

Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
Socio-economic Wellbeing	Impact on existing businesses in surrounding areas	Negative	High Risk	Moderate Significance	• Devise a compensation plan for direct impacts of mining on adjacent farms, such as loss or pollution of land. • Screen mining activities from the adjacent farms and the main access road to minimize the impact on the general sense of place and tourists. • Identification of employees that may lose their employment and enrol in skills programme	Moderate Risk	Low Significance
Socio-economic Wellbeing	Change in property values	Negative	High Risk	Moderate Significance	• Attempt to minimize impacts through implementation of mitigation strategies focusing on aspects that may affect tourism characteristics including traffic, noise, and visual aspects such as screening mining activities from the adjacent farms and the main access road to minimize the impact on the general sense of place. Establish a baseline of property values by conducting baseline valuations on representative properties and providing such to landowners, thereafter conducting monitoring valuations in periods of 5 years or as may be agreed with landowners • Establish a communication channel with direct adjacent land owners to address impacts and grievances • Adopting principles of good corporate citizenship focused on conservation of natural resources such as water, biodiversity, etc. Inclusion of these principles and actions into information disseminated in the local area ("how mining can be done differently")	Moderate Risk	Low Significance
Socio-economic Wellbeing	Decrease of visitors, tourists and hunting parties	Negative	High Risk	Moderate Significance	• Attempt to minimize impacts through implementation of mitigation strategies focusing on aspects that may affect tourism characteristics including traffic, noise, and visual aspects such as screening mining activities from the adjacent farms and the main access road to minimize the impact on the general sense of place. • Collaborate with local stakeholders in terms of regional planning to ensure certain areas are protected for tourism and hunting activities. • Adopting principles of good corporate citizenship focused on conservation of natural resources such as water, biodiversity, etc. Inclusion of these principles and actions into information disseminated in the local area ("how mining can be done	Moderate Risk	Low Significance

Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
					differently")		
Socio-economic Wellbeing	Equity Participation of the Local Communities	Positive	Moderate Risk	Moderate Significance	• Ensure communities are fully involved and properly represented in the structures • Ensure capacity is built at an early stage for communities to understand how equity and dividends work • Place protective measures in place that will shield the communities from any business risk or liabilities	High Positive	Moderate Significance
Socio-economic Wellbeing	Participation of local business in procurement opportunities	Positive	High Positive	Moderate Significance	• Ensure communities are fully involved and understand the local procurement policy and procedure • Ensure capacity is built at an early stage through enterprise development to enable local business to participate in opportunities • Identify local only opportunities that is reserved for local business	High Positive	Moderate Significance
Socio-economic Wellbeing	Decline in South African GDP and Trade Balance at Decommissioning	Negative	Moderate Risk	Moderate Significance	• None	Low Risk	Moderate Significance
Socio-economic Wellbeing	Decline in provincial and local GDP at decommissioning	Negative	High Risk	Moderate Significance	• Actively promote the development of different economic sectors from an early stage, e.g. through incentivising other industries to locate in the area, providing adequate infrastructure and promoting an increase and diversity of skills in the local population. • Actively engage with a range of stakeholders throughout the life-of-mine to discuss potential consequences of mine closure and possible mitigation. • Incorporate measures to retrain workers in the Social and Labour Plan.	Moderate Risk	Moderate Significance
Socio-economic Wellbeing	Decline in government revenue at Decommissioning	Negative	High Risk	Moderate Significance	• None	Moderate Risk	Moderate Significance

Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
Socio-economic Wellbeing	Decline in employment, income and skills development at decommissioning	Negative	High Risk	Moderate Significance	• Aim to use local workers as far as possible and formalise this policy in contracts. • Consider implementing labour-intensive rather than capital-intensive work methods wherever possible. • Purchase resources from local sources wherever possible. • Institute training programmes for local workers to raise skills levels. • Include training for general life skills such as financial management and health.	Moderate Risk	Moderate Significance
Vulnerable Group Impacts	Gendered Division of labour	Negative	Moderate Risk	Low Significance	• Women must have equal employment opportunities, • Training and skills development for women, and • Salaries of women must be equal to that of men • Establish opportunities that are suitable for women employment • Implement measures to enable working environment for women • Establishing gender-sensitive policy positions, such as for cultural heritage, employment and business development • Mainstreaming gender into project planning, particularly for community development • Using gender-sensitive indicators, such as employment data disaggregated by gender • Consultation with national women's organizations	Low Risk	Low Significance
Vulnerable Group Impacts	Potential Infringements on Historically Disadvantaged People's Human Rights	Negative	Moderate Risk	Low Significance	• Focusing local benefits on those communities previously disadvantaged to ensure upliftment • Enter into agreements with local communities to address post closure land use and sustainability • Optimization of local employment to minimize impacts of external or migrant workers on the local communities	Low Risk	Low Significance

7 COMPARATIVE ASSESSMENT OF LAND USE AND DEVELOPMENT ALTERNATIVES

7.1 CURRENT LOCAL ECONOMIC ACTIVITIES

The following Current Economic Activities have been identified as being present in the area:

- Live Stock Farming
  - Commercial Cattle
- Game Farming
  - Live Sales
  - Hunting, sub-divided into "Trophy" and "Biltong"
    - Trophy hunting including services like professional hunter, skinner, tracker, etc.
    - Biltong hunting including the services of trackers, skinners, etc.
  - Hunting Accommodation
- Eco- and Holiday Tourism
- Irrigation

Mosaka Economic Consultants was appointed to perform a Macro- and Micro-Economic Impact Assessment Analysis for the Generaal Project – refer to ANNEX-10 for the full report.

The approach followed was to first establish the current activities in the area which then formed the baseline used to draw up a risk profile in order to calculate the projected impacts and lastly convert it to macro-economic parameters. However, as so often happens, the economic benefits accruing from the mining project could put a negative burden on the current local economic activities in the project area and outside of the project area. For purposes of this evaluation the project area has been divided into two, namely the area comprising of the Mount Stuart Section, which includes the farm Schuitdrift and the other comprising of the Generaal Section, excluding the farm Schuitdrift. The two areas are referred to as Generaal and Mount Stuart.

The following table presents a summary of the current land use in the project area.

Land Use	Generaal		Mount Stuart		Total	
	Percentage	Hectares	Percentage	Hectares	Percentage	Hectares
Irrigation	0.0%	0	3.3%	168	0.8%	168
Beef Game	10.0%	1 705	10.0%	527	10.0%	2 232
Game	90.0%	15 347	86.7%	4 576	89.2%	19 919
Total	**100.0%**	**17 052**	**100.0%**	**5 271**	**100.0%**	**22 323**

The table shows that 89% of the land is used for game farming and related activities, 10% beef farming and the balance irrigation.

The following table gives an indication of the magnitude of the current activities in the project area.

	Annual Income (Rand million)		
	Generaal	Mount Stuart	Total
Beef Farming	0.45	0.07	0.52
Game Farming – Animals (Turn Over)	3.81	1.17	4.98
Hunting and related activities	4.43	1.34	5.77
Eco-Tourism	6.82	1.74	8.56
Irrigation	0.00	23.30	23.30
Grand Total	**15.51**	**27.62**	**43.13**

The table shows that irrigation and game farming with the related activities such as accommodation are by far the largest income generators in the area representing more than 97% of the total annual turnover of R 43.13 million, expressed in 2013 prices.

In the following table the total economic activities for the Generaal Project is shown, expressed in terms of GDP, employment opportunities and payment to households.

	Gross Domestic Product (R mil)			Employment (Number)			Payments to Households (Rmil)		
	Direct	Indirect/ Induced	Total	Direct	Indirect/ Induced	Total	Total	High/ Medium	Low
Irrigation	13.11	11.39	24.51	215	54	269	7.39	5.55	1.84
Beef Farming	0.56	0.29	0.85	2	1	3	0.15	0.12	0.04
Game Farming	7.95	5.58	13.53	17	43	60	3.27	2.47	0.81
Hunting	1.51	1.48	2.98	24	5	29	1.40	0.95	0.45
Taxidermy, Gamecatching, etc.	2.35	2.36	4.71	13	8	21	1.49	1.11	0.38
Accomodation	3.88	4.53	8.41	26	17	43	4.39	2.97	1.42
Total	**29.36**	**25.64**	**55.00**	**297**	**128**	**425**	**18.09**	**13.16**	**4.94**

The table shows that the activities support 297 full time direct employment opportunities with another 128 indirect and induced opportunities and in total 425. It generates a total of R55.00 million in GDP of which R29.36 million is direct, expressed in 2013 prices.

The total payments to households are R18.09 million with R4.94 million to low income households.

The following table presents the estimated incremental negative impact of the mine in the study area expressed in macro-economic parameters, including both the Generaal and Mount Stuart Sections.

	Gross Domestic Product (R mil)			Employment (Number)			Payments to Households (R mil)		
	Direct	Indirect/ Induced	Total	Direct	Indirect/ Induced	Total	Total	High/ Medium	Low
Irrigation	-1.16	-1.01	-2.17	-19	-5	-24	-0.65	-0.49	-0.16
Beef Farming	-0.06	-0.03	-0.09	0	-1	-1	-0.02	-0.01	-0.00
Game Farming	-2.04	-1.40	-3.44	-4	-11	-15	-0.81	-0.60	-0.21
Hunting	-0.32	-0.32	-0.64	-5	0	-5	-0.30	-0.20	-0.10
Taxidermy, Gamecatching, etc.	-0.54	-0.55	-1.09	-3	-1	-4	-0.35	-0.26	-0.09
Accommodation	-1.49	-1.74	-3.24	-10	-6	-16	-1.69	-1.14	-0.55
Total	**-5.62**	**-5.04**	**-10.66**	**-41**	**-24**	**-65**	**-3.82**	**-2.71**	**-1.11**

The table shows that as many as 41 direct employment opportunities can be lost in the project area and a total of 65 overall. The projected direct GDP loss is R5.62 million with a total of R10.66 million.

7.2 PROPERTY VALUES

The estimated property values depend on a number of issues and are normally valuated using a number of different fixed capital improvements. The economic values differ from R1 503 per hectare for a beef producing unit and R2 344 for a basic game producing unit without any value added improvements to R12 204 for the units catering for the luxury market.

It is possible that the game farming and lodge facility property owners will not only suffer losses as far as income is concerned but also face the possibility that their property value will be devaluated. It must be kept in mind that the major contributing factor to a possible devaluation in property values is the negative experience of "sense of place" for a specific property. The two main issues affecting the formation of these perceptions are noise and visual intrusions.

In the case of the irrigation units the possible threat of contamination to the water that can affect the property values exists; however it appears that the risk in this case is low.

7.3 TSHIPISE FOREVER RESORTS

The resort offers 3-star style fully-equipped holiday accommodation, hotel accommodation and conference facilities. The main attraction of the resort is the natural hot water spring which feeds the different bathing facilities. As a result of the hot water bathing facilities the prime holiday period for both camping and chalet visitors is during the winter months of May to August.

The Groundwater Flow Impact Model (ANNEX-3: WSM Leshika, 2013) shows the impact on reductions in water for abstraction and discharge, without mitigation, and the possibility exists that the hot water spring at Tshipise Forever Resorts could be affected or even dry up. This is not a certainty at this stage due to limited data being available on the source and catchment area feeding the spring.

If the spring is not affected then no economic impact will take place. However, if the spring is impacted upon the macro-economic analysis shows the following impact:

- The current direct GDP created is around R25.49 million with a total GDP of R54.49 million. The total employment created is 258 with 135 direct and 123 indirect and induced opportunities. The payments to households come to R17.49 million, with R4.44 million to low income households in the area; this is 25.4% of the total.
- It was established that 49% of the resorts annual income ensues from visitors to the resort during the four winter months. The 49% income of the winter months was used to reflect the possible impact expressed in macro-economic parameters. As many as 65 of the direct employment opportunities could be destroyed with a further 61 indirect and induced. Payments to low income households can be reduced by R2.17 million.

Proposed mitigation measures are that a detailed analysis of the source of the hot water spring be made in cooperation of the Forever Resorts management, before any mining activities proceed.

7.4 COST BENEFIT ANALYSIS – ECONOMIC VIABILITY

A detailed Economic Cost Benefit Analysis was performed for the mining activity and the coal rail transport option to the identified siding in current financial prices using 6% inflation and constant economic prices. The CBA analysis incorporated the negative impacts on current local activities as a cost item over the mining period, environmental and loss of biodiversity costs and identified social costs.

In the following table the differences between a private sector financial CBA and a public sector economic CBA is presented.

Attributes	Economic CBA	Financial CBA
Perspective	The broader community.	Project shareholders/capital providers.
Goal	The most effective application of scarce resources.	Maximization of net value.
Discount Rate	Social discount rate.	Market determined weighted cost of capital.
Unit of	Opportunity costs.	Market prices.
Scope	All aspects necessary for a rational, economic decision.	Limited to aspects that affect profits.
Benefits	Additional goods, services, income and/or cost saving.	Profit and financial return on capital employed.
Costs	Opportunity costs of goods and services foregone.	Financial payments and depreciation calculated according to generally accepted accounting principles.

The benefits associated with the project are the revenue resulting from the sale of the coking coal variety and Eskom quality coal. Approximately 10.1 million tons of coking coal is expected to be produced over the LOM from the Mount Stuart Section with another approximate 8.6 million tons from the Generaal Section. About 62% of the total estimated production from the Generaal Section will be destined to Eskom. For the Mount Stuart Section, 63% of total production is destined to Eskom. The 2011 price of HCC coking coal was at an all-time high, the Australian coking coal varied from July 2010 to June 2011 from US$ 225 to US$ 328 per ton FOB. The September 2013 price is

varying around US$ 171 per ton FOB. Determining the Free-on-Board (FOB.) price was therefore complex and it is necessary to discuss some of the parameters used in the calculations:

- The 2011 situation
  - FOB HCC price expressed in US$ - $207 ton/coking coal, the average 2010 price,
  - Exchange rate – R7 per 1US$,
  - Providing a FOR price of R1449 per ton.
- Current 2013 situation
  - Average 2013 FOB HCC price expressed in US$ - $171 per ton,
  - Exchange Rate –R9.50 per 1 US$,
  - Providing a FOB price of R1 624 per ton.

Although the price has dropped in US$ terms by 8%, expressed in terms of Rand the price has actually increased by 12%, compensating for any inflated expenditure prices.

Coal had a separate coking coal market study done by Wood Mackenzie; the report forecasted the following price scenario for the next number of years based on the different coking quality coal. A summary of the forecasted prices for hard coking coal (HCC) and semi-hard coking coal (SHCC) varieties is shown in the table below.

	2013	2014	2015	2020	2025	2030
HCC (Qld)	171.25	176.25	184.00	194.00	229.00	235.00
SHCC (Qld)	143.64	147.84	154.56	164.90	194.65	202.10

The table shows it is expected that the price over time will increase in constant terms; Mosaka Economists accepted these figures for the base scenario as they are in line with other predictions found in a cursory research of possible coal price expectations.

The second issue is the possible movement of the South African Rand exchange rate. For the base scenario, an annual weakening of 0.50% of the South African Rand against the US Dollar was assumed. However, current predictions produce even a faster deterioration of the value of the Rand.

The following table presents the results of the financial and economic CBA models excluding the impact on the Tshipise Holiday Resort.

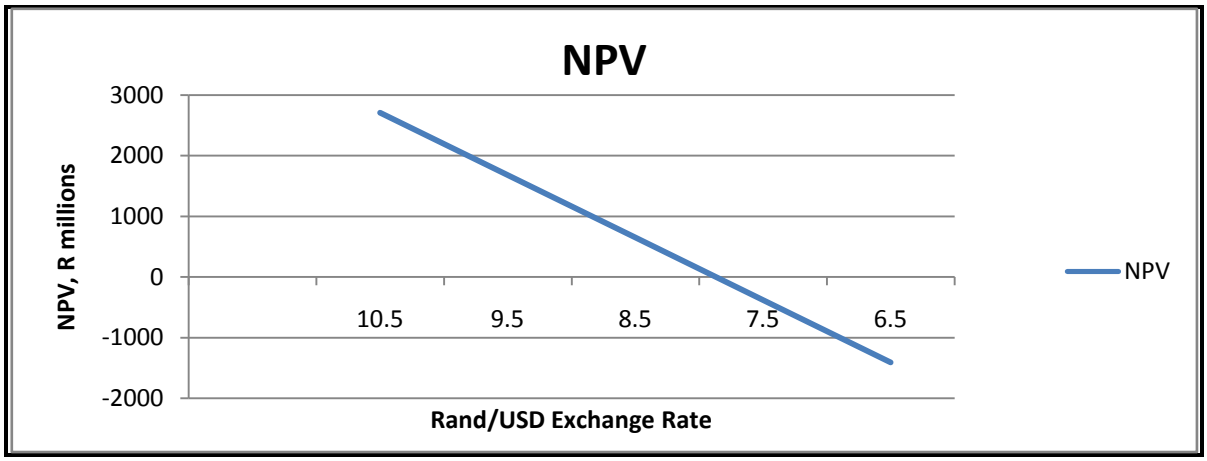
	Financial CBA	Economic CBA
Net Present Value (NPV) (Rand million)	3 479.34	1 845.94
Benefit Cost Ratio (BCR)	2.17	1.86
Internal Rate of Return (IRR)	23.4%	17.2%

The following table presents the results of the financial and economic CBA models including the potential impact on the Tshipise Forever Resorts.

	Financial CBA	Economic CBA
Net Present Value (NPV) (Rand million)	3 111.33	1 599.81
Benefit Cost Ratio (BCR)	2.05	1.75
Internal Rate of Return (IRR)	21.8%	15.7%

The results show that the project is financially and economically viable when the impacts on Tshipise Holiday Resort are both included as well as excluded and is expected to render positive results.

The following graph shows the impact of different exchange rates on the Net Present Value at a price of US$ 171 per ton.



The graph shows that a linear relationship exists between the exchange rate and economic viability of the project. Currently the exchange rate is very volatile with dramatic movements up and down, however, a consensus opinion is that the lower limit would be R9.5 to the US$, although no guarantee exists that this would be the lower limit.

The graph indicates that with a $171 per ton international price and an exchange rate of about R8.00 to the US$ the NPV still remains positive. The current $171 per ton at R8.00 to the US$ gives a rand price of R1 368 per ton and with the prevailing exchange rate of R9.50 plus to the US$, the price per ton expressed in RSA Rand is R1 624.

The analyses for Generaal and Mount Stuart Sections were based on a certain number of assumptions regarding the Rand/USD exchange rate as well as the real domestic price. The real domestic price of coal was assumed to increase at a rate of 0.92% per annum. It is also assumed that the Rand will get weaker overtime (deteriorating at a rate of 0.5% per annum), resulting in higher export prices.

A comparison of IRR at different price and exchange rate scenarios is given below.

IRR	Exchange Rate R9/1$US	Domestic Price
15.8%	R9.00*	R283.72**
23.4%	R9.50***	R283.72****

* Constant Rand/USD exchange rate

** Constant coal domestic price

*** Rand deteriorating at 0.50% against US Dollar

**** Domestic coal price increasing at a real growth rate of 0.92% per annum

The table above indicates the extent to which the results are affected by the movements in the exchange rate and the assumptions on real growth of domestic coal price. If the domestic price and the exchange rate are kept constant, the IRR becomes slightly less.

7.5 MACRO-ECONOMIC IMPACT ANALYSIS

The macro-economic impact analysis also shows a positive picture for both the economic impacts on the Limpopo Province as well as the South African economy. In the following table a summary of the Construction Phase annual impact results for the Generaal Project [R millions, 2012/2013 Prices] is presented.

	National - RSA Economy	Provincial - Limpopo Economy
Impact on Total GDP (R millions)	**1 298**	**391**
Impact on Total Employment [numbers]:	**5 212**	**2 143**
Impact on Households (R millions):	**972.2**	**144.96**
Low Income Households (R millions)	136.1	49.24
Medium Income Households (R millions)	168.2	25.57
High Income Households (R millions)	567.9	79.34
Fiscal Impact (R million):	**392.0**	**64.82**

The above table shows that the construction phase will have a positive impact on the National as well as the Limpopo Provincial economy for the duration of the construction phase. It is interesting to observe that out of a total 5 212 employment opportunities created, 2 143 will be in the Limpopo Province during the construction period.

The table below is a summary of the Operational Phase Results of the Generaal Project showing the impact on the National and Limpopo Province economies [R millions, 2013 Prices]. The Limpopo results are included in the National results.

	National - RSA Economy	Provincial - Limpopo Economy
Impact on Total GDP (R millions)	**5 450**	**3 090**
Impact on Total Employment [numbers]:	**9 769**	**3 703**
Impact on Households (R millions):	**3 810.5**	**1 614.3**
Low Income Households (R millions)	644.8	485.1
Medium Income Households (R millions)	1 565.6	316.9
High Income Households (R millions)	1 832.5	812.3
Fiscal Impact (R million):	**1 497.6**	**621.3**
Balance of Payment	**2 329.6**	

The table shows that the operational phase of the proposed mine will have a very positive impact on the economy of the province and that as much as 3 703 employment opportunities can be created of which over 984 will be direct employment opportunities on the mine itself.

The mine will, at full production, pay various taxes amounting to R1 497.6 million annually and have a positive contribution to the "Balance of Payments" of R2 329.6 million per annum if expressed in 2013 prices and values.

7.6 CONCLUSION

A comparison of the Local Economic Activities Baseline (excluding the potential impact on Tshipise Forever Resorts) and estimated Negative Impact of the operational phase of the proposed Generaal Project (2013 prices) on the National as well as the Limpopo Provincial Economy is shown in the table below.

Mining Operational Phase - Annual Impact Current Activities							
		Baseline	Impact			Baseline	Impact
GDP R million	Direct	29.36	-5.62	**Employment Numbers**	Direct	297	-41
	Indirect/Induced	25.64	-5.04		Indirect/Induced	128	-24
	Total	**55.00**	**-10.66**		**Total**	**425**	**-65**
Mining Operational Phase - Annual Impact on the National and Limpopo Provincial Economy							
		National	Provincial			National	Provincial
GDP R million	Direct	2 263	2 263		Direct	984	984
	Indirect/Induced	3 187	827		Indirect/Induced	8 785	2 719
	Total	**5 450**	**3 090**		**Total**	**9 769**	**3 703**

From the above table it appears that the current local economic activities in the defined project area contributes R55.00 million in total GDP and sustains 425 total employment opportunities of which 297 are direct. The mine activity will cost the local economic activities R10.66 million in GDP and 65 employment opportunities, of which 41 will be direct.

The Generaal Project will offer a minimum of 984 direct new employment opportunities compensating for the loss of 41 jobs in the project area. It is, however, in the rest of the Limpopo province where the mine will create many more jobs than the current activities, namely 2 719 versus the 128 indirect and induced opportunities created by the local economic activities. However, an additional 8 785 indirect and induced employment opportunities are also created in the rest of South Africa.

Probably the two most important benefits to the national economy are:

- The annual impact on the "Fiscus" with an annual tax contribution of R1 497 million expressed in 2013 prices.
- The second impact is the favourable annual impact on the "Balance of Payments "amounting to R2 329 million, if expressed in 2013 prices.

Considering that this is the estimated results of the total Generaal Project, it appears that, from the rest of the analysis, that the proposed mining project will be an economically viable entity which will add value to the Limpopo Province and the rest of the country. However, it will take place at the expense of some of the current local economic activities, impacting negatively on the irrigation areas as well as on the game and ecology sectors.

As discussed in Section 7.3 above, the Tshipise Forever Resort could also experience a negative impact if the hot water spring is affected by the mining operations and it is necessary that an in depth analysis be performed on the possible impact of the mining operations.

There is also a possibility that the water supply to a number of rural villages outside of the project area might be impacted on by the mining operations. This issue must be investigated further as it might involve some additional costs.

8 LIST OF SIGNIFICANT IMPACTS AND MITIGATORY MEASURES

The lists of significant environmental and socio-economic impacts are provided in Table 45 and Table 46 respectively, together with the proposed mitigation measures to prevent and/or reduce these impacts.

8.1 CONCERNS RAISED BY IAPS

The main concerns raised by the stakeholders included the following:

- Water scarcity / availability for mining
- Surface & groundwater impacts (quantity and quality)
- Biodiversity, Sensitive and Protected Areas
- Conservation value and initiatives of the area
- Heritage and Cultural Resources, Sensitivity of Graves / Consultation with next of kin
- Cumulative impacts
- Noise and dust pollution
- Visual and aesthetic value of the area / Sense of place
- Impacts on existing land use, intensive irrigation, citrus production
- Land value, compensation
- Impact on Property Values of neighbouring properties
- Consultation process
- Phasing of project (schedule of larger GSP)
- Sustainability of land use options in the short and long term
- Potential changes in social structure and character of the area, due to the influx of work-seekers and illegal immigrants to the area
- Job creation, procurement opportunities
- Equity / Community ownership in project
- Finalisation of land claim validation process
- Safety and Security

These concerns were addressed as far as possible in the specialist studies and included in this report.

In addition, the following alternative options were proposed by stakeholders during the various engagement sessions and will be investigated further during the Feasibility Phase of the project:

- Infrastructure and stockpiles must be placed in such a way that it does not impact on Marula / Sandveld vegetation areas, as these areas offer the best grazing. Mountainous area is not such good grazing areas. For this reason the discard stockpile at Mount Stuart Section was moved since the Scoping Report as the previously proposed position was considered good grazing area.
- If stockpiles are placed at the foot of the mountain it can be landscaped and revegetated to become part of the mountain.
- Also consider placing the stockpiles further to the south behind the mountainous area.
- Processing plant should be placed as far as possible from Honnet and Kuduland to reduce sense of place impacts.
- Alignment of all linear activities (conveyors) with existing road / power line servitudes and/or fence lines.

To address the issue of cumulative impact and phasing of mining projects, the following commitments have been made by MbeuYashu:

- Ensure close collaboration with the Vhembe Biosphere Reserve in respect of final end land use and sustainable mining.
- Participation on a collaborative approach for the development of a Regional Strategic Environmental Impact Assessment (SEIA).

Table 45: List of all potential environmental impacts for the Generaal Project with proposed mitigation measures

Activity	Environmental Aspect	Potential Impact	Mitigation Measures
All activities	**Biodiversity / Land Use & Capability**	Surface disturbance of approximately 1,700 hectares for the purpose of mining and infrastructure development over the LOM will lead to impacts on the soil, land use and land capability, natural vegetation and fauna	• Development and implementation of a detailed Mine Rehabilitation and Reclamation Plan during the Feasibility Phase. • Concurrent rehabilitation and levelling of opencast pits in line with the Mine Rehabilitation and Reclamation Plan. • Monitoring, auditing and regular review (if required) of the Mine Rehabilitation and Reclamation Plan. • Rehabilitation of infrastructure and other disturbed areas post-mining. • Implementation of Flora Rescue and Relocation Plan prior to any surface disturbances. • Develop species rescue, relocation and re-introduction plan (fauna) with the assistance of specialists in this field. • Develop and implement Biodiversity Action Plan, including avifaunal plan. • Fencing of designated mining and infrastructure areas. • Implementation of biodiversity monitoring. • Close collaboration with the Vhembe Biosphere Reserve in respect of final end land use and sustainable mining. • Participation on a collaborative approach for the development of a Regional Strategic Environmental Impact Assessment (SEIA).
All activities	**Waste management**	Poor waste management could lead to environmental impacts	• Implementation and regular review of Waste Management Procedure. • Appoint an approved, registered waste contractor to manage the waste generation and safe disposal thereof. • No waste will be disposed of or buried on site, or in any other location that is not a licensed waste disposal site.
		Poor sewage management could impact on water resources	• Sewage effluent will be treated to General Standards and pumped to the dirty water dams for re-use in the process and/or dust suppression. No effluent will be discharged to the environment.
All activities	**Bulk water**	Impact on water stressed catchment - fully allocated	• The bulk water source will be determined during the Feasibility Phase, followed by a detail EIA for the selected option. • Design closed system to ensure optimal recycling of water and minimise water requirements for the mine. • Installation of filter presses to increase water recovery in the process plant.

Activity	Environmental Aspect	Potential Impact	Mitigation Measures

All activities	**Bulk electricity**	Further impact on over-allocated electricity reticulation system	• Energy efficient designs such as:
			  ○ High efficiency motors in plant and workshops
			  ○ Power Factor Correction
			  ○ Use VSDs
			  ○ Use solar power where possible
			  ○ Install solar geysers at change houses\Optimal building design to make use of ambient light
			• Energy Policy must govern energy efficient designs such as: power factor correction; lighting designs; cooking and heating - avoid electricity use gas; process efficiency; high efficiency motors; low loss transformers; green building designs; use of solar and heat pumps for water heating.
			• Implement Energy Management Plan.
			• Monitor and record energy usage on site. Ongoing improvement in energy consumption should form part of the mine's KPIs.

All activities	**Heritage resources**	Destruction of heritage & cultural resources as a result of mining and associated infrastructure (including linear activities)	• A Heritage Management Plan will be developed during the Feasibility Phase once the mining and infrastructure designs and footprints have been finalised. • Implementation of Heritage Management Plan dealing with the Phase 1B&2 assessments as well as the relocation of burial sites. • National Heritage and Cultural issues will be included in the environmental awareness programme. • Regular monitoring of off-site heritage resources of importance.
All activities	**Sense of place**	Impact on conservation value of the region	• Identify and implement biodiversity offset programmes in conjunction with the IAPs and authorities, including the Vhembe Biosphere Reserve. • Close collaboration with the Vhembe Biosphere Reserve in respect of final end land use and sustainable mining. • Participation on a collaborative approach for the development of a Regional Strategic Environmental Impact Assessment (SEIA). • Implementation of environmental monitoring programme. • Develop environmental awareness & educational programmes. • Environmental auditing and reporting.
Opencast mining (Generaal Section)	**Soils / Land Use & Capability**	Potential hard setting of soils post-reclamation	• Soil analyses and amelioration during reclamation.
		Subsidence of rehabilitated areas	• Free-draining profile (as far as practically possible) for rehabilitated areas and ongoing monitoring.

Activity	Environmental Aspect	Potential Impact	Mitigation Measures
Opencast mining (Generaal Section)	**Surface water**	Impact on non-perennial streams cutting through mining areas leading to decrease in runoff	• Optimisation of the storm water management plan and positioning of mining pits during the Feasibility Phase. • Diversion of non-perennial streams around opencast areas to minimise decrease in surface runoff. • Rehabilitation concurrent to mining – limit dirty footprint.
		Impact on 1:100 year flood-line of the Mutamba River	• Revise mining and infrastructure footprints during the Feasibility Phase to avoid 1:100 flood-lines of the major drainage lines, plus a 100m buffer zone.
		Impact on wetland areas and aquatic ecosystems	• Maintain a buffer zone of 100 m from the 1:100 year flood-line of major drainage lines to reduce impact on aquatic systems. • Reposition surface infrastructure and stockpiles to avoid drainage lines and sensitive wetlands systems. • Implement aquatic (bio) monitoring. • Create small impoundments at head of stream diversions to limit erosion. This could potentially become artificial wetlands over time. • Identify and implement biodiversity offset programmes (including wetland offsets) in conjunction with the IAPs and authorities, including the Vhembe Biosphere Reserve.
		Increased sedimentation into the river systems due to uncontrolled surface run-off	• Design and install appropriate outlet structures to retard flow velocity. • Construction of energy dissipating structures along steep slopes. • Side slopes of earth berms / canals to be designed to 1:3 and protected & vegetated to prevent erosion.
		Potential impact on in-stream habitat and riverine vegetation as a result of decrease in runoff	• Implementation of monitoring programme for early detection of impacts (plant moisture stress monitoring). • Diversion of clean storm water runoff around opencast areas to minimise impact of flow within the Mutamba and Nzhelele River catchments.
		Impact of long-term decant on water quality	• Investigate appropriate management measures over the LOM.

Activity	Environmental Aspect	Potential Impact	Mitigation Measures
Opencast mining (Generaal Section)	**Groundwater**	Dewatering of aquifer as a result of mining, resulting in drying up of boreholes and springs	• Revision and phasing in of mining schedules during the Feasibility Phase on a regional basis to reduce the radius of influence. The groundwater flow model will be utilized during this exercise to obtain the most feasible option from a groundwater impact perspective. • Implementation of baseline monitoring programme on farms and within communities that are potentially impacted once the mining and infrastructure feasibility studies have been completed. • Provide alternative water sources where appropriate. • Compensation mechanisms need to be developed and agreed with impacted landowners and communities to compensate those who are impacted upon.
		Impact on surrounding vegetation as a result of dewatering and subsequent recovery	• Ongoing monitoring of fountains and springs. • Implementation of monitoring programme for early detection of impacts (plant moisture stress monitoring). • Diversion of clean storm water runoff around opencast areas to minimise impact of flow within the Mutamba and Nzhelele River catchments.
		Decrease in regional water quality due to seepage from rehabilitated pits	• Potential acid generating horizons will be placed at bottom of pit and submerged below the water table, thereby preventing oxidation. • Rehabilitation will be concurrent with mining, minimising the potential for oxidation of sulphide bearing rocks and controlling the migration of high sulphate leachate. • Exposed residue material will be minimised by direct placement of overburden and topsoil. • Vegetation will be re-established as soon as possible after topsoiling to minimise infiltration of water through residue material. • Implementation of baseline monitoring programme to detect any seepage. • Compensation mechanism to compensate landowners and communities who are impacted upon.
		Migration of pollution plume after full recovery of groundwater levels (prior to decant)	• Investigate appropriate management measures over the LOM. • Groundwater and geochemical models must be updated on a regular basis (every 5 years) to verify potential for decant.
Opencast mining (Generaal Section)	**Air Quality**	Dust impact caused by vehicle movement	• Application of dust suppression measures (surface surfactants) such as Dustex. • Reduce vehicle speed on unpaved roads to limit dust creation.
		Dust impact caused by blasting activities	• Develop Blasting Procedure to minimise impacts.

Activity	Environmental Aspect	Potential Impact	Mitigation Measures
		Dust impact caused by materials handling	• Reduction of drop height to reduce the dispersion of materials being transferred, and increase in moisture content (water sprays). • Creation of wind breaks in close proximity to storage piles to reduce the potential erosive forces of the wind.
		Methane emissions leading to air quality impacts	• Ongoing methane monitoring if required.
Opencast mining (Generaal Section)	**Noise**	Elevated noise levels caused by mining operation, dewatering (pumping) and blasting activities	• Noise attenuation berms (topsoil) on footprint of opencast areas. • Noise suppression devices on heavy vehicles and all noisy plant. • Alternative reverse hooting systems will be implemented to reduce the noise levels. • Low noise generator sets will be used in pit. • Develop air blast control measures. • Blasting limited on regular times, restricted to 08:00-18:00. • All plant, equipment and vehicles to be kept in good repair. • Employees / contractors working in areas where the 8-hour ambient noise levels exceed 85 dBA shall wear ear protection equipment.
Opencast mining (Generaal Section)	**Visual / Aesthetics**	The mining will have a negative on the aesthetics / sense of place	• Berms on footprint of opencast areas to be protected and vegetated to reduce the visual impact. • Avoid the unnecessary removal of vegetation during the operational phase. • Rehabilitation and revegetation will be performed concurrent to mining. • Introduce trees to the landscape at strategic locations (sensitive receptors) to break full exposure of the mine. Further analyses and stakeholder engagement will be required for this commitment.
Opencast mining (Generaal Section)	**Blasting**	Impact on the communities and sensitive receptors as a result of blasting	• Develop and implement Blasting Procedure as well as an Evacuation Procedure.
Underground mining (Mount Stuart Section)	**Soils / Land Use & Capability**	Soil impacts as a result of poor hydrocarbon management and spillages	• Develop and implement hydrocarbon management procedure. • Reclamation of soils in the event of accidental spillages.
		Surface disturbance caused by infrastructure	• Dismantling of infrastructure. • Final rehabilitation of disturbed areas. • Rehabilitation of dams and storm water drainage.
Underground mining (Mount Stuart Section)	**Surface water**	Impact on non-perennial streams cutting through proposed incline shaft area, leading to decrease in runoff	• Optimisation of the storm water management plan and positioning of the incline shaft during the Feasibility Phase. • Diversion of non-perennial streams around shaft area to minimise decrease in surface runoff. • Minimise footprint of incline shaft area.

Activity	Environmental Aspect	Potential Impact	Mitigation Measures
		Increased sedimentation into the river systems due to uncontrolled surface run-off	• Design and install appropriate outlet structures to retard flow velocity. • Construction of energy dissipating structures along steep slopes. • Side slopes of earth berms / canals to be designed to 1:3 and protected & vegetated to prevent erosion.
Underground mining (Mount Stuart Section)	**Groundwater**	Dewatering of aquifer as a result of mining, resulting in drying up of boreholes and springs	• Revision and phasing in of mining schedules during the Feasibility Phase on a regional basis to reduce the radius of influence. The groundwater flow model will be utilized during this exercise to obtain the most feasible option from a groundwater impact perspective. • Further investigations to determine the source and catchment of the Tshipise Hot spring to confirm potential impact and the extent thereof. • Implementation of baseline monitoring programme on farms and within communities that are potentially impacted once the mining and infrastructure feasibility studies have been completed. • Provide alternative water sources where appropriate. • Compensation mechanisms need to be developed and agreed with impacted landowners and communities to compensate those who are impacted upon.
		Impact on surrounding vegetation as a result of dewatering and subsequent recovery	• Ongoing monitoring of fountains and springs. • Implementation of monitoring programme for early detection of impacts (plant moisture stress monitoring).
Underground mining (Mount Stuart Section)	**Air quality**	Air quality impacts associated with ventilation shafts	• Dust collection systems in ventilation shafts.
		Methane emissions leading to air quality impacts	• Ongoing methane monitoring if required.
Underground mining (Mount Stuart Section)	**Noise**	Noise impact (especially during the night) as a result of the ventilation system / extractor fans	• Cladding of ventilation system / extractor fans – encapsulation in buildings, acoustic covers.
Underground mining (Mount Stuart Section)	**Visual / aesthetics**	The shaft complexes will have a negative on the aesthetics / sense of place	• Avoid the use of highly reflective material in construction. Metal surfaces should be painted in natural soft colours (Aloe Green) that would blend in with the environment. • Introduce trees to the landscape at strategic locations (sensitive receptors) to break full exposure of the shafts. Further analyses and stakeholder engagement will be required for this commitment.
Processing plant / infrastructure areas	**Soils / Land Use & Capability**	Soil impacts as a result of poor hydrocarbon management and spillages	• Develop and implement hydrocarbon management procedure. • Reclamation of soils in the event of accidental spillages.

Activity	Environmental Aspect	Potential Impact	Mitigation Measures
		Surface disturbance caused by infrastructure	• Dismantling of infrastructure. • Final rehabilitation of disturbed areas. • Rehabilitation of dams and storm water drainage.
Processing plant / infrastructure areas	**Surface water**	Water quantity impact due to decreased surface runoff	• Optimisation of the storm water management plan and positioning of infrastructure during the Feasibility Phase. • Separation of clean and dirty water systems (stream diversions) to minimise impact on runoff.
		Water quality impact on Mutamba and Nzhelele Rivers	• Directing and containment of dirty water runoff in dirty water dams and providing silt traps. • Recycling (reuse) of dirty water in process. • The dirty water dam will be designed for the 1:50 year flood-event and HDPE lined to prevent discharges / seepage into the surface water resources.
		Water quality impacts as a result of poor hydrocarbon management and spillages	• Develop and implement hydrocarbon management procedure. • Bulk facilities to be concrete lined and bunded to capacity of 110%.
		Impact on wetland areas and aquatic ecosystems	• Maintain a buffer zone of 100 m from the 1:100 year flood-line of major drainage lines to reduce impact on aquatic systems. • Reposition surface infrastructure to avoid drainage lines and sensitive wetlands systems. • Implement aquatic (bio) monitoring.
Processing plant / infrastructure areas	**Groundwater**	Water quality impacts due to infiltration of dirty water from the plant and infrastructure areas	• Dirty water dams to be plastic (HDPE) lined to prevent groundwater contamination. • Carbonaceous plant stockpile areas to be appropriately lined with dedicated dirty water drainage from the stockpile to prevent groundwater contamination. • Dirty water canals in the infrastructure areas to be concrete lined to prevent groundwater contamination.
Processing plant / infrastructure areas	**Air quality**	Air quality impacts associated with processing activities and movement of vehicles	• Reduction of drop height to reduce the dispersion of materials being transferred, and increase in moisture content (water sprays). • Plant and access roads to be surfaced or treated with dust palliatives such as Dustex.
		Dust impact caused by crushing and screening operations	• Introduce dust suppression systems, either in the form of water sprays or cladding in order to reduce the potential emissions. • Reduce vehicle speed on unpaved roads to limit dust creation.

Activity	Environmental Aspect	Potential Impact	Mitigation Measures
Processing plant / infrastructure areas	**Noise**	Elevated noise levels caused by crushing and processing activities	• Rubber vulcanised belt – less noisy / vibration. • Cladding of crushing and screening plants and noisy equipment – encapsulation in buildings, acoustic covers, screens or sheds. • Noise suppression devices on heavy vehicles / crushing equipment. • Low noise generator sets will be used in plant. • Employees / contractors working in areas where the 8-hour ambient noise levels exceed 85 dBA shall wear ear protection equipment.
Processing plant / infrastructure areas	**Visual / aesthetics**	Processing plant will have a visual impact as a result of high buildings	• Avoid the use of highly reflective material in construction. • Metal surfaces should be painted in natural soft colours (Aloe Green) that would blend in with the environment.
Processing plant / infrastructure areas	**Lighting**	Sky glow effect will have an impact on the sense of place at night	• Use specifically designed lighting equipment that minimises the upward spread of light near to and above the horizontal. Care should be taken when selecting luminaries to ensure that appropriate units are chosen and that their location will reduce spill light and glare to a minimum. • Keep glare to a minimum by ensuring that the main beam angle of all lights directed towards any potential observer is not more than 70°. Higher mounting heights allow lower main beam angles, which can assist in reducing glare. In areas with low ambient lighting levels, glare can be very obtrusive and extra care should be taken when positioning and aiming lighting equipment. • Covering of high lighting masts to reduce the glow. • Suppress dust forming to minimise the effect of sky glow during night.
		Impact on invertebrates	• Long-wavelength light sources should be used, e.g. low-pressure sodium vapour lights.
On-site conveyance of ROM and product	**Air Quality**	On-site conveyance will increase the ambient air quality	• Application of dust suppression (Dustex) on internal haul roads. • Surfacing of access road and main haul roads. • Water sprays at stockpiles and transfer points. • Water misters will be installed at strategic points at the transfer points along the conveyors in order to abate dust emission. • Vehicle speed on unpaved roads limited to prevent dust creation. • Conveyor design to include 'dogsheeting' on top and along the prevailing wind direction sides to minimise dust generation. • Use of appropriate plant operation and material handling techniques, good maintenance and housekeeping. Therefore the implement measures to minimise the generation and dispersion of dust and surface disturbances. • Employ latest technology to reduce vehicle exhaust gas emissions.

Activity	Environmental Aspect	Potential Impact	Mitigation Measures
On-site conveyance of ROM and product	**Surface water**	Stream crossings (road and conveyor) could potentially impact on the stream flow and lead to stream flow reductions downstream	• Design crossings for 1:20 year flood to minimise effect of damming of water upstream. No permanent retention of water in river at crossings. • Avoid sensitive wetland systems as far as possible.
		Spillages along conveyors/roads could impact on water quality	• Regular inspections will be implemented for early detection of spillages. Cleaning up of any spillages that may have occurred. • All conveyors to be fully enclosed for zero spillage over all stream crossings. • Conveyors covered to deflect rain water away from conveyor belt. • Installation of primary and secondary scrapers ensures that there is continuous contact between the scrapers and the belt which will prevent spillages on the return belt.
On-site conveyance of ROM and product	**Noise**	Elevated noise levels caused by trucking and conveying activities	• Rubber vulcanised belt – less noisy / vibration. • Maintenance of vehicles. • All equipment selection to fall in line with permissible noise dBA. • During the selection of the main components and equipment of the proposed undertaking as a whole, installation of alternative low-noise generating makes and models will be considered. • Noise suppression devices on heavy vehicles / conveying equipment.
On-site conveyance of ROM and product	**Soils / Land Use & Capability**	Surface disturbance caused by infrastructure	• Dismantling of infrastructure. • Final rehabilitation of disturbed areas and storm water drainage.
Mine residue stockpiles	**Groundwater**	Impact of carbonaceous stockpiles on groundwater resources	• Carbonaceous stockpiles to be appropriately lined with a sub-surface drainage system. • Stockpiles to be compacted, properly capped and revegetated to reduce recharge. • Stockpiles slopes to be designed such to increase runoff whilst preventing erosion. • Carbonaceous stockpiles to be disposed in-pit as far as possible at closure to minimise final footprint of surface carbonaceous stockpiles.
Mine residue stockpiles	**Surface water**	Impact on non-perennial streams cutting through mining areas leading to decrease in runoff	• Optimisation of the storm water management plan and re-positioning of stockpiles during the Feasibility Phase. • Diversion of non-perennial streams around stockpile areas to minimise decrease in surface runoff.
		Impact on wetland areas and aquatic ecosystems	• Maintain a buffer zone of 100 m from the 1:100 year flood-line of major drainage lines to reduce impact on aquatic systems. • Reposition stockpiles to avoid drainage lines and sensitive wetlands systems. • Implement aquatic (bio) monitoring.

Activity	Environmental Aspect	Potential Impact	Mitigation Measures
		Increased sedimentation in drainage lines due to uncontrolled surface run-off and erosion	• Side slopes of stockpiles to be protected and vegetated to prevent erosion. • Construction of energy dissipating structures along steep slopes.
		Water quality impacts as a result of dirty water runoff / seepage from carbonaceous stockpiles	• Dirty water / seepage to be collected in lined facility and recycled to dirty water dams for use in process.
Mine residue stockpiles	**Visual / Aesthetics**	Large stockpiles will impact on the landscape	• In-pit disposal as far as possible. • Stockpiles to be protected and vegetated to reduce visual impact. • Landscaping of stockpiles to minimise impact – avoid straight lines and design contoured stockpiles that represent the natural lines of the existing topography.
Mine residue stockpiles	**Air quality**	Increase dust emissions as a result of stockpiles	• Compaction by heavy vehicles used for stockpile operations. • Stockpiles to be vegetated to reduce dust emissions.
Mine residue stockpiles	**Noise**	Noise from stockpile construction leading to the main contributing factors to the noise at the sensitive receptors, especially at night-time	• Noise suppression devices on heavy vehicles and other noisy equipment. • Alternative reverse hooting systems will be implemented to reduce the noise levels.
Off-site conveyance of product - conveyor system between Mount Stuart & Generaal	**Safety**	Road / conveyor crossings could lead to safety risks to road users	• Appropriate crossings (under or over-passes) will be designed to eliminate the safety risks. • The conveyor route will be fenced off to prevent people and animals from going onto or across the conveyor.
Off-site conveyance of product - conveyor system between Mount Stuart & Generaal	**Surface water**	Stream crossings where culverts may concentrate flow, leading to enhanced flow velocities and associated erosion problems	• Design crossings for 1:20 year flood to minimise effect of damming of water upstream. No permanent retention of water in river at crossings. • Construct the necessary erosion control measures at these crossings to reduce the impact. • Avoid sensitive wetland systems as far as possible.
		Potential for water quality impacts due to dirty runoff and spillages along the conveyor	• Regular inspections will be implemented for early detection of spillages. Cleaning up of any spillages that may have occurred. • All conveyors to be fully enclosed for zero spillage over all stream crossings. • Conveyors covered to deflect rain water away from conveyor belt. • Installation of primary and secondary scrapers ensures that there is continuous contact between the scrapers and the belt which will prevent spillages on the return belt.
Off-site conveyance of product - conveyor system between Mount Stuart & Generaal	**Noise**	Increase of ambient noise levels along the conveyor route	• Cladding of conveyor drives and other noisy equipment – encapsulation in buildings, acoustic covers, screens or sheds. • Rubber vulcanised belt – less noisy / vibration. • Noise suppression devices on conveying equipment.

Activity	Environmental Aspect	Potential Impact	Mitigation Measures
Off-site conveyance of product - conveyor system between Mount Stuart & Generaal	**Air quality**	Increase of dust emissions along the conveyor route	• Dust fallout monitoring points will be established along the conveyor route to detect an increase in emissions. • Regular inspections will be done along the conveyor route to detect and clean any spillages from the conveyor.
Off-site conveyance of product - conveyor system between Mount Stuart & Generaal	**Biodiversity**	Land units will be divided into smaller units which may not be ecologically viable	• Re-route conveyor to align with existing disturbed corridors, i.e. road/power line servitudes, fences. This will be finalised during the Feasibility Phase. • Animal crossings (underpasses) will be created along the conveyor for animals and domestic livestock, if the route cannot feasibly be re-routed.
		Potential impact on protected flora species identified along the route	• The conveyor route will be diverted to prevent impact to specific protected species, e.g. baobabs, impala lilies. • Where possible, the species that cannot be avoided will be rescued and relocated as per the Rescue & Relocation Plan.
		Creation of additional corridors which could lead to increased poaching	• Establishment of an anti-poaching unit in conjunction with adjacent landowners and communities. • Fencing (game fence) of the conveyor for safety and access control.
		Killing of animals crossing the conveyor	• The conveyor will be fenced off to prevent animals from going onto the conveyor system.
Rail link to main TFR railway line	**Safety**	Road / rail crossings could lead to safety risks to road users	• Appropriate crossings (under or over-passes) will be designed to eliminate the safety risks. • The rail link will be fenced off to prevent people and animals from going onto or across the railway line.
Rail link to main TFR railway line	**Surface water**	Stream crossings where culverts may concentrate flow, leading to enhanced flow velocities and associated erosion problems	• Design crossings according to TFR standards – design flow rate 1:50 year flood event – to minimise effect of damming of water upstream. No permanent retention of water in river at crossings. • Construct the necessary erosion control measures at these crossings to reduce the impact. • Avoid sensitive wetland systems as far as possible.
Rail link to main TFR railway line	**Surface water**	Potential for water quality impacts due to dirty runoff and spillages along the rail link	• Regular inspections will be implemented for early detection of spillages. Cleaning up of any spillages that may have occurred.
Rail link to main TFR railway line	**Noise**	Increase of ambient noise levels along the rail route	• Rail line to be flush-welded to reduce noise. • Diesel locomotives to operate at slower speed along the rail link. • Noise attenuation berms should be constructed at sensitive receptors closest to the rail link in cooperation with the landowners and/or communities.

Activity	Environmental Aspect	Potential Impact	Mitigation Measures
Rail link to main TFR railway line	**Air quality**	Increase of dust emissions along the rail link	• Dust fallout monitoring points will be established along the rail link to detect an increase in emissions. • Regular inspections will be done along the rail route to detect and clean any spillages that could lead to increased dust levels. • Use of low sulphur grade fuels.
Rail link to main TFR railway line	**Biodiversity**	Land units will be divided into smaller units which may not be ecologically viable	• Align rail link with existing disturbed corridors, i.e. roads, fence lines. This will be finalised during the Feasibility Phase. • Animal crossings (underpasses or level-crossings with cattle grid) will be created along the rail link for animals and domestic livestock.
		Potential impact on protected flora species identified along the route	• The rail route will be diverted to prevent impact to specific protected species, e.g. baobabs, impala lilies. • Where possible, the species that cannot be avoided will be rescued and relocated as per the Rescue & Relocation Plan.
		Creation of additional corridors which could lead to increased poaching	• Establishment of an anti-poaching unit in conjunction with adjacent landowners and communities. • Fencing (game fence) of the rail link for safety and access control.
		Killing of animals crossing the rail line	• The rail link will be fenced off to prevent animals from going onto the track. • Animal crossings (underpasses or level-crossings with cattle grid) will be created along the rail link for animals and domestic livestock.

Off-site conveyance of product by truck (in emergencies)	**Safety**	Road transport of product will impact on the traffic along the route, safety risk to road users	• Implementation of Community Safety and Traffic Management Procedure, including:
			  ○ Upgrading of road intersections.
			  ○ Other traffic calming measures identified during the LOM.
			  ○ Maintaining vehicle speeds.
			  ○ Covering of vehicles when in motion, both for loaded and unloaded vehicles.
			  ○ Switching on head lights of trucks.
			• Due notification to the surrounding landowners and communities in the event of emergency trucking.
			• Implement a Traffic Awareness Programme within the surrounding communities.

Off-site conveyance of product by truck (in emergencies)	**Biodiversity**	Killing of animals and avifauna on the roads, especially nocturnal animals/birds	• Maintaining vehicle speeds. • Trucking during daylight hours only. • Implement an Environmental Awareness Programme for trucking contractor.

Activity	Environmental Aspect	Potential Impact	Mitigation Measures
Off-site conveyance of product by truck (in emergencies)	**Surface water**	Potential for water quality impacts due to spillages and dirty runoff into the streams	• Regular inspections will be done along the route to detect and clean any spillages from the trucks. • Emergency procedure to be developed and implemented in the event of any spillage / accident along the route. • Covering of vehicles when in motion, both for loaded and unloaded vehicles.
Off-site conveyance of product by truck (in emergencies)	**Air quality**	Material and product loss from trucks	• Gravel roads to be surfaced or treated with dust palliatives such as Dustex. • Covering of vehicles when in motion, both for loaded and unloaded vehicles. • Regular inspections will be done along the route to detect and clean any spillages from the trucks.
Off-site conveyance of product by truck (in emergencies)	**Noise**	Increase of ambient noise levels along the route	• Noise suppression devices on transport trucks. • Trucking during daylight hours only.

Table 46: List of all potential socio-economic impacts for the Generaal Project with proposed mitigation measures

Social Aspect	Potential Impact	Mitigation Measures
Demographic and Population Impacts	Influx of work seekers into the area	• Optimise the use of local labour as far as possible. Establishing early on skills development programmes in the local area will support to possibility of finding skilled people locally. • Development and Implementation of an Influx and Land Use Management Plan. • Develop a code of conduct with which contractors and their employees must comply. The code should deal with the interaction with local communities and substance abuse among other things. • Develop a Stakeholder Engagement Plan (SEP) which clarifies the principles of engagement with community and other stakeholders, sets in place appropriate liaison forums (a community forum is recommended), and describes the grievance management procedure to be adopted by the Generaal Project. Establishment of a local labour recruitment committee to monitor recruitment procedures and results. • Communicate through media the recruitment procedures and priorities to discourage work seekers from outside the area.
Demographic and Population Impacts	Influx of construction labour with pressure on services and social structures	• Facilitate the provision of housing and associated infrastructure. Establishment of a construction accommodation camp to house those employees that cannot be sourced from the local community due to a lack of skills. • Optimise the use of local labour as far as possible. Establishing early on skills development programmes in the local area will support to possibility of finding skilled people locally. • Development and Implementation of an Influx and Land Use Management Plan. • Develop a code of conduct with which contractors and their employees must comply. The code should deal with the interaction with local communities and substance abuse among other things. • Develop a Stakeholder Engagement Plan (SEP) which clarifies the principles of engagement with community and other stakeholders, sets in place appropriate liaison forums (a community forum is recommended), and describes the grievance management procedure to be adopted by the Generaal Project. Establishment of a local labour recruitment committee to monitor recruitment procedures and results. • Develop and communicate a clear and concise employment and recruitment policy to prevent opportunistic job seekers from settling in the area. • Implementation of a programme of STD and HIV/AIDS screening, counselling and (where possible) treatment.

Social Aspect	Potential Impact	Mitigation Measures
Demographic and Population Impacts	Influx of operational workforce with pressure on services and social structures	• Contribution towards the provision of housing, infrastructure and services for operational staff. • The establishment of partnerships with other private sector stakeholders, government authorities and civil society organisations to integrate planning around the provision of services and infrastructure, and to ensure that Mine inputs in this context compliment initiatives led by other players, especially the local and district municipality. • Development and Implementation of an Influx and Land Use Management Plan. • Optimise the use of local labour as far as possible. Establishing early on skills development programmes in the local area will support to possibility of finding skilled people locally. • Induction of contractors and workforce with regard to their code of conduct in the local communities. • Develop and communicate a clear and concise employment and recruitment policy to prevent opportunistic job seekers from settling in the area. • Implementation of a programme of STD and HIV/AIDS screening, counselling and (where possible) treatment. • Continuous assessment and monitoring of infrastructure and services capacity in focal points (assessment every 5 years). • Determine scale of assistance required at focal points and enter into an agreement with the municipality. • Establish a development, infrastructure and service monitoring forum with the municipality to continuously assess and monitor capacity, determine assistance required and oversee implementation.

Social Aspect	Potential Impact	Mitigation Measures
Demographic and Population Impacts	Influx of people and the development of spontaneous settlements near project facilities, in the nearby communities and surrounding areas	• Develop a Community Development Plan which addresses issues relating to provision of housing for the workforce through on-going communication and engagement between the mine and local authorities for implementation of this plan. • Develop and adoption of an Influx Management Plan in consultation with the local government that outlines proactive management measures to discourage and manage influx, outlines and refines relevant stakeholders and their roles and responsibilities and the way in which each role-player intends to manage influx and spontaneous settlements. • Support the compilation of a development master plan, in cooperation with relevant local and regional authorities for the Musina and Makhado areas, whereby new development areas for workers' and new arrivals' accommodation will be catered for and duly planned. • Support local government capacity for integrated development planning. • Develop and communicate a clear and concise employment and recruitment policy to prevent opportunistic job seekers from settling in the area. • Continuous assessment and monitoring of infrastructure and services capacity in focal points (assessment every 5 years). • Determine scale of assistance required at focal points and enter into an agreement with the municipality. • Establish a development, infrastructure and service monitoring forum with the municipality to continuously assess and monitor capacity, determine assistance required and oversee implementation.
Demographic and Population Impacts	Conflicts arising at the end of construction due to the termination of job opportunities for contractors	• Investigate the possibility of transferring labour from one operation to another – depending on the phasing of the projects. • Develop the MbeuYashu grievance procedure to capture and address grievances arising due to retrenchments and downscaling. • Ensure compliance with all applicable Labour Regulations of South Africa. • Consider compliance with Best Practice, i.e. IFC's Performance Standard 2 "Labour and Working Conditions". • Monitoring of all contractors and sub-contractors for compliance with the above standards, with contractually-established financial sanctions for observed non-compliances. • Communicate the termination conditions to the communication structure established. • Communicate the termination conditions to all employees – including contractors and sub-contractors.

Social Aspect	Potential Impact	Mitigation Measures
Health and Social Wellbeing	Increased chances of the spread of communicable diseases such as HIV/AIDS and STDs linked to influx of predominantly male job-seekers and workers	• Develop a comprehensive HIV/AIDS and STD program to employees through employee wellness programmes which should include prevention, voluntary counselling for HIV testing, as well as anti-retroviral treatment for employees. • Develop a Community Health Action Plan which focuses on HIV/AIDS, tuberculosis. • Repeated awareness campaigns that is focused beyond employees and includes contractors and the communities near project facilities.
Health and Social Wellbeing	Safety and Risk Exposure through an increase in crime	• Increased security on mine premises. • Construction and permanent workers are identified and marked with clear identifiable clothing. • Code of Conduct to form part of induction of new workers with a clear statement and procedure regarding access, conduct and identification. All construction workers should wear clothing marked (and reflective vests) with the logo of the construction firm/contractor or sub-contractor as well as identification cards that cannot be easily forged, so that they can be easily recognized as being legitimate. • Workers to be screened including criminal background checks. • Properly constructed and secured fences can control access to construction sites. Implementing strict access control of the project site and specifically the contractors' workforce camp. • Workers should be urged to recognize and report suspicious activity and signs of burglary and be informed of crime prevention measures that they themselves can take. • Employment of local people on the mine to improve the poverty levels in the host and neighbouring communities. • MbeuYashu to liaise with existing community policing forums and project security to properly secure the project area and surrounding area. • Investigate the implementation of an anti-poaching unit in collaboration with local stakeholders, policing forums and police.

Social Aspect	Potential Impact	Mitigation Measures
Health and Social Wellbeing	Safety and Risk Exposure due to an increase in poaching on neighbouring game farming properties	• Establishment of an anti-poaching unit available to adjacent land owners, and establishing a security forum in collaboration with these land owners. Land owners are to be actively involved in the selection of the contracting company employed to conduct anti-poaching in the area. • Increased security measures (fencing, access control and monitoring) on mine premises. Properly constructed and secured fences can control access to construction sites. Implementing strict access control of the project site and the contractors' workforce camp. Curfew times to be established in accommodation areas. Construction workers accommodated on mine are identified and marked with clear identifiable clothing. • Code of Conduct to form part of induction of new workers with a clear statement and procedure regarding access, conduct and identification. All construction workers should wear clothing marked (and reflective vests) with the logo of the construction firm/contractor or sub-contractor as well as identification cards that cannot be easily forged, so that they can be easily recognized as being legitimate. • Workers to be screened including criminal background checks. • Employment of local people on the mine to improve the poverty levels in the local communities.
Quality of Living Environment	Change in "sense of place"	• Regular and effective engagement with stakeholders through the SEP. • An effective grievance management procedure managed within the framework of the SEP. Grievance mechanisms must be in place throughout the life of the mine, including for a determined period post-closure, to address any impact for affected communities. • Implementation of traffic management measures. • Implementation of mitigation measures for noise. • Implementation of visual barriers and other mitigation measures as recommended in the visual study. • Colour schemes must complement the local environment. • Minimising disturbance to vegetated areas outside the critical development areas where possible. • Revegetation/rehabilitation of disturbed sites in parallel with development. • Successful mitigation interventions can reduce the intensity of the impact to at least moderate and ultimately moderate-low levels. If grievances are addressed adequately, and communication and engagement is effective affected communities may be able to adjust more easily to the changes.
Quality of Living Environment	Disruption of Social Networks and decrease in Social Capital	• Employment of local people already part of the community. • Code of conduct to form part of induction for all new workers. • Grievance Procedure within the local communities.

Social Aspect	Potential Impact	Mitigation Measures
Quality of Living Environment	Perceptions of and Feelings in relation to the project	• Establish on-going Consultative Forums with concerned groups to air concerns, find possible mitigation measures for their perceived impacts, solutions to co-existence and monitor implementation and effectiveness of mitigation measures. • Continuous communication with all stakeholders providing information on anticipated impacts and planned mitigation measures.
Family and Community Impacts	Impacts on land owner and labourers	• Development of a land acquisition and lease policy defining the negotiation process to minimize the feelings of uncertainty. • Financial compensation of affected property owners/tenants, employees and their families in terms of the relevant legislation. • Displacement of workers and their dependents requires an equitable policy, principles, financial guidelines and clarification of operational approaches. • Land Acquisition, lease and compensation agreements reached with affected landowners that include arrangements and measures for labour tenants.
Family and Community Impacts	Change processes and impacts related to daily movement patterns	• The project description defines that no hauling will take place along existing farm roads or regional / national roads. It is planned that the run-of-mine (ROM) coal will be transported for short distances by truck, on the in-pit haul roads to the crushing and screening facilities. The crushed and screened ROM product will be transported to the coal beneficiation plant via conveyor. It is further planned that the product will be loaded directly onto trains at the Rail Load-out Terminal which links up with the existing Musina-Makhado railway line. • Therefore only supplier light-vehicles and employee busses will disrupt movement patterns, these will stabilize once the mine is fully operational.
Family and Community Impacts	Conversion of land use	• Acquisition and or leasing of directly impacted land. • Fair compensation negotiated and agreed with land owners that will lose agricultural land. • Continuous consultation with landowners discussing co-existence and feasibility. • Educate landowners in terms of their rights and responsibilities prior to the construction phase. • Assist landowners in identifying ways to adapt their land uses, to the benefit of both the landowner and MbeuYashu. • Implement a consultation programme with regional stakeholders in the development of a closure plan and rehabilitation programme. • Determine the regional needs and characteristics to ensure post mining use of land enhances the regional characteristics.

Social Aspect	Potential Impact	Mitigation Measures
Institutional/Legal/Political/ Equity Impacts	Challenge to local government capacity	• Intensive engagement between MbeuYashu / CoAL and the municipality well in advance of construction. In this context the responsibilities of local government should be well understood, and potential problems defined and addressed as early as possible. • Establishment of a limited and time-bound municipal support function. MbeuYashu / CoAL should contribute funding and appropriate technical resources. The participation of other major mines and industries in the area should be promoted by both MbeuYashu / CoAL and the local municipality.
Institutional/Legal/Political/ Equity Impacts	Participation and Consultation in process	• Provide transport and/or reimbursement to the Historical Disadvantaged Communities. • During the Operational phase, the structures established for participation should have a proper constitution that addresses reimbursement of costs. • Arrangement of meetings in proximity to the mine or in affected communities to minimize the distance of directly affected parties to travel. Cluster meetings together on the same day or over 2 days to minimize disruption of personal schedules.
Institutional/Legal/Political/ Equity Impacts	Impact equity	• Tax and Profit benefits must be ploughed back into the Local Municipal areas and immediate communities. • Employment should be prioritized to local communities. • Local beneficiation programmes to be investigated and implemented.
Socio-economic Wellbeing	Increase in South African GDP and Trade Balance	• Procure goods and services from South African suppliers as far as possible. • Procure ancillary services for goods procured abroad, such as installation, customisation and maintenance, from South African companies as far as possible.
Socio-economic Wellbeing	Increase in provincial and local GDP	• Procure goods and services from local or provincial suppliers as far as possible. • Procure ancillary services for goods purchased from outside of the Limpopo Province, such as installation, customisation and maintenance, from local or provincial companies as far as possible.
Socio-economic Wellbeing	Increase in government revenue	• None

Social Aspect	Potential Impact	Mitigation Measures
Socio-economic Wellbeing	Increase in employment, income and skills development	• Aim to use local workers as far as possible and formalise this policy in contracts. • Consider implementing labour-intensive rather than capital-intensive work methods wherever possible. • Procure resources from local sources wherever possible. • Establish a database of local people with information on qualifications and skills, utilize this database to develop skills plans and recruit local people. • Implement early on skills development programmes in the areas where most job opportunities will be created, i.e. operators and drivers. • Include training for general life skills such as financial management and health. • Implement portable skills development programmes. • Design and implement economic development programmes that will assist people being retrenched in sustaining their livelihoods. • Establish a future forum with representation from the workforce to discuss potential difficulties and solutions. • Implementation of programmes to minimize and mitigate the impact of downscaling and retrenchment.
Socio-economic Wellbeing	Impact on existing businesses in surrounding areas	• Devise a compensation plan for direct impacts of mining on adjacent farms, such as loss or pollution of land. • Screen mining activities from the adjacent farms and the main access road to minimize the impact on the general sense of place and tourists. • Identification of employees that may lose their employment and enrol in skills programme.
Socio-economic Wellbeing	Change in property values	• Attempt to minimize impacts through implementation of mitigation strategies focusing on aspects that may affect tourism characteristics including traffic, noise, and visual aspects such as screening mining activities from the adjacent farms and the main access road to minimize the impact on the general sense of place. • Establish a baseline of property values by conducting baseline valuations on representative properties and providing such to landowners, thereafter conducting monitoring valuations in periods of 5 years or as may be agreed with landowners. • Establish a communication channel with direct adjacent land owners to address impacts and grievances. • Adopting principles of good corporate citizenship focused on conservation of natural resources such as water, biodiversity, etc. Inclusion of these principles and actions into information disseminated in the local area (“how mining can be done differently”).

Social Aspect	Potential Impact	Mitigation Measures
Socio-economic Wellbeing	Decrease of visitors, tourists and hunting parties	• Attempt to minimize impacts through implementation of mitigation strategies focusing on aspects that may affect tourism characteristics including traffic, noise, and visual aspects such as screening mining activities from the adjacent farms and the main access road to minimize the impact on the general sense of place. • Collaborate with local stakeholders in terms of regional planning to ensure certain areas are protected for tourism and hunting activities. • Adopting principles of good corporate citizenship focused on conservation of natural resources such as water, biodiversity, etc. Inclusion of these principles and actions into information disseminated in the local area ("how mining can be done differently").
Socio-economic Wellbeing	Equity Participation of the Local Communities	• Ensure communities are fully involved and properly represented in the structures. • Ensure capacity is built at an early stage for communities to understand how equity and dividends work. • Place protective measures in place that will shield the communities from any business risk or liabilities.
Socio-economic Wellbeing	Participation of local business in procurement opportunities	• Ensure communities are fully involved and understand the local procurement policy and procedure. • Ensure capacity is built at an early stage through enterprise development to enable local business to participate in opportunities. • Identify local only opportunities that are reserved for local business.
Socio-economic Wellbeing	Decline in South African GDP and Trade Balance at Decommissioning	• None
Socio-economic Wellbeing	Decline in provincial and local GDP at decommissioning	• Actively promote the development of different economic sectors from an early stage, e.g. through incentivising other industries to locate in the area, providing adequate infrastructure and promoting an increase and diversity of skills in the local population. • Actively engage with a range of stakeholders throughout the life-of-mine to discuss potential consequences of mine closure and possible mitigation. • Incorporate measures to retrain workers in the Social and Labour Plan.
Socio-economic Wellbeing	Decline in government revenue at Decommissioning	• None
Socio-economic Wellbeing	Decline in employment, income and skills development at decommissioning	• Aim to use local workers as far as possible and formalise this policy in contracts. • Consider implementing labour-intensive rather than capital-intensive work methods wherever possible. • Purchase resources from local sources wherever possible. • Institute training programmes for local workers to raise skills levels. • Include training for general life skills such as financial management and health.

Social Aspect	Potential Impact	Mitigation Measures
Vulnerable Group Impacts	Gendered Division of labour	• Women must have equal employment opportunities. • Training and skills development for women. • Salaries of women must be equal to that of men. • Establish opportunities that are suitable for women employment. • Implement measures to enable working environment for women. • Establishing gender-sensitive policy positions, such as for cultural heritage, employment and business development. • Mainstreaming gender into project planning, particularly for community development. • Using gender-sensitive indicators, such as employment data disaggregated by gender. • Consultation with national women's organizations.
Vulnerable Group Impacts	Potential Infringements on Historically Disadvantaged People's Human Rights	• Focusing local benefits on those communities previously disadvantaged to ensure upliftment. • Enter into agreements with local communities to address post closure land use and sustainability. • Optimization of local employment to minimize impacts of external or migrant workers on the local communities.

9 STAKEHOLDER ENGAGEMENT

The report on the results of consultation with communities and Interested and Affected Parties (IAPs) is attached as ANNEX-11 (Naledi Development, 2014). This document presents the results of the Consultation with landowners, lawful occupants, communities and IAPs in terms of the MPRDA for the Generaal Project NOMR application. Compliance with other South African legislation will not be done in parallel but will follow a staggered process, which will only commence after compliance with the MPRDA is complete.

The consultation process of the GSP is subject to a newly developed MbeuYashu Stakeholder Policy, whose primary aim is to create sustainable value for all stakeholders, while recognising that stakeholders contribute, create and develop, together with the MbeuYashu's management, the company for its advantage and success. The company seeks to earn its social licence to operate through its engagement processes with its key stakeholders.

This policy was benchmarked against international best practice, and included the principles of inclusivity, mutuality, materiality and open and collaborative engagement. The adherence to ensure compliance has not been compromised through the process.

The following aspects are addressed in the Stakeholder Engagement Policy and are only highlighted here:

- The foundation for the policy is the Company Vision and the Management Commitment to sustainable development and participatory co-operative governance;
- The policy is based on global and local frameworks (compliance with South African legislation), guidelines and standards;
- Changing expectations and the role of business in society;
- Emerging and latest thinking on Stakeholder Engagement theory and practice;
- Changes in cultures and behavior; and
- Reflections, thinking and discussion with internal role players.

Public participation provides the opportunity for IAPs to participate on an informed basis, and to ensure that their needs and concerns are considered during the impact assessment process. In so doing, a sense of ownership of the project is vested in both the project proponent and interested or affected parties. The Public Participation Process is aimed at achieving the following:

- Striving for adherence to best practice and international standards;
- Compliance with the MPRDA and its Regulations;
- Encourage involvement and participation in the Environmental Specialist Studies and process for authorization;
- Provide opportunities for IAPs and the authorities to obtain clear, accurate and understandable information about the expected environmental and socioeconomic impacts of the proposed development;
- Establish a formal platform for the public with the opportunity to voice their concerns and to raise questions regarding the project;

- Utilise the opportunity to formulate ways for reducing or mitigating any negative impacts of the project, and for enhancing its benefits;
- Enable MbeuYashu to consider the needs, preferences and values of IAPs in their decisions;
- Clear up any misunderstandings about technical issues; and
- Provide a proactive indication of issues which may inhibit project progress resulting in delays, or which may result in enhanced and shared benefits.

The following methodology was utilised:

- Establishment and maintenance of the IAP Register and Landowner Register (ANNEX-11: Appendix A1).
- Announcement of Project Activities via letters (emailed, faxed, posted and hand-delivered), SMS's, advertisements, and on site notices (ANNEX-11: Appendix A2, A3 & A4).
- Notification of the availability of Project Documentation such as the Background Information Document, Scoping Report and EIA/EMP Report (ANNEX-11: Appendix A2, A3 & A4).
- Arrangement and Facilitation of Engagement Sessions and Public Meetings (ANNEX-11: Appendix A5) which included Landowner structure meetings (i.e. Landowner & Water User Forum and Vhembe Mineral Resources Stakeholder Forum, Community meetings, Land Claimant meetings and meetings with other IAPs).
- Recording, Considering and Responding to Comments, Issues and Inputs from IAPs (ANNEX-11: Appendix A6 & A7).

The main comments and responses raised throughout the Public Participation Process focused on the following aspects:

- Water scarcity / availability for mining
- Surface & groundwater impacts (quantity and quality)
- Biodiversity, Sensitive and Protected Areas
- Conservation value and initiatives of the area
- Heritage and Cultural Resources, Sensitivity of Graves / Consultation with next of kin
- Cumulative impacts
- Noise and dust pollution
- Visual and aesthetic value of the area / Sense of place
- Impacts on existing land use, intensive irrigation, citrus production
- Land value, compensation
- Impact on Property Values of neighbouring properties
- Consultation process
- Phasing of project (schedule of larger GSP)
- Sustainability of land use options in the short and long term
- Potential changes in social structure and character of the area, due to the influx of work-seekers and illegal immigrants to the area
- Job creation, procurement opportunities
- Equity / Community ownership in project
- Finalisation of land claim validation process
- Safety and Security

10 ADEQUACY OF PREDICTIVE METHODS AND KNOWLEDGE GAPS

10.1 ACCESS CONSTRAINTS

A number of properties could not be accessed for specialist surveys for a number of reasons, as summarised below:

- Area surveyed – 63%
- Area partially surveyed – 18%
- No access – 19%

The mining and infrastructure footprint areas for the Generaal and Mount Stuart Sections were accessible (surveyed) for 100% and 65% respectively of the total footprint area.

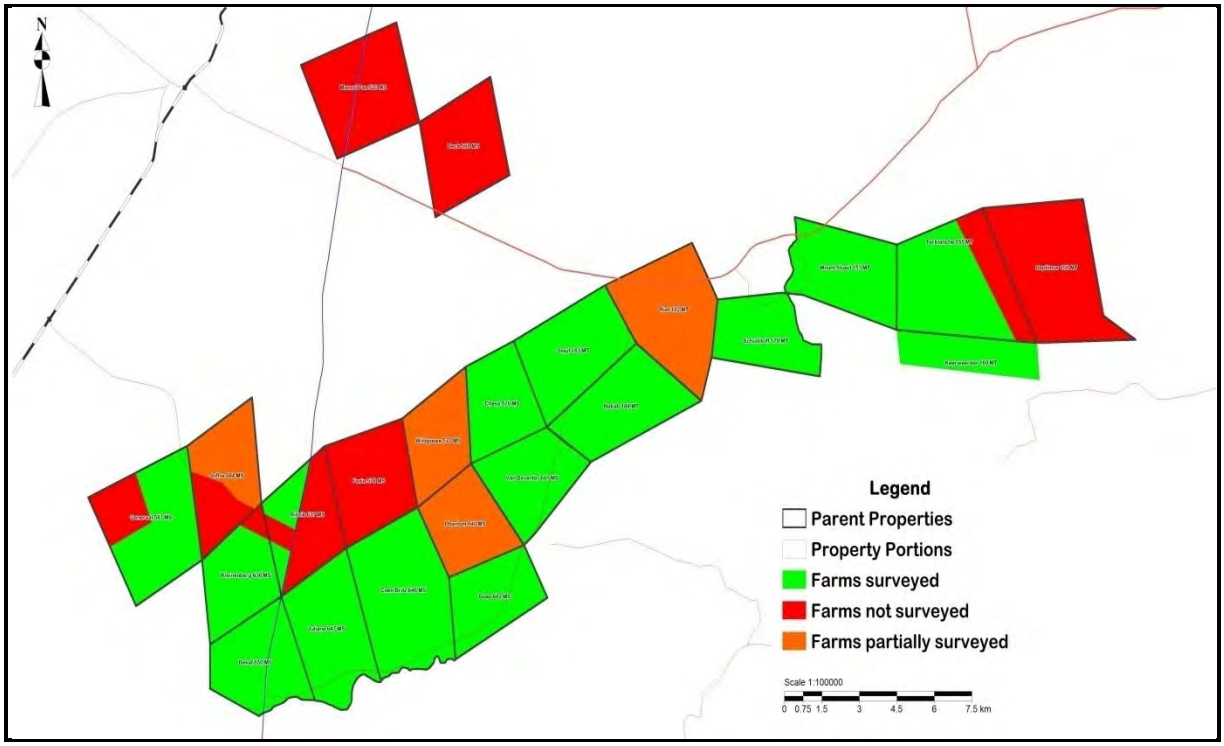


Figure 100: Properties accessed during specialist investigations

10.2 TIME CONSTRAINTS

In order to obtain a comprehensive understanding of the dynamics of the communities and status of the endemic (rare or threatened species in an area), ecological studies should be ideally replicated over several seasons and over a number of years. However, due to time constraints imposed by the MPRDA, such long-term studies are not always feasible and the specialist surveys were only conducted in one season (dry winter season).

Due to the arid climate with a very dry winter, the vegetation is deciduous, with only a few tree species retaining leaves. The herbaceous layer is absent, which limits the effectiveness of conducting vegetation surveys. An early spring (within a few weeks of the first rainfall) and mid to

late summer survey is strongly recommended due to the scale of the project. This resulted in numerous constraints to sampling and the effectiveness of a applying a multivariate community analysis as per the terms of reference. Data collected is thus considered to be incomplete at this point in time.

Aquatic, wetland and riparian ecosystems are dynamic and complex. Some aspects of the ecology of these systems, some of which may be important may have been overlooked. The findings of this study were largely based on a single site visit undertaken late in the low flow season at a time when extremely low flows were being experienced. A more reliable assessment would have required that seasonal assessments take place with at least one assessment in the high flow season also undertaken.

It is therefore recommended that further detailed biodiversity surveys be conducted during the Feasibility Phase to determine additional species that may have been omitted and to clarify indeterminate species that may be resolved during their flowering seasons, i.e. early-mid spring (September – November, after first rains) and late summer (March - April). The same applies for the surface water and aquatic surveys in order to collect intermediate-high flow data/events.

10.3 LIMITATIONS ON AVAILABLE DATA AND IMPACT MODELLING

10.3.1 GROUNDWATER FLOW

Although, all available data was collected and utilised to develop the groundwater model, and ensure that the model presents the actual situation as accurately as possible, some limitations can be noted:

- Limited and inaccurate data on actual groundwater usage, hence abstraction estimates are based on hectares observed under irrigation. Registered and claimed water uses do not correlate with observed water use based on lands under irrigation. Since recharge to the area is low, abstraction estimates have a significant impact on water levels.
- Current water levels were only obtained from a local hydrocensus. Due to the cumulative impacts of several mining projects, current water levels need to be obtained over a broad area covering the entire impacted area.
- Data collected in a relatively wet period.
- Aquifer storage data based solely on best estimate and inflows into the bulk sample pit undertaken at Makhado. Similar data is required at the Generaal Project to calibrate projected inflows.
- The Mount Stuart underground section was only modelled down to a depth of 400m due to the size and complexity of the model.

To further improve the conceptual groundwater model and validate the conclusions made in this report, several items require additional work:

- Monitoring: Establishment of monitoring piezometers near where initial mine workings will commence. Transient state parameters of mining are at present best estimates based on data collected during the box-cut exploration at Makhado. Predictions cannot be calibrated without data collected after mining commences. Water level changes once open bit mining

begins should be used to further refine storage parameters in the groundwater model and drain conductance's used for the mine workings. These estimates will affect projections of inflows at other mines and the cumulative impacts of all mining operations in the region.

- Verification of inflows and water levels by monitoring is required to validate model after mining commences.
- Verification of abstractions especially from irrigation farmers.
- Derivation of local more detailed multilayer models at a monthly time scale for each mine once a more detailed mining plan becomes available.
- Model Sensitivity analysis: Once the model is complete with all the required information, supported by monitoring data, a sensitivity analysis needs to be undertaken to determine how sensitive the model results are to parameters with some uncertainty. This involves simulations with parameter values increased and reduced to determine how it affects the calibration results, and the confidence in the selected parameter values
- Model Verification: Model verification means comparing model results against an independent data set from that which the model was calibrated against. Monitoring data can be used, as well as the extended model data, and additional data to be obtained from farmers private records not previously submitted to the consulting team.

10.3.2 SURFACE WATER

Similarly, limited surface water flow and quality data are available for the area and due to the season (no flow) limited additional data could be gathered. Further monitoring is therefore proposed during the Feasibility Phase.

10.3.3 GROUNDWATER QUALITY

No pollution plume modelling has been performed as part of this EIA.

In addition, no geochemical testing has been done during the current EIA and the brief evaluation on the potential for AMD (Section 3.3) is based on the results of tests done previously for the Makhado Colliery Project. The conclusions drawn can only be fully confirmed with the completion of detailed testing including long-term kinetic test work.

10.3.4 AIR QUALITY MODELLING

The following assumptions were made as part of this assessment:

- The volume and height of the stockpiles and discard dumps were estimated based on previous impact assessments and the US-EPA emission models for mining activities.
- The moisture content for the different type of materials was not available therefore use was made of the moisture content values given in the US-EPA for quarrying and processing.
- Use was made of the US-EPA AP42 for all calculations as no detailed source specific information is available at the commencement of a project of this nature.

10.3.5 SOCIO- AND MACRO-ECONOMIC ASSESSMENTS

Due to a number of properties where field workers could not gain access, the necessary current land use calculations for such farming enterprises were based on assumptions made for the possible crops cultivated, or beef production according to the land carrying capacity and/or game reared for trophy or biltong hunting with or without accommodation facilities. The required information was, as far as possible, acquired, but could not be verified. Therefore, more detailed surveys are proposed for the Generaal Project area in order to validate the macro-economic result.

11 MONITORING AND MANAGEMENT OF ENVIRONMENTAL IMPACTS

A comprehensive monitoring system was developed for the Generaal Project in line with the proposals of the specialists. The objective of the environmental monitoring system is to:

- Prevent and/or minimise the environmental impact associated with the proposed mining operation;
- Ensure that the environmental management system at the Generaal Project performs according to specifications;
- Ensure conformance with the environmental objectives;
- Ensure timeous implementation of the environmental strategies and implementation programme;
- Act as a pollution early-warning system;
- Obtain the necessary data required to address knowledge gaps;
- Check compliance with license requirements; and
- Ensure consistent auditing and reporting protocols.

11.1 MONITORING REQUIREMENTS

Based on the impact assessment and risk assessment, the following aspects were identified that require monitoring.

Aspect	Issue	Purpose
Climate	Weather station	To obtain detailed weather records for the LOM
Surface water	Surface water quality	Determine any deterioration in water quality as a result of the mining related activities
	Potable water	Determine quality of drinking water
	Sewage effluent	Determine water quality of sewage effluent
	Clean water canals	Determine the sediment levels or any other contamination prior to discharge into the Mutamba River and its tributaries
	Water management infrastructure	Monitoring of condition, identifying areas that require maintenance
	Dirty water systems	Determine the water quality and long-term chemical changes in the dirty water systems
	Haul road crossings	To identify and mitigate any spillages into the clean water system
	Aquatic monitoring	To determine the impact on the aquatic ecosystems
	Riverine vegetation	To early detect impact on riverine vegetation as a result of dewatering and reduced surface runoff
Groundwater	Groundwater quality	To determine any impact on the groundwater quality as a result of mining
	Groundwater levels	To determine any impact on the groundwater levels as a result of mining
	Geochemical	To collect sufficient geochemical data to verify and quantify

Aspect	Issue	Purpose
		the geochemical models during mining
	Surface-groundwater interaction	To quantify the interaction between surface and groundwater to determine possible seepage volumes
Mine water balance	Water levels in dams	To verify water balance and volume of water stored
	Dirty water recycled	To determine volume of dirty water abstracted & recycled for processing and dust suppression
	Clean water abstraction	To determine volume of clean water abstracted
	Process flow	To determine accurate process water balance
Land use management	Concurrent rehabilitation	To determine conformance with environmental objectives for concurrent rehabilitation
	Rehabilitation plan	To ensure conformance with final rehabilitation plan
	Soil analysis	To determine any deficiencies in soil fertility prior to seeding
	Soil erosion	To pro-actively identify soil erosion in order to rectify prior to serious degradation
Biodiversity	Land use coverage / Vegetation health	To determine effectiveness of reclamation plan and long-term sustainability of vegetated areas
	Species diversity	To determine species diversity (fauna & flora)
	Landscape Function Analysis	To establish ecosystem functionality of rehabilitated areas
	Riparian condition assessment	To determine the impact on the riverine forest as a result of mining
	Alien vegetation	To monitor conformance with alien vegetation programme
Air quality	Dust outfall	To determine the levels of dust outfall as a result of the mining activities
	Particulate Matter	To determine the particular matter levels for PM_{10} and $PM_{2.5}$
Environmental noise	Noise levels	To determine the noise levels within the communities and sensitive areas
Blasting	Air blast and ground vibration	To determine the effectiveness of the blasting procedure
Waste	Waste generation & management	To determine volume of waste generated & disposed
Heritage	Heritage/cultural resources	To capture all heritage/cultural resources exposed by mining

11.2 ROLES AND RESPONSIBILITY

The Action Plan for Implementation, together with frequency and responsibility is given below:

Activity	Implementation Phase	Review / Repeat Frequency	Responsibility
Implement Rescue and Relocation Plan (flora)	Prior to mining	Annual rescue operation for areas to be disturbed in the next 12 months	Specialist to be appointed
Develop and implement Biodiversity Action Plan, including avifaunal plan	Within one year of mining	Annual review	Specialist to be appointed
Develop Rehabilitation Plan and Materials Placement Plan in line with the final mining plan	Feasibility Phase	Annual review or if major change in scheduling	Mining Dept
Reporting of rehabilitation plan • Areas disturbed • Areas levelled • Areas topsoiled/capped • Areas vegetated	Construction Phase	Monthly	Environmental Dept
Initiate alien vegetation programme	Construction Phase	Annual review	Environmental Dept
Phases 1B and 2 heritage studies	Prior to Construction Phase	Prior to new areas being disturbed	Specialist to be appointed
Heritage monitoring	Construction phase	Prior to new areas being disturbed	Archaeologist to be appointed
Identify offset programmes	Construction Phase	Annual review	Env Dept with the necessary inputs from stakeholders and specialists, as required
Revision of groundwater flow & geochemical model	During Feasibility Phase in line with final mining plans	Revise every 5 years	Specialist to be appointed
Develop detail blasting procedure in line with specialist advise	Prior to opencast mining	Ongoing review based on monitoring data	Blasting contractor
Stipulate best practice requirements in tender documentation iro emissions, noise, equipment, transport, etc.	Prior to appointment of contractors	Ongoing review as new technology becomes available	Procurement Dept
Implement environmental awareness programme	Construction Phase	Ongoing review Include in annual induction programme	Environmental Dept Human Resources
Maintenance of clean and dirty water system	Operational Phase	Weekly	Engineering Dept
Dam safety inspections of clean and dirty water dams	Operational Phase	Annually	Specialist to be appointed
Identify and clean-up of any spillages along transport routes (haul roads / rail line / overland conveyors)	Operational Phase	Weekly	Engineering Dept
Identify and report any road maintenance issues	Operational Phase	Ongoing	Engineering Dept RAL
Implement aftercare and maintenance programme for rehabilitated areas	Within 2 years of mining	Ongoing implementation as per specialist recommendations	Environmental Dept
Implement monitoring programme	Prior to mining	Annual review of monitoring programme or if major change in scheduling	Environmental Dept

Activity	Implementation Phase	Review / Repeat Frequency	Responsibility
Review and analyses of monitoring data for: • Surface & groundwater • Mine water balance • Land use management • Air quality • Environmental noise • Blasting • Natural resources, including riverine forest • Waste management	Commencement of mining	Monthly	Environmental Dept HSEC Committee
Internal review of EMP compliance, conformance to environmental objectives and strategies and their implementation	Commencement of mining	Bi-annually (6-monthly)	Environmental Dept HSEC Committee
EMP performance assessment to determine conformance with the EMP, including effectiveness and appropriateness of EMP	Commencement of mining	Annually	External appointment
Vegetation audit to determine effectiveness of land use management plan and long-term sustainability	Commencement of rehabilitation	Annually	External appointment
Environmental legal compliance audit	Commencement of mining	Bi-annually (2-yearly)	External appointment
Revision of closure cost assessment	Commencement of mining	Annually	Engineering Dept
Stakeholder Engagement Forum	Commencement of mining	Quarterly	Mine Management
Establish and update Recruitment database	Commencement of construction	Upfront and then Annually updated	Human Resource Manager
Compile and workshop of recruitment procedure	Commencement of construction	Prior construction Prior operations	Human Resource Manager
Define and communicate the Community Safety and Traffic Management Plan	Prior to construction	Prior construction	Community Engagement Manager
Compilation of an existing and future land use plan	Commencement of construction	Annually	Community Engagement Manager
Awareness Newsletters	Commencement of construction	Bi-annually (6-monthly)	Community Engagement Manager
Establish a Grievance and Issue Management Procedure	Construction and Operational Phase	Continuously	Community Engagement Manager

11.3 MONITORING MANAGEMENT AND REPORTING

A proper data management system will be set up to facilitate trend analyses and preparation of reports. All the monitoring data will be collated and analysed on a bi-annual basis and included in management reports.

It must be noted that the monitoring programme is a dynamic system changing over the different life-cycle phases of the mine. The programme will be reviewed on a bi-annual basis and revised if necessary.

12 TECHNICAL AND SUPPORTING INFORMATION

12.1 SPECIALIST REPORTS

The EIA specialist reports are attached as Annexures, as indicated below.

Annexure	Aspect	Independent Consultant
ANNEX-1	Soils, Land Use & Capability	Gudani Consulting - EcoSoil Consortium
ANNEX-2	Surface Water	WSM Leshika Consulting (Pty) Ltd
ANNEX-3	Groundwater	WSM Leshika Consulting (Pty) Ltd
ANNEX-4	Biodiversity	Phaki Phakanani Environmental Consultants
ANNEX-5	Aquatic Systems	Scientific Aquatic Services
ANNEX-6	Ambient Noise	Gudani Consulting
ANNEX-7	Air Quality	Royal Haskoning DHV
ANNEX-8	Heritage Resources	Mbofho Consulting and Projects
ANNEX-9	Socio-Economic Aspects	Naledi Development Restructured (Pty) Ltd
ANNEX-10	Macro-Economic Aspects	Mosaka Economic Consultants cc

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13 ANNEXURES

ANNEX-1	Soils, Land Use & Capability	Gudani Consulting - EcoSoil Consortium
ANNEX-2	Surface Water	WSM Leshika Consulting (Pty) Ltd
ANNEX-3	Groundwater	WSM Leshika Consulting (Pty) Ltd
ANNEX-4	Biodiversity	Phaki Phakanani Environmental Consultants
ANNEX-5	Aquatic Systems	Scientific Aquatic Services
ANNEX-6	Ambient Noise	Gudani Consulting
ANNEX-7	Air Quality	Royal Haskoning DHV
ANNEX-8	Heritage Resources	Mbofho Consulting and Projects
ANNEX-9	Socio-Economic Aspects	Naledi Development Restructured (Pty) Ltd
ANNEX-10	Macro-Economic Aspects	Mosaka Economic Consultants cc
ANNEX-11	Stakeholder Engagement	Naledi Development Restructured (Pty) Ltd