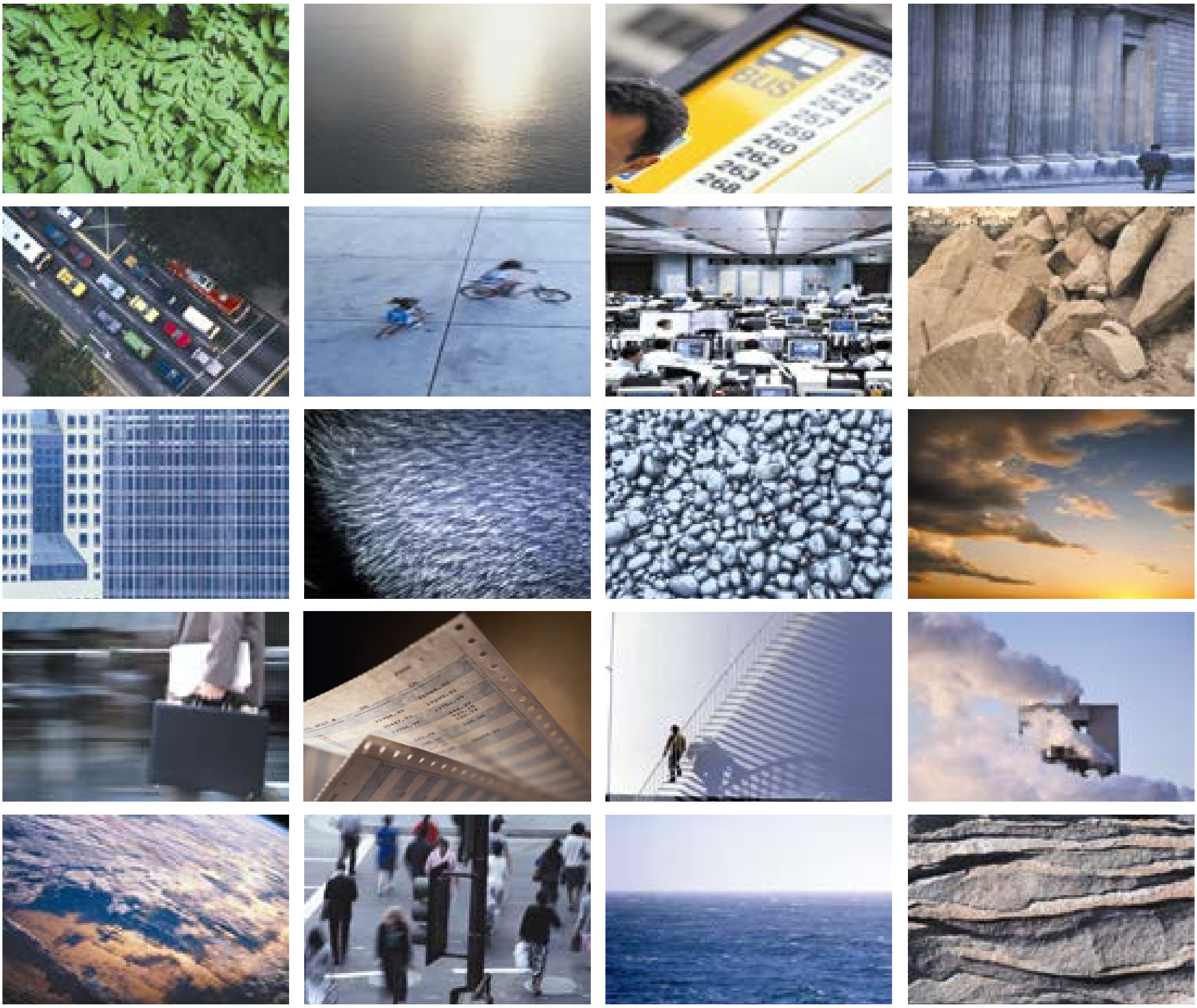


Environmental and Social Impact Assessment Report for the Gamsberg Zinc Mine and Associated Infrastructure in the Northern Cape

FINAL REPORT

Black Mountain Mining (Pty) Ltd

June 2013

www.erm.com

Delivering sustainable solutions in a more competitive world

ERM

<u>FINAL</u> REPORT

Environmental and Social Impact Assessment for the Gamsberg Zinc Mine and Associated Infrastructure in the Northern Cape

Black Mountain Mining (Pty) Ltd

<u>June</u> 2013

Prepared by: Tania Swanepoel and Stuart Heather-Clark

For and on behalf of
Environmental Resources Management

Approved by: Mr Stuart Heather-Clark

Signed:

Position: Partner in Charge

CONTENTS

TABLES

FIGURES

BOXES

GLOSSARY OF TERMS

"**alternative**", in relation to a proposed activity, means different means of meeting the general purpose and requirements of the activity, which may include alternatives to-

(a) the property on which or location where it is proposed to undertake the activity;
(b) the type of activity to be undertaken;
(c) the design or layout of the activity;
(d) the technology to be used in the activity;
(e) the operational aspects of the activity; and
(f) the option of not implementing the activity.

"**aquifer**" means a geological formation which has structures or textures that hold water or permit appreciable water movement through them.

"biodiversity" ("biological diversity" or "biodiversity") means the variability among living organisms from all sources including, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part and also includes diversity within species, between species, and of ecosystems.

"buffer area" means, unless specifically defined, an area extending 10 kilometres from the proclaimed boundary of a world heritage site or national park and 5 kilometres from the proclaimed boundary of a nature reserve, respectively, or that defined as such for a biosphere.W

"catchment" The area from which any rainfall will drain into the watercourse or watercourses or part of the water course, through surface flow to a common point or common points.

"clean water system" includes any dam, other form of impoundment, canal, works, pipeline and any other structure or facility constructed for the retention or conveyance of unpolluted water.

"**concentration**" Concentrating involves milling, crushing and flotation of the ore to produce a concentrate for smelting. The ore is crushed and milled to reduce the size of the rock particles and to expose the minerals which contain the PGMs. The particles are mixed with water and special reagents and air is pumped through the liquid, creating bubbles to which the PGM-containing particles adhere. These float to the surface and are removed as a soapy froth.

"construction" means the building, erection or establishment of a facility, structure or infrastructure that is necessary for the undertaking of a listed or specified activity but excludes any modification, alteration or expansion of such a facility, structure or infrastructure and excluding the reconstruction of the same facility in the same location, with the same capacity and footprint.

"dam" includes any settling dam, slurry dam, evaporation dam, catchment or barrier dam and any other form of impoundment used for the storage of unpolluted water or water containing waste.

"dirty area" means any area at a mine or activity which causes, has caused or is likely to cause pollution of a water resource.

"dirty water system" includes any dam, other form of impoundment, canal, works, pipeline, residue deposit and any other structure or facility constructed for the retention or conveyance of water containing waste.

"environment" The surroundings within which humans exist and that are made up of:

i. the land, water and atmosphere of the earth;
ii. micro-organisms, plant and animal life;
iii. any part or combination of (i) and (ii) and the interrelationships among and between them; and
iv. the physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being. This includes the economic, social, cultural, historical and political circumstances, conditions and objects that affect the existence and development of an individual, organism or group.

"environmental impact assessment" refers to the process of systematically identifying, predicting, assessing and reporting the potential positive and negative social, economic and biophysical impacts of any proposed project, plan, programme or policy which requires authorisation or permission by law and which may significantly affect the environment. The EIA includes an evaluation of alternatives, as well as recommendations for appropriate mitigation measures for minimising or avoiding negative impacts, measures enhancing the positive aspects of the proposal and environmental management and monitoring measures. Although recognised as an EIA process in a South African context, the EIA process for this project is referred to as an Environmental and Social Impact Assessment (ESIA) in line with International good practice.

"expansion" means the modification, extension, alteration or upgrading of a facility, structure or infrastructure at which an activity takes place in such a manner that the capacity of the facility or the footprint of the activity is increased.

"fault" a zone of displacement in rock formations resulting from forces of tension or compression of the earth's crust.

"**Formation"** a general term used to describe a sequence of rock layers.

"**fractured-rock aquifer"** groundwater occurring in within fractures and fissures in hard-rock formations.

"freeboard" - with respect to water storage dams can be defined as the distance between the full supply level (spillway crest level) and the lowest point on the dam wall crest. Freeboard with respect to tailings dams can be defined as the distance between the mean operating level plus the 1:50 year flood-level and the lowest point on the wall crest of the tailings dam.

"groundwater flow" The movement of water through openings and pore spaces in rocks below the water table i.e. in the saturated zone. Groundwater naturally drains from higher lying areas to low lying areas such as rivers, lakes and the oceans. The rate of flow depends on the slope of the water table and the transmissivity of the geological formations.

"groundwater recharge" Refers to the portion of rainfall that actually infiltrates the soil, percolates under gravity through the unsaturated zone (also called the Vadose Zone) down to the saturated zone below the water table (also called the Phreatic

Zone).

“habitat” means a place where a species or ecological community naturally occurs.

“**Heavy metals** “include the elements in the centre of the Periodic Table (Transition metals) and have a density of >3g/cm^3 . Common examples are V, Mn, Fe, Co, Ni, Cu, Zn, Ag, Cd, Au, Hg.

“hydrogeological” The study of distribution and movement of groundwater.

“hydrological” The study of movement, distribution and quality of surface water.

“impact” The positive or negative effects on human well-being and / or on the environment.

“interested and affected parties (I&APs)” any person, group of persons, organisation or any organ of state that may have jurisdiction over any aspect of / or whose interests may be positively or negatively affected by the proposal or activity and/ or who are concerned with a proposal or activity and its consequences.

“Irreplaceable loss” a permanent impact that is impossible to replace if lost or damaged.

“natural habitat” Land and water areas where (i) the ecosystems' biological communities are formed largely by native plant and animal species, and (ii) human activity have not essentially modified the area's primary ecological functions. All natural habitats have important biological, social, economic, and existence value.

“mitigate” The implementation of practical measures to reduce adverse impacts or enhance beneficial impacts of an action.

“permeability” the ease with which a fluid can pass through a porous medium and is defined as the volume of fluid discharged from a unit area of an aquifer under unit hydraulic gradient in unit time (expressed as m^3, m^2 or m/d). It is an intrinsic property of the porous medium and is independent of the properties of the saturating fluid; not to be confused with hydraulic conductivity, which relates specifically to the movement of water.

“**porosity**” Ratio of the volume of void space to the total volume of the rock or earth material.

“proponent” Black Mountain Mining (Pty) Ltd, part of the Vedanta Group plc, is applying for various environmental authorisations / permits / licences in terms of the relevant environmental legislation.

"phased activities" means an activity that is developed in phases over time on the same or adjacent properties to create a single or linked entity through interconnected internal vehicular or pedestrian circulation, sharing of infrastructure, or the continuum of design, style or concept by the same proponent or his or her successors.

“**Prescribe**” Means only as prescribe by regulation in the Government Gazette.

“**Project** “ As demarcated according to mining license boundaries – exclude the town, Eskom and those portions of the land under company charge where mining or accessory works are being carried out.

“protected area” means those protected areas contemplated in section 9 of the NEMPAA.

“public participation process” A process of involving the public in order to identify issues and concerns, and obtain feedback on options and impacts associated with a proposed project, programme or development. Public Participation Process in terms of NEMA refers to: a process in which potential interested and affected parties are given an opportunity to comment on, or raise issues relevant to specific matters.

“reasonable measures” - The measures that a reasonable (ordinary) person would regard necessary for the specific purpose. Reasonable person in this case would refer to a person with expertise in the specific field.

“**Regulator**“ Means the government agent responsible for the application processing, permitting, implementation, control and prosecution of persons and their actions in order to adhere to a specific piece of legislation.

“residual deposit” means any residue stockpile remaining at the termination, cancellation or expiry of a prospecting right, mining right, mining permit, exploration right or production right.

“residual stockpile” means any debris, discard, tailings, slimes, screening, slurry, waste rock, foundry sand, beneficiation plant waste, ash or any other product derived from or incidental to a mining operation and which is stockpiled, stored or accumulated for potential re-use, or which is disposed of, by the holder of a mining right, mining permit or production right.

“**runoff**” All surface and subsurface flow from a catchment, but in practice refers to the flow in a river i.e. excludes groundwater not discharged into a river.

“SANS Class 1” South African National Standard 241:2006 for Drinking Water (Class 1).

“**saturated zone**” The subsurface zone below the water table where interstices are filled with water under pressure greater than that of the atmosphere.

“scoping” the process of determining the spatial and temporal boundaries (i.e. extent) and key issues to be addressed in an environmental assessment. The main purpose of scoping is to focus the environmental assessment on a manageable number of important questions. Scoping should also ensure that only significant issues and reasonable alternatives are examined.

“significance” significance can be differentiated into impact magnitude and impact significance. Impact magnitude is the measurable change (i.e. intensity, duration and likelihood). Impact significance is the value placed on the change by different affected parties (i.e. level of significance and acceptability). It is an anthropocentric concept, which makes use of value judgements and science-based criteria (i.e. biophysical, social and economic).

“**Social & Labour Plan (SLP)”**Plan required by the Department of Mineral Resources to outline a mine’s plan to align itself with the pillars of the Mining Charter.

“**Stakeholder**” A person, group or organization with the potential to affect or be affected by the process or outcome of mine closure.

“**storage coefficient**” the volume of water an aquifer releases from or takes into storage per unit surface area of the aquifer per unit change in head.

“**test pumping**” or aquifer testing is the process whereby an aquifer is subjected to pumping from a borehole under controlled test conditions in order to determine the hydraulic parameters of the groundwater system through its response to the stress of abstraction.

“**total dissolved solids**” It (often abbreviated TDS) is an expression for the total mass content of dissolved ions and molecules or suspended microgranules in a liquid medium.

“**transmissivity**” the rate at which a volume of water is transmitted through a unit width of aquifer under a unit hydraulic head (m^2/d); product of the thickness and average hydraulic conductivity of an aquifer.

“**Wetland**” “wetland is the land which is transitional between dry and wet systems, where the water table is usually at or near the surface, or the land is periodically covered with shallow water and which supports or would support vegetation that is adapted to life in saturated soil (National Water Act 36 of 1998 In DWAF, 2005).

ACRONYMS

ADT	Average Daily Traffic
AIA	Archaeological Impact Assessment
ANC	African National Congress
ANFO	Ammonium Nitrate Fuel Oil
ARC	Agricultural Research Centre
ARD	Acid Rock Drainage
ARVs	Anti-Retroviral Treatment
BBBEE	Broad-based Black Economic Empowerment
BID	Background Information Document
BIR	Bushmanland Inselberg Region
BMM	Black Mountain Mining (Pty) Ltd
BMP	Biodiversity Management Plan
CAPEX	Capital Expenditure
CARA	Conservation of Agricultural Resources Act, 1983 (No. 43 of 1983)
CBA	Critical Biodiversity Area
CBO	Community Base Organisation
CDW	Community Development Workers
CI	Conservation International
CMA	Catchment Management Agency
Cope	Congress of the People
CPA	Communal Property Association
CRR	Comments and Responses Report
DA	Democratic Alliance
DoA	Department of Agriculture
DEA	Department of Environmental Affairs
DENC	Northern Cape Department of Environment and Nature Conservation
DEM	Digital Elevation Model
DGDS	District Growth and Development Strategy
DM	District Municipalities
DMR	Department of Mineral Resources (previously Department of Mineral Energy – DME)
DMS	Dense Medium Separation
DSR	Draft Scoping Report
DWA	Department of Water Affairs
EAP	Environmental Assessment Practitioner
EC	Electrical Conductivity
ECA	Environmental Conservation Act (No. 73 of 1989)
EIA	Environmental Impact Assessment
ESIA	Environmental and Social Impact Assessment
EIAR	Environmental Impact Assessment Report
EMF	Environmental Management Framework
EMPr	Environmental Management Programme
EMS	Environmental Management System
ERM	Environmental Resources Management (Pty) Ltd
ESA	Earlier Stone Age
ESMP	Environmental and Social Management Plan
FAS	Foetal Alcohol Syndrome
FET	Further Education and Training
FGD	Focus Group Discussions
GDP	Gross Domestic Product
GGP	Gross Geographic Product

GHG	Greenhouse Gas
GIF	Gamsberg Iron Formation
GN	General Notice
GNR	General Notice Regulation
Ha	Hectares
HCM	Highway Capacity Manual
HDPE	High Density Polyethylene
HIA	Heritage Impact Assessment
HIV/AIDS	Human Immunodeficiency Virus / Acquired Immunodeficiency Syndrome
HNC	Heritage Northern Cape
HSE	Health, Safety and Environment
HNC	Heritage Northern Cape
I&AP's	Interested and Affected Parties
IBA	Important Bird Area
ICMI	International Cyanide Management Code
IDP	Integrated Development Plan
IFC	International Finance Corporation
ILO	International Labour Organisation
ILZSG	International Lead and Zinc Study Group
IPCC	Intergovernmental Panel on Climate Change
IT	Information Technology
IUCN	International Union for Conservation of Nature
IWULA	Integrated Water Use Licence Application
KII	Key Informant Interviews
KMLM	Khai-Ma Local Municipality
Ktpa	kilotons per annum
kV	Kilovolts
kWh	Kilowatt hours
LC	Least Concern
LED	Local Economic Development
LM	Local Municipalities
LOS	Level of Service
LoM	Life of Mine
LRAD	Land Redistribution for Agricultural Development
LSU	Large stock unit
MAE	Mean Annual Evaporation
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
mamsl	Metres above mean sea level
mbgl	Metres below ground level
MF	Monitoring Forum
Ml	Mega litre
MPRDA	Mineral and Petroleum Resources Development (No. 28 of 2002)
Mm³	Million cubic metres
m³	Cubic metres
m²	Square metres
m	Metres
m/s	Metres per second
MSA	Middle Stone Age
Mt	Million tons
Mtpa	Million tons per annum
MVA	Million Volt-Amperes
MW	Mega Watts

MWP	Mine Works Programme
NAG	Net Acid Generating
NCPGDS	Northern Cape Provincial Growth and Development Strategy
NCPSDF	Northern Cape Provincial Spatial Development Framework
NDM	Namakwa District Municipality
NDT	Namakwa Diamond Trust
NEMA	National Environmental Management Act, 1998
NEM:AQA	National Environmental Management: Air Quality Act, 2004
NEM:BA	National Environmental Management: Biodiversity Act, 2004
NEM:PAA	National Environmental Management Protected Areas Act,
NEM:WA	National Environmental Management: Waste Act, 2008
NGO	Non-Governmental Organisation
NHRA	National Heritage Resources Act, 1999 (No. 25 of 1999)
NWA	National Water Act, 1998 (No. 36 of 1998)
NWMS	National Waste Management Strategy
PCD	Pollution Control Dam
PGNC	Provincial Growth and Development Strategy
PoS	Plan of Study
PWB	Pelladrift Water Board
PIA	Paleontological Impact Assessment
PV	Present value
RDP	Reconstruction and Development Programme
ROM	Run of Mine
ROSE	Recycling Oil Saves the Environment
SA	South Africa
SAG	Semi-Autogenous Grinding
SAHRA	South African Heritage Resources Agency
SALT	South African Large Telescope
SANRAL	South African National Roads Agency Limited
SANS	South African National Standards
SAPS	South African Police Service
SAWQ	South African Water Quality
SAWS	South African Weather Services
SCEP	Stakeholder Consultation and Engagement Plan
SCP	Social Closure Plan
SDF	Spatial Development Framework
SHE	Safety, Health and Environment
SIA	Social Impact Assessment
SKA	Square Kilometre Array
SKEP	Succulent Karoo Ecosystem Programme
SLAG	Settlement Land Acquisition Grant
SLP	Social and Labour Plan
SMME	Small, Medium and Micro-sized Enterprises
SS	Suspended Solids
STD	Sexually Transmitted Disease
TB	Tuberculosis
TDS	Total Dissolved Solids
TFS	Technical Feasibility Study
ToR	Terms of Reference
Tpa	Tonnes per annum
TSF	Tailings Storage Facility
UNESCO	United Nations Educational, Scientific and Cultural Organisation
WMA	Water Management Area

WML	Waste Management License
VAC	Visual Absorption Capacity
VIA	Visual Impact Assessment
VOPI	Vegetable and Ornamental Plan Institute
VU	Vulnerable
WMA	Water Management Area
WMP	Waste Management Plan
WRD	Waste Rock Dump

1 INTRODUCTION

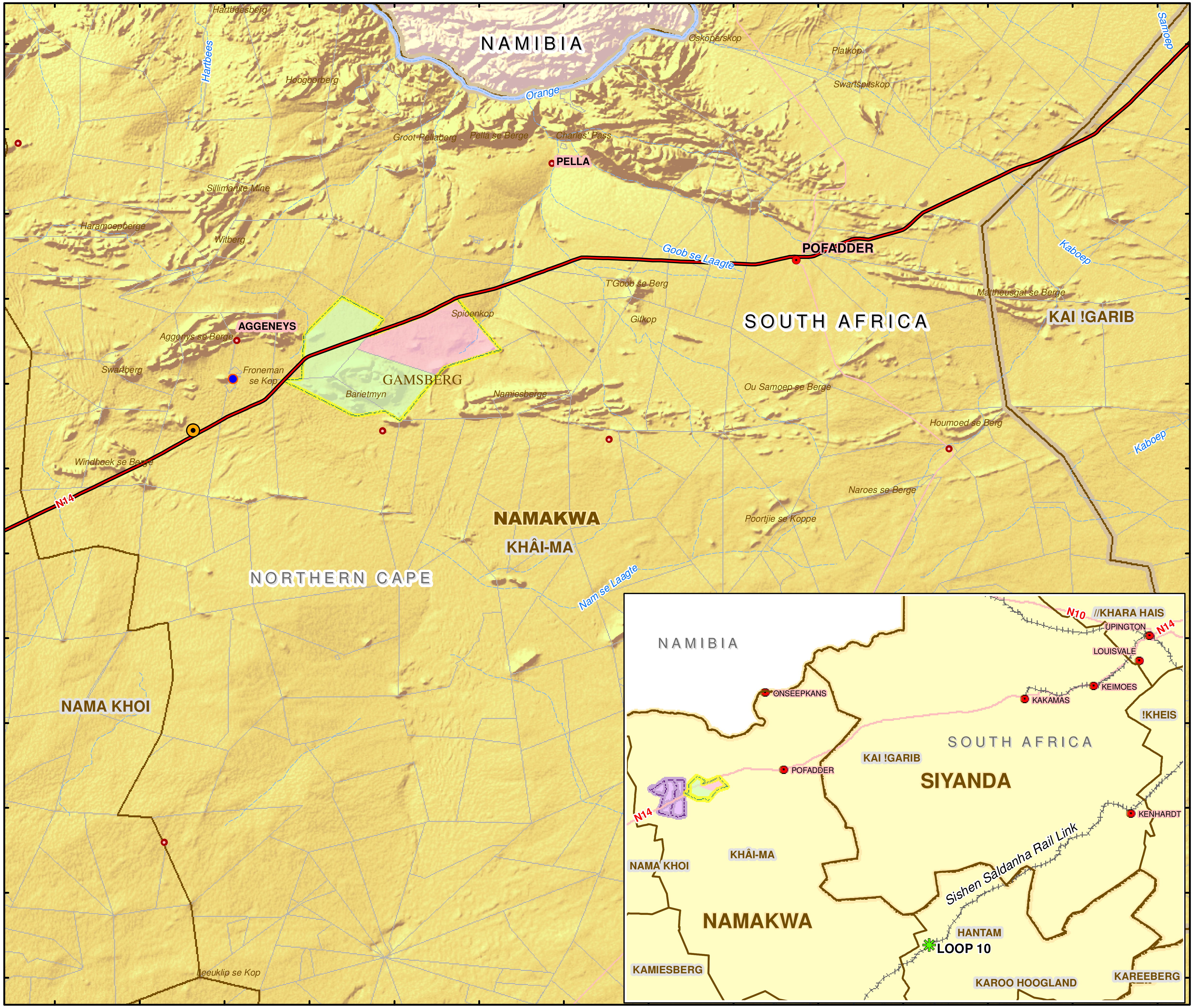
Black Mountain Mining (Pty) Ltd (herein referred to as BMM), part of the global Vedanta mining group, intends to establish a new zinc mine and associated infrastructure 10 km east of the town of Aggeneys, Northern Cape Province. The new Gamsberg zinc mine (hereafter referred to as 'the Project') will include the establishment of a new 10 Million tons per annum (Mtpa) open pit zinc mine (beneficiation volume), in the Gamsberg inselberg, together with a concentrator plant and associated infrastructure. The regional location of the Project and associated transport corridor is presented in *Figure 1.1* below.

BMM is already in the possession of a mining right and subsequently approved Environmental Management Programme (EMPr). The amended EMPr was approved by the Department of Mineral Resources (DMR) (formerly Department of Minerals and Energy) in 2009. This approval relates to the current underground mining activities being undertaken at Gamsberg, which includes the current authorised extraction volumes and concentrate processing at Black Mountain processing plant (see *Section 1.3* below), as well as surface exploration along the north eastern section of the Gamsberg inselberg.

An integrated Environmental and Social Impact Assessment (ESIA) process is being conducted to authorise listed activities triggered by the Project in terms of the National Environmental Management Act (No. 107 of 1998) (NEMA) (as amended), the Environmental Impact Assessment (EIA) Regulations (2010) and other applicable National laws and regulations, such as the National Environmental Management: Waste Act (59 of 2008) (refer to *Section 2.1* for more detail on the integrated legislation processes being undertaken as part of this ESIA process). This application for authorisation under NEMA was submitted to the Northern Cape Department of Environment and Nature Conservation (DENC) on 27 June 2012 (NC/EIA/NAM/KHAI/AGG/2012/NCP/EIA/0000155/2012).

Similarly, BMM is required to submit an EMPr amendment (DMR Reference Number: NCS 30/5/1/2/2/1/518) for the new proposed zinc mine and associated infrastructure, in terms of the Minerals Resources Petroleum Development Act (No. 28 of 2002) Regulations (GNR. 527 of 23 April 2004). This EMPr will describe how the environmental impacts of the Project will be managed and mitigated and will be largely based on information derived from this ESIA process.

Environmental Resources Management Southern Africa (Pty) Ltd (hereafter referred to as ERM) has been appointed, as an independent company, to undertake the associated ESIA and EMPr amendment processes for the construction, operational and decommissioning phases of the Project.



Legend

- MainTown
- Towns
- Loop 10 Siding
- Existing Aggeneys Sub-Station
- Main Rivers
- Rivers
- Dams
- Cadastral Boundaries
- Gamsberg Project Area - Mineral Rights Area
- Gamsberg Project Area - Mining License
- Gamsberg Project Area - Surface Rights
- Local Municipalities
- District Municipalities
- Area of Proposed Additional Housing

SCALE: 0 5 10 15 20 Kilometres

N

TITLE:

Figure 1.1:
Location of Gamsberg Study Area

CLIENT:

vedanta
BLACK MOUNTAIN MINING (PTY) LTD

DATE: Apr 2013	CHECKED: NB	PROJECT: 0164903
DRAWN: LDT/AB	APPROVED: SP	SCALE: 1 : 400 000

DRAWING: Location of Gamsberg Study Area.mxd

REV: 5

ERM
Great Westerford Building
240 Main Road
Rondebosch, 7725
Cape Town, SOUTH AFRICA
Tel: +27 21 681 5400
Fax +27 21 686 073

Projection: Geographic, Datum: WGS84
Source: NGI - Chief Directorate National Geo-Spatial Information, SANBI, EnPAT
Inset: ESRI Data and Maps

SIZE: A3

T:\Gis Projects\0164903_Gamsberg\Mapping\MXD\Report\April2013\Location of Gamsberg Study Area.mxd

1.1 *PURPOSE OF REPORT*

This report has been compiled as part of an ESIA process in accordance with regulatory requirements stipulated in terms of the 2010 EIA Regulations (GNR. 543, 18 June 2010), promulgated in terms of Section 24(5) of the NEMA, as amended.

The information contained in this report, along with comments and inputs received from stakeholders and commenting authorities (including SAHRA, Department of Water Affairs and Department of Mineral Resources) will assist the Northern Cape Department of Environment and Nature Conservation DENC in making an informed decision on the Project.

The identification, prediction and evaluation of the actual and potential environmental and social consequences of this Project are essential to an environmental and social assessment. Furthermore, the potential for mitigation of negative impacts and enhancement of positive impacts (DEAT, 2003) are also fundamental to the ESIA process. It is often possible to introduce measures to avoid, mitigate or compensate for many of the negative impacts of a particular development, provided that these potential impacts are identified early in the planning process. At the same time, it is important to also look at opportunities for enhancement of positive impacts or benefits.

The objectives of this document are to:

- Communicate the findings of the ESIA process, including specialist studies, for the Project and alternatives considered;
- Undertake a robust assessment of potential impacts identified during the Scoping phase;
- Present the Applicant's response to the concerns raised, and subsequent efforts towards mitigating the negative, and enhancing positive impacts;
- Provide reasonable opportunity for Interested and Affected Parties (I&APs) to raise any issues or concerns they may have regarding the Project, anticipated impacts and associated mitigation measures;
- Provide a record of comments and responses received from I&APs during the process, together with responses from the project team; and
- Facilitate an informed, transparent and accountable decision-making process by the relevant authorities.

1.2 *BACKGROUND TO THE PROJECT*

In 1971, zinc deposits were discovered at Gamsberg by O'okiep Copper Company (Newmont). In 1988, Gold Field bought Newmont's interest in Gamsberg;

however the mine was not developed due to unfavourable market conditions. In the same year (1988), Anglo American Corporation acquired the site and completed subsequent prefeasibility and feasibility investigations in order to explore the viability of mining the zinc deposit. These feasibility investigations included an ESIA, which addressed the open pit mine development and associated infrastructure. The necessary (under the previous Minerals Act, No. 50 of 1991) approvals for the mining right and associated EMPr were obtained in 2001. An amendment (conducted in terms of the Minerals and Petroleum Resources Development Act, No. 28 of 2002) to this EMPr was approved in 2003 to undertake underground mining of a small part of the deposit. This amended EMPr was further expanded in 2005 (under the MPRDA, No. 28 of 2002) to include the current authorised extraction volumes and concentrate processing at the existing BMM Processing Plant in Aggeneys. An additional amendment was made (under the MPRDA, No. 28 of 2002) to the EMPr and an EIA and EMP amendment submitted in 2009 for surface exploration along the north eastern section of Gamsberg, which was subsequently approved.

Vedanta Resource Plc. acquired BMM from Anglo American Corporation in 2011. Apart from the abovementioned mining and EMPr right obtained in terms of the MPRDA, all other approvals obtained previously by Anglo American (ie EIA approval under Environmental Conservation Act, 73 of 1989), have lapsed.

Given the changes to the previous Project description and changes in applicable environmental legislation (refer to *Section 2*), a new ESIA process will be undertaken in order to obtain the necessary authorisation (in terms of NEMA) for the new zinc mine and associated infrastructure. This process will provide a detailed assessment of potential impacts as well as suitable mitigation measures. As mentioned above, an EMPr amendment will also be required in terms of the MPRDA. This will be largely based on the findings from this ESIA process.

In addition to this, ERM will compile and submit an Integrated Water Use License Application (IWULA) for the variety of water uses that have been identified in terms of the National Water Act (No 36 of 1998). Applications in terms of National Environmental Management: Air Quality Act (No 39 of 2008) (NEM:AQA) and National Environmental Management: Waste Act (No. 59 of 2008) (NEM:WA) have also been submitted.

As mentioned before, all legislative processes will be undertaken in an integrated manner, through the ESIA process as indicated in *Chapter 2* in *Figure 2.1* (Integrated Flow Diagram of ESIA Process).

1.3 CURRENT OPERATIONS

BMM currently operates the Deeps Mine located near the town of Aggeneys, based on an existing mining right. The existing Deeps Mine currently mines zinc, lead, copper and silver.

In addition to this, BMM currently has a new order mining right and approved EMPr for the zinc resources located within the Gamsberg inselberg, 10 km east of Aggeneys. BMM are presently mining 60,000 tons per annum (tpa) (metal production) from underground workings in the Gamsberg inselberg. The ore currently mined at the existing underground operation is transported to the BMM concentrator plant in Aggeneys where it is processed, together with ore from the Black Mountain Deeps Mine.

Table 1.1 Black Mountain's Current Mining Operations in Aggeneys and Gamsberg

Current Operations	**Minerals extracted**	**Volume of ore extracted (tpa)**
Existing Black Mountain Mine: Aggeneys.	Zinc, lead, copper and silver.	Zinc: 64,682 Lead: 74,645 Copper: 10,182 Silver: 54,26
Existing Gamsberg Underground Mine.	Zinc	Zinc: 60,000

1.4 PROJECT APPLICANT AND PROPERTY DETAILS

1.4.1 Property Details

The Project area is located across four properties, which are owned by BMM. In addition to the open pit zinc mine, associated infrastructure in the form of tailings dam, waste rock dump and a zinc concentrator will be located on the following properties rezoned for this purpose during 2001 (Reference number HRN/FF/1/8 – Namaqua District):

- Bloemhoek 61 Portion 1;
- Gams 60 Portion 1;
- Aroams 57 RE; and
- Gams 60 Portion 4.

In light of associated infrastructure, all directly affected properties are presented below, per project components:

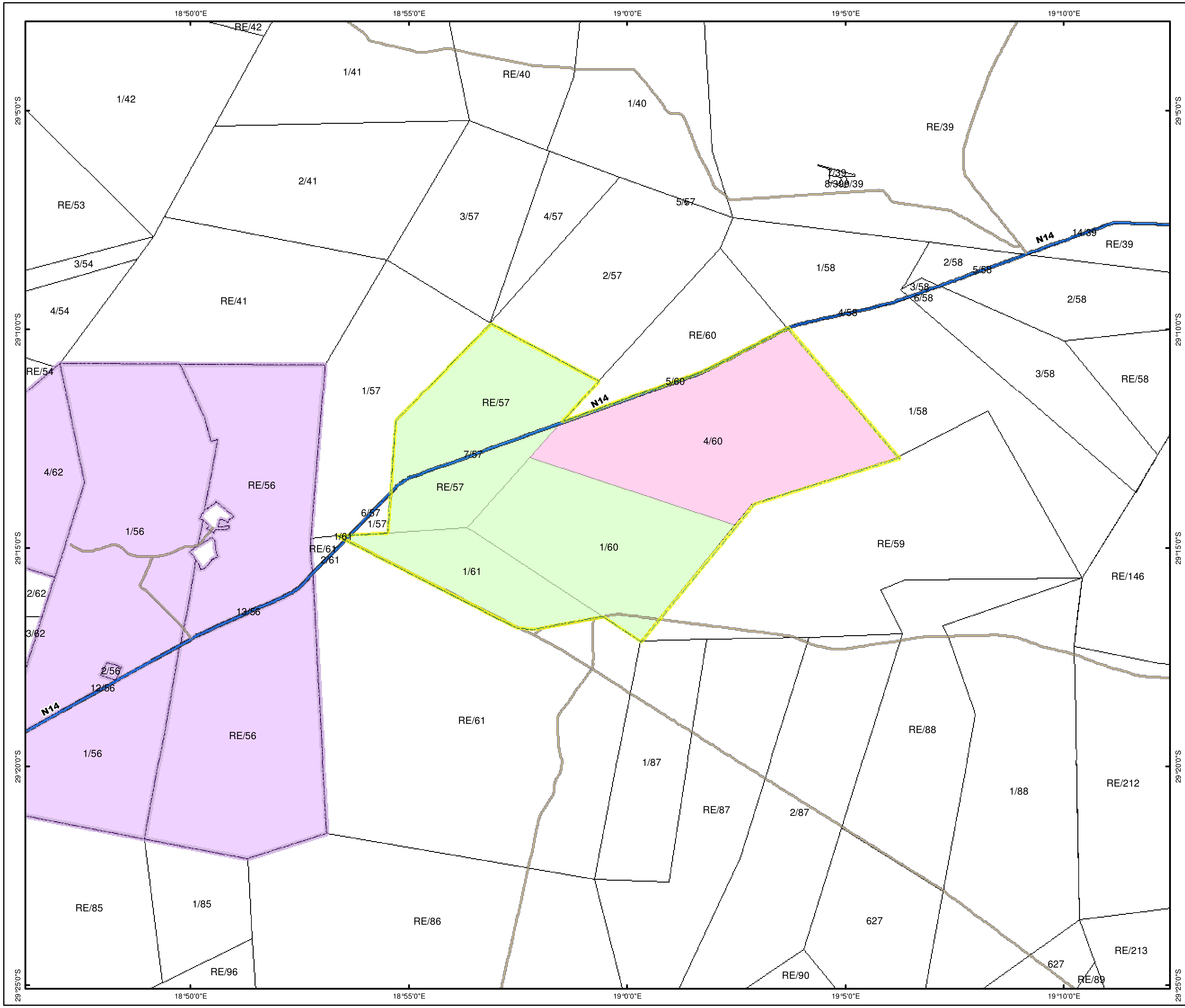
Table 1.2 Directly Affected Properties

Project Component	Affected properties
Distribution Line and Associated Sub-stations.	• Aroams 57 RE; • Bloemhoek 61 Portion 1; • Gams 60 Portion 1; • Gams 60 Portion 4; • Aroams 57 RE (Registered Servitude: land owned by Black Mountain, servitude owned by Eskom); and • Gams 60 Portion 4 (Registered Servitude: land owned by Black Mountain, servitude owned by Eskom).
Additional Housing.	• Aggeneys 56 RE; and • Housing location in Aggeneys.

Project Component	Affected properties
Transport Option 1 (N14 to Port of Saldanha).	• N14 National Road (Owned by SANRAL). • N7 National Road (Owned by SANRAL). • R399 Regional Route (Owned by Western Cape Roads Authorities). • Transnet National Ports Authority.
Transport Option 2 (Road to Loop 10, load onto Sishen – Saldanha Railway Line to Port of Saldanha).	• Uitkyk 889 Portion 3; • F 197/Portion 15; and • Aroams 57 RE (Proclaimed Road RL (P) 5/2002: land owned by Black Mountain, servitude owned by PD Carstens).

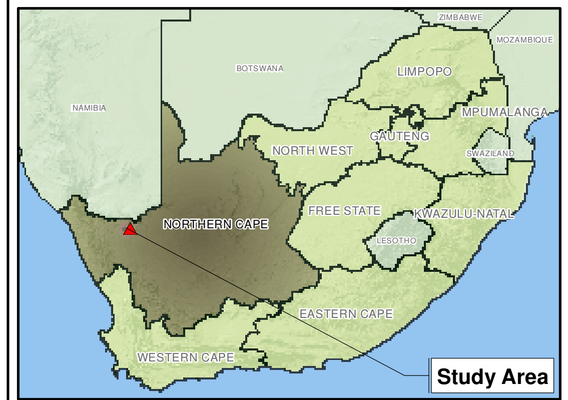
Figure 1.2 below reflects the location of the proposed mining right areas that have been approved by the Department of Mineral Resources (DMR). In addition, it reflects the properties directly adjacent to the Project area.

Apart from the proclaimed road [RL(P)5/2002] and the registered servitude owned by Eskom and Pella Drift Water Board respectively, all remaining properties in the mine area are owned by BMM.



Legend

- National Route (N14)
- Secondary Road
- Cadastral Farm Portions
- Gamsberg Project Area - Mineral Rights Area
- Gamsberg Project Area - Mining License
- Gamsberg Project Area - Surface Rights
- Black Mountain Mine Area - Mining Licence



SCALE:

0 2 4 6 8
Kilometres

N

TITLE:

Figure 1.2: Cadastral Map of Mineral Rights Area

CLIENT:

vedanta
BLACK MOUNTAIN MINING (PTY) LTD

DATE: Apr 2013	CHECKED: NB	PROJECT: 0164903
DRAWN: LDT	APPROVED: SP	SCALE: 1 : 150 000

DRAWING: Cadastral Map Mineral Rights Area.mxd

REV: 0

ERM
Great Westerford Building
240 Main Road
Rondebosch, 7725
Cape Town, SOUTH AFRICA
Tel: +27 21 681 5400
Fax +27 21 686 073

ERM

Projection: Geographic, Datum: WGS84
Source: NGI - Chief Directorate National Geo-Spatial Information, SANBI, EnPAT
Inset: ESRI Data and Maps

SIZE: A3

T:\Gis Projects\0164903_Gamsberg\Mapping\MXD\Report\April2013\Cadastral Map Mineral Rights Area.mxd

1.4.2 *Holder of the Mining Right*

Rights to Mineral Resources

BMM currently has a mining right over the Gamsberg zinc ore deposit, which extends across Bloemhoek 61 Portion 1, Gams 60 Portion 1, and Aroams 57 RE. The existing mining right covers a total area of 9,505.7 hectares, which includes the Gamsberg inselberg itself. A new order mining right was submitted during 2006 (Licence number ML003200). A new order mining right was issued to BMM (Anglo Operations Ltd) in August 2008 and then ceded to BMM in September 2008. An illustration of the mining license area, for both the Black Mountain Deeps Mine and the proposed Gamsberg mine, is reflected in *Figure 1.2* above.

1.5 *ASSUMPTIONS AND LIMITATIONS*

During the compilation of this ESIA Report, the following limitations and assumptions were made:

- Information sourced from secondary sources is correct.

- The scope of the ESIA process is limited to the Gamsberg mine, the associated infrastructure (including concentrator plant, waste rock dumps, tailings dams, internal road network, housing, workshops etc.) and transport options to the Port of Saldanha and Loop 10 siding.

- It is expected that additional storage and transfer facilities at the Port of Saldanha may be required to accommodate the Gamsberg concentrate. However, for purposes of this ESIA, it is assumed that the Port has sufficient capacity to accommodate the additional concentrate and that no upgrades will be required. The decision to exclude future upgrades to the Port of Saldanha from the scope of work relates to the fact that only preliminary design and layout options have been undertaken at this stage. Pending outcomes from further feasibility studies and engagement with the Transnet National Ports Authority, the preferred option to accommodate the increase in zinc exports will be confirmed and this will be subject to a separate environmental application process, if required.

- In terms of the Loop 10 rail siding, it is assumed that the necessary expansions or upgrades will be limited to the existing disturbed area. All baseline information used to assess the impacts associated with the Loop 10 rail siding was taken from previous studies (SHE Cape Environmental cc, 2008) undertaken at the site as well as satellite imagery.

- The report was prepared based on the most up to date project description provided.

- All information received from the applicant and associated engineering consultant team is accurate. It was assumed that the dimensions and footprint of all project infrastructures are accurate and consistent with the project description.

- Study takes cognisance of the associated works and applications made by the Pella Drift Water Board (PDWB) for a Basic Assessment process to upgrade their water infrastructure.

- It is assumed that any technical and financial motivation for preference of mining techniques was correctly analysed and presented to ERM.

- It is assumed that underground mining will only become more unviable, subsequent to the additional costs for environmental mitigation.

- The business case for open pit mining has excluded the potential costs for environmental mitigation. It is assumed that open pit will remain viable, upon implementation of the environmental mitigation measures.

- Note that the costs associated with biodiversity offsetting have not yet been incorporated into the aforementioned business case. This will be determined, based on findings of the ESIA process (ie defining residual impact).

- The financial analysis of the different mining technique has adopted a future projection of zinc prices, which are subject to variation, based on varying market prices.

1.6 DETAILS OF THE ESIA PROJECT TEAM

ERM is a global environmental consulting firm employing over 4,000 specialists in over 140 offices across 40 countries. ERM Southern Africa in turn is one of the largest environmental consulting firms in the region, with extensive experience in South Africa and several other African countries. A list of the ESIA project team is tabulated in *Table 1.3* below, together with the associated qualifications and experience:

Table 1.3 Expertise of EAPs

Name	Role in Project	Education/certifications	Experience
Stuart Heather-Clark	Partner in Charge	• BSc Civil Engineering – Univ. of Cape Town (1992). • MPhil. Environ Science – Univ. of Cape Town (1996). • EAPSA Certification.	Stuart Heather-Clark is a Partner in the Impact Assessment and Planning Team within ERM Southern Africa based in Cape Town, South Africa. Stuart has over 17 years of experience in industrial, oil & gas and infrastructure related ESIA and Strategic Environmental Assessments (SEA) throughout Africa. His experience has afforded him a sound understanding of the sustainability issues facing development in Africa. He has been involved in a number of internationally

			funded projects in Cameroon, Ethiopia, Zambia, Tanzania, Angola, Botswana, Namibia, Uganda and Mozambique. All of these projects involved interaction with lenders, developers, local stakeholders, including NGO's, government officials and local communities. Mr Heather-Clark has an in-depth understanding of the Equator Principles and IFC performance Standards.
Tania Swanepoel	Project Manager	• BSc Hons (Engineering & Environmental Geology), University of Pretoria, 2000. • BSc Hons (Geology and Geohydrology), University of the Western Cape, 1997. • BSc (Geology, Mathematics) , University of the Western Cape, 1996. • Registered Natural Scientist (Pr Sci Nat).	Tania Swanepoel is a Principal Consultant in the Impact Assessment and Planning team based in Cape Town, South Africa. Tania has over 13 years of broad based environmental experience. Her experience includes environmental impact assessments, management plans, public participation, environmental site investigations, pollution risk assessments, remedial system monitoring, geotechnical investigations, groundwater monitoring and rural water supply & sanitation studies.

1.7 *STRUCTURE OF THIS REPORT*

The structure of the Final ESIA Report is described in *Table 1.4* below.

Table 1.4 Structure of Final ESIA Report

Chapter	Description
Chapter 1	**Introduction** Contains a brief description of the proposed activity and an outline of the report structure.
Chapter 2	**Administrative Framework** Contains a brief description of the proposed activity and an outline of the report structure.
Chapter 3	**Project Description** Includes a detailed description of the proposed project activities being considered.
Chapter 4	**Summary of Alternatives** This Chapter provides a detailed review of the initial alternatives considered and the motivation for the screening and subsequent selection of a preferred alternative for detailed impact assessment. Note that this Chapter also contains a summary of the alternatives considered in the previous EIA process completed in 2001.

Chapter	Description
Chapter 5	**Biophysical Receiving Environment** Provides a detailed describes of the receiving biophysical baseline environment.
Chapter 6	**Socio-economic Receiving Environment** Provides a detailed describes of the receiving socio-economic baseline environment.
Chapter 7	**Stakeholder Engagement** Provides a summary of the stakeholder engagement process that forms part of the ESIA process, in terms of the EIA Regulations (2010) and Government Notice R543.
Chapter 8	**Waste Management and Classification** Provides a summary of key issues associated with the management of non-hazardous and hazardous wastes generated as a result of the proposed Project.
Chapter 9	**Biophysical Impact Assessment** Provides a detailed assessment of all potential biophysical impacts identified during the Scoping Phase, together with mitigation measures and expected residual impacts. Lastly, cumulative impacts are also addressed in this Chapter.
Chapter 10	**Socio-economic Impact Assessment** Provides a detailed assessment of all potential socio-economic impacts identified during the Scoping Phase, together with mitigation measures and expected residual impacts. Lastly, cumulative impacts are also addressed in this Chapter.
Chapter 11	**Closure and Post Mining Landuse** Provides a summary of closure and rehabilitation goals, including financial provision and suggestions for post mining landuse.
Chapter 12	**Summary of Biodiversity Offsetting Process** Provides a brief summary of the biodiversity offsetting process that is currently being undertaken. This includes the approach, methodology, assumptions and limitations and way forward.
Chapter 13	**Conclusion and Recommendations** Summarises the key findings of the ESIA and provides recommendations for the mitigation of potential impacts and the management of the proposed project.
Chapter 14	**References** Contains a list of references used in compiling the report.

2 ADMINISTRATIVE FRAMEWORK

The proposed Gamsberg zinc mine and associated infrastructure (hereafter referred to as 'the Project') is subject to legislative and policy requirements at national, provincial and local level, as well as international guidelines and conventions. This chapter provides a broad description of key environmental and social legislation governing the ESIA process and the construction, operation and decommissioning phases of the Project. It specifically focuses on legal requirements related to the environmental authorisation of activities, as well as legal requirements for environmental protection, such as:

- standards for environmental quality control and pollution;
- biodiversity protection; and
- the protection of natural, cultural and historic heritage sites.

In addition to this, it provides a broader policy and planning context within which the Project will take place. This relates to regional and local planning policies and frameworks that are applicable to the Project and finally, a brief summary of applicable International policies and internal Corporate Standards is given. Additional detail on the administrative framework is included in *Annex A*.

2.1 NATIONAL LEGISLATIVE REQUIREMENTS

2.1.1 The Constitution of the Republic of South Africa (No. 108 of 1996)

South African law, including environmental law, is strongly influenced by the Constitution (No. 108 of 1996), which promotes specific moral, social and political values. The Constitution is the highest law of the land, and all South African law has to follow the spirit of the Constitution. The Constitution commits to the establishment of a society based on democratic values, social justice and fundamental human rights through improving the quality of life of all citizens and realising the potential of each person. Chapter Two of the Constitution contains the Bill of Rights which is the cornerstone of South African democracy. The Bill of Rights is binding on South African law and courts, all government departments and organisations and all South Africans, not only in terms of the rights, privileges and benefits which it confers, but also in terms of the duty and responsibility which it imposes, namely to implement and protect Constitutional rights and values. Sections 7, 8 and 24 of the Bill of Rights give constitutional force to sustainable development and provide that all people in South Africa have the right to a clean and healthy environment. These sections oblige government to pass reasonable legislation to protect the environment, prevent pollution and ecological degradation, and secure sustainable development.

All mining operations are obliged to operate within the spirit and to the letter of the South African Constitution, as it is the supreme law of South Africa and as such, all other legislation is consistent with its provisions and principles. Furthermore, it is important for such companies to have knowledge of the

Constitution, as an infringement of any of the fundamental rights entrenched in the Constitution may result in civil damage claims.

2.1.2 *National Environmental Management Act (No. 107 of 1998)*

The National Environmental Management Act (NEMA) is a framework Act which embraces three major areas of environmental concern, namely resource conservation and exploitation; pollution control and waste management; and land use planning and development. NEMA is underpinned by the globally accepted principle of sustainable development. Section 2 (4)(b) of NEMA gives effect to the South African Constitution, which states that all South African citizens have a right to an environment that is not harmful to their health or well-being.

The most important provisions set out in terms of NEMA that are applicable to the proposed Project are described in the sections that follow.

NEMA Principles

Key principles of NEMA are described in Chapter 2 of the Act and include the following:

- Development must be socially, environmentally and economically sustainable;
- Environmental management must be integrated;
- Avoidance, minimisation and remediation of ecosystem disturbance and biodiversity loss;
- Waste must be avoided or reduced, reused and recycled;
- Decisions concerning the environment must take into account the needs, interests and values of all Interested and Affected Parties (I&APs);
- Community well-being and empowerment must be promoted through environmental education and awareness, and the sharing of knowledge and experience;
- Specific attention must be given to sensitive, vulnerable and highly dynamic ecosystems;
- Lifecycle responsibility must be ensured; and
- Decisions must be taken in an open and transparent manner, and access to information must be provided in accordance with law.

These principles apply alongside other considerations (including socio-economic considerations) and guide the administration and interpretation of environmental management legislation in South Africa.

Environmental Authorisations

Chapter 5 of NEMA requires that the potential impact on the environment, socio-economic conditions, and cultural heritage of activities that require authorisation or permission by law must be considered, investigated and assessed prior to implementation, and reported to the relevant authority.

An EIA Application was submitted to the Department of Environment and Nature Conservation (DENC) to formally initiate the ESIA process on 26 June 2012 (Reference number: NC/EIA/NAM/KHAI/AGG/2012-NCP/EIA/0000155/2012).

The EIA Regulations (R543) promulgated in terms of the NEMA, identifies a suite of activities, which "*could have a substantial detrimental effect on the environment*". The listed activities identified require an environmental authorisation from the environmental authority, ie the Provincial Department of Environment and Nature Conservation (DENC), prior to commencement of the activity. The proposed zinc mine and associated infrastructure triggers a list of activities, tabulated in *Table 2.1, Table 2.2 and Table 2.3* below. Activities listed in terms of R544 and R546 require a Basic Assessment, while activities listed in R545 require a full Scoping and EIA process. Despite the proposed project triggering the need for a Basic Assessment process, a single Scoping and ESIA process will be undertaken to meet the requirements in terms of NEMA.

Table 2.1 Listed Activities in Terms of NEMA EIA Regulations

Government Notice R544 of 2010	Applicability to Project
Activity 2 The construction of facilities or infrastructure for the storage of ore or coal that requires an atmospheric emissions license in terms of the National Environmental Management: Air Quality Act (Act No. 39 of 2004).	Construction of open stockpile areas for the storage ore.
Activity 9 The construction of facilities or infrastructure exceeding 1000 metres in length for the bulk transportation of water, sewage or storm water - i. with an internal diameter of 0,36 metres or more; or ii. with a peak throughput of 120 litres per second or more, excluding where: a) such facilities or infrastructure are for bulk transportation of water, sewage or storm water or storm water drainage inside a road reserve; or b) where such construction will occur within urban areas but further than 32 metres from a watercourse, measured from the edge of the watercourse.	Construction of an off-take water pipeline (550 mm) from the existing PDWB water pipeline to the Gamsberg mine.

Government Notice R544 of 2010	Applicability to Project
Activity 10 The construction of facilities or infrastructure for the transmission and distribution of electricity— i. outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts; or ii. inside urban areas or industrial complexes with a capacity of 275 kilovolts or more.	Construction of new 66 kV transmission lines and potentially the construction of new 220kV/ 66kV and 66 kV/11kV sub-stations (Option 1).
Activity 11 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.	Mine infrastructure exceeding 50 m^2 will be located within 32 m of a watercourse.
Activity 12 The construction of facilities or infrastructure for the off-stream storage of water, including dams and reservoirs, with a combined capacity of 50 000 cubic metres or more, unless such storage falls within the ambit of activity 19 of Notice 545 of 2010.	On-site dams for raw water, potable water and dirty water will be constructed.
Activity 18 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 or more than 5 cubic metres 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 highwater mark of the sea or an estuary, whichever distance is the greater but excluding where such infilling, depositing , dredging, excavation, removal or moving; (a) is for maintenance purposes undertaken in accordance with a management plan agreed to by the relevant environmental authority; or (b) occurs behind the development setback line.	Mining infrastructure such as, the open pit, the explosives magazine and the truck workshop will all be constructed within a watercourse. These will require the excavation of more than 5 cubic metres of soil and/or rock. In addition to this, the upgrading of the existing water pipeline (Gamsberg off-take pipeline) may require excavation and infilling into a watercourse that will exceed 5 m^3.

Government Notice R544 of 2010	Applicability to Project
Activity 22 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.	Internal haul roads within the Project area are expected to have a reserve wider than 13.5 m. Service roads with different reserves will also be constructed.
Activity 23 The transformation of undeveloped, vacant or derelict land to— i. residential, retail, commercial, recreational, industrial or institutional use, inside an urban area, and where the total area to be transformed is 5 hectares or more, but less than 20 hectares, or ii. residential, retail, commercial, recreational, industrial or institutional use, outside an urban area and where the total area to be transformed is bigger than 1 hectare but less than 20 hectares; except where such transformation takes place— i. for linear activities; or ii. for purposes of agriculture or afforestation, in which case Activity 16 of Notice No. 545 applies.	The Project area exceeds 5 hectares.
Activity 24 The transformation of land bigger than 1000 square metres in size, to residential, retail, commercial, industrial or institutional use, where, at the time of the coming into effect of this Schedule or thereafter such land was zoned open space, conservation or had an equivalent zoning.	The development of the additional staff housing units at Aggeneys and the expansion of the Aggeneys Waste Water Treatment Plant.
Activity 26 Any process or activity identified in terms of Section 53 (1) of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004).	The Project will result in removal of and impact on sensitive vegetation, which will potentially constitute a restricted activity in terms of NEMBA.

Government Notice R544 of 2010	Applicability to Project
Activity 37 The expansion of facilities or infrastructure for the bulk transportation of water, sewage or storm water where— (a) the facility or infrastructure is expanded by more than 1000 metres in length; or (b) where the throughput capacity of the facility or infrastructure will be increased by 10% or more– excluding where such expansion: i. relates to transportation of water, sewage or storm water within a road reserve; or ii. where such expansion will occur within urban areas but further than 32 metres from a watercourse, measured from the edge of the watercourse.	The expansion of the Aggeneys Waste Water Treatment Plant (WWTP). The construction/expansion of the 5km Gamsberg water off take pipeline from the existing PWB pipeline to the mine.
Activity 41 The expansion of facilities or infrastructure for the off-stream storage of water, including dams and reservoirs, where the combined capacity will be increased by 50,000 cubic metres or more.	44 ML reservoir (water supply) being constructed to the north of the N14, within the existing mining right area.
Activity 42 The expansion of facilities for the storage, or storage and handling, of a dangerous good, where the capacity of such storage facility will be expanded by 80 cubic metres or more.	Loop 10 or possible on site fuel storage.
Activity 47 The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre— i. where the existing reserve is wider than 13,5 meters; or ii. where no reserve exists, where the existing road is wider than 8 metres excluding widening or lengthening occurring inside urban areas.	Existing gravel roads within and around the site may need to be widened to accommodate for the traffic flow.

Table 2.2 Government Notice R545 of 2010 (Full Scoping and EIA)

Government Notice R545 of 2010	Applicability to project
Activity 3 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 meters.	Proposed storage of fuel on-site that exceeds 500 m³.

Government Notice R545 of 2010	Applicability to project
Activity 5 The construction of facilities or infrastructure for any process or activity which requires a permit or license in terms of national or provincial legislation governing the generation or release of emissions, pollution or effluent and which is not identified in Notice No. 544 of 2010 or included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case that Act will apply.	The process of concentration will result in the production of effluent.
Activity 15 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; except where such physical alteration takes place for— i. linear development activities; or ii. agriculture or afforrestation where activity 16 in this Schedule will apply.	The Project area exceeds 20 hectares.
Activity 19 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.	On-site dams will be constructed that may exceed 5 m in height.
Activity 26 Commencing of an activity, which requires an atmospheric emission licence in terms of section 21 of the National Environmental Management: Air Quality Act, 2004 (No. 39 of 2004), except where such commencement requires basic assessment in terms of Notice No. R.544 of 2010.	The bulk storage of liquid fuel above ground, exceeding a capacity of 500 m³ will be required on site.

Table 2.3 Government Notice R546 of 2010 (Basic Assessment Required for Activities within Specific Geographic Areas)

Government Notice R.546 of 2010	Applicability to project
Activity 4 The construction of a road wider than 4 metres with a reserve less than 13,5 metres. i. In an estuary; ii. In a protected area identified in terms of NEMPAA, excluding conservancies; iii. Outside urban areas, in: - National Protected Area Expansion Strategy Focus areas;	Internal road networks will be constructed.

Government Notice R.546 of 2010	Applicability to project
- Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; - Sites or areas identified in terms of an International Convention; - Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; - Core areas in biosphere reserves; - Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve; and - Areas seawards of the development setback line or within 1 kilometre from the high-water mark of the sea if no such development setback line is determined.	
Activity 10 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 30 but not exceeding 80 cubic metres. i. In an estuary; ii. In a protected area identified in terms of NEMPAA, excluding conservancies; iii. Outside urban areas, in: - National Protected Area Expansion Strategy Focus areas; - Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; - Sites or areas identified in terms of an International Convention; - Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; - Core areas in biosphere reserves; - Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve; and - Areas seawards of the development setback line or within 1 kilometre from the high-water	The mine bulk storage tank farm is being established within the Gamsberg inselberg, which is a Critical Biodiversity Area (CBA) as identified in the Succulent Karoo Ecosystem Programme (SKEP).

Government Notice R.546 of 2010	Applicability to project
mark of the sea if no such development setback line is determined.	
Activity 12 The clearance of an area of 300 square metres or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation. (a) Within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004; (b) Within critical biodiversity areas identified in bioregional plans; (c) Within the littoral active zone or 100 metres inland from high water mark of the sea or an estuary, whichever distance is the greater, excluding where such removal will occur behind the development setback line on erven in urban areas.	The proposed establishment of the mine may result in the loss of more than 300 m^2 of vegetation, with 75% being indigenous.
Activity 13 The clearance of an area of 1 hectare or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation, except where such removal of vegetation is required for: (1) the undertaking of a process or activity included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008), in which case the activity is regarded to be excluded from this list. (2) the undertaking of a linear activity falling below the thresholds mentioned in Listing Notice 1 in terms of GN No. 544 of 2010. In the following areas: (a) Critical biodiversity areas and ecological support areas as identified in systematic biodiversity plans adopted by the competent authority. (b) National Protected Area Expansion Strategy Focus areas. i. In an estuary; ii. Outside urban areas, the following: (aa) A protected area identified in terms of NEMPAA, excluding conservancies; (bb) National Protected Area Expansion Strategy Focus areas;	The proposed establishment of the mine and associated infrastructure will result in the loss of 1 hectare of vegetation, with more than 75% being indigenous.

Government Notice R.546 of 2010	Applicability to project
(cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; (dd) Sites or areas identified in terms of an International Convention; (ee) Core areas in biosphere reserves; (ff) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve; and (gg) Areas seawards of the development setback line or within 1 kilometre from the high-water mark of the sea if no such development setback line is determined.	
Activity 14 The clearance of an area of 5 hectares or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation, except where such removal of vegetation is required for: (1) purposes of agriculture or afforestation inside areas identified in spatial instruments adopted by the competent authority for agriculture or afforestation purposes; (2) the undertaking of a process or activity included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case the activity is regarded to be excluded from this list; and (3) the undertaking of a linear activity falling below the thresholds in Notice 544 of 2010. Within the following areas: i. All areas outside urban areas.	The proposed establishment of the mine and associated infrastructure may result in the loss of 5 hectares of vegetation, with 75% being indigenous.
Activity 16 The construction of: i. jetties exceeding 10 square metres in size; ii. slipways exceeding 10 square metres in size; iii. buildings with a footprint exceeding 10 square metres in size; or iv. infrastructure covering 10 square metres or more where such construction occurs within a watercourse or within 32 metres of a	Infrastructure exceeding 10 m² will be constructed within 32 m of a watercourse, within the Gamsberg inselberg, which located within a critical biodiversity area (CBA) as identified in the Succulent Karoo Ecosystem Programme (SKEP).

Government Notice R.546 of 2010	Applicability to project
watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line. Within the following areas: i. In an estuary; ii. In a protected area identified in terms of NEMPAA, excluding conservancies; iii. Outside urban areas, in: - National Protected Area Expansion Strategy Focus areas; - Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; - Sites or areas identified in terms of an International Convention; - Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; - Core areas in biosphere reserves; - Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve; and - Areas seawards of the development setback line or within 1 kilometre from the high-water mark of the sea if no such development setback line is determined.	
Activity 19 The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre. Within the following areas: i. In an estuary; ii. In a protected area identified in terms of NEMPAA, excluding conservancies; iii. Outside urban areas, in: - National Protected Area Expansion Strategy Focus areas; - Sensitive areas as identified in an environmental management framework as contemplated in	Existing road networks may need to be widened or lengthened by more than 4 m or 1 km, respectively.

Government Notice R.546 of 2010	Applicability to project
chapter 5 of the Act and as adopted by the competent authority; - Sites or areas identified in terms of an International Convention; - Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; - Core areas in biosphere reserves; - Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve; and - Areas seawards of the development setback line or within 1 kilometre from the high-water mark of the sea if no such development setback line is determined.	

Additional requirements of NEMA and the EIA Regulations which are considered important to highlight in the context of the ESIA process are briefly outlined in *Annex A*, these include:

- NEMA 'duty of care';
- Emergency incidents;
- Report requirements for an EIA;
- Public participation requirements; and
- Consideration of alternatives.

2.1.3 National Environmental Management: Waste Act, 2008 (No. 59 of 2008)

The National Environmental Management: Waste Act (NEMWA) is the major piece of legislation governing waste management in South Africa and is relevant to all aspects of both hazardous and non-hazardous waste management.

It aims to regulate waste management in order to protect human health and the environment by providing reasonable measures for the prevention of pollution and ecological degradation and for securing ecologically sustainable development. In this regard, it provides for the following issues related to waste management:

- Institutional arrangements and planning matters;
- National norms and standards for regulating the management of waste;
- Specific waste management measures;
- Licensing and control of waste management activities;
- The remediation of contaminated land;
- A national waste information system; and
- The issue of compliance and enforcement.

Based on the infrastructure requirements, the Project would result in the storage of general and hazardous waste within the proposed Project area. In addition, the Project would also undertake the treatment of waste and wastewater resulting in the generation of effluent.

NEMWA identifies various activities that would require a waste management license (WML) before proceeding. These listed activities are divided into Category A and B activities. Category A activities require a Basic Assessment process to be approved before commencement, while Category B activities require a full Scoping and EIA process.

With regard to the Project, the following Category A and B activities identified in terms of Government Notice 718 are anticipated to be triggered (see *Table 2.5* and *Table 2.6* below):

Table 2.4 Category A Listed Activities in Terms of NEMWA

Government Notice 718 - Category A	
Activity 1	The storage, including the temporary storage of general waste at a facility that has the capacity to store in excess of $100m^3$ of general waste at any one time, excluding the storage of waste in lagoons.
Activity 2	The storage, excluding the temporary storage, of hazardous waste at a facility that has the capacity to store in excess of $80m^3$ of hazardous waste at an one time.
Activity 4	The storage of waste tyres in a storage area exceeding $500m^2$.
Activity 5	The sorting, shredding, grinding or bailing of general waste at a facility that has the capacity to process in excess of one ton of general waste per day.
Activity 7	The recycling of general waste at a facility that has an operational area in excess of $500m^2$.
Activity 12	The remediation of contaminated land.
Activity 14	The disposal of general waste to land covering an area of more than $50m^2$ but less than $200m^2$ and with a cumulative total not exceeding 25 000 tons.
Activity 15	The disposal of general waste to land covering an area of more than $50m^2$ but less than 200m and with a cumulative total not exceeding 25 000 tons.
Activity 18	The construction of facilities for activities listed in Category A of this Schedule (not in isolation to associated activity).

Table 2.5 Category B Listed Activities in Terms of NEMWA

Government Notice 718 - Category B	
Activity 1	The storage, including temporary storage, of hazardous waste in lagoons.
Activity 2	The reuse and recycling of hazardous wastes.
Activity 5	The treatment of hazardous waste using any form of treatment regardless of the size or capacity of such a facility to treat such waste.
Activity 6	The treatment of hazardous wastes in Lagoons.
Activity 7	The treatment of effluent, wastewater or sewage with an annual throughput capacity of 15 000 cubic metres or more.

Government Notice 718 - Category B	
Activity 9	The disposal of any quantity of hazardous waste to land.
Activity 10	The disposal of general waste to land covering an area in excess of $200m^2$.
Activity 11	The construction of facilities for activities listed in Category B of this Schedule (not in isolation to associated activity).

A Waste Management License (WML) Application was submitted on 27 June 2012 to the National Department of Environmental (Reference number: 12/9/11/L955/8). A waste mitigation hierarchy will be adopted for the construction, operational and decommissioning phases of the Project.

Other key provisions in terms of NEMWA that will apply to the Project during its construction and operational phases are included in *Annex A*.

2.1.4 Mineral and Petroleum Resources Development Act (No. 28 of 2002)

The objectives of the MPRDA, inter alia, is to promote equitable access to the nations minerals and petroleum resources, expand opportunities for previously disadvantaged individuals, promote economic growth and mineral and petroleum resources development (objective), employment opportunities and ensure that the holders of the mining right contribute to the socio-economic development on the surrounding communities.

The MPRDA identifies the state as the official custodian of South Africa's Mineral and Petroleum Resources.

Therefore all activities relating to reconnaissance, prospecting rights, mining rights, mining permits and retention permits are regulated by the State.

An application must be submitted and approved by the National Department of Mineral Resources, before proceeding.

As briefly discussed in Section 1, Black Mountain Mining (Pty) Ltd already has an existing new order mining right and approved Environmental Management Programme (EMPr) for the mining activities that are currently being undertaken within the Project area. In this regard, the existing mining right allows the applicant to mine (using an open pit technique) an area of 9,505 hectares on erf Bloemhoek 61 Portion 1 and Gams 60 Portion 1, Aroams 57 RE. It should be noted however that the existing mining right is applicable to the current mining operations in terms of mining method, volumes and infrastructure scope. Due to the increased ambit of the proposed new development, the existing EMPr (including the social labour plan and associated works programme) will require amendment, specifically in light of the changes to the proposed project description.

In terms of Section 102 of the MPRDA, amendments to an approved EMPr will require an EIA process to be undertaken in terms of NEMA. In addition, Section

49 and 50 of Regulation 527 of the MPRDA outlines specific information requirements for the Scoping and EIA Reports, inter alia, are as follows:

- Stakeholder engagement process;
- Assessment of impacts;
- Assessment of feasible alternatives;
- Development of an environmental management and monitoring plan;
- Provision of maintenance and emergency procedures; and
- Environmental awareness plan.

The amended EMPr will also need to include a revised Social and Labour Plan (SLP), Mine Works Programme (MWP), Closure Plan and Financial Provision for the Rehabilitation of Land Disturbed by Mining Activities.

MPRDA ESIA report and public participation requirements are summarised in *Annex A*.

2.1.5 National Heritage Resources Act (No. 25 of 1999)

The protection and management of South Africa's heritage resources is controlled by the National Heritage Resources Act (NHRA). The objective of the NHRA is to introduce an integrated system for the management of national heritage resources.

Section 38 of the NHRA requires that Heritage Impact Assessments (HIA's) are required for certain kinds of development such as rezoning of land greater than 10,000 m^2 in extent or exceeding three or more sub-divisions, or for any activity that will alter the character of a site greater than 5,000 m^2 (see *Box 2.3*). The Western Cape and Kwa-Zulu Natal have functioning Provincial Heritage Authorities, and consequently South African Heritage Resources Agency (SAHRA) administers heritage in the remaining provinces particularly where archaeology and palaeontology are the dominant concerns. Heritage Northern Cape (Ngwao Boswa Kapa Bokoni) deals largely with built environment issues at this stage. SAHRA and Heritage Northern Cape are key commenting authorities in the ESIA process.

The responsible heritage resources authority must, within 14 days of receipt of such a notification if there is reason to believe that heritage resources will be affected by such development, notify the person who intends to undertake the development to submit an impact assessment report or notify the person concerned that this section does not apply.

Box 2.1 Permitting Requirements for Heritage Resources Management

PERMIT APPLICATION SECTION 38 (Ref: NHRA 1999 : 62)

(a) The construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length;

(b) the construction of a bridge or similar structure exceeding 50 m in length;

(c) any development or other activity which will change the character of a site exceeding 5 000 m^2 in extent; or

i. involving three or more existing erven or subdivisions thereof; or

ii. involving three or more erven or divisions thereof which have been consolidated within the past five years; or

iii. the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority;

(d) the re-zoning of a site exceeding 10 000 m^2 in extent; or

(e) any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority.

Archaeology, Palaeontology and Meteorites

According to Section 35 (Archaeology, Palaeontology and Meteorites) and Section 38 (Heritage Resources Management) of the South African National Heritage Resources Act (SAHRA), Paleontological Heritage Impact Assessments (PIAs) and Archaeological Impact Assessments (AIAs) are required by law in the case of developments in areas underlain by potentially fossiliferous (fossil-bearing) rocks, especially where substantial bedrock excavations are envisaged, and where human settlement is known to have occurred during prehistoric and the historic period. Depending on the sensitivity of the fossil and archaeological heritage, and the scale of the development concerned, the paleontological, and archaeological impact assessment required may take the form of (a) a stand-alone desktop study, or (b) a field scoping plus desktop study leading to a consolidated report. In some cases these studies may recommend further paleontological and archaeological mitigation, usually at the construction phase. These recommendations would normally be endorsed by the responsible heritage management authority, Heritage Northern Cape (HNC), to whom the reports are submitted for review.

As part of the EIA, a Heritage Impact Assessment (including both archaeology and palaeontology) will be submitted to HNC to elicit comments. Comments received from HNC will be included in the Comments and Responses Report in the Final ESIA Report.

Box 2.4 outlines when a permit is required depending on the sensitivity of the heritage resources.

Box 2.2 *Permitting Requirements for Fossil, Built Environment and Stone Age Archaeology*

PERMIT APPLICATION SECTION 35: FOSSILS, BUILT ENVIRONMENT FEATURES, SHIPWRECKS & STONE AGE ARCHAEOLOGY (Ref : NHRA 1999: 58)

(a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;

(b) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite; or

(c) trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite.

Burial Grounds and Graves

A Section 36 permit application is made to the South African Heritage Resources Agency (SAHRA) which protects burial grounds and graves that are older than 60 years, and must conserve and generally care for burial grounds and graves protected in terms of this section, and it may make such arrangements for their conservation as it sees fit. SAHRA must also identify and record the graves of victims of conflict and any other graves which it deems to be of cultural significance and may erect memorials associated with these graves and must maintain such memorials. A permit is required under the conditions listed below.

Box 2.3 *Permitting Requirements for Burial Grounds and Graves Older than 60 years to Heritage Northern Cape (HNC) and Historic Burials to the South African Heritage Resources Agency (SAHRA)*

PERMIT APPLICATION SECTION 36: BURIAL GROUNDS & GRAVES (REF: NHRA 1999:60)

(a) destroy, damage, alter, exhume or remove from its original position or otherwise disturb the grave of a victim of conflict, or any burial ground or part thereof which contains such graves;

(b) destroy, damage, alter, exhume, remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority;

(c) bring onto or use at a burial ground or grave referred to in paragraph (a) or (b) any excavation equipment, or any equipment which assists in the detection or recovery of metals; or

(d) SAHRA or a provincial heritage resources authority may not issue a permit for the destruction or damage of any burial ground or grave referred to in subsection (3)(a) unless it is satisfied that the applicant has made satisfactory arrangements for the exhumation and re-interment of the contents of such graves, at the cost of the applicant.

2.1.6 National Environmental Management: Air Quality Act, 2008 (No. 39 of 2008)

The aim of the National Environment Management: Air Quality Act (NEMAQA) is to govern the release of pollutants in order to manage air quality parameters, norms and standards within South Africa. Since the repeal of the Atmospheric Pollution Prevention Act (No. 45 of 1965), Regulation GN 248 was promulgated in 2010 (in terms of NEMAQA), which list activities resulting in atmospheric emissions which have or may have a significant detrimental effect on the environment. In light of this Regulation GN248 and the nature of the proposed project, the following activities will be triggered in terms of NEMAQA, and therefore require the submission of an Atmospheric Emissions License Application Form to the Provincial Department of Environment and Nature Conservation (DENC).

Table 2.6 Listed Activities in Terms of NEMAQA

Government Notice 248	
Sub-category 2.2: Storage and Handling of Petroleum Products (exceeding 500m^3)	Petroleum product storage tanks and product transfer facilities, except those used for liquefied petroleum gas.
Sub-category 5.1: Mineral processing, storage and handling	Storage and handling of ore and coal for facilities designed to hold more than 100 000 tons.

2.1.7 National Water Act (No. 36 of 1998)

The National Water Act (NWA) provides for the sustainable and equitable use and protection of water resources. It is founded on the principle that the National Government has overall responsibility for and authority over water resource management, including the equitable allocation and beneficial use of water in the public interest, and that a person can only be entitled to use water if the use is permissible under the NWA. The Department of Water Affairs (herein referred to as DWA) is the delegated custodian of water resources in South Africa. Part of the DWA mandate is to enact and enforce the legal requirements outlined in the NWA.

Section 19 of the NWA deals with pollution prevention, and in particular, the situation where pollution of a water resource occurs or might occur because of activities on land. The Act states that the person who owns, controls, occupies or uses the land is responsible for preventing pollution of the water resources and is also responsible to remedy (correct) the effects of the pollution. If the person responsible does not take measures to prevent pollution, the catchment management agency (or the Minister if there is no catchment management agency in place) may take steps to prevent pollution or to address the effects of pollution. The person or persons responsible for the pollution is also responsible for paying the costs to address the effects of the pollution.

Section 21 sets out general principles for regulating water use. Water use is defined broadly, and includes taking and storing water, activities which reduce stream flow, waste discharges and disposals, controlled activities (activities which impact detrimentally on a water resource), altering a watercourse, removing water found underground for certain purposes, and recreation. In general a water use must be licensed unless it is listed in schedule I, is an existing lawful use, is permissible under a general authorisation (as listed in GNR 399), or if a responsible authority waives the need for a licence (Section 22). The Minister may limit the amount of water which a responsible authority may allocate (Section 23). In making regulations the Minister may differentiate between different water resources, classes of water resources and geographical areas (Section 26).

Based on potential water uses, the NWA requires that a water user must either register a water use in terms of the General Authorisation or alternatively undertake a full licensing process. In order to distinguish between the need for registration and licensing, the DWA have issued a General Authorisation (Government Notice 1199 of 2009) for water uses in terms of Section 21 (c) and (i) only (see below). However, this General Authorisation is applicable to these specific water uses and contains exclusionary clauses. Should a water use activity fall outside of this General Authorisation or alternatively trigger any exclusionary clauses contained therein, a full license application process would need to be completed, prior to commencement of a water use.

Black Mountain currently has a water use license for numerous activities and a total water allocation of 4,380,000 m^3/a (12,000 m^3/d) potable water supplied by Pella Drift Water Board. The proposed Project will require additional water provision that may exceed the current allocation volumes. Water supply applications are submitted by the supplier, the Pella Drift Water Board. Although water uses are property dependent, Black Mountain will revise the water supply agreement with Pella Drift Water Board to permanently transfer the required percentage of the total allocated water to the Mine, while retaining the remainder of the water allocation for the existing Black Mountain Mine, the towns of Aggeneys, Pofadder and Pella

The Project will undertake an application for water use activities related to the Project area. Based on the current project description, the following water uses will likely be triggered in terms of Section 21 of the NWA.

Box 2.4 Water Uses in Terms of Section 21 of the NWA

(a) taking water from a water resource;

(b) storing water;

(c) impeding or diverting the flow of water in a watercourse;

(d) engaging in a stream flow reduction activity contemplated in section 36;

(e) engaging in a controlled activity identified as such in section 37 (1) or declared under section 38 (1);

(f) discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;

(g) disposing of waste in a manner which may detrimentally impact on a water resource;

(h) disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process;

(i) altering the bed, banks, course or characteristics of a watercourse;

(j) removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; and

(k) using water for recreational purposes.

Tailings facilities will be constructed for the Project that will require dam safety clearance. In accordance with section 121 of the NWA the following factors need to be considered in declaring or category of dams with safety risk:

- the manner in which that dam is designed, constructed, altered, repaired, operated, inspected, maintained or abandoned;

- the person by whom that dam is designed, constructed, altered, repaired, operated, inspected, maintained or abandoned; and

- the manner in which the water is contained, stored or impounded in that dam.

Cognisance will be taken of other applicable Regulations which have been published in terms of the NWA, including the Dam Safety Regulations and the regulations relating to measures aimed at the prevention of water pollution resulting from mining and related activities (published on 4 June 1999 in terms of GNR704). In terms of GNR704:

- Restrictions are imposed on the locality of certain infrastructure like residue deposits, dams, boreholes, sanitary conveniences, fuel deposits as well as the carrying out of mining or other activities within certain distances of water resources.

- A duty is imposed to confine clean water to a clean water system and dirty water to a dirty water system which must be designed so as not to spill into the clean water system more than once in 50 years.

- Regulation 7 imposes various requirements regarding the protection of water resources.

To the extent that these Regulations apply to the Project, compliance therewith will be sought. Finally, the general duty of care provisions of the NWA will be considered and applied.

2.1.8 The National Environmental Management: Biodiversity Act, 2008 (No. 10 of 2004)

The National Environmental Management: Biodiversity Act (NEMBA) serves to provide a framework for the management and conservation of South African biodiversity, under the auspices of the NEMA. This legislation promotes the sustainable use of natural biological resources, ensuring equitable access and sharing of benefits arising from the use of biological resources. In terms of Section 56(1) of NEMBA a person may not carry out a restricted activity involving a specimen of a listed threatened or protected species without a permit issued in terms of Chapter 7. These threatened and protected species have been listed in terms of GNR.151 of 2007: Publication of lists of critically endangered, endangered, vulnerable and protected species. A restricted activity in relation to a specimen of a listed threatened or protected species means:

- hunting, catching, capturing or killing any living specimen of a listed threatened or protected species by any means, method or device whatsoever, including searching, pursuing, driving, lying in wait, luring, alluring, discharging a missile or injuring with intent to hunt, catch, capture or kill any such specimen;

- gathering, collecting or plucking any specimen of a listed threatened or protected species;

- picking parts of, or cutting, chopping off, uprooting, damaging or destroying, any specimen of a listed threatened or protected species;

- importing into the Republic, including introducing from the sea, any specimen of a listed threatened or protected species;

- exporting from the Republic, including re-exporting from the Republic, any specimen of a listed threatened or protected species;

- having in possession or exercising physical control over any specimen of a listed threatened or protected species;

- growing, breeding or in any other way propagating any specimen of a listed threatened or protected species, or causing it to multiply;

- conveying, moving or otherwise translocating any specimen of a listed threatened or protected species;

- selling or otherwise trading in, buying, receiving, giving, donating or accepting as a gift, or in any way acquiring or disposing of any specimen of a listed threatened or protected species; or

- any other prescribed activity which involves a specimen of a listed threatened or protected species.

Should a project result in the loss of biodiversity identified in terms of GN 151 of 2010, a permit application will need to be submitted to the Provincial Department of Environment and Nature Conservation for approval, before proceeding with the activity. A specialist botanical impacts assessment will be undertaken as part of the ESIA phase of the Project. Additional aspects of NEMBA related to the listing of threatened ecosystems, alien species, invasive species and duty of care are included in *Annex A*.

2.1.9 Integrated Legislative Processes

Due to nature of the Project, a suite of environmental legislation will be applicable, as described above. In order to meet the various legislative requirements, ERM intends to run a single integrated ESIA process, which will also meet the requirements in terms of the following laws:

- NEMA;
- NEMWA;
- MPRDA;
- NEMAQA;
- NHRA;
- NWA; and
- NEMBA.

Table 2.7 Summary of Legislative Applications and Relevant Authorities

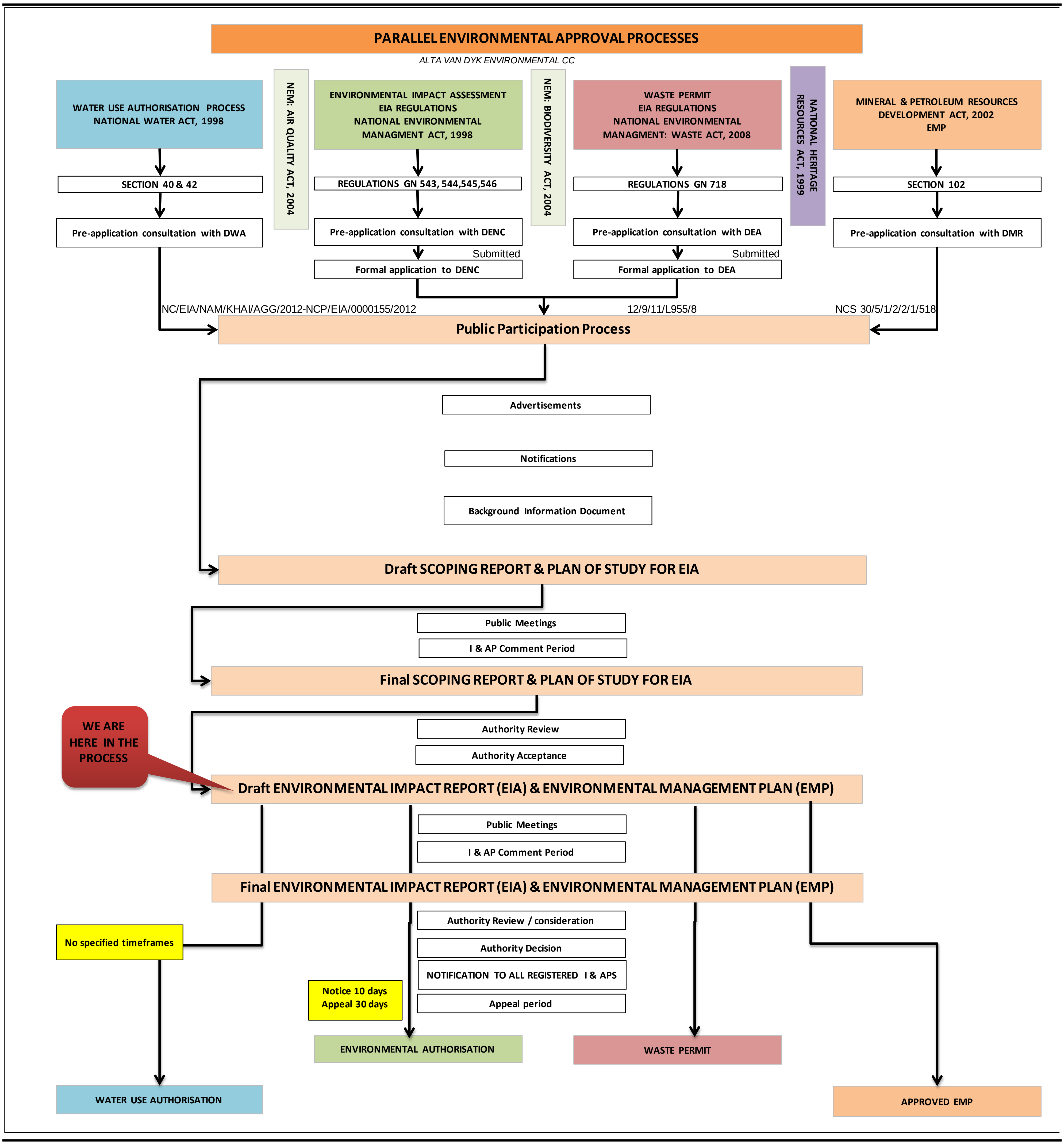
Law	Permit(s) / Application(s)	Competent Authority
NEMA	• Environmental and Social Impact Assessment.	Provincial Department of Environment and Nature Conservation.
NEMWA	• Waste Management License Application.	National Department of Environmental Affairs (Waste Directorate).
NEMAQA	• Atmospheric Emissions License Application.	Provincial Department of Environment and Nature Conservation (Air Quality and Climate Change Directorate).
NWA	• Water Use Licence Application. • Authorisation for stream flow reduction activities or 'controlled activities'. • License for construction of dam. • General authorisation.	Department of Water Affairs (DWA).

Law	Permit(s) / Application(s)	Competent Authority
NHRA	• Notice of Intent to Develop and Phase 1 Heritage Impact Assessment. • Authorisation for disturbing buildings older than 60 years. • Authorisation for disturbing archaeological and palaeontological sites and materials and meteorites. • Authorisation for disturbing significant graves and all graves which are older than 60 years and not in a cemetery.	South African Heritage Resources Agency. Heritage Northern Cape (Ngwao Boswa Kapa Bokoni).
MPRDA	• Application for amendment to existing Environmental Management Programme.	Department of Mineral Resources.
NEMBA	• Permit to undertake restricted activities involving listed threatened or protected species.	Provincial Department of Environment and Nature Conservation.

The proposed ESIA process will be undertaken in terms of NEMA and the associated EIA Regulations of 2010 (as amended). The requirements for the WML and AEL Application can be met as part of the ESIA process. The public participation requirements in terms NEMWA and NEMAQA will be met through the EIA Regulations requirement for public participation.

Based on the existing new order mining right for Gamsberg, the existing EMPr will need to be amended in accordance with the project description and proposed activities. The amended EMPr will be produced during the ESIA phase of the project, and will fulfil the requirements in terms of the MPRDA and the associated Government Notice 527 of 2004. The public participation requirements for an amendment to an existing EMPr will be undertaken in line with the ESIA requirements. The legislative requirements in terms of the NHRA will be fulfilled through the completion of a comprehensive heritage impact assessment, with the documents made available for public comment during the ESIA phase.

Figure 2.1 Integrated Flow Diagram of ESIA Process



Based on the identification of the potential water uses, an Integrated Water Use License Application (IWULA) will also be compiled and upon completion of the ESIA process including public participation, the IWULA will be submitted to the DWA for review and decision-making.

2.2 *BROADER POLICY AND PLANNING CONTEXT*

This Section briefly describes the broader policy and planning context within which the Project will take place. The strategies and planning documents are briefly summarised below with an expanded explanation included in *Annex A*.

2.2.1 *Northern Cape Provincial Growth and Development Strategy (2011)*

The Northern Cape Provincial Growth and Development Strategy (NCPGDS) (2011) plays a vital role in achieving efficacy in delivery of the overall strategic development objectives of Northern Cape.

From the plethora of societal challenges that are prevalent in South Africa, the NCPGDS identifies the following aspects that require attention:

- Reducing the backlog of basic needs such as water, sanitation and housing;
- Improving and increasing access to health, education and social services;
- Decreasing the prevalence rate of TB, HIV and AIDS;
- Creating opportunities for employment;
- Reducing contact crime; and
- Targeting vulnerable groups.

The strategy identifies long-term sustainable economic growth and development as an effective means to target the key societal concerns. Mining is identified as an important economic sector to promote such growth, as well as agriculture and tourism.

2.2.2 *The Northern Cape Provincial Spatial Development Framework (2012)*

Spatial Development Frameworks attempt to guide overall development in a direction that local and provincial authorities see as being desirable. They also aim to specify the spatial implications of Integrated Development Plans (IDPs) that are designed to optimise economic opportunities.

Amongst other things, the Northern Cape Provincial Spatial Development Framework (2012) recognises the importance of the mining sector, as a driver behind the region's economic growth. Nevertheless, it also identifies that economic development often has a detrimental impact on the environment which, in turn, often manifests in a negative impact on human-wellbeing and on tourism in the region. As such, the NCPSDF sets out the following objectives and policies to address such concerns:

- Offsetting direct detrimental impacts of resource use.

- Providing measures to cater for indirect impacts or impacts that may in the long-term emerge as a result of resource use.

- Unlocking the latent benefits and synergies vested in the resource use in order to create a positive socio-economic legacy once the initial resource use has reached its productive life cycle.

Similarly, but at a slightly lower level, the Namakwa District SDF (2012) addresses key trends in the area (*Figure 2.2* shows the composite map produced in the Namakwa District SDF). In addition to the provisions made in the NCPSDF, it proposes a conceptual Solar Corridor consisting of a roughly 30km wide strip of land with the N14 at its centre encompassing Aggeneys, as well as Pofadder and surrounds.

2.2.3 Namakwa District Municipality Local Economic Development Strategy (2007)

A Local Economic Development (LED) Strategy is a government funded initiative that attempts to improve the economic environment of all District Municipalities (DMs) and Local Municipalities (LMs) through the implementation of various projects.

The Local Economic Development strategy (2007) for the Namakwa District Municipality identifies a suite of sectors that are seen to play a critical role in the economic growth of the District. With respect to this the strategy advocates the following major activities:

- Agricultural development in selected group of targeted areas namely hydroponic and organic crop production next to the Orange River, mariculture and cultivation of the hoodia plant for medicinal purposes;

- Copper beneficiation as well as diamond cutting and processing;

- Recycled manufacturing;

- Cultural, science and nature tourism;

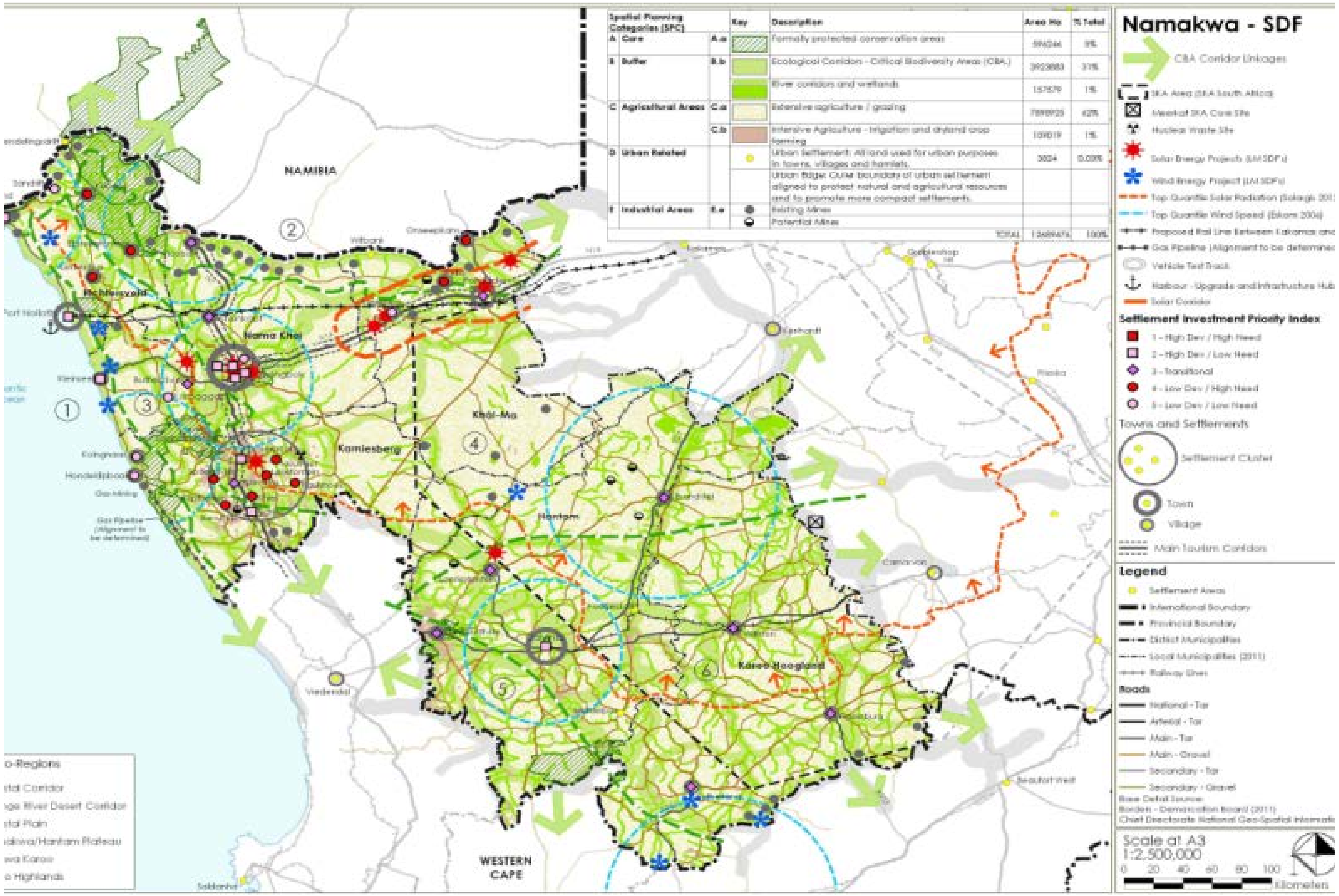
- Infrastructure upgrades; and

- Alternative energy production.

Also identifies the mining sector as one of the key potential development sectors within the District Municipality. In this regard, there is a drive to encourage processing and manufacturing of minerals into final product, as this will result in increased economic development as well as additional employment opportunities.

Finally, the strategy refers to a "One-Stop Mining Centre". This is envisaged as a facilitation centre where information and guidance on business opportunities will be made available, as well as assist with formulating business plans, proposals and tenders related to the local mining industry.

Figure 2.2 Namakwa District Municipality Spatial Development Framework Composite Map (2012)



2.2.4 *Khai Ma Integrated Development Plan (2006-2011)*

The Integrated Development Plan (IDP) constitutes the blueprint with respect to Khai Ma Municipality's strategies in addressing the socio-economic development needs of local communities (Local Government: Municipal Systems Act, Act 32 of 2000). As such, it reflects the key development focus areas agreed upon with communities and stakeholders in the Khai Ma municipality.

The following issues are highlighted in the Khai Ma IDP (2006-2011) as local development areas that need specific attention/intervention:

- Increasing unemployment rates;
- No rent is paid and no management or maintenance is undertaken by small upcoming farmers on farms allocated to them by government;
- Lack of land for livestock farming and irrigation farming;
- Need for housing; and
- Backlogs in relation to the provision of basic services.

In terms of the vision and mission set out in the IDP, the Local Municipality aims to utilise its limited resources in improving the quality of life of its residents by striving to provide improved basic services and create an environment conducive to investment through strengthening local economic development.

Gamsberg is identified in the IDP as being a significant potential growth point for the Municipality. Furthermore, one of the priority projects in the Local Municipality is supporting sustainable mining development at Gamsberg.

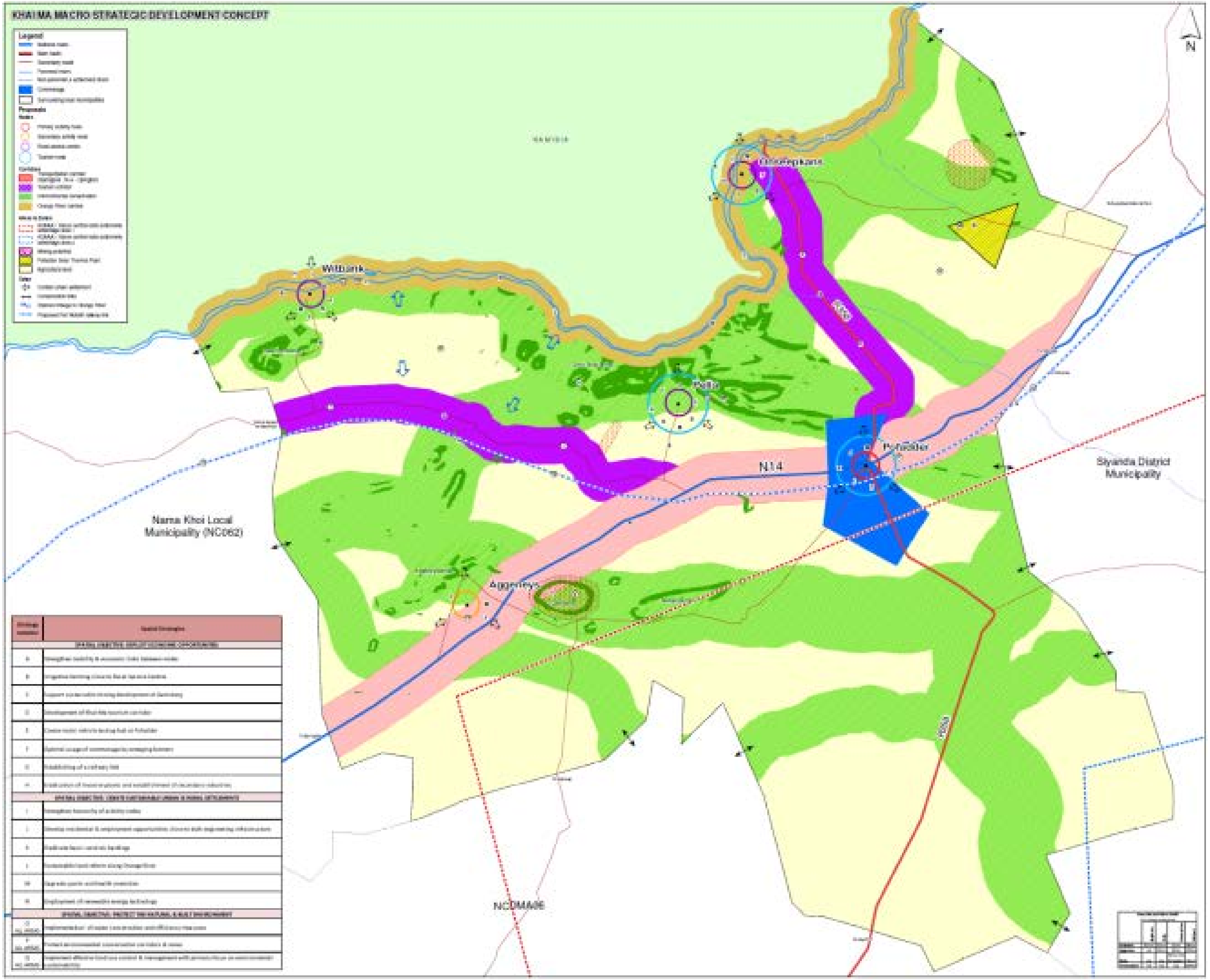
2.2.5 *Khai Ma Rural Spatial Development Framework Plan (2010)*

The Khai Ma Spatial Development Framework (SDF) guides and informs land development and management in the region. Three key aspects transpire from the SDF in relation to what is required in order to achieve its vision. These include the following:

- Improve living standards;
- Ensure health and safety; and
- Strengthen local economic development.

The mining, agricultural and tourism sectors are again highlighted as important sectors to drive local economic growth in the area. The Khai Ma SDF also recognises the importance of Pella and its surroundings for potential tourism activities in the area and identifies two primary tourism corridors between Pofadder and Witbank (along the Klein Pella Road) and between Pofadder and Onseepkans (refer to *Figure 2.3* below). In general, the SDF places particular emphasis on the protection of tourism assets and the development of tourism in areas north of the N14, along the Orange River and the mountainous areas relatively close to the Orange River.

Figure 2.3 *Khâi-Ma Local Municipality Spatial Development Framework Composite Map (2010)*



Source: KMLM, 2010

Finally, the SDF recognises that mining activities could present a significant threat to local biodiversity in the area, particularly with respect to the proposed development of an opencast mine at Gamsberg. As such, mining development in areas with sensitive biodiversity is earmarked as an area that should require specific policy intervention. With respect to this, the compilation of an Environmental Management Plan for mining and agricultural activities in the municipality is recommended in order to protect environmental conservation corridors and zones.

Alignment with Regional Planning Policies

Given the above, it is clear that the Project achieves in-principle compatibility with the key thrusts of planning documents for the province, district and local municipality. These documents also do, however, call for caution regarding the conservation status of the Project site in particular. Further discussion on the Projects alignment with applicable regional and local planning and land-use policies/frameworks is discussed in the following section, which provides a background to the 'Need and Desirability' guidelines developed by the Western Cape Department of Environmental Affairs and Development Planning (2010).

2.2.6 *Need and Desirability Guidelines*

The 'Need and Desirability' guidelines (2010) have been developed by the Western Cape Department of Environmental Affairs and Development Planning (DEA&DP) to guide the appropriate selection of projects (ie the need and desirability of a development) through assessing them against applicable regional and local policy/planning criteria. This includes sustainable development vision, goals and objectives formulated in, and the desired spatial form and pattern of land use reflected in the selected area's IDP's, SDF's and EMF's. This serves to provide an indication as to whether or not the proposed land-use/activity is the best practicable use for the land or the most sustainable use for the site.

A set of questions have been set out in the guidelines to prompt responses, which provide information as to the suitability of alternatives for the site, including the option of not proceeding with the development. Responses to these questions are listed in *Table 1.6* and *Table 1.7* in *Annex A*.

2.3 *INTERNATIONAL GUIDELINES*

2.3.1 *IFC Performance Indicators for Sustainability*

The International Finance Corporation (IFC) have developed a set of performance standards that are directed towards providing guidance on how to identify risks and impacts and measures to avoid, mitigate and manage risks and impacts. The performance indicators also promote stakeholder engagement at various stages of the project lifecycle.

In the case of direct investments for the IFC (including project and corporate finance provided through financial intermediaries), the IFC requires that its clients apply eight established Performance Standards to manage associated environmental and social risks and impacts (IFC, 2012). These fall under the following categories listed below:

- PS 1: Social and Environmental Assessment and Management System;
- PS 2: Labour and Working Conditions;
- PS 3: Pollution Prevention and Abatement;
- PS 4: Community Health, Safety and Security;
- PS 5: Land Acquisition and Involuntary Resettlement (n/a);
- PS 6: Biodiversity Conservation and Sustainable Natural Resource Management;
- PS 7: Indigenous Peoples; and
- PS 8: Cultural Heritage.

Specific details regarding each of the eight listed Performance Standards that developments are measured against are provided in *Annex A*.

2.4 *INTERNAL CORPORATE STANDARDS*

2.4.1 *Vedanta's Corporate Standards*

Vedanta Resources Plc. has developed a suite of environmental policies to guide the company's activities with respect to environmental management. The policies strive to align with IFC Performance Standards (2012), thus achieving international good practice. The following is a list of environmental polices developed and implemented on all developments associated with Vedanta's activities:

- Biodiversity Policy;
- Energy and Carbon Policy;
- HIV/ AID Policy;
- Health, Safety and Environment Policy;
- Human Rights Policy;
- Social Policy; and
- Water Management Policy.

A short summary of the key elements from each of the above categories is provided in *Annex A*.

3 PROJECT DESCRIPTION

3.1 INTRODUCTION

The purpose of this Chapter is to provide a description of the Project. In doing so the section provides a description of:

- Background to Project;
- Project location;
- Overview of Project;
- Rationale for the Project;
- Proposed Project timeframes; and
- Description of and motivation for mining method.

3.1.1 *Background to Project*

In 1998, Anglo American (hereafter referred to as Anglo) purchased Goldfield's interest in the Gamsberg Zinc Mine (hereafter referred to as 'the Project) and commenced detailed feasibility studies for the establishment of a large scale open pit mine with a metal production capacity of 300 kilotons per annum (ktpa). Upon completion of the feasibility study in 1999, Anglo commenced with all environmental and other regulatory approval processes in order to establish the mine. An old order mining right was granted in terms of the Mineral Act (No. 50 of 1991). Environmental approval was received in 2000 for the proposed mine, associated infrastructure and waste management facilities in terms of the Environmental Conservation Act (No. 73 of 1989).

Despite receiving the necessary approvals to proceed with the construction and operation of an open pit mine and associated refinery, Anglo did not initiate the full project development for various reasons. Subsequently, Anglo established a small scale underground mining operation which commenced along the northern section of the Gamsberg inselberg in 2003. These underground mining operations are on-going and currently produce a total of 60,000 tpa of ore. The material is concentrated at the existing Black Mountain Mine concentrator; it is then transported to Loop 10 siding (approximately 160 km east of Aggeneys) and railed to the Port of Saldanha, via the Sishen – Saldanha railway line.

The feasibility study undertaken during the initial EIA process in 2000 (SRK Consulting) explored various mining options. The study concluded that the viability of a mine at Gamsberg would be dependent on a zinc metal production of 300,000 tpa for at least 25 years. In order to achieve this zinc metal production, open pit mining was identified to be the only feasible option, as it would have a life span of 33 years, meet the production targets and recover 95% of the ore reserves. The underground mining option confirmed that the production level could only attain 250,000 tpa, with a life span of less than 25 years as only 65% of ore deposits could be recovered. Based on these findings, Anglo pursued the option of open pit mining to achieve project viability.

The proposed construction of the open pit zinc mine and associated refinery was placed on hold until 2007, at which time Anglo commenced a Concept Study to augment the 1999 Feasibility Study. The Concept Study scaled up the proposed metal production from 300 ktpa to 400 ktpa. However, upon completion of this study, the project was placed on hold once again due to insecurity of electricity supply and rising costs of power.

In 2009/2010, Anglo introduced additional project components and initiated a Gap Analysis. The purpose of the Gap Analysis served to identify legislative and technical requirements that were now required, based on the changes in environmental legislation (ie EIA regulations) and project components. Upon completion of the Gap Analysis in 2010, Vedanta Resources plc. acquired BMM as well as the Project area. BMM (now a subsidiary of the Vedanta Resources plc.) intends developing the mine and has initiated the necessary feasibility studies and associated environmental studies. BMM has appointed ERM to undertake the necessary environmental regulatory processes in terms of NEMA, the NWA, and MPRDA (amongst others).

3.1.2 Project Location

The mine is located in the Northern Cape Province of South Africa, between the existing town of Aggeneys and the town of Pofadder, approximately 120 km east of the Springbok, along the N14. The mine and associated plant facilities will be located on the following properties, approximately 14 km east of the town of Aggeneys, along the eastern border of the N14 (refer to *Figure 1.1*):

- Bloemhoek 61 Portion 1;
- Gams 60 Portion 1;
- Aroams 57 RE; and
- Gams 60 Portion 4;

The site is commonly referred to as Gamsberg, and is characterised by an oval shaped inselberg, that extends approximately 220 meters above the surrounding plains.

There is an existing gravel road that runs in a south-easterly direction from the Mine to Loop 10 rail siding, on the Sishen-Saldanha railway line, which is located approximately 160 km south-east of the Mine. It is expected that half of the zinc concentrate produced will be transported via this route to the Port of Saldanha. It is also expected that the remaining proportion of the zinc concentrate will be trucked to the Port of Saldanha directly from the mine along the N14, via N7 and R399.

3.1.3 Overview of Project

BMM intends to establish the mine with resultant waste rock dumps; mine machinery fleet and workshops. A concentrator plant with resultant stockpile areas, tailings facility and supporting infrastructure (ie water supply distribution network, laboratories, sewage works and an office complex) will be established to process the mined ore. Off-site linear infrastructure in the form of energy and water supply as well as transport routes will be established. Residential housing in support of the project will also be established. All of the above will be the subject of this ESIA application.

The Port of Saldanha is currently used by BMM for exporting its products and it is intended that the Project will also utilise this Port. At this stage, only preliminary design and layout options for the expected expansions or upgrades to accommodate the additional zinc concentrate export have been undertaken. Pending outcomes from further feasibility studies and engagement with the National Ports Authority, the preferred option to accommodate the increase in zinc exports will be confirmed and this will be subject to a separate environmental application process, if required.

3.1.4 *Global Demand*

In order to understand the need and desirability for the project, the driving factors for the establishment of the mine are presented below. The need for the project is presented within the context of the global market and its relation to the South African context. BMM's motivation for the Project is presented, followed by the regional mining context within the Northern Cape.

Zinc is the fourth most common metal in use globally, behind iron, aluminium, and copper, with an annual production of about 12 million tons (*www.minerals.usgs.gov*). According to the United States Geological Survey, the total global zinc resource is approximately 1,9 billion metric tons. According to the International Lead and Zinc Study Group (ILZSG), 50% of the end use of zinc is galvanising, followed by zinc alloying and the production of brass and bronze. Zinc is also used in the chemical industries as well as household products, but the volumes are minimal compared to the end uses identified above.

The current global mine production of zinc slightly exceeds the current global usage of zinc, as indicated in *Table 3.1* below. The forecasted growth of zinc demand however is projected to increase over the period 2012 – 2025 at a rate of 3.7% per annum (Wood Mackenzie, 2012). The growing global demand for zinc will exceed current global production by approximately 503 Ktpa by the year 2015 (Wood Mackenzie, 2012).

Table 3.1 Estimated Zinc Mine Production and Metal Usage (Sourced from Wood Mackenzie, 2012)

World Refined Zinc Supply and Usage 2008 – 2012 (thousand tons) & projection for 2015						
Year	**2008**	**2009**	**2010**	**2011**	**2012**	**2015**
Mine production	11 487	11 174	12 712	12 992	13 457	14 870
Metal Usage	11 198	10 136	11 681	12 584	13 191	15 373

The establishment of the mine is expected to introduce approximately 500,000 tpa of zinc into the global market at its peak production capacity. The zinc concentrate generated from the Project would be exported to Europe and Asia for refining and distribution, until such time a zinc refinery is established in South Africa. Although the current global supply exceeds the current global usage of zinc (Wood Mackenzie, 2012), the mine intends to meet the growing demand, at the time of commencement of operation (ie 2015). The viability of the Project is closely linked to timing of, and increasing, global demand trends. Leading zinc mines like Century in Australia and Lisheen in Ireland are expected to close during 2014-16 and other large zinc mines like Rampura-Agucha in India would experience a fall in production, thereby generating greater global demand for concentrate produced from the Project.

Regional Mining

Mining is a major gross domestic product (GDP) contributor and provides about 50% of the employment in Northern Cape Province (SRK Consulting, 2010). Mining in the north western area of the Northern Cape is however declining and is expected to have a significant impact on the region.

BMM has a long term view to exploit additional resources to ensure mining continues in the region. The Swartberg Mine and Broken Hill Mine are no longer mined and the Deeps Mine (in Aggeneys) has a life of mine until 2020. The Deeps Mine will continue to explore potential mining opportunities to expand its life of mine. The Project is a key project to ensure mining continues in the region and will have an expected life of mine of 19 years with future potential for the possible extension of this period.

South Africa has been a net importer of refined zinc resulting in loss of foreign exchange for the nation. While the Project will not reduce the countries dependency on importing refined zinc (as there is no zinc refinery in South Africa), it will create many new job opportunities, stimulate the Northern Cape economy.

Regional contribution to local economy by the existing Black Mountain Mine

BMM's current contribution to the local and regional economy includes:

- Employing in excess of 1,300 persons, operating as the largest private employer in the Namakwa region and it is a stable employer for the last 30 years. 80 % of the employees are local, with 62% from Namakwa, Khai-Ma and Nama Khoi municipal area.

- Residential accommodation is provided by the mine to almost all its employees. Aggeneys currently houses the existing BMM work force of approximately 700 permanent employees and approximately 680 sub contracted staff.

- Basic service provision to the town of Aggeneys is maintained for all residents. Monitoring of resources like water, energy as well as waste and its recycling takes place continually to enable sustainable management of resources by all the users.

- An indirect result of the Deeps Mine and by the support of BMM, potable water is provided to Pofadder, Pella, Aggeneys and surrounding farmers (a total of approximately 11,200 people).

- The public provincial gravel road of 160 km from the N14 to Loop 10 railroad siding is maintained by BMM.

- Supporting businesses and clubs are directly or indirectly supported by BMM providing additional employment and non-mine skills development and economic benefit to the area.

- In addition to the above, the Black Mountain Social and Labour plan currently implement four projects, affecting approximately 9,000 persons positively with a total spent of approximately R 16.5 million over five years.

It is expected that the proposed Project will continue to add socio-economic value in similar manner in the future.

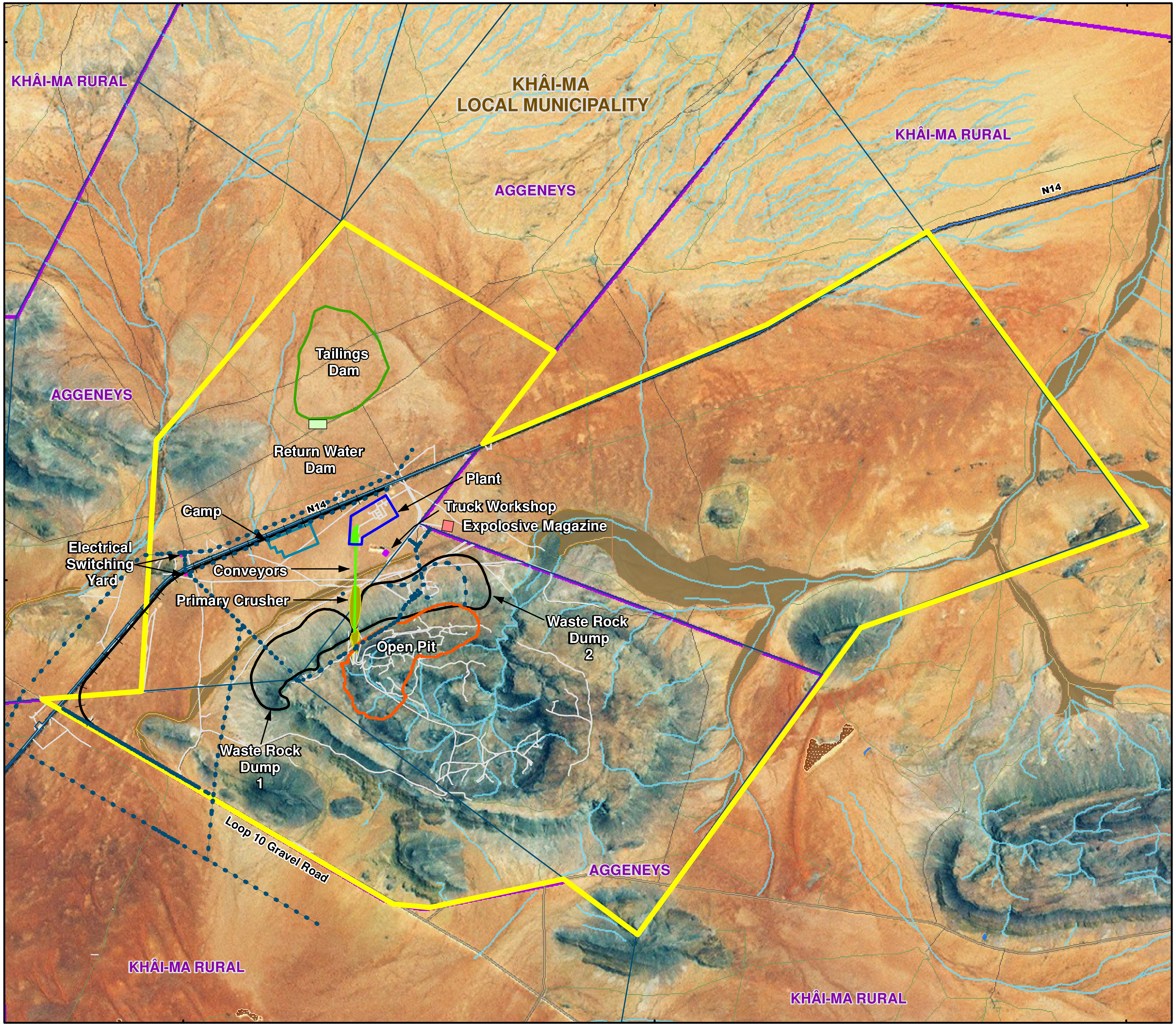
3.1.5 Proposed Project timeframes

The project programme, based on the current work schedule, is summarised below:

Table 3.2 Estimated Project Programme

Phase	Commencement	Completion	Duration	Remarks
Planning & Design	First Quarter 2012	First Quarter 2013	12 Months	
Construction	Fourth Quarter 2013	First Quarter 2017	42 Months	First stream of 3.35 Mtpa will come into operation from 1st quarter of 2015
Operation	Second Quarter 2015	2032	19 years	Two additional streams will be added, during the remaining life of mine.
Decommissioning	2033		12 months	Decommissioning phase to be refined during updates of the mine closure plan.

The final layout plan for the Project is presented in *Figure 3.1* below. Please note that the layout planning was subject to a detailed assessment of alternatives, which are contained in *Section 4*.



Legend

- Non-Perennial River
- Dry Water Course Centre Line
- Dry Water Course Floodplain
- Dam
- Dry Pan
- National Route (N14)
- Main Road
- Secondary Road
- Other Road
- Track/Footpath
- Railway
- Electrical cables
- Haul Roads
- Town Boundary
- Cadastral Boundaries
- Open Pit
- Contractors Camp
- Conveyor
- Electrical Switching Yard
- Explosive Magazine
- Plant
- Primary Crusher
- Return Water Dam
- Tailings Dam
- Truck Workshop
- Waste Rock Dump 1
- Waste Rock Dump 2
- Mineral Rights Area

SCALE:

0 1 2 3 4

Kilometres

N

TITLE:

Figure 3.1:
Updated General Layout Plan

CLIENT:

vedanta

BLACK MOUNTAIN MINING (PTY) LTD

DATE: Apr 2013	CHECKED: MP	PROJECT: 0164903
DRAWN: AB	APPROVED: SHC	SCALE: 1 : 70 000

DRAWING:	REV:
Updated General Layout Plan.mxd	0

ERM
Great Westerford Building
240 Main Road
Rondebosch, 7725
Cape Town, SOUTH AFRICA
Tel: +27 21 681 5400
Fax +27 21 686 073

ERM

Projection: Transverse Mecator, CM19. Datum : WGS84 Source: Chief Directorate National Geo-Spatial Information. Black Mountain Mining (Pty) LTD Inset Map: Esri Data & Maps	SIZE: A3

T:\Gis Projects\0164903_Gamsberg\Mapping\MXD\Report\April2013\Updated General Layout Plan.mxd

3.2 CONSTRUCTION PHASE

Key activities that will be undertaken during the construction phase of the Project include the following:

- upgrading/widening of site access routes;
- earth-moving, levelling, grading and excavations;
- site clearance;
- blasting;
- pre-stripping;
- installation of equipment;
- construction of temporary construction camp and associated bulk services;
- construction of all mine infrastructures and facilities; and
- construction of bulk services facilities (ie power infrastructure, waste facilities and water supply system and sewerage treatment plant).

This section focuses on the construction phase of the project and describes the following:

- Job creation during the construction phase;
- Construction camp infrastructure (office, workshop, temporary storage of fuels and wastes);
- Contractor housing camp (temporary staff housing);
- Bulk service requirements for the construction camp and temporary contractor housing camp;
- Non-mineral waste management;
- Storm water management; and
- Concentrator plant.

3.2.1 *Job Creation during the Construction Phase*

The construction phase of the Project will result in between approximately 3,200 construction phase jobs. *Table 3.3* provides a breakdown of the number and types of jobs expected for different components associated with the construction phase.

Table 3.3 Estimated Direct Temporary Employment during Construction

Construction component	Total number of workers needed				Ave duration of each employment contract within overall 36 to 42 month construction period
	Highly skilled	Medium skilled	Low skilled	Total	
Mine & Pre-Stripping	150	375	675	1200	19 months
Concentrator plant	120	300	550	970	
Housing	50	125	225	400	
Infrastructure	80	200	350	630	
Total	**400**	**1000**	**1800**	**3200**	

3.2.2 *Construction Camp Infrastructure (Office, Workshop, Temporary Storage of Fuels and Wastes)*

A construction camp will be established during the construction phase of the Project, which will cover a total area of approximately 2 to 4 hectares. It is proposed to locate the construction camp north of the Gamsberg inselberg, south of the proposed concentrator plant. The following areas will be needed for the construction camp:

- an office complex;
- workshops;
- housing for contractors;
- servicing areas;
- temporary storage of materials;
- bulk fuel storage (100 m^3);
- bulk lubricant storage (20 m^3); and
- truck yard and vehicle parking.

It is expected that the following variety of large equipment will be required during the construction phase:

- cranes;
- dump trucks;
- front end loaders;
- shovels;
- concrete batch plant;
- excavators;
- boom placers; and
- road rollers.

3.2.3 *Contractor Housing Camp (Temporary Staff Housing)*

In order to house the contracted work force, temporary on-site housing will be constructed. The proposed housing will be located adjacent to the south of the plant and cover a total area of approximately 30 hectares (refer to *Figure 3.2* below). A total of approximately 500 units will be erected to house workers from the estimated 5000 jobs that will be created during the 30 month construction period. The proposed housing and construction camp will have bulk water, sewage, electricity and supporting road networks as discussed below.

3.2.4 *Bulk Service Requirements for the Construction Camp and Temporary Contractor Housing Camp*

Water

The Pella Drift Water Board is the official water service provider for the towns of, *inter alia*, Aggeneys and Pofadder. The Pella Drift's Water Board current infrastructure includes an existing pump-station and water treatment works, located along the Orange River, near the town of Pella. An existing pipeline extends from the water treatment works to the town of Aggeneys.

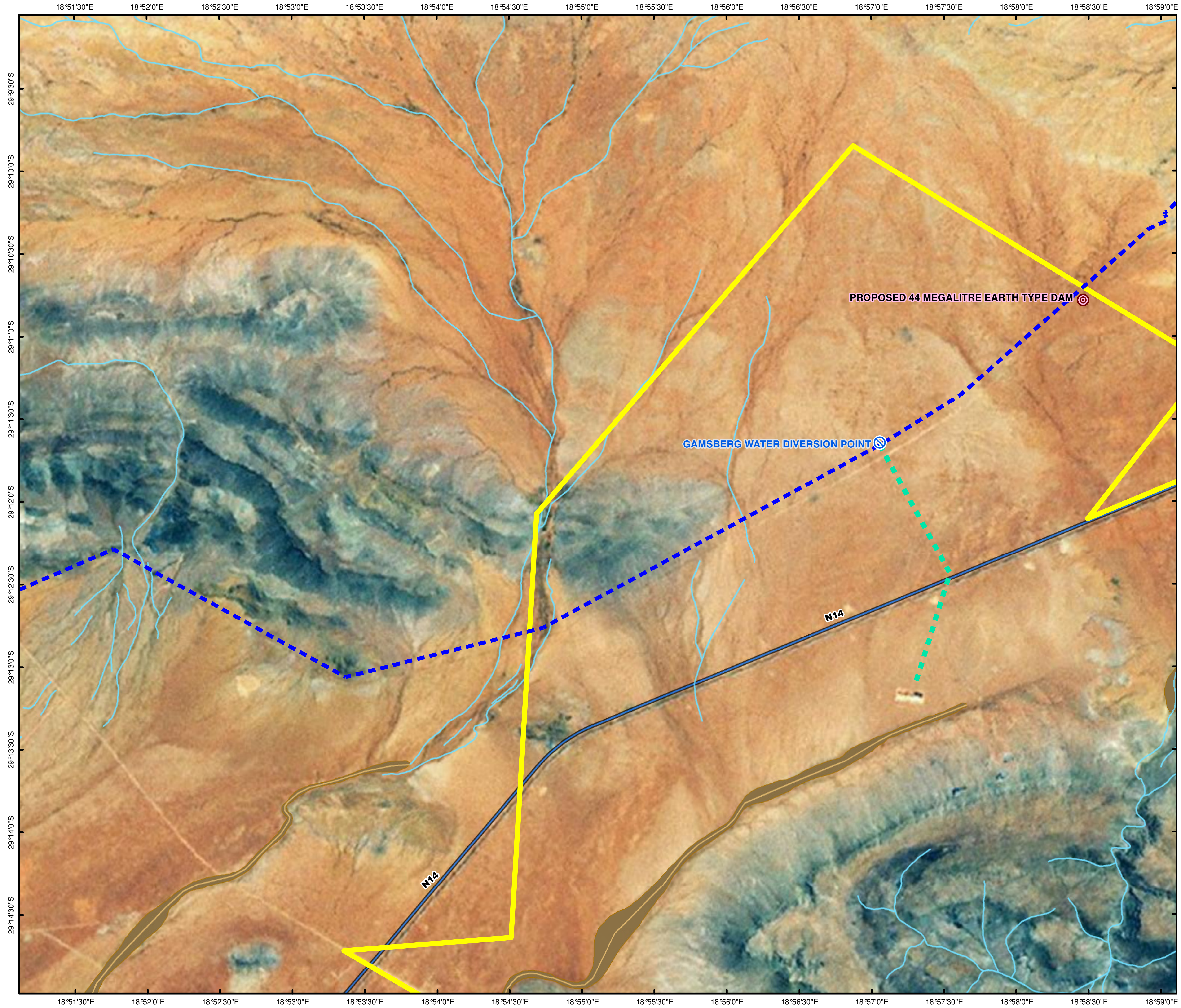
In response to the growing demand for water in the towns of Pella, Pofadder and Aggeneys, the Pella Drift Water Board is currently in the process of upgrading the water supply infrastructure. The upgrade will include, amongst another:

- Upgrading of existing pump-station to increase abstraction volumes;
- Upgrading of water treatment works to increase treatment capacity;
- Construction of a new steel pipeline extending from the water treatment works to the town of Aggeneys. The pipeline diameter will vary between 500 – 750 mm; and
- Construction of new reservoirs at the treatment works as well as along the pipeline route.

Pella Drift Water Board is currently in the planning and design phase. An environmental legislative requirement for the upgrading of the water infrastructure is still to be determined, based on a finalisation of the project description. Pella Drift Water Board will undertake a Basic Assessment for the water infrastructure upgrades.

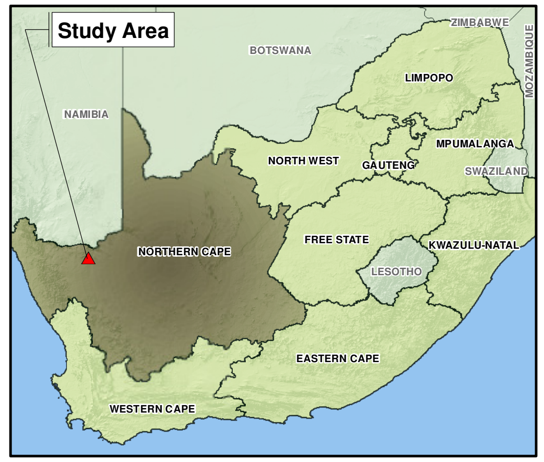
Based on the current project timing, the operational phase for the upgraded water infrastructure is expected to commence prior to the construction phase of the Mine. Construction phase water requirements for the Mine will be sourced from the Pella Drift Water Board water pipeline.

According to current estimations, the water requirement for the construction phase is approximately 2,000 m^3/day and will be sourced from Pella Drift Water Board, via a 5 km off-take pipeline that is going to be constructed from the Pella Drift Water Board pipeline to the Mine (refer to *Figure 3.2*). The off-take pipe will be 550 to 750 mm in diameter and will be constructed aboveground from the discharge point to the mine, except for the section that crosses the N14. A culvert will be constructed under the N14 in order to facilitate this pipeline crossing. While the impacted footprint during the construction of the pipeline will cover an area of 1000 m^2, the pipeline itself will cover a total area of 0.5 hectares. Two water storage reservoirs will be located adjacent to the off take pipe. These include a 44Ml reservoir located within the existing mining right area, adjacent to the Pella Drift Water Board pipeline and a 25 Ml reservoir that is being proposed at the existing tailings dams to the north of the Gamsberg inselberg (*Figure 3.2*). Should the construction of the off take pipeline or the associated reservoirs be delayed, the water requirement will be transport to site via road tankers. A breakdown of the water requirements and associated percentage usages are set out in terms of *Table 3.4* below.



Legend

- Non-Perennial River
- Dry Water Course Centre Line
- Dam
- Dry Pan
- Dry Water Course Floodplain
- National Route (N14)
- Water Diversion Points
- Proposed 44 Megalitre Earth Type Dam
- Proposed Pella Water Board pipeline
- Gamsberg Offtake Water Pipeline



SCALE:

0 500 1 000 1 500 2 000

Metres

N

TITLE:

Figure 3.2: Gamsberg Offtake Water Pipeline

CLIENT:

vedanta

BLACK MOUNTAIN MINING (PTY) LTD

DATE: Apr 2013	CHECKED: MJ	PROJECT: 0164903
DRAWN: AT	APPROVED: SP	SCALE: 1 : 40 000

DRAWING:	REV:
Gamsberg Offtake Water Pipeline.mxd	0

ERM
Great Westerford Building
240 Main Road
Rondebosch, 7725
Cape Town, SOUTH AFRICA
Tel: +27 21 681 5400
Fax +27 21 686 073

ERM

Projection: Transverse Mercator CM 19, Datum: WGS84 Source: Bing Maps Aerial Imagery - (c) 2010 Microsoft Corporation and its data suppliers. Inset: ESRI Data and Maps	SIZE: A3

T:Gis Projects\0164903_Gamsberg\Mapping\MXD\Report\April2013\Gamsberg Offtake Water Pipeline.mxd

Table 3.4 *Construction Phase Water Usage*

Construction Activity	Water volume requirements (%)
Contractor Camp	25
Temporary Housing	25
Waste Water Treatment Works	15
Open Pit	15
Construction Staff	25
Total	**100%**

Power

The construction phase is expected to require a temporary 4 MVA supply point on the existing Gamsberg 11kV line using 21 million kilowatts hour per year. The electricity will be supplied to the construction site via a 5km overhead line and 4 x 500kVA miniature substations. One of the substations will be in a fixed position at the construction camp and the other 3 will be movable units on the construction site. One miniature substation has a footprint of about 4 square meters.

Fuel and Lubricants

The expected bulk fuel requirements for all on-site equipment during the construction phase will be approximately 100 m^3 per day, without exceeding more than two days of storage at any one time. The fuel will be stored in a bunded area of 50 m^2 within the construction camp. In addition to this, approximately 20 m^3 of lubricants and oils will be stored in the contractor's camp site, for the duration of construction. The lubricant and oil containers will also be stored within a bunded area of approximately 10 m^2.

Sewage

In order to manage the sewage generated during the construction period, a temporary sewage treatment plant will be constructed to service the construction team <u>and located near the contractor's camp</u>. The proposed sewage plant will have a treatment capacity of approximately 600 m^3 per day. The proposed treatment works will use a biological treatment method, with 3 maturation ponds and 3 aerators. The temporary treatment plant is expected to treat 600 m^3 per day and generate an estimated 480 m^3 amount of effluent discharge and 1 500 tons of sludge per day. All treated effluent will be reused in the processing plant and for dust suppression (if effluent quality allows). Upon completion of the construction phase, the sewage treatment plant will probably be decommissioned and closed. All remaining sludge will be investigated for re-use or final disposal. If the sludge is to be disposed of, it will be removed by an authorised waste contractor and taken to Vissershok hazardous landfill site for final disposal.

Access Roads

Access to the inselberg, will be facilitated via an existing access road that is located to the South of the inselberg (refer to *Figure 3.2*). The existing road will be widened by approximately 15 m and will be used only during the construction phase only by various construction vehicles (eg cranes, dump trucks, front end loaders, shovels, excavators etc.) to prepare the open pit for operation.

3.2.5 *Non-mineral Waste Management*

Domestic waste from the contractor's camp and the construction operations will be separated. Paper and plastics will be recycled, with the remaining domestic wastes and disposed of at the existing BMM waste disposal site. General industrial waste produced would include steel, packaging material and material off-cuts. The temporary waste disposal site will be divided between general/ domestic and hazardous wastes and cover a total area of 100 m^2 and 200m^2 respectively. A total of 5-10 ton/month of domestic wastes are expected to be generated during construction. Domestic wastes will be stored within the contractor's camp site, covering a total area of half a hectare. All non-hazardous wastes will be disposed of at the existing BMM waste site (which is a registered landfill site), as and when required. This existing landfill site will be used until it reaches full capacity (include total capacity here and when it is expected to be reached) at which point (or before) a separate environmental assessment process will be undertaken to identify another suitable waste disposal site.

Hazardous waste will mainly include oil contaminated wastes, which will be collected and disposed of as and when required. The proposed hazardous temporary storage facility will be located within the contractor's yard and cover a total area of 0.5 hectares. Hazardous wastes will be temporarily stored within closed containers (possibly within covered skips) and removed, as and when needed (about every two weeks). The hazardous waste storage area is expected to cover an area of approximately 0.5 hectares. In order to manage the construction phase wastes, the existing Black Mountain salvage yard and disposal facility will also be utilised. It should be noted that Black Mountain currently has two authorised waste management contractors on site, who are responsible for general and hazardous waste collection and removal. A total volume of 2 ton/month of hazardous waste is expected to be generated during the construction phase. All hazardous wastes will be disposed of at the Vissershok hazardous waste facility. Proof will be obtained from each contractor as to the final disposal location and volume of domestic and hazardous wastes.

3.3 *MINING PHASE*

Based on current estimations, a total of 150,000,000 tons of ore will be mined from the Gamsberg inselberg over the 19 year life of mine. Of this expected tonnage, approximately 18,000,000 tons of zinc concentrate will be extracted. Based on the relatively low grade of the zinc deposit, the treatment process will generate approximately 132,000,000 tons of tailings and approximately 1.5 billion tons of waste rock over the life of mine.

A conceptual mine work plan for an initial 16 years is presented below (*Table 3.5*) and will be refined throughout the process taking into due consideration the environmental, health, safety and social and labour considerations.

Ramp up and phasing of the mine production will have to align with a phased construction of the concentrator plant in three streams. The scope of the infrastructure for mining and the mining process is detailed according to:

- open pit;
- primary crusher;
- explosives storage area and ammonium nitrate and emulsion silos;
- drilling and blasting;
- load and haul of overburden and ore;
- waste rock dumps;
- earth moving equipment;
- engineering workshops;
- mine bulk fuel and lubricant storage facilities; and
- conveyor system network.

Table 3.5 Conceptual Mine Work Plan

Years	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**
KT	1 083	3 333	4 416	6 666	7 750	10 000	10 000	10 000
Zinc %	6.05	7.11	7.08	6.53	6.17	6.21	5.61	6.12
Years	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Year 16**
KT	10 000	10 000	10 000	10 000	10 000	10 000	10 000	7 750
Zinc %	6.32	5.86	5.32	5.89	6.17	5.41	5.29	5.67

3.3.1 Open Pit

The Gamsberg deposit is a tabular relatively thin mineralised lens dipping to the south east, which will result in a pit that is initially developed to extract the ore reserve found closest to surface. Following this, a process of sequentially excavating push backs will be undertaken in order to gain depth and access to deeper reserves. The north and western faces will be excavated to final slope angles of approximately 45 to 53 degrees on the footwall face of the deposit, whilst pushbacks will extract ore and hanging wall overburden.

The final pit (as reflected in *Figure 3.1*) is generally determined by the economics of the operation which in turn are determined by, amongst other things, the following parameters:

- resource characteristics (grade of zinc, contaminants, etc.);
- geotechnical parameters (pit slope angle, height and width of benches);
- pit geometrical characteristics (as defined by geotechnical parameters and which determine overall strip ratio (ie waste to ore);
- pit operating costs;
- process plant operating costs; and
- process plant recoveries.

The final open pit is expected to cover a total area of 600 ha, which is expected to be the result of the extraction of some 1.65 billion tons of material. The final depth of the open pit is estimated at approximately 650 metres, while the width and length of the pit are expected to extend 2,220 metres and 2,700 metres. A typical image of an open pit, which is likely to be in a similar order of magnitude to that of the proposed Gamsberg open pit, is shown below (*Figure 3.3*).

Figure 3.3 Typical Open Pit Operation

Source: http://tslope.com/44th-us-rock-mechanics-symposium.

3.3.2 *Explosive Storage Area and Ammonium Nitrate and Emulsion Silos*

To access the ore, blasting by means of explosives will take place. On average, blasting will be undertaken once a day.

The proposed explosives magazine facility was initially located immediately adjacent to the open pit area however, based on specialist comment, this has been moved to an area southeast of the concentrator plant to avoid three watercourses and reduce the ecological impact (see *Figure 3.1*). This facility is estimated to cover a total area of approximately 20 hectares and will be operated in accordance with the Explosives Act (no 15 of 2003) to store ammonium nitrate fuel oil (ANFO), detonators, boosters and cartridges. The cumulative volume of explosives on-site (at peak capacity) will be 2 x 85 ton Emulsion silos and 2 x 50 ton silos. Provision will also be made for 1 x 200 case detonator magazine and 2 x 200 case explosive magazines. The silos will have a total height of 12 m and cover a total area of 20 hectares m^2. Explosives will be transported from the storage facility into the pit for blasting operations in specially constructed and marked vehicles. All traffic in the pit will stop during the explosives transport operation to minimise the risk of accidents between explosives vehicles and hauling or service vehicles in the pit.

3.3.3 *Drilling and Blasting*

As indicated earlier, drilling and blasting of rock faces will be required to excavate the ore and overburden waste in the pit. The drilling and blasting operation in the open pit is defined by a compromise between trying to achieve small particles of rock at the minimum possible cost. Drilling patterns are designed to produce rock fragments that are as large as possible but sufficiently small not to require additional drilling and blasting (secondary blasting) before loading and hauling.

The rock particle sizes accepted on the waste material are generally bigger than those required for ore as the crushing efficiency is greatly affected by the size of the biggest fragments in the ore feed. Details of drilling and blasting patterns for the Mine are not defined at this stage but will be designed to satisfy the above requirements during the next stage of the project.

It is expected that two types of drilling equipment will be used in the drilling operations as follows:

- Large diameter electric drill rigs for primary blasting. These machines generally have lower mobility but higher drilling efficiency making them ideal for drilling of regular and pre-determined drilling patterns like those used for daily production blasting in the open pit.

- Smaller hydraulically driven drill rigs. These drill rigs are generally track mounted and due to their smaller size have greater mobility within the pit and provide additional flexibility to drilling operations. They are generally used for secondary drilling (used for blasting of larger rocks not suitable for hauling and left following primary blasting of benches).

3.3.4 *Load and Haul of Overburden and Ore*

Loading and hauling of ore and overburden waste will be performed in the pit using a fleet of large capacity shovels, loaders, excavators, haul trucks and other service equipment. All topsoil will be removed and stored separate to ore and overburden.

Large electric shovels are expected to be used for the excavation and loading of waste material where selectivity of the excavation is not required. Back hoe hydraulic excavators (also large capacity) are expected to be used for the excavation of ore and generally in areas where greater selectivity is required.

Due to the large dimensions and limited mobility of the electric shovels and to a lesser extent the hydraulic excavators, wheeled front end loaders will also be made available in the open pit to provide additional flexibility to the loading operations.

Hauling of ore to the primary crusher and waste to the waste rock dump will be undertaken using large capacity haul trucks (typically between 220 t and 300 t capacity). Haul trucks of this size are electrically driven with a diesel engine acting as a generator to provide electric power to the electrical drives located in each wheel. The option of providing an overhead electrical system (trolley system) will also be investigated in order to minimise hauling operation costs.

Service equipment will include graders for road maintenance, water trucks to minimise the generation of dust during hauling operations, dozers and wheel dozers for the effective construction of safety berms along hauling ramps and the safe and efficient construction of the waste rock dumps as well as maintenance and repair equipment including lubrication trucks, tow trucks and wheel replacement cranes amongst others. A typical image of a haul truck expected to be used at the mine, is presented *Figure 3.4*.

Figure 3.4 ***Mining Haul Trucks Expected to be used***

Source: http://boothopia.wordpress.com/2010/01/31/welcome-to-fort-mcmurray/

3.3.5 Primary Crusher

Upon stripping of overburden, the ore will be transported via haul trucks to the primary crusher located adjacent to the open pit, on a flat point of the V cut access road along the northern slope of the inselberg. The bulk ore will be transported to the primary crusher that will have a total processing capacity of 10 Mtpa.

The primary crushed ore will be transported from the Primary Crusher to the ROM (Run of Mine) ore stockpile via a conveyor system to a ROM stock-pile. Ore will be conveyed through a reclaim conveyor to the milling circuit.

3.3.6 Waste Rock Dumps

An estimated 1.5 billion tons of waste rock will be generated during the life of mine. The trucks will transport the waste material to the edge of the inselberg where it will be tipped over the edge to form a waster rock dump. In terms of the estimated dimensions of the waste rock dump, it was initially expected to cover an area of 270 hectares and reach a total height of 215 m. However, in order to achieve the natural angle of repose, the footprint of the rock dump was increased to 490 hectares. An image of an existing waste rock dump, similar to the expected magnitude of waste to be produced at the Mine is presented in *Figure 3.5*.

Figure 3.5 *Image of a Typical Waste Rock Dump*

Source: http://technology.infomine.com/WasteRockDumps/

3.3.7 *Earth Moving Equipment*

An inventory for all earth moving equipment required for the Mine at an operational level is included in *Table 3.6* below.

Table 3.6 *Inventory of Equipment*

Mining equipment	No. Required
Excavator (34 M3/45m³)	6
Trucks (220 / 300 T)	32
Water Carts (40/50 KL)	3
FE Loaders (18 m3) - For Blending	2
Track Dozers - For Pit, Roads and waste Dump	5
Motor Graders for Road Maintenance	2
Rock Breaker (mines)	1
Rock breaker (Crusher)	1
Back Hoes	2
Wheel Dozer	1

3.3.8 *Engineering Workshops*

The Mine will have two workshop areas, one within the concentrator plant and another located between the process plant and the proposed rock waste dump site (refer to *Figure 3.2*). The first workshop (referred to as the Mine workshop) will be located north of the inselberg adjacent to the pit access road. This workshop will be a dedicated heavy duty workshop and will be responsible for servicing of all mine related equipment. It will cover a total area of approximately 1 hectare, with an internal haul road linking to the mine entrance. The other workshop will be used for minor mechanical servicing and maintenance. It is expected to cover a total area of approximately 1.5 hectares.

3.3.9 Mine Bulk Fuel and Lubricant Storage Facility

The mine bulk storage tank farm will be located adjacent to the Mine workshop area, as depicted in the revised layout plan (refer to ***Error! Reference source not found.***). This tank farm will store approximately 500 m^3 of diesel and cover a total area of approximately 2,500 m^2. The tank farm may include up to six refuelling bays. The mine would also require the usage of lubricants for equipment and operational activities. Approximately 5,000 litres of various grades of lubricants will be stored in a bunded area adjacent to the Mine workshop area. This proposed storage facility for the lubricants will cover a total area of approximately 1,000 m^2.

3.3.10 Conveyor System Network

The blasted ore from the pit will be trammed [(1)] to the primary crusher. The primary crushed ore will be transported by means of a conveyor system to the crushed ore (ROM) stock piles. Subsequently the ore will be reclaimed from under the stockpiles and conveyed to the milling section. The proposed conveyor system will be 2 m wide and extend over a distance of 2.5 km as shown in *Figure 3*.2. The conveyor system will be covered.

3.4 PROCESSING CONCENTRATOR PLANT

The full production capacity of the mine will be 10 Mtpa ore. This capacity will be reached in a modular approach following the mine ramp up plan as shown in *Table 3.6*. The current approach will be to ramp up to the full capacity in three modules. With the first module sized to process 3.35 Mtpa ore and with two additional modules to be added at later stages of the mine ramp up. Modules will share some common facilities.

Table 3.7 Phasing of Concentrator Plant

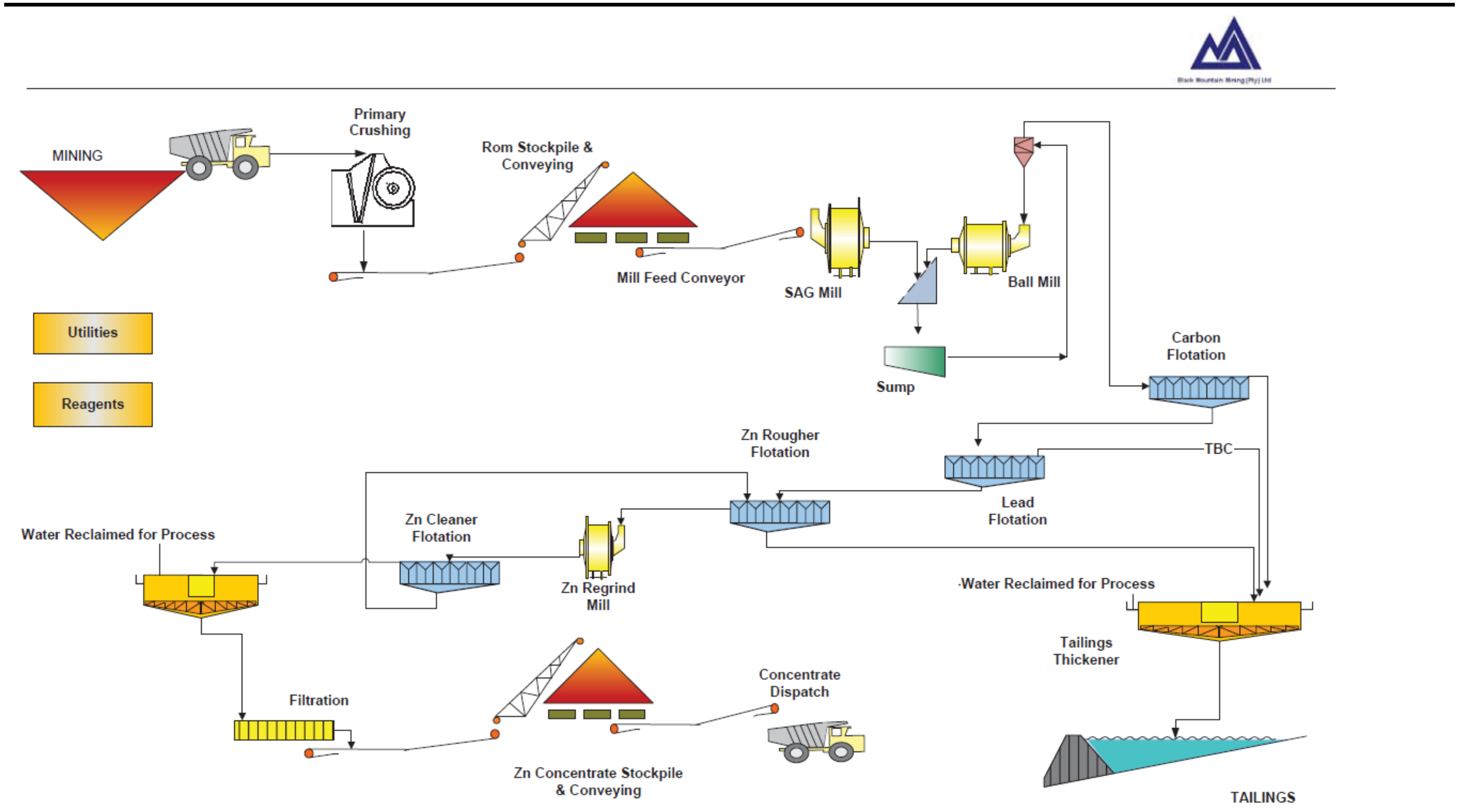
Phase	Infrastructure	Process Capacity
1	• Supporting utility and supporting infrastructure. • First concentrator stream.	3.35 million tons per annum
2	• Supporting utility and supporting infrastructure. • Second concentrator stream.	3.35 million tons per annum
3	• Supporting utility and supporting infrastructure. • Third concentrator stream.	3.35 million tons per annum

(1) A tram is a vehicle or wagon that runs on tracks within the mining license area.

The concentrator processing plant area consists of the following:

- Milling circuit;
- Ore stockpile;
- Flotation;
- Dewatering, filtration and zinc concentrate handling;
- Tailings facility (see tailings section below) (see comments below, would move this to after the filtration and concentrate storage, as it represents to end of the processing process. The other "facilities" not actually part of the processing process).
- Material lay down and storage areas;
- Equipment wash areas;
- Additional on-site plant infrastructure; and
- A block flow schematic diagram, for the ore extraction, processing and transportation is shown below (*Figure 3.7*).

Figure 3.6 Block Flow Schematic Diagram



A typical image of a concentrator plant is presented in *Figure 3.8*, while the schematic above provides an indication of the various components of a Concentrator plant, from mining to concentrate. The proposed concentrator plant will be located between the N14 highway and the Gamsberg inselberg (Refer to *Figure 3.2*).

Figure 3.7 Typical Image of Concentrator Plant

3.4.1 Primary Crusher Plant

Upon stripping of overburden, the ore will be transported via haul trucks to the primary crusher located on a flat point of the V cut access road along the northern slope of the inselberg. The primary crusher will have a total processing capacity of 10 Mtpa. The crusher plant will reach a maximum height of 40 m above ground level and cover a total area of 0.1 hectares. It will also be situated in such a way that the highest point will not extend above the inselberg ridge. As such, the crusher will not be visible from the N14 highway.

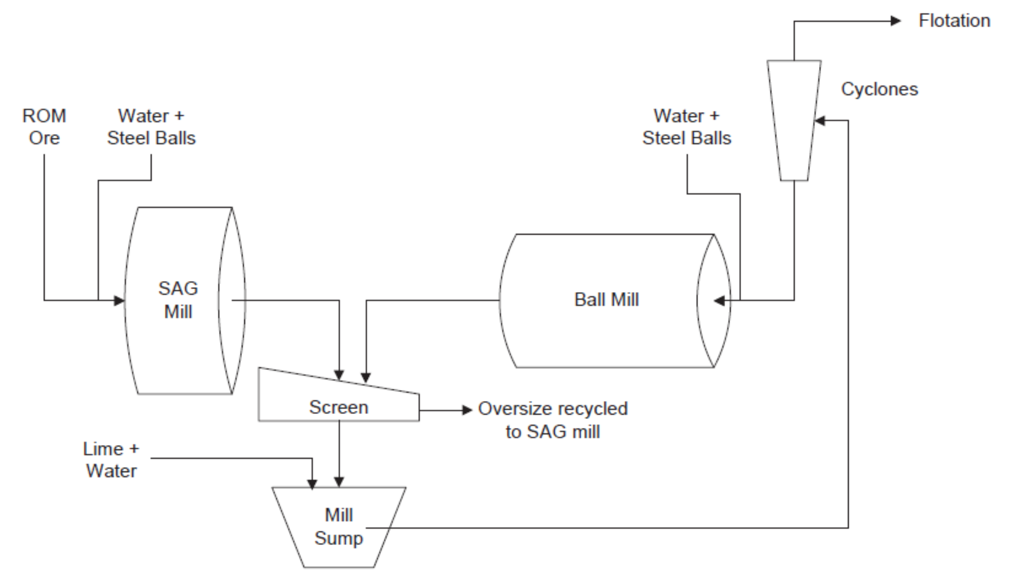
The primary crushed ore will be transported from the Primary Crusher to the ROM (Run of Mine) ore stockpiles (high and low grade) via a conveyor system, where it will be stored with a 3 day capacity and a total height of approximately 20 m and length of approximately 90 m. Ore will be conveyed through a reclaim conveyor to the milling circuit.

3.4.2 *Milling Circuit*

Based on the 10 Mtpa ROM ore, the process of concentration will produce 1 Mtpa of concentrate after full mine ramp-up. The concentrator plant will be approximately 40 m high, and contain lower end dust extraction vents (four in total) of about 30 m in height. No stacks or stack emission is applicable to this concentrator. The plant and supported infrastructure will cover a total area of about 45 hectares in total.

Milling is performed to reduce broken ore to a size at which the minerals can be liberated (valuable mineral grain exposed) from the ore. A Semi-Autogenous Grinding (SAG) mill will be used together with a ball mill and cyclone to perform this duty. Refer to *Figure 3.9* for circuit configuration.

Figure 3.8 *Milling Circuit Schematic*



The SAG mill is a large rotating drum filled with ore, water and steel grinding balls (*Figure 3.9*). The mill makes use of the material itself being crushed as well as additional grinding balls to reduce the size of crushed ore received. The SAG mill material is screened, with the oversized material recycled back to the SAG mill feed, while the undersized material proceeds to the cyclone (*Figure 3.9*).

A cyclone is used to separate the small particles from the larger particles. The small particles will overflow to the flotation circuit, which will have the required grain size for the flotation circuit. The cyclone underflow (larger sized particles) feeds into the ball mill (*Figure 3.9*). The ball mill is similar to the SAG mill but operates with a higher load of steel grinding balls to achieve a finer product size. Steel balls will be added continuously to both the SAG mill and the ball mill.

The ball mill discharges onto the same screen as the SAG mill screen. The material is then re-circulated through the cyclone in a closed circuit with the cyclone overflow proceeding to flotation.

3.4.3 *Ore Stockpile Pads*

The Mine will require a total of four stockpile (two ore, blended ore and one concentrate) areas at an operational level. The first two ore stockpiles areas (low grade, high grade and blended) will be open stockpile areas. Given below are approximate dimensions of these stockpiles (*Table 3.8*):

Table 3.8 Stockpile Dimensions

	Length	Width	Height
High Grade	90m	54m	20m
Low Grade	72m	54m	20m
Blended	60m	54m	20m

When mined, the ore will be transferred into the first open stockpile area. The ore is then crushed at the open pit and transported via conveyor to the second open stockpile area within the processing plant. From the second stockpile area the ore will be processed and subsequently transported to the final stockpile area, which is a covered stockpile area that is proposed for the storage of zinc concentrate (ie the final product).

The first open stockpile area (prior to primary crushing) will be located within the open pit area. It will cover an estimated area of 1 hectare and reach a maximum height of 4 metres. The second open stockpile will consist of three stockpiles (High Grade, low Grade and Blended) located within the processing plant, and will cover an area of 1 hectare each. The maximum height of these stockpiles will be approximately 20 metres. The final stockpile area will be located within the processing plant and will cover a total area of 0.25 hectares. The height and length of this stockpile should not extend past 12 metres and 50 metres respectively.

3.4.4 *Flotation*

In the flotation process, milled ore mixed with water (pulp) are passed through a series of agitating tanks. Various chemicals are added to the pulp in a sequence that renders some minerals hydrophobic (water-repellent) and other minerals hydrophilic (water-loving). Air is dispersed through the tanks and rises to the surface. The hydrophobic particles attach to the rising air bubbles and are removed from the main volume of pulp as froth.

Various combinations of flotation cells in series are utilised to produce a concentrated stream of valuable mineral particles, called the 'concentrate' and a waste pulp stream, called 'tailings'. Similar to the milling plant, the full processing capacity will be obtained with 3 flotation modules, namely Carbon floatation, Lead floatation and Zinc flotation. Each module capable of processing approximately 3.35 Mtpa of ore.

Carbon Floatation

The Carbon flotation circuit consists of carbon conditioning, carbon rougher and carbon cleaner flotation steps. In the carbon flotation circuit graphite is removed from the ore to prevent downstream contamination. Depressants (zinc sulphate and calcium cyanide) are added to depress the flotation of sphalerite (zinc containing crystal). Frother is added to stabilise the air bubble and froth layer which contains the graphite. The graphite froth overflows and is removed to the tailing plant. The flotation tails (zinc containing particles) proceeds to the lead flotation circuit.

Lead Flotation

The lead flotation circuit consists of lead conditioning, lead rougher and lead cleaner flotation steps. Collector (Sodium ethyl xanthate) is added to the conditioning step to assist with galena (Lead containing particle) flotation. Frother is added to the circuit to assist with bubble and froth stabilisation. The galena froth is removed to the tailings plant. The lead flotation tails (zinc containing particles) proceeds to the Zn flotation circuit.

Zinc Flotation

The zinc flotation consists of zinc conditioning, zinc rougher flotation, zinc concentrate regrind, followed by a zinc cleaner flotation circuit.
Activator (copper sulphate), pH Modifier (lime) and collector (sodium ethyl xanthate) reagents are added to the flotation circuit. The activator makes it possible for the collector to adsorb onto the zinc particle surface. The collector assists with zinc flotation. The pH modifier ensures the discrimination between zinc rich particles and others.

Frother is added to the circuit to assist with bubble and froth stabilisation. The zinc particles froth is removed to the Regrind circuit. The zinc flotation tails (gangue material) proceeds to the tailings plant.

The zinc flotation concentrate requires regrinding in order to improve the quality of the final zinc concentrate. The regrind mill discharge is diluted with water and pumped through a cyclone cluster. The overflow gravitates to the zinc cleaner flotation circuit.

Again activator, collector and frother are added to perform duties as described above. The zinc cleaner flotation concentrate gravitates to the thickening and dewatering circuit. The zinc cleaner flotation tails goes to a scavenging step to recover any zinc left over in the cleaner tails. The savenger tails is returned to the zinc rougher flotation circuit.

In support of this process, the use of calcium cyanide, copper sulphate according to the regulated Code of Practice will take place as per the International Cyanide Management Code (ICMI) guidelines.

3.4.5 *Dewatering, Filtration and Zinc Concentrate Handling*

The dewatering process is comprised of two stages, thickening and filtration. A thickener is a large cylindrical tank with a conical bottom. The thickener allows solids to settle to the bottom. Conventional thickeners have rakes at the bottom which moves the solids to an exit point. The solid containing slurry is called the underflow and exits the thickener at the bottom. The liquid in the upper part of the thickener (clear process water) overflows into a launder and is called the overflow.

Underflow from zinc thickener will be taken to the filter plant for further dewatering to reduce water content in concentrate. The thickener overflow will return to the plant for re-use.

In the filtration process excess water is removed in a filter by mechanical/physical means. The remaining solids are termed filter cake with the liquid removed termed as filtrate. The filtrate will be sent to the plant for re-use.
The filter cake (zinc concentrate) will be stored, within the processing plant, under a covered stockpile until dispatched. The stockpile will have a storage capacity of 7 days and will be approximately 12 m high and 50 m in length. In total, the above mentioned stockpile will cover an estimated area of 0.25 hectares.

The balance of the material from the processing process is waste material, with tailings running at a grind size of 80% passing 75 microns. These tailings will be taken to the tailings pump station from where it will be pumped to the tailings dam via safe pipeline. The tailings thickeners that are used to separate the waste material (slurry) from the water content in the tails treatment plant will be a maximum of 9 m high and 45 m in diameter. These will be located within the processing plant. In the tailings dam, the decanted and percolated water will be collected and pumped back to the plant for re-use.

3.4.6 *Tailings Dam*

The treatment of 10 Mtpa run of mine ore is expected to lead to approximately 9 Mtpa of tailings material (approximately 6.9 million m^3 of slurry containing approximately 4.5 million m^3 of water). The mineral wastes (tailings) will be sent to the thickener to reduce the water contents and then pumped to a tailings dam (see *Figure 3.2*). Percolated water in the tailings dam will be extracted, returned to a process plant and re-used in the concentrating process, via a return water dam.

Based on the expected production of tailings material, one tailings dam will be constructed with a final height of approximately 70m high, covering a total area of 290 hectares, with a total storage capacity of 132 million tons. Protection of the environment and in particular the potential groundwater resource in the area is critical and this will be taken into account when designing and constructing the tailings facility. Drainage measures will be incorporated in the design such that the potential for seepage into the groundwater is minimised. Preparation of the tailings inundation area will also be undertaken such that the risk of seepage is also minimised. The tailings dam will be constructed in phases and may initially consist of one dam with other dams added later that can be amalgamated to one large dam.

An image of an existing tailings facility, similar to the expected magnitude of waste to be produced at the Mine is presented below (*Figure 3.10*). The location of the proposed tailings dam for the Mine is represented in *Figure 3.1* below.

Figure 3.9 Typical Example of a Tailings Facility

Source: http://www.casadei.eng.br/page_7.html

3.4.7 Pollution Control Dams

Pollution control dams will be constructed according to the final design and location of the plant and pit. Three pollution control dams will be constructed during the construction phase of the project (refer to *Figure 3.2*). These will all be lined with a 1 mm to 1.5 mm high density polyethylene (HDPE) lining. A total of three dams will be constructed by the operational phase and therefore have a cumulative total storage capacity of approximately 25,000 m^3 and cover a total area of approximately half a hectare. The proposed dam wall will be three meters high.

3.4.8 Concentrator Plant Bulk Fuel and Lubricant Storage Facilities

There will also be bulk storage of diesel and petrol within the concentrator plant. This storage facility will be developed to store a total capacity of 100 m^3 of diesel and petrol and will cover a maximum area of 400 m^2. The facility will include two fuel supply points, which will be used to re-supply vehicles and equipment.

3.4.9 Material Lay Down and Storage Areas

The designated lay down and storage area will be located within the processing plant. The lay down area will cover a total area of 2,500 m^2 (close to or inside the plant area) and include approximate quantities of materials and equipment, as shown in *Table 3.8*.

Table 3.9 *Approximate Inventory of Materials*

Material types	Approximate Quantities
Piping	3000 m
Platework	500m²
Pump spares	10% of installed pipes
General Mechanical Spares	15% of installed mechanicals
Electrical Cable	3000 m

3.4.10 Equipment Wash Areas

An equipment wash area is proposed at the Plant and will cover a total area of approximately 750 m^2. The wash area is expected to store a number of detergents/cleaning solution for cleaning of on-site equipment. It is estimated that a total of 45,000 m^3 (1.5 m^3/vehicle for 80 vehicles over 364 days) of water will be required annually for washing purposes. The water will be sourced from recycled water reservoirs at the site for washing/cleaning of equipment. In order to reduce potential run-off of contaminated water, a specific storm water management system will be designed to optimise re-use.

3.4.11 Additional On-Site Plant Infrastructure

Five back-up generators will be required in the event of a power failure. Each back-up generator will have a generation capacity of 10 MVA. This would be for emergency lighting, security, certain process equipment, instrumentation, information technology (IT) equipment and communications.

3.5 ASSOCIATED MINE INFRASTRUCTURE

A suite of associated infrastructure is required for the daily operations of the proposed mine and plant. All associated infrastructure will be located within the approved mine area and is described in detail below in terms of:

- Power Supply and Substation Network;
- Water Supply System and Storage Dams;
- Raw Water Dam;
- Process Water Dam;
- Dust Suppression Dam;
- Storm Water Management Infrastructure;
- Fire Control Systems;
- Waste and wastewater Facilities;
    - Waste Sorting, Re-use and Recycling;
    - Domestic Waste Facility;
    - Temporary Hazardous Waste Facility;
    - Sewerage Treatment Facility;

- Road Network;

- Transportation Corridor;
- Entrance and Exit Points;
- Parking Areas;
- Mine Area Roads;
- Plant Area roads;
- Borrow Pit for Road Network; and

- Administrative Buildings.

3.5.1 *Power Supply and Substation Network*

The proposed mine and associated infrastructure will have a peak power requirement of 70MW and this provision has been secured from Eskom by BMM. The power infrastructure requirements during operation include:

- The 220kV/66V substation will cover a total area of 2 hectares and reach a total height of 8 m;
- 66 kV/11kV sub-station;
- The 660kV/11KV substation will cover a total area of 1 hectares and reach a total height of 8 m;
- Two 66 kV distribution lines;
- The connecting distribution lines will extend 3 km and require 12 pylons, with a span length of 6m each; and
- The distribution lines will cover a total distance of 10 km and total footprint of 2 Ha.

3.5.2 *Water Supply System and Storage Dams*

The proposed mine and associated infrastructure will require 9,125 million m^3 of water per annum to meet the mine and associated infrastructure requirements. In order to meet the water requirements, the applicant intends to construct new 5 km off-take pipeline from the existing Pella Drift Water board pipeline to the Mine. A proposed off-take pipeline will be constructed from main line, across the N14 and into the Project area over a distance of 5 km. The proposed off-take pipeline will also be a surface pipeline, with the exception of crossing the N14. The method for constructing across the N14 is pipe jacking, so as not to disrupt the traffic flows during construction.

The percentage water requirements per project component for the operational phase of the proposed project as shown in the table below.

Table 3.10 Operational Phase Water Requirement

Operational Activity	Water Volume Requirement (%)
Open pit	10%
Concentrator Plant	40%
Housing	15%
Dust Suppression	10%
Plant infrastructure	10%
On-site staff	15%

All water on the site will be recycled and used where feasible.

Raw Water Dam

A raw water storage dam will be constructed at the processing plant. The proposed water storage dam will have a total capacity of 25,000 m^3, cover a total area of 0.5 hectares and have a maximum wall height of 4.5 m. The raw water storage dam serves to provide water to the plant, mine and fire hydrant system. The proposed dam will be supplied from the Orange River, via Pella Water Board.

Process Water Dam

A process water dam will be constructed at the plant and fed with recycled water from the plant, treated water and make-up water from the raw water dam. The proposed dam will cover a total area of 0.5 hectares and has a total storage capacity of 25,000 m^3. The proposed dam will have a wall height of 4.5 m and will be used as part of the zinc concentrating process.

Dust Suppression Dam

A dust suppression dam will be constructed adjacent to the open pit, between the Plant and the waste rock dump. The proposed dam will have a total storage capacity of 1,000 m^3. The dam wall will reach a maximum height of 5 m and cover a total area of 100 m^2. Water for dust suppression will be sourced from the raw water dam.

Fire Control System

Due to the types of substances being handled on a daily basis, the risk of fire is high. In response to the suggested risks, a fire control system will be installed adjacent to the open pit, explosives storage area and fuel tank farm. The system will consist of a water tank, which will have a total wall height of 5 m and cover a total area of 200 m^2. The dam will have a total storage volume of 20,000 m^3 and the water will be sourced from the raw water dam.

Stormwater Management Infrastructure

Stormwater management infrastructure is critical for the day to day management of the proposed mine. Based on the nature of on-site activities proposed, the potential for contaminated stormwater run-off is great, and therefore stormwater infrastructure will be constructed to optimise re-use of stormwater.

As part of such management procedures a stormwater dam will be constructed adjacent to the south of the plant, along the western foothills of the Gamsberg inselberg. This dam will have a storage capacity of approximately 5,000 m^3 and will cover a total area of 1,000 m^2. The dam wall will not exceed 3 metres in height (above ground level).

3.5.3 *Waste and Wastewater Facilities*

The project will have a mineral waste and non-mineral waste stream. Mineral waste will be generated by the open pit; waste rock dumps, tailings facilities and pollution control dams.

Non-mineral waste will consist of general waste in the form of domestic waste that will be disposed of in the existing Black Mountain waste disposal facility and solid waste that will be processed in a sewage treatment facility. Besides the general waste, hazardous waste will be generated from materials stored and used on site such as hydrocarbon fuels and lubricants, laboratory chemicals, radioactive waste from technical equipment, explosives waste and medical wastes.

Waste Sorting, Re-Use and Recycling

Salvageable wastes in the form of metal plate, old tyres, batteries and salvage spares will be separated and stored in the salvage yard. The salvage yard will be located within the Plant area and cover a total area of 750 m^2. It will have a total storage capacity of 1,800 m^3 and wall height that will not extend beyond 3 metres in height. All waste contained in the salvage yard will be temporarily stored and subsequently sold as scrap to local contractors.

Domestic Waste Facility

The proposed temporary domestic waste disposal facility will be constructed within the plant area and will have a total storage area of 100 m^2 and walls of that will be no higher than 2 metres in height. Upon nearing the maximum storage capacity (ie 150 m^3), all domestic wastes will be collected and disposed of at the existing Aggeneys registered landfill site for domestic wastes.

Temporary Hazardous Waste Management Facility

At an operational level, the Mine will result in the generation of hazardous wastes. Based on the proposed operations of the mine, it is likely that hazardous wastes will include fuel or oil laden rags, chemical wastes from the on-site laboratory medical wastes and items contaminated with hazardous substances. Further details of the waste generated by this Project are included into *Chapter 8* below. A temporary hazardous waste management facility will be constructed within the plant area to store this waste before it is removed from site. The temporary hazardous waste management facility will have a total storage capacity of 100m^3 and cover a total area of 150 m^2. All hazardous waste collected will be transferred to the licenced Vissershok hazardous waste disposal facility located ~ 10 km north of the City of Cape Town in the Western Cape Province. The storage, transport and disposal of all hazardous waste will be undertaken in accordance with applicable guidelines and legislation.

Sewage Treatment Facility

Based on the expected number of operational phase employment opportunities generated, the Mine will require sewage treatment plants to fulfil the wastewater management requirements. The sewage treatment plant will be located at the processing plant. The treatment plant will have a daily processing capacity of approximately 200 m^3/day to service an expected work force of approximately 750 people which includes the process plant, mining and administrative labour.

A sewage collection sump will be constructed near the open pit area. The sump is expected to collect sewage from the mine work force (approximately 140 people) and pump it to the main sewage treatment plant periodically. Based on the design, the treatment plant will generate approximately 160m3/day of treated effluent and approximately 500 tons of sludge per month. The effluent will be treated to comply with the acceptable water discharge criteria.

The treated effluent will be fed into treated sewage effluent dam. The dam will have a 7 day capacity and will be an HDPE lined pond. The pond is expected to be 5m deep with a total storage capacity of 1,150 m3 and is expected to cover a total area of approximately 250 m^2. Based on the expected quality of effluent and other wastes produced, effluents will likely be treated and reused.

Lastly, all sludge generated from the proposed sewage treatment plant will be collected and disposed of appropriately or considered for potential re-use.

3.5.4 Road Network

Entrance and Exit Points

The proposed mine will have a main entrance/exit point, located along the southern border of the N14. The proposed entrance/exit point will be tarred and have a total width of 45 m. A second entrance/exit point will be located along the western border of the inselberg, leading onto the existing Loop 10 gravel road. This entrance/exit point will not be tarred, but rather a compacted gravel road. In addition to this, the width of the second entrance/exit is expected to only be 15 metres. Surface material will be sourced from the existing borrow pit located north of the inselberg.

Parking Areas

A parking area will be established adjacent to the Plant. The proposed parking area is expected to cover a total area of approximately 5,000 m^2 and will be tarred. The proposed area will be designed to accommodate 300 - 350 vehicles, which will include employees and visitors. The proposed parking area will include a design specific stormwater management plan to optimise re-use. The material that will be used to tar the road will be sourced from waste rock or existing Lemoenplaas borrow pits in the region.

Mine Area Roads

A new 60 m wide gravel road will be constructed to access the proposed open pit. The access road will be located on the Northern side of the Gamsberg inselberg and will accommodate haul trucks, commercial vehicles and access to the conveyor. The length of the access road will be approximately 1000 m, with a maximum footprint width at the bottom of approximately 128 m.

Haul Roads will be limited from the Open Pit to the waste rock dumps, from the Open Pit to the Primary Crusher area and from the Open Pit to the mining workshops adjacent to the Open Pit. Additional supporting roads for lighter vehicles may also be required. The slope angle of the roads will not be more than 10 degrees. This requirement results in an extensive road network. The total footprint area of internal haul and mine area roads is expected cover an area of 55 hectares. Surface material for the roads will be sourced from suitable overburden material and/or available borrow pits.

As mentioned above, an existing approach road towards the western side of the Gamsberg inselberg will be widened to 12 metres in width (including a 2 metres shoulder on either side). This will be used for start-up activities. The main permanent approach road will be constructed from the northern side, once permission is granted.

Plant Area Roads

Internal plant roads (a network of roads totalling approximately 4km in length) will be required for operational and maintenance access between the various plant areas. These will generally be between 6 m to 8 m wide, depending on function. It is also important to note that the construction footprint (affected area) is approximately 12 metres wide. Access tracks will be required for inspection and maintenance of outlying features such as stormwater impoundments, sewage treatment ponds and the perimeter fence. These roads are expected to cover a total area of 1,000 m^2. Off-road parking will also be provided, which is expected to cover a total area of 5,000 m^2. Surface material for the roads will be sourced from suitable overburden material and/or available borrow pits.

Borrow Pits for Road Network

Surface material for the internal road network will be sourced from either suitable overburden material and/or available borrow pits at Lemoenplaas located to the north of the Black Mountain township and compacted over the road surfaces. The final decision regarding the choice of sources will be informed by the analysis of overburden material.

Administrative Buildings

A building and associated offices will be constructed within the Plant. The building will cover a total area of approximately 1,500 m^2, and reach a maximum height of 12 m. The proposed building and associated offices will be used to meet the administrative requirements associated with the daily operations of the proposed Mine. The building is expected to accommodate at least 100 employees, working 7 days a week.

A control room will also be constructed at the Plant, to facilitate the logistics and monitor day to day activities associated with the Mine. The proposed control room will cover a total area of approximately 300 m^2 and reach a maximum height of 12 m. Another office will be housed at the Project area as a control room with total area of approximately 200 m^2.

A security and induction training area will be constructed near the main entrance to the Mine, along the southern border of the N14. A security office will be single storey building, covering a total area of approximately 120m^2. Adjacent to the security offices, an induction training area will be constructed, which will cover a total area of approximately 500 m^2. In line with the Health and Safety requirements of Black Mountain, any person entering the Project area must undertake a health and safety induction training course.

A medical clinic will be established within the Plant area. The proposed clinic will contain basic medical supplies and facilities to treat emergencies related to accidents etc. The facility will not exceed 6 metres in height and will cover a total area of approximately 80 m^2. The medical clinic is expected to produce around 5 to 6 kg of medical waste per month. All wastes produced at the clinic will be treated as hazardous waste and will therefore be disposed of at the Vissershok Hazardous Waste Site located approximately 20 km north-east of Cape Town in the Western Cape.

3.6 *RESIDENTIAL HOUSING DEVELOPMENT*

Based on expected employment figures, additional housing will be required to house the expected workforce. The necessary housing will be constructed in accordance with the mining charter and located in Aggeneys, between the existing northern and southern township (refer to *Figure 3.12*).

Preliminary projections for the Aggeneys housing development estimate that approximately 1000 units of varying type/size (ie 1 to 4 bedrooms) will be constructed to accommodate employees and contractors working at the proposed Project site. The total development is expected to cover a total building area of 100 hectares. The average home size is expected to cover an area of approximately 100 m^2. Various accommodation packages will be put together to enable employee home ownership.

3.6.1 *Bulk Service Requirements for the Employment and Residential Housing Development*

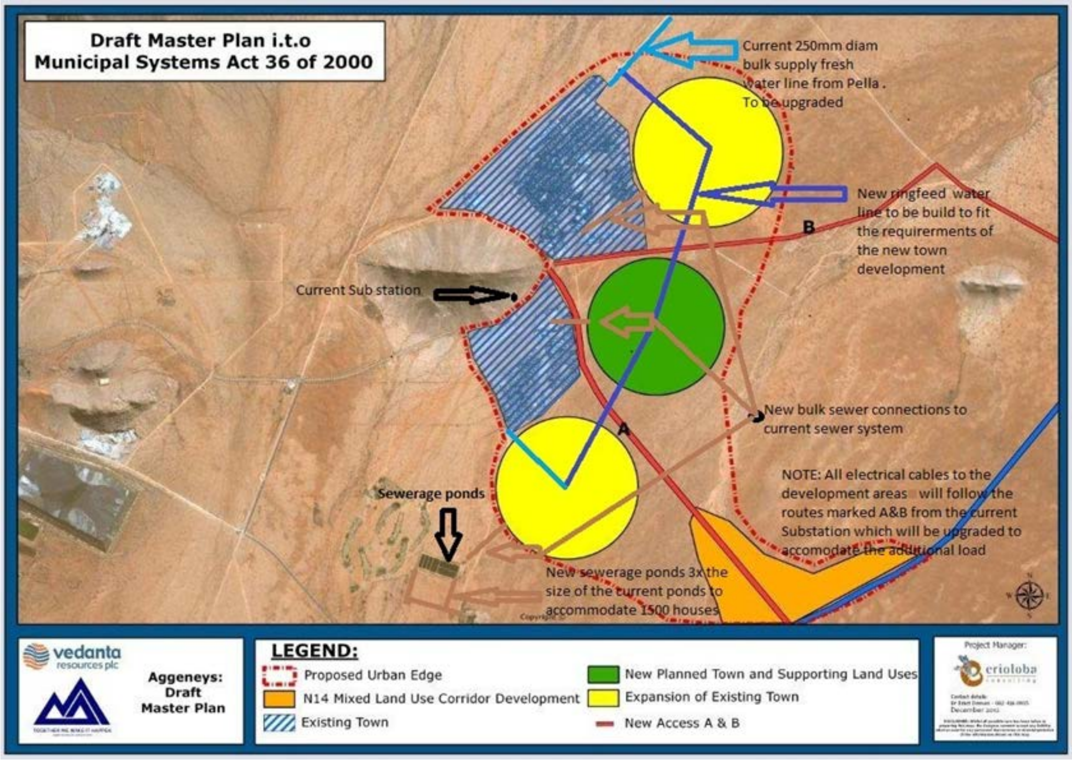
Water

As mentioned before, the Pella Drift Water Board is the official water service provider for the Aggeneys town. The Pella Drift's Water Board current infrastructure includes an existing pumpstation and water treatment works, located along the Orange River, near the town of Pella. An existing pipeline extends from the water treatment works to the town of Aggeneys (refer to *Figure 3.12* above).

In response to the growing demand for water in the towns of Pella, Pofadder and Aggeneys, the Pella Drift Water Board is currently in the process of upgrading the water supply infrastructure. Pella Drift Water Board will therefore provide for the increase in demand, as part of their on-going expansion plan.

According to current estimations, the water requirement for the housing development is approximately 1 500 m^3/day and will be sourced from Pella Drift Water Board, via a new 'ringfeed water line', which is shown in *Figure 3.12* above. This water line will be a pipeline constructed from the existing Aggeneys outlet point to the new housing development (refer to *Figure 3.12*).

Figure 3.10 Proposed Staff Housing in Aggeneys



Power

The housing development is expected to require an average power requirement of 12 million kilowatts hourly per annum during the operational phase. In order to meet these requirements Eskom power will be sourced.

Power supply to the housing development will need to be upgraded. This will be managed through expanding the capacity of the existing sub-station (refer to *Figure 3.12*) from 4 MW to 10 MW. Expansions to the existing substation will fall within the previously disturbed/fenced off area surrounding the existing Aggeneys substation. Actual power usage is expected to drop proportionately as more energy efficient systems (eg solar geysers) are fitted in the new housing units.

Sewage

The existing sewerage plant has a design capacity of 1235 m^3 per day and currently runs at 700m^3 per day in serving about 600 homes and businesses in Aggeneys. Running the plant at 80% of its hydraulic load it is therefore calculated that it would handle an additional 300 houses before expansion is required. To cater for the additional 1000 housing units, the capacity of the existing facility will need to be doubled. This will increase the footprint from the existing 61,000 m^2 to 122,000 m^2.

The expanded sewage plant will have a treatment capacity of approximately 4 470 m^3 per day. This will generate an estimated 800 m^3 amount of effluent discharge and 2 500 tons of sludge per month. The discharge after treatment will be according to South African water quality standards and tested for quality before being released. All remaining sludge will be investigated for re-use or final disposal. If the sludge is to be disposed of, it will be removed by an authorised waste contractor and taken to the Vissershok landfill site for final disposal.

Specific details regarding the location and dimension of each of the above mentioned operational phase components (ie buildings, infrastructure and equipment) are attached as *Annex B*.

3.7 TRANSPORT OPTIONS

3.7.1 *Transport Option 1: Truck via N14 and N7 National Road to Port of Saldanha*

Based on the phasing of the Project, the transportation requirements will increase as production increases at the Gamsberg mine. Two transport options will be utilised when the Gamsberg mine reaches full production. During Phase 1 (initial two years of the project), a total of 0.335 Mtpa of zinc concentrate will be produced. During Phases 2 and 3, production will increase to 0.67 Mtpa and 1 Mtpa respectively. Phase 2 is expected to last for two years, at which point production will ramp up (ie Phase 3) to 1 Mtpa for next 14 years (assuming Life of Mine of 19 years). Production is expected to reduce during year 19 to 0.67 Mtpa.

Assuming the Port of Saldanha is selected as the preferred export port and based on the anticipated volume for Phase 1, an average of 960 tons per day of zinc concentrate (assuming 350 days a year) will be trucked to the Port of Saldanha. All zinc concentrate produced during Phase 1 will be loaded into 32 ton trucks (axle load) and transported to the Port of Saldanha, via the N14, N7 and R399 (refer to *Figure 3.11* below). The trucks will divert from the N7 onto the R399 and lead to the Port of Saldanha. In order to manage the transportation requirements in Phase 1, 30 trucks per day will be used to transport the concentrate. The existing road infrastructure will not require any form of upgrades to the existing road network.

Based on the anticipated production volume for Phase 2, 50% of concentrate produced (ie 960 tons per day assuming 350 days a year) will be transported by truck to the Port of Saldanha. In order to manage the transportation requirements, 30 trucks per day will be used to transport the concentrate.

During Phase 3, 50% of concentrate produced (ie 1 430 tons per day assuming 350 days a year) will be transported by truck to the Port of Saldanha. In order to manage the transportation requirements, 45 trucks per day will be used to transport the concentrate.

3.7.2 *Transport Option 2: Truck to Loop 10 via existing Proclaimed Road (RL(P)5/2002) and then by Sishen-Saldanha Railway Line to Port of Saldanha*

During Phase 2 and 3, an additional option will be utilised to transport zinc concentrate to the Port of Saldanha, assuming the port is selected as the preferred option. Transport Option 2 includes the trucking of zinc concentrate via the Loop 10 gravel road (off the N7), to Loop 10 siding along the Sishen-Saldanha railway line (refer to *Figure 3.12* below). The existing Sishen-Saldanha railway line is located approximately 150 km south east of the Gamsberg mine.

Based on the anticipated production volume during Phase 2, 50% of concentrate produced (ie 960 tons per day assuming 350 days a year) will be transported by truck to Loop 10 siding, and railed to the Port of Saldanha. In order to manage the transportation requirements, 30 trucks per day will be used to transport the concentrate to Loop 10, during Phase 2. Each truck will carry 32 tons of concentrate per trip.

During Phase 3, 50% of concentrate produced (ie1 430 tons per day assuming 350 days a year) will be transported by truck to Loop 10 siding and railed to the Port of Saldanha. In order to manage the transportation requirements, 45 trucks per day will be used to transport the concentrate to Loop 10 siding.

Despite the expected increase in traffic volumes, the existing Loop 10 gravel road will not be widened as the current width of 7 – 10 m is sufficient. Upon arrival at the Loop 10 siding, the zinc concentrate will be unloaded into an existing storage shed and then transferred onto rail carriages via a tippler. Further engagement will be undertaken with Transnet to confirm if sufficient capacity is available along the Sishen-Saldanha Railway Line to accommodate the production volumes during Phase 2 and 3 of the Project.

However, for purposes of this ESIA process, it is assumed that 50% of the zinc concentrate produced will be transported to the Port of Saldanha via trucks (ie via N14, N7 and R399). The remaining 50% of zinc concentrate will be trucked to the Loop 10 siding (via *Proclaimed Road RL[P]5/2002)* along the Sishen-Saldanha railway line, and railed to the Port of Saldanha. A summary of the Transport options are presented below, relative to the Project phasing.

Should the Port of Saldanha not be selected as the preferred option, transport routes to Port Nolloth will be investigated as part of a separate ESIA process.

Table 3.11 Summary of Transport Options

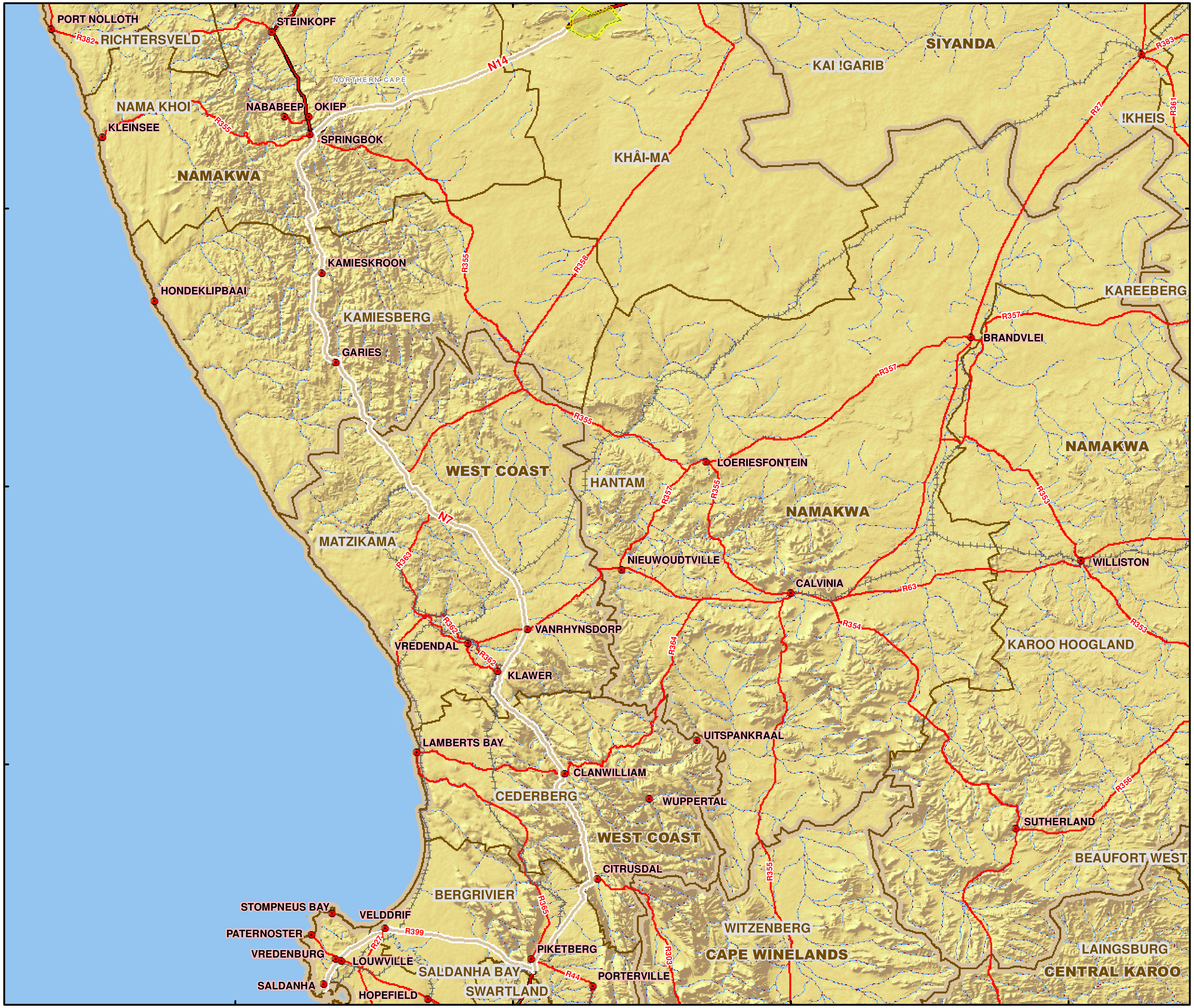
	Phase 1 (Year 1 and 2)	Phase 2 (Year 3 and 4)	Phase 3 (Year 5 – 18)
Transport Option 1: Road	0.335 Mtpa	0.335 Mtpa	0.500 Mtpa
Transport Option 2: Rail	0 Mtpa	0.335 Mtpa	0.500 Mtpa

Loop 10 Siding

BMM has an existing offloading facility at Loop 10 siding. The existing storage shed at the siding covers a total area of 2000 m² and has a total height of 10 m. It is anticipated that additional facilities, located within the existing disturbed footprint will accommodate Phase 2 volumes of zinc concentrate generated by Gamsberg. However, due to the expected volumes at Phase 3 of production (500 000 Mtpa), additional infrastructure will be required at BMM's existing Loop 10 siding facility, which is as follows:

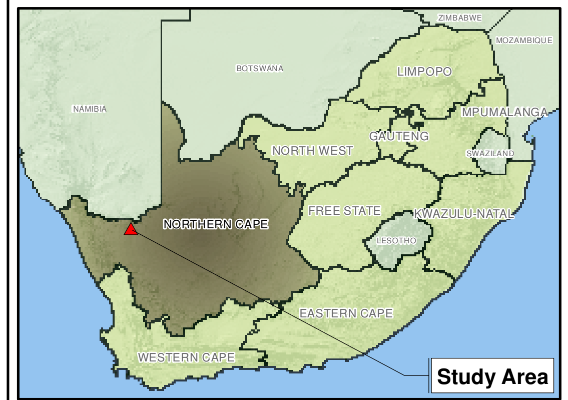
- Truck unloading and wash station;
- Truck Loading Facilities and Equipment (324nos of 67t trucks per week);
- Truck Cue/Parking;
- Concentrate Storage Facility;
- Support Facilities/offices/lab;
- Rail Wagon Loading Facilities and Equipment; and
- Rail Yard/Storage.

It should be noted that although the existing facility will be expanded, it will remain with the existing operational boundaries of the site. The site is currently subject to daily operational activities related to offloading and handling of product from the Deeps Mine. The existing access roads will be utilised and all new infrastructure will be located as close as possible to the existing facility, so as to consolidate the existing impacted areas.



Legend

- MainTown
- Rivers
- National Roads
- Main Roads
- Railways
- Local Municipalities
- District Municipalities
- Transport Option 1
- Gamsberg Project Area - Mineral Rights Area



SCALE:

0 10 20 30 40 50

Kilometres

N

TITLE:

Figure 3.11:
Transport Option 1
(Truck to Port of Saldanha)

CLIENT:

vedanta

BLACK MOUNTAIN MINING (PTY) LTD

DATE: Apr 2013	CHECKED: MP	PROJECT: 0164903
DRAWN: LDT/AB	APPROVED: SHC	SCALE: 1 : 550 000

DRAWING: Transport Option 1.mxd

REV: 0

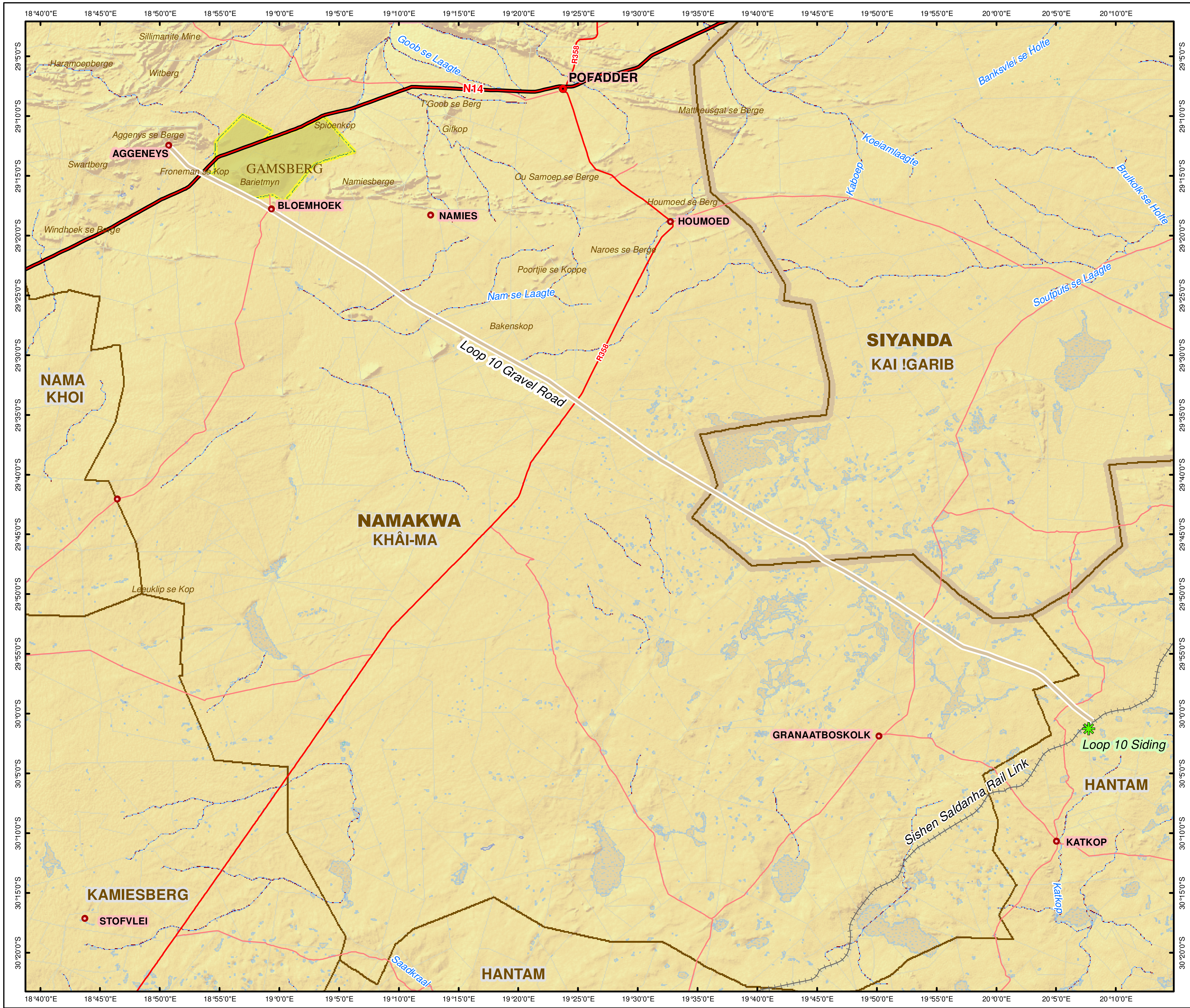
ERM
Great Westerford Building
240 Main Road
Rondebosch, 7725
Cape Town, SOUTH AFRICA
Tel: +27 21 681 5400
Fax +27 21 686 073

ERM

Projection: Geographic, Datum: WGS84
Source: NGI - Chief Directorate National Geo-Spatial Information, SANBI, EnPAT
Inset: ESRI Data and Maps

SIZE: A3

T:Gis Projects\0164903_Gamsberg\Mapping\MXD\Report\April2013\Transport Option 1.mxd



SCALE:

0 5 10 15 20

Kilometres

N

TITLE:

Figure 3.12:
Transport Option 2 (Truck to Loop 10 siding and railed to Port of Saldanha via Sishen Saldahna Railway)

CLIENT:

vedanta

BLACK MOUNTAIN MINING (PTY) LTD

DATE: Apr 2013	CHECKED: MP	PROJECT: 0164903
DRAWN: LDT/AB	APPROVED: SHC	SCALE: 1 : 550 000

DRAWING:	REV:
Transport Option 2.mxd	0

ERM
Great Westerford Building
240 Main Road
Rondebosch, 7725
Cape Town, SOUTH AFRICA
Tel: +27 21 681 5400
Fax +27 21 686 073

Projection: Geographic, Datum: WGS84
Source: NGI - Chief Directorate National Geo-Spatial Information, SANBI, EnPAT
Inset: ESRI Data and Maps

SIZE: A3

T:\Gis Projects\0164903_Gamsberg\Mapping\MXD\Report\April2013\Transport Option 2.mxd

3.8 *EXPORT OPTIONS*

Based on current estimates, a total of 1 Mtpa of zinc concentrate will be produced at the Mine. Potential options to export the concentrate are currently being explored by BMM, which include utilising the Port of Saldanha or alternatively constructing a new Port at Port Nolloth in the Northern Cape Province.

Should the Port of Saldanha be the preferred option, the infrastructure requirements will need to be confirmed, however, additional facilities may be required in the form of storage sheds. Should upgrades at the Port of Saldanha trigger a listed activity in terms of the EIA Regulations (2010), a separate ESIA process will be undertaken for the Port upgrade. Alternatively, should the construction of a new port at Port Nolloth be the preferred option, the necessary environmental legislative requirements will be met through a separate ESIA process.

The feasibility to utilise either option is currently being explored. For purposes of this ESIA process, it is assumed that the zinc concentrate will be transported to the Port of Saldanha, with no upgrades required.

4 *CONSIDERATION OF ALTERNATIVES*

4.1 *INTRODUCTION*

The purpose of this Section is to present a detailed description of project alternatives considered in the ESIA process. A detailed motivation for selecting specific alternatives, in line with the mitigation hierarchy of avoid, abate, mitigate and replace/compensate is presented. The assessment of alternatives is based on new information gathered during the present ESIA process, but also uses information gathered and used for assessing alternatives in the EIA process completed in 2000 (SRK Consulting).

4.2 *MITIGATION HIERARCHY: AVOIDANCE, PREVENTION AND MINIMIZATION OF IMPACTS*

The biodiversity sensitivity of the project area requires that the consideration of alternatives is closely aligned with the Mitigation Hierarchy (*Table 4.1* below). The priority in mitigation is to first avoid or reduce at source the magnitude of the impact from the associated Project activity through the design of the project ie avoid by siting or rerouting the activities away from sensitive areas. Once this is achieved, the resultant effect to the resource/receptor can be addressed via abatement at a site then the receptor level. Restoration or rehabilitation can then be undertaken and only once the above have been considered can compensatory measures or offsets be considered (ie to reduce the significance of the effect once all reasonably practicable mitigations have been applied to reduce the impact magnitude). In line with good practice, avoidance has been applied to help guide the location alternatives.

Table 4.1 Mitigation Hierarchy

• **Avoid at Source; Reduce at Source:** avoiding or reducing at source through the design of the Project (e.g., avoiding by siting or re-routing activity away from sensitive areas or reducing by restricting the working area or changing the time of the activity).
• **Abate on Site:** add something to the design to abate the impact (e.g., pollution control equipment, traffic controls, perimeter screening and landscaping).
• **Abate at Receptor:** if an impact cannot be abated on-site then control measures can be implemented off-site (e.g., noise barriers to reduce noise impact at a nearby residence or fencing to prevent animals straying onto the site).
• **Repair or Remedy***:* some impacts involve unavoidable damage to a resource (e.g. agricultural land and forestry due to creating access, work camps or materials storage areas) and these impacts can be addressed through repair, restoration or reinstatement measures.
• **Compensate in Kind; Compensate Through Other Means:** where other mitigation approaches are not possible or fully effective, then compensation for loss, damage and disturbance might be appropriate (e.g., planting to replace damaged vegetation, financial compensation for damaged crops or providing community facilities for loss of fisheries access, recreation and amenity space).

4.3 SUMMARY OF ALTERNATIVES FROM PREVIOUS EIA (SRK CONSULTING, 2000)

In 1999, Anglo American initiated an EIA process (undertaken by SRK Consulting) for the establishment of the Gamsberg mine and associated zinc refinery. An environmental authorisation was received in 2000, allowing Anglo American to proceed with the development. Due to a variety of factors (as outlined in Section 3), the project was placed on hold and the environmental authorisation expired.

During the 2000 EIA process, a suite of project alternatives were considered, including process alternatives, residue disposal alternatives from the refinery and a number of location alternatives for various major infrastructure components. The final list of alternatives that were considered is tabulated below. A tabulated summary of the various alternatives considered during the EIA process (SRK Consulting, 2000), together with the specialist preference, is presented in *Table 4.2* below.

Table 4.2 Summary of Pre-screened Project Alternatives Considered during Previous EIA Process (adapted from previous EIA Report: SRK Consulting, 2000)

Alternative type	Alternatives	Specialist motivation for preferred alternative
Location alternatives		
Contractors' camp	Site 1: Located between inselberg and southern border of the N14.	No particular preference was demonstrated.
	Site 2: Located along northern border of the N14.	No particular preference was demonstrated.
	Site 3: Located south of the N14 and west of the inselberg.	No particular preference was demonstrated.
Ore crusher	Site 1: South of pit, inside the inselberg.	Due to the presence of habitat of high ecological importance, this option was not considered viable. Furthermore, hauling costs to the waste rock dump and plant will be high.
	Site 2: Located along northern edge of open pit, along the rim of the inselberg.	Limited presence of habitat of high ecological importance, however, would likely be visible from the N14.
	Site 3: Located at the foot of the inselberg, north of the open pit.	Limited presence of habitat of high ecological importance, however, would result in greater haulage costs.
	Site 4: Located along the rim of the inselberg, adjacent to the proposed conveyor system.	Limited presence of habitat of high ecological importance and as this is located at a natural low point along the rim of the inselberg, the proposed crusher will not be visible from the N14. **This was identified to be the preferred choice.**
Waste rock dump	Dumped over the top of the inselberg and levelled to the same height as the inselberg (Site 1).	The location contains habitat of ecological importance. From the visual perspective, development of only the western dump would be desirable. Consolidation of disturbed areas as much as is possible is desirable. This is a financially viable option and is consistent with the technical design of the access road to the inselberg. **This was identified to be the preferred choice**.
	Within the pit (Site 2).	Ecologically preferable however handling costs excessive, in the order of R2.5 billion will influence the feasibility of the project.
	Inside the crater (site 3).	Ecologically least acceptable due to the presence of sensitive ecological habitat. Visually undesirable as the waste rock dump will be visible from all sides of the inselberg.
	Inside the crater (60%) and within pit (40%) (Site 2/3).	Ecologically least acceptable due to the presence of sensitive ecological habitat. Visually undesirable as the waste rock dump will be visible from all sides of the inselberg.
	North of the N14 national road (Site 4).	Ecologically preferable however excessive handling costs will influence the feasibility of the project. High

		visual impact.
Tailings dam	East of the plant – 1km to the east (Site 1).	The location contained some levels of sensitive ecological habitat. The location is preferred from a hydrogeological and visual perspective. Dust generation and dispersion maybe higher, when consolidated with dust from the waste rock dump.
	East of the plant – 3km to the east (Site 2).	Not recommend from the hydrogeological perspective because of the presence of a major fault.
	South-west of the inselberg (Site 3).	Ecologically least acceptable due to floral and faunal habitats. Not preferred from the hydrogeological perspective because of the presence of major fault. The footprint of the tailings dam is smaller because the dam is a natural valley. While this option has the lowest visual impact from the N14, it could have the highest impact post closure because it disturbs a visually attractive valley.
	South-west of the plant site – 2.5km south-west (Site 4).	Ecologically least acceptable and not preferred from the hydrogeological perspective because of the presence of a major fault.
	Inside of the pit, on top of the inselberg (Site 5).	Ecologically least acceptable and not recommended from the hydrogeological perspective.
	In the area of the waste rock dump so that it is ultimately covered by waste rock (Site 6).	Good from the hydrogeological perspective, but not a technically feasible option.
	Proposed at the workshop – north of the N14 national road (Site 7).	Ecologically desirable because away from sensitive habitats on and around Gamsberg. Further technical and economic studies required by the project engineers. Not desirable from the visual perspective because it will be a new area of disturbance. High winds could result in dust clouds blowing off the dump. The dust clouds could reduce visibility and this could be a traffic hazard on the N14. The dust clouds would also have a visual impact, depending on proximity to the N14. **This was identified to be the preferred choice**.
A non-hazardous solid waste disposal site	East of the plant (Site 1).	Smaller development footprint and located within same catchment as the Plant. **This was identified to be the preferred choice**.
	West of the plant (Site 2).	Greater operational costs and larger development footprint.
	Existing waste site at Aggeneys (Site 3).	Ecologically most acceptable, however, larger economic costs to upgrade the existing Aggeneys site.
Location of the EMV Workshop	On top of the inselberg, along the rim of the inselberg (Site 1).	The lighting could be visually disturbing and will impact sensitive ecological habitat. **This was identified to be the preferred choice**.
	Inside the inselberg (Site 2).	This is considered ecological least preferable. Operating costs will be large and technically unsuitable for the transfer of heavy vehicle in need of repair.

	On the plain, between the inselberg and N14 (Site 3).	Technically unfeasible to move heavy duty vehicles down steep slopes. In addition, operating costs will be greater than the other options.
Routes		
Access from the plains to the mountain top	Repair the existing road to the south-west of the inselberg (Option 1).	Ecologically least unacceptable. This is recognised by the project engineers as a no-go option from the ecological perspective.
	Construct new road up the front (northern) slope of the inselberg (Option 2).	Construction of this road will be prioritised. **This was identified to be the preferred choice**.
Relocation of the N14	No relocation (Option 1).	Status quo. **This was identified to be the preferred choice**.
	Relocation south of the Gamsberg (Option 2).	Ecologically unacceptable. Visual impact will be dispersed further from the inselberg.

4.4 *ANALYSIS OF OPEN PIT AND UNDERGROUND MINING TECHNIQUES*

BMM's base case for this project included the open pit mining option. However, it was broadly understood that open pit mining would result in a greater impact on the biodiversity resources that an Underground mining option. As a result, and to adhere to the mitigation hierarchy of firstly avoiding the impacts, BMM was requested to consider the potential to adopt an underground mining technique. BMM appointed AMEC Engineers to undertake a Technical Feasibility Study (TFS) (AMEC, 2013) to consider the technical and commercial viability of undertaking underground and open pit mining at the Gamsberg inselberg. As part of the technical and commercial analysis, the following criteria/ factors were considered:

- Geology and dimensions of the reserve: This included a detailed review of the depth, width and length of the reserve, the sequencing and composition of the geological formations and general topographical reviews.

- Geotechnical conditions: Based on previous investigations, the TFS reviewed the geotechnical suitability of the site and considered, *inter alia*, slope stability, groundwater conditions and potential slope failure.

- Net smelter return: The net smelter return considered the total cost of saleable product, after the removal of other minerals. This also included a review of the concentration of the zinc deposit itself, and manganese content within the reserve. Lastly, a predicted future costs for shipping, smelter charges, exchange rates and zinc prices were also incorporated into the commercial analysis.

- Processing costs: This included a review of the processing costs for both mining techniques, including aspects of labour, power and equipment, to name a few.

- Mining rate and operating costs: The mining rate for each mining technique will vary, due to technical differences in the construction and operation.

- Mine production schedule: Based on the dimensions and location of the reserve, the life of mine for both mining techniques were factored into the feasibility study.

- Physical and cash flow schedules: This considered the physical infrastructure and cash flow requirements for the different mining technique, in light of the proposed mining production schedule.

- Mine closure measures: Based on the different mining techniques, the mine closure costs were developed and factored into the study.

At this early stage, no environmental costs were considered in the Technical Feasibility Study for the underground options. It was, however, acknowledged upfront, that an open pit mine may result in greater impacts on biodiversity and that a biodiversity off-set was highly likely to be required. The associated off-set costs would need to be considered as part of the overall feasibility of the open pit option. However, the first step in the process was to establish if underground mining was feasible based on the existing site conditions.

4.4.1 *Open Pit VS Underground Mining*

The Gamsberg zinc deposit is confined to a steep-sided inselberg about 7 km east to west by 5 km north to south. During a site visit at Gamsberg from 15 to 17 October 2012, AMEC had the opportunity to inspect the underground workings of the existing underground mine. The ground can be described as competent with ground support in the 5 m wide by 4 m high cross-sections consists of occasional spot bolting with split-set bolts. The large open slopes with dimensions of 25 m by 20 m by 60 m height are not backfilled. Cavity monitoring surveys did not indicate any slope failures of concern. The geotechnical conditions are considered to be suitable for both mining techniques. However, a detailed geotechnical assessment will be undertaken, during the detailed design phase, to verify these preliminary findings.

The zinc deposit present within the Gamsberg inselberg is a defined ore body that is characterised with high content of sulphide and manganese, resulting in a low grade ore deposit of approximately 6% of zinc. Most smelters prefer the manganese grades in concentrates to be in the range 0.2 % to 0.8 % with preferred maximum levels of 0.4 % (AMEC, 2013). Importantly, the Gamsberg deposit has high in situ manganese concentrations and metallurgical testing in recent studies indicates that much of the manganese reports to the zinc concentrate, with the potential for manganese in concentrate to exceed 2.5 %. The low grade concentrate will impact the overall financial viability for both underground and open pit mining.

The feasibility study confirmed that both mining techniques will result in a life of mine of approximately 19 years. However, due to the shape and dimensions of the reserve, open pit mining would be able to produce 10 million tpa of concentrate per year, at full production capacity. The open pit mine will result in the production of approximately 190 million tons of concentrate, over the life of mine. However, underground mining has a slow mining rate (ie abstraction of ore) and will therefore only be able to produce 6.6 million tpa of concentrate, at full production capacity, therefore producing approximately 125.4 million tons of zinc concentrate in the same period.

The footprint of the waste rock dump and tailings facility will also vary with the different mining techniques. An open pit mining technique will generate 155 million tons of tailings, and 1.69 billion tons of waste rock, over the life of mine. Adopting an underground mining approach, the mine will generate 41 million tons of tailings and 7.2 million tons of waste rock (1). The proposed waste generation for an open pit mine will be in an order of magnitude higher, than that of underground mining and therefore the footprint impacts of the mineral waste infrastructure will be greater.

(1) Note that is was assumed, for underground mining, that some waste rock will be backfilled into the underground shafts.

Open pit mining is expected to have an average work force of 504 people, whereas underground mining will require an average total workforce of 378. Based on approximate projections, the water and power requirements for open pit mining are 522 mega litres per annum and 22 Giga watts hourly per annum respectively. Underground mining would require 1 787 mega litres per annum of water and 73 Giga watts hourly per annum of power.

Due to the technical requirements for underground mining, approximately 58% of the reserve can be accessed, and therefore 42% of the reserve will be sterilised, at the end of life of mine. The method for open pit mining enables BMM to access up to 89% of the reserve, over the life of mine. The open pit mining technique will result in the sterilisation of 11% of the reserve. The construction costs (ie capex) for open pit and underground mining are estimated at R5.1 billion and R4.6 billion respectively.

In light of the technical constraints, financial return rates and sterilisation of the reserve, BMM considers underground mining not to be a viable options to pursue. Notwithstanding, due to the larger impacts anticipated with open pit mining, mitigation measures will be more stringent. Therefore the next step is to determine if open pit mining remains viable, once all mitigation measures (including biodiversity offsetting requirements) are determined and applied. BMM will incorporate the recommended mitigation measures of this ESIA Report into the Projects financial model to confirm if the proposed open pit mining option can retain viability.

Table 4.3 Summary of Comparison of Both Mining Techniques

Criteria/ Item	Open Pit	Underground
Mining rate	10 million tons per annum	6.6 million tons per annum
Life of mine	19 years	19 years
Percentage of reserve that is accessible	89%	58%
CAPEX	R5 122 million	R4 616 million
Operating costs (for 10mtpa and 6.6mtpa, respectively)	R50 753 million	R48 311 million
Employment	504	378
Volume of waste rock dump	155 million tons	41 million tons
Volume of Tailings Facility	1 690 million tons	7.2 million tons
Water requirements	502 mega litres per annum	1 787 mega litres per annum
Electrical power requirements	22 gig watts hourly per annum	73 gig watts hourly per annum
Revenue	R 97.4 Bn	R 65.6 Bn
Cash flow	R 41.6 Bn	R 12.7 Bn
C1 Costs	USD 0.94/lb	USD 1.10/lb

4.5 ALTERNATIVES CONSIDERED FOR OPEN PIT TECHNIQUE

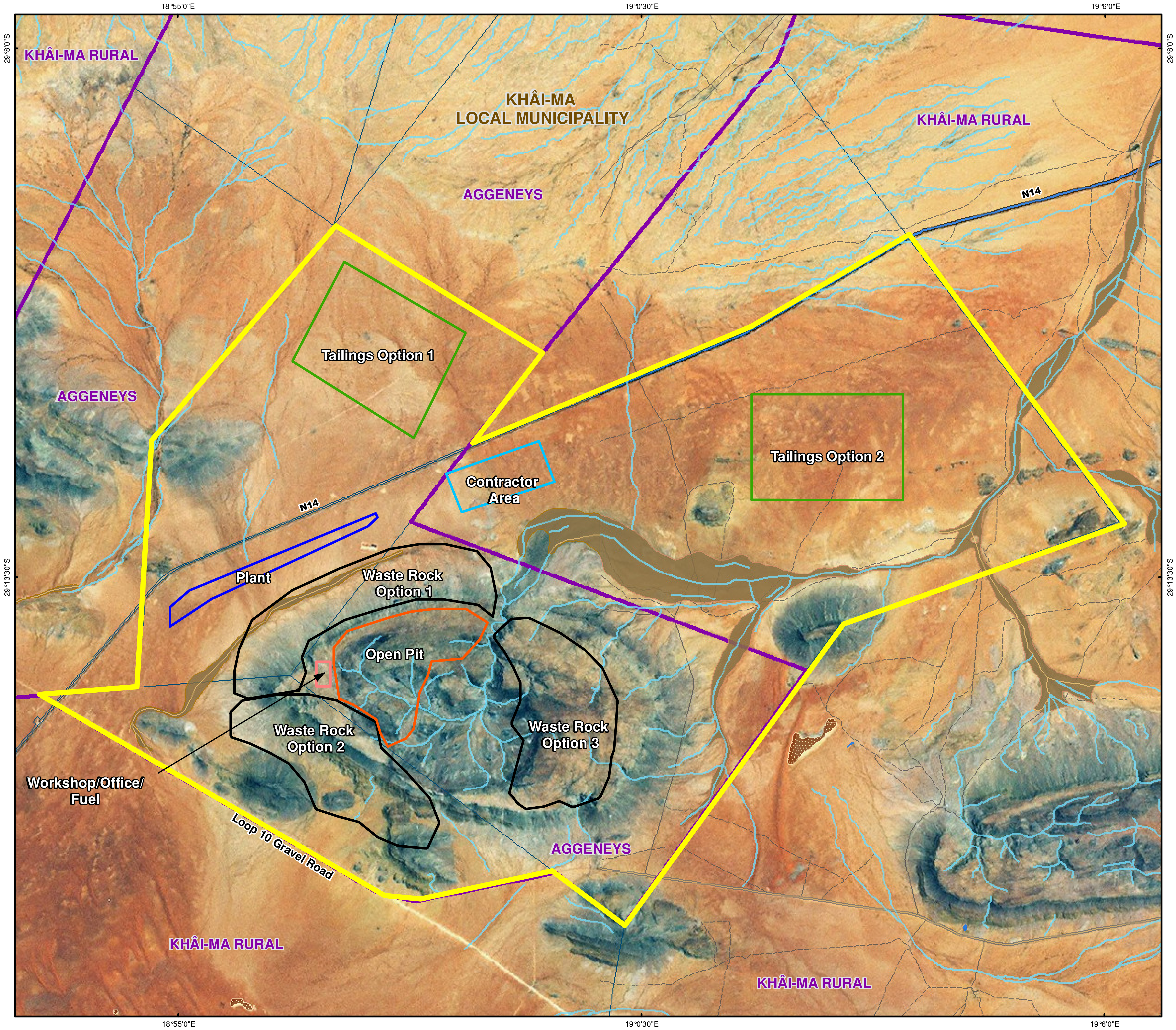
During the prefeasibility phase, an initial layout plan was developed. The initial layout plan was based on a high level feasibility analysis of the potential location alternatives of project infrastructure together with previous studies that were undertaken. The original layout plan is presented in *Figure 4.1*below.

The original layout plan identified the potential location or location alternatives for all major infrastructure required for the project. This included the following project components:

- Three waste rock dump options;
- Two tailings dam options;
- Open pit;
- Plant;
- Contractor area; and
- Access road alternatives.

Locations were identified for the open pit, plant and contractor area, based on discussions between the environmental and engineering teams. The locations were finalised primarily based on avoidance of sensitive habitats and previous assessment that were undertaken by SRK Consulting (2000). Discussions were initiated with the applicant's technical team regarding the potential relocation of these specific infrastructure components, based on the presence of sensitivities. It was agreed that the plant and contractor area could be shifted or inter-changed. However, due to the location and dimensions of the ore body, the location of the open pit could not be relocated, as it would result in the sterilisation of parts of the ore body.

In adopting a conservative approach, all estimations of footprints were based on worst case scenarios. It is understood that as detailed design is complete, the expected footprints of the development will be refined.



Legend

- Non-Perennial River
- Dry Water Course Centre Line
- Dry Water Course Floodplain
- Dam
- Dry Pan
- National Route
- Main Road
- Secondary Road
- Other Road
- Track/Footpath
- Town Boundary
- Open Pit
- Contractor Area
- Plant
- Workshop/Office/Fuel
- Tailings Dam Option 1
- Tailings Dam Option 2
- Waste Rock Dump Option 1
- Waste Rock Dump Option 2
- Waste Rock Dump Option 3
- Mineral Rights Area

SCALE:

0 1 2 3 4

Kilometres

N

TITLE:

Figure 4.1:
Original Layout Plan

CLIENT:

vedanta

BLACK MOUNTAIN MINING (PTY) LTD

DATE: Apr 2012	CHECKED: MP	PROJECT: 0164903
DRAWN: AB	APPROVED: SHC	SCALE: 1 : 70 000

DRAWING: Original Layout Plan.mxd

REV: 0

ERM
Great Westerford Building
240 Main Road
Rondebosch, 7725
Cape Town, SOUTH AFRICA
Tel: +27 21 681 5400
Fax +27 21 686 073

ERM

Projection: Transverse Mecator, CM19. Datum : WGS84
Source: Chief Directorate National Geo-Spatial Information.
McGregor Museum
Inset Map: Esri Data & Maps

SIZE: A3

T:\Gis Projects\0164903_Gamsberg\Mapping\MXD\Report\April2013\Original Layout Plan.mxd

Upon receipt, the original layout plan was distributed to the specialist team for review and preparation for their respective site visits. Specialists were requested to base their field analyses on this original layout plan and upon their return, provide a sensitivity map in relation to the suggested layout options. The following sensitivity maps were presented to commence with the first mitigation hierarchy measure (ie ***Avoidance***):

1 Habitat Sensitivity Map.
2 Archaeological and Heritage Sensitivity Map.
3 Noise and Vibration Sensitivity Map.

Note that hydrological sensitivities were derived from satellite imagery, topographical surveys and previous hydrological analyses undertaken. In addition, the visual specialist provided preliminary feedback on the initial layout options, which are contained below.

Upon receipt of these specialist sensitivity maps and feedback on hydrological and visual sensitivities, the proposed location alternatives were reviewed in light of the specialist mapping and amended whenever feasible to avoid or prevent significant impacts/ conflict areas.

Although archaeological, visual, hydrological and noise sensitivities were considered and incorporated into the layout planning, the primary driver for *avoidance* was that of the habitat sensitivity map. A copy of the initial specialist sensitivity maps are presented below.

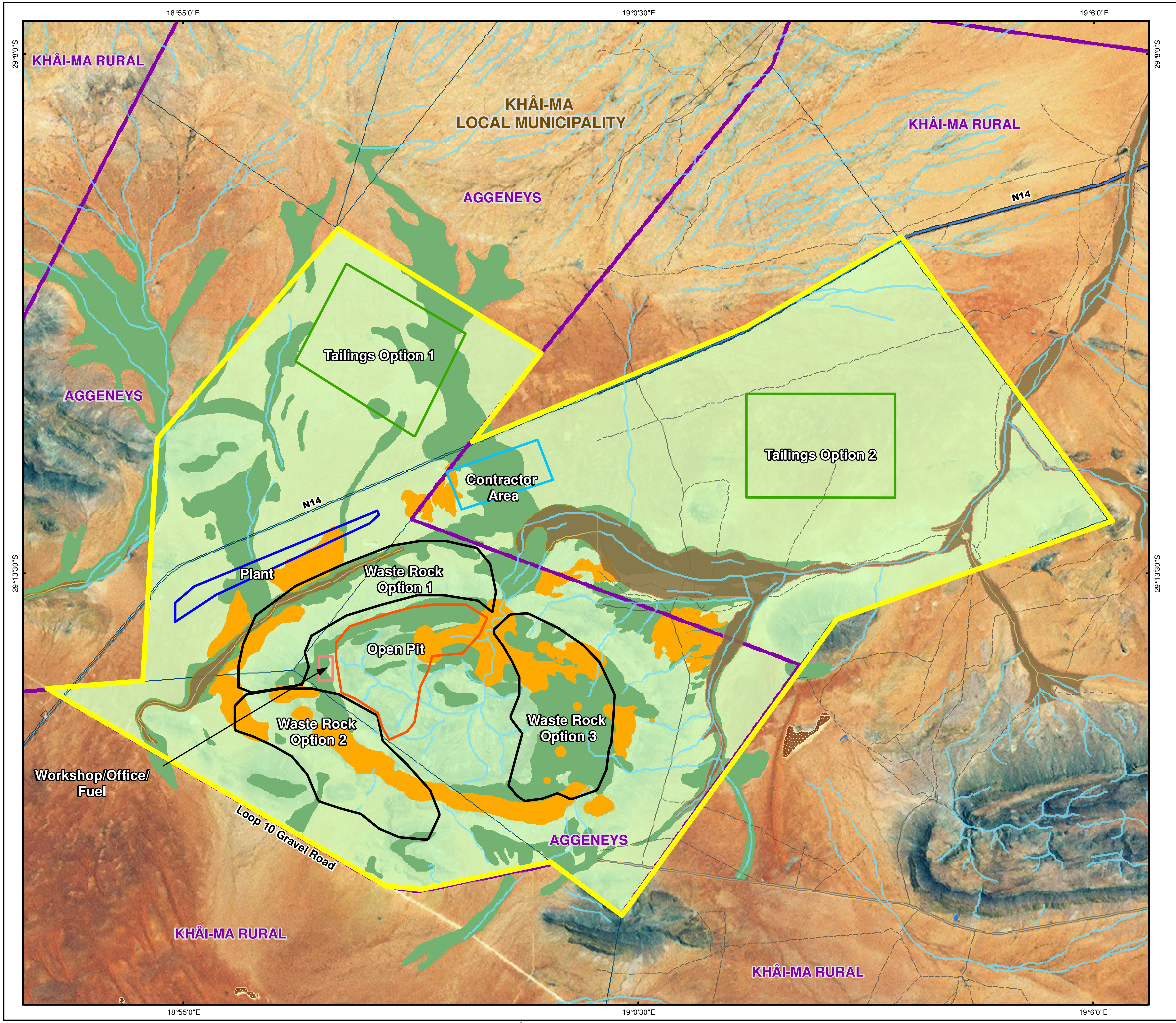
4.5.1 Habitat Sensitivities

In order to manage the impacts associated with the habitats and species of special concern, the botanical specialist has mapped areas of sensitivity, and provides a scale to rate the different sensitivities of each habitat. The habitat sensitivity map helped with delineating areas of conservation importance and thereby guided the location of Project related infrastructure. The scale to rate the different sensitivities of each habitat will be used as a guiding framework in distinguishing and prioritising areas of biodiversity importance.

Biodiversity "features of conservation concern" were identified based on quantifiable criteria such as their uniqueness to the site (ie local endemic); rarity; threatened status (ie risk of going extinct); cultural value; or, sensitivity to disturbance. Three categories of features of conservation can be defined, ie species, habitats and sites. In line with these categories of features, a flexibility map was developed to define constraints within the affected environment. A description of the flexibility is presented below:

Table 4.4 Habitat Sensitivity Scale

Level of Flexibility	Criteria	Offset Options
Flexible	Impact <5% of regional extent of feature (ie minimum 1:20 offset can be achieved).	Complete like-for-like offset possible.
Constrained	Impact 5-20% of regional extent impacted (ie Offset possible but at best a 1:5 offset can be achieved).	Offset likely to be possible.
Irreplaceable	Impact >20% of regional extent. Contains feature of conservation concern that are only know from 5 or less localities.	Potential fatal flaw with no offset possible.



Legend

- Non-Perennial River
- Dry Water Course Centre Line
- Dry Water Course Floodplain
- Dam
- Dry Pan

- National Route
- Main Road
- Secondary Road
- Other Road
- Track/Footpath

- Town Boundary

- Open Pit
- Contractor Area
- Plant
- Workshop/Office/Fuel

- Tailings Dam Option 1
- Tailings Dam Option 2

- Waste Rock Dump Option 1
- Waste Rock Dump Option 2
- Waste Rock Dump Option 3

- Mineral Rights Area

Botanical Sensitivity

- Irreplaceable
- Constrained
- Flexible

SCALE: 0 1 2 3 4 Kilometres N

TITLE:

Figure 4.2: Habitat Sensitivity Map

CLIENT: vedanta BLACK MOUNTAIN MINING (PTY) LTD

DATE: Apr 2012	CHECKED: MP	PROJECT: 0164903
DRAWN: AB	APPROVED: SHC	SCALE: 1 : 70 000

DRAWING: Habitat Sensitivity Map.mxd

REV: 0

ERM
Great Westerford Building
240 Main Road
Rondebosch, 7725
Cape Town, SOUTH AFRICA
Tel: +27 21 681 5400
Fax +27 21 686 073

Projection: Transverse Mecator, CM19. Datum : WGS84
Source: Chief Directorate National Geo-Spatial Information.
McGregor Museum
Inset Map: Esri Data & Maps

SIZE: A3

T:\Gis Projects\0164903_Gamsberg\Mapping\MXD\Report\April2013\Habitat Sensitivity Map.mxd

4.5.2 *Archaeological/ Heritage Sensitivities*

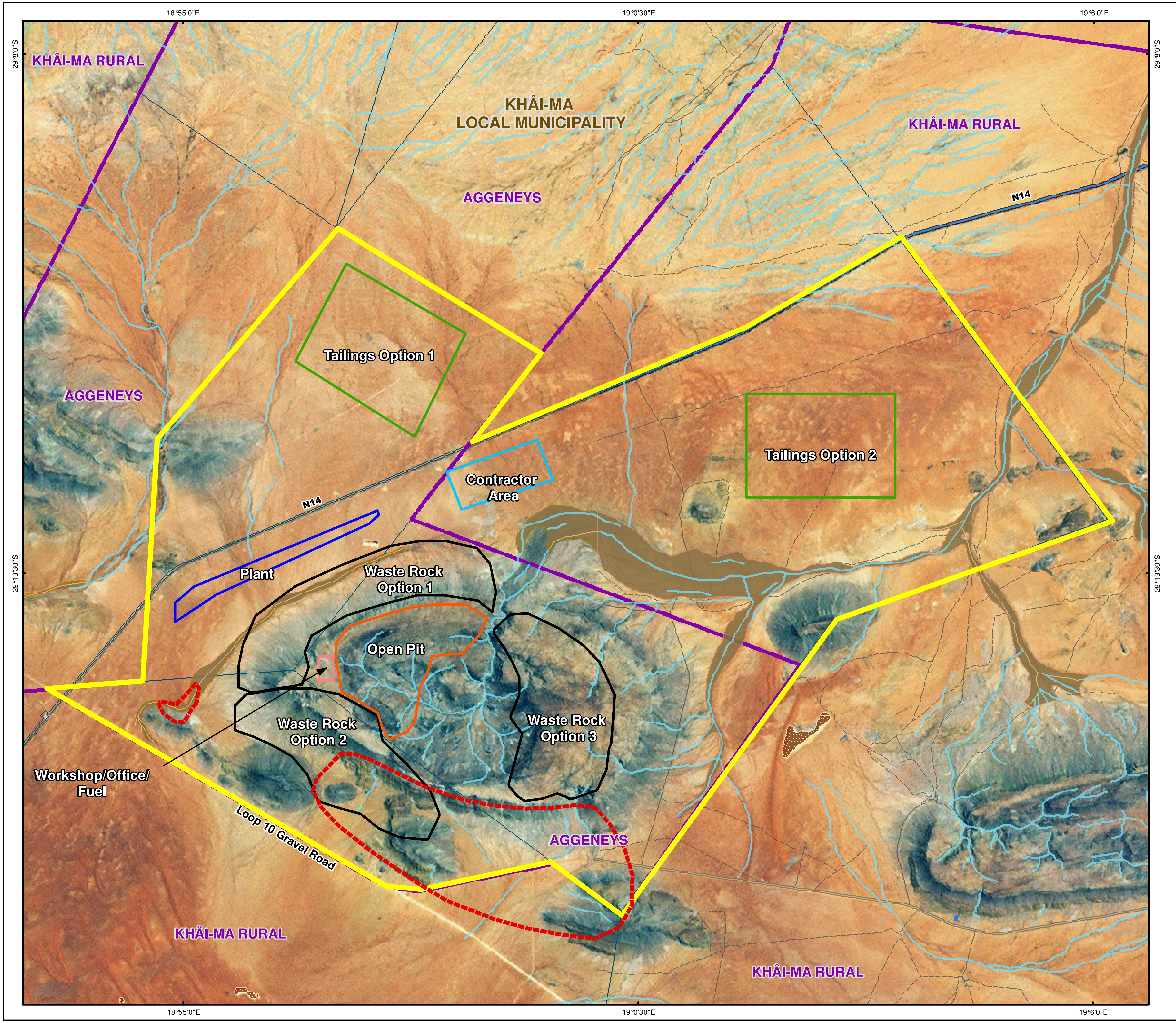
During the archaeological site visit, the Gamsberg inselberg contained limited archaeological artefacts, in the form of isolated stone flakes. A Middle Stone Age workshop site was identified along the northern rim of the inselberg. Two Acheulean workshop sites were also identified, and similar to the workshop site identified along the northern rim, indicates that the Gamsberg inselberg was favoured as a raw material source for historical communities. In addition, the stream courses found within the Gamsberg basin contains a mixture of low density Middle Stone Age and Acheulean material, which could be indicative of an area in which historical communities lived in (Morris, 2010). However, as the inselberg was previously and currently quarried, artefacts are therefore unlikely to be discovered below the surface, and thus represent limited sensitivity.

The archaeologist has noted that an area may pertain to the people who were subject to local genocide in the later nineteenth century (the south western corner of Gamsberg might have been one of the massacre sites), making this a rather sensitive landscape that may in future become increasingly a focus of genocide consciousness (refer to *Figure 4.3* below).

4.5.3 *Noise and Vibration Sensitivities*

The Gamsberg inselberg is located in an area that is sparsely populated, with limited sensitive noise receptors in the immediate area. Sensitive receptors in the area include the town of Aggeneys, adjacent land owners and road users (N14 and Loop 10 gravel road). The proposed Gamsberg mine will result in the generation of noise through the use of diesel equipment, crushing, concentrating and activity of mining such as blasting and drilling and hauling of rock and concentrate. Current noise generation activities include the Black Mountain Mine, road users of the N14 and residents within the town of Aggeneys.

During the site visit, the noise specialist has identified receptors located within close proximity to the mining license area (refer to *Figure 4.4* below).



Legend

- Non-Perennial River
- Dry Water Course Centre Line
- Dry Water Course Floodplain
- Dam
- Dry Pan
- National Route
- Main Road
- Secondary Road
- Other Road
- Track/Footpath
- Town Boundary
- Open Pit
- Contractor Area
- Plant
- Workshop/Office/Fuel
- Tailings Dam Option 1
- Tailings Dam Option 2
- Waste Rock Dump Option 1
- Waste Rock Dump Option 2
- Waste Rock Dump Option 3
- Mineral Rights Area
- Areas of Archaeological Sensitivity

SCALE:
0 1 2 3 4
Kilometres
N

TITLE:

Figure 4.3:
Archaeological Sensitivity Map

CLIENT:

vedanta
BLACK MOUNTAIN MINING (PTY) LTD

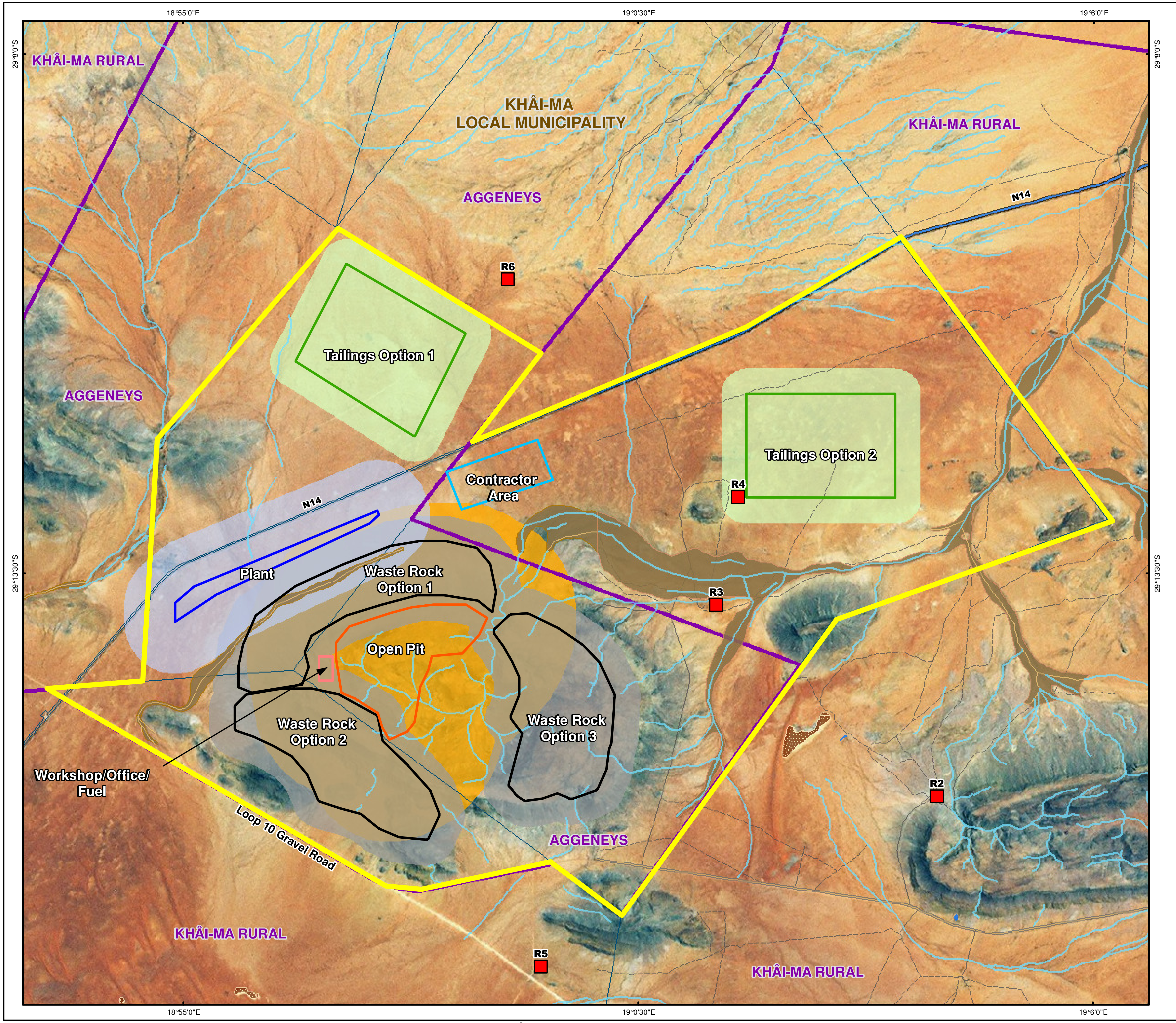
DATE: Apr 2012	CHECKED: MP	PROJECT: 0164903
DRAWN: AB	APPROVED: SHC	SCALE: 1 : 70 000

DRAWING: Archaeological Sensitivity Map.mxd
REV: 0

ERM
Great Westerford Building
240 Main Road
Rondebosch, 7725
Cape Town, SOUTH AFRICA
Tel: +27 21 681 5400
Fax +27 21 686 073

Projection: Transverse Mecator, CM19. Datum : WGS84
Source: Chief Directorate National Geo-Spatial Information.
McGregor Museum
Inset Map: Esri Data & Maps
SIZE: A3

T:\Gis Projects\0164903_Gamsberg\Mapping\MXD\Report\April2013\Archaeological Sensitivity Map.mxd



Legend

- Non-Perennial River
- Dry Water Course Centre Line
- Dry Water Course Floodplain
- Dam
- Dry Pan
- National Route
- Main Road
- Secondary Road
- Other Road
- Track/Footpath
- Town Boundary
- Open Pit
- Contractor Area
- Plant
- Workshop/Office/Fuel
- Tailings Dam Option 1
- Tailings Dam Option 2
- Waste Rock Dump Option 1
- Waste Rock Dump Option 2
- Waste Rock Dump Option 3
- Mineral Rights Area
- Potential Sensitive Receptors
- Open Pit (2000m Buffer)
- Plant (1000m Buffer)
- Tailings (500m Buffer)
- Waste Rock (500m Buffer)

SCALE: 0 1 2 3 4 Kilometres N

TITLE:

Figure 4.4:
Noise Sensitivity Map

CLIENT:

vedanta
BLACK MOUNTAIN MINING (PTY) LTD

DATE: Apr 2012	CHECKED: MP	PROJECT: 0164903
DRAWN: AB	APPROVED: SHC	SCALE: 1 : 70 000

DRAWING: Noise Sensitivity Map.mxd

REV: 0

ERM
Great Westerford Building
240 Main Road
Rondebosch, 7725
Cape Town, SOUTH AFRICA
Tel: +27 21 681 5400
Fax +27 21 686 073

Projection: Transverse Mecator, CM19. Datum : WGS84
Source: Chief Directorate National Geo-Spatial Information.
DDA Environmental Engineers
Inset Map: Esri Data & Maps

SIZE: A3

T:\Gis Projects\0164903_Gamsberg\Mapping\MXD\Report\April2013\Noise Sensitivity Map.mxd

4.5.4 *Hydrological Sensitivities*

As outlined above, the hydrological sensitivities identified were based on satellite imagery, topographical surveys and previous studies.

The mine is located at the watershed between two quaternary catchments, being D81G (northern catchment) and D82C (southern catchment). The latter (D82C) is an endoreic catchment, which means that it is an interior drainage basin that does not drain to the sea. Part of the Gamsberg inselberg is situated within quaternary catchment D81G, which drains in a northerly direction towards the Orange River some 35km away. In light of the two catchments, efforts were made to locate all project infrastructure within a single catchment, so as to avoid potential impacts to more than one catchment area. However, despite the efforts made, the open pit (the location of which is dictated by the location and dimensions of the ore body) is situated in catchment D81G. The remaining infrastructure is located within catchment D82C and will therefore not impact on the catchment leading to the Orange River. A detailed review of the two catchment areas (D81G and D82C) is presented in Chapter 5 below.

4.5.5 *Visual Sensitivities*

The visual specialist was requested to consider the initial design and provide feedback in terms of key sensitivities. The specialist was of the opinion that the Project will have a large visual impact regardless of where infrastructure is located. The relative scale and physical presence of project components, in essentially a 'green fields' location, make it difficult to mitigate. The specialist suggested that the location of facilities must try to be 'consolidated' into the smallest 'footprint' possible and preferably closer to the inselberg to maximise the visual absorption capacity of the impacted landscape.

4.6 *OUTCOMES OF AVOIDANCE*

As previously indicated, the habitat sensitivities were used as the primary driver to determine locations of project infrastructure. The aforementioned sensitivity maps were overlaid onto the original layout plan and subsequently used by the engineering team to shift infrastructure to avoid irreplaceable and sensitive vegetation.

4.6.1 *Waste Rock Dump Options*

Habitat

The habitat sensitivity map identified irreplaceable habitat within various sections of the inselberg and adjacent plains. Based on the original layout plan, waste rock dump *Options 2* and *3* (as reflected in *Figure 4.1* above) will impact on large sections of irreplaceable and sensitive vegetation habitats. Furthermore, Option 2 is located along the southern face of the inselberg, which is known to contain sensitive vegetation, indicative of the Succulent Karoo. Option 1, located along the northern slopes of the inselberg, is primarily limited to areas identified to possess a limited features of conservation concern. However, the north western section of Option 1 impacts irreplaceable vegetation. Therefore, a request was made to BMM to reconsider the location of Option 1and shift the expected footprint further north, so as to avoid the features of conservation concern.

Archaeological/ Heritage

The archaeologist has noted that an area (south and south west of the inselberg) may pertain to the people who were subject to local genocide in the later nineteenth century. Although this has not yet been confirmed and in adopting a risk adverse approach, Option 2 was identified to be unsuitable from an archaeological perspective and thus screened out. The archaeological sensitivity map identified Options 1 and 3 to be more suitable for the waste rock dump.

Noise

Despite adopting a conservative approach through the use of a 500 m buffer for the waste rock dump, no specific sensitivities were identified in this respect. Neither of the waste rock dump options was considered to impact sensitive noise receptors in the surrounding region. The noise specialist has not identified any preference with regard to the waste rock dump options.

Hydrology

The waste rock Options 2 and 3 are located within catchment D81G, which forms part of the larger catchment area that flows into the Orange River. Waste rock dump Option 1 is located within sub-catchment D82C, which is a closed catchment (ie does not flow into the sea). Due to the sensitive nature of the Kloof found within the inselberg and downstream users of the Orange River, an effort was made to avoid catchment D81G. The faunal and botanical specialists also identified this feature to be of concern from an ecological perspective. It was recommended that Option 1 be selected, so as to try and limit the mineral waste infrastructure facilities to a single sub-catchment.

Visual

Based on preliminary analysis, the visual specialist demonstrated preference to waste rock Option 2. Waste rock Option 2 would be the "easiest" to partially absorb the visual impact of this huge feature, as it would be 'enclosed' by the natural koppies to its south and the main Gamsberg to its north (assuming that the height of the dump is not higher than the Gamsberg). Option 2 would also ensure that major infrastructure is consolidated along the southern border of the N14, so as to limit the visual exposure of the project.

Based on habitat sensitivities identified around Option 2 (ie the catchment of the Kloof and botanical sensitivities associated with the southern slope of the inselberg), due consideration was given to both the visual and ecological sensitivities. In light of the larger Bushmanland Inselberg Region (BIR) and the nature of island geography applicable to the BIR, the ecological sensitivities were identified to have a greater regional importance.

Summary of Preferred Option

Based on the aforementioned inputs, waste rock dump *Option 1* was selected to be the preferred choice, with specific refinements required to avoid irreplaceable ecological habitat located to the south west.

4.6.2 Tailings Dam Options

Habitat

Based on the two tailings dam location alternatives identified, neither option was located in irreplaceable habitat. However, sensitive habitat was identified around sections of Tailings Option 1. Tailings Option 2 was located in an area that did not contain any features of special concern and was therefore identified to be marginally preferable, as it will not impact on sensitive habitat. It should be noted that subsequent to this, the size and location of Tailings option 1 was refined and confirmed to avoid any sensitive habitats. As the expected impacts to sensitive habitat is likely to be the similar for each option, there was not strong preference for a particular location option.

Archaeological/ Heritage

Based on the archaeological sensitivities identified, neither location alternative appeared to impact the areas of archaeological sensitivity identified and therefore no preference was demonstrated.

Noise

In defining the noise sensitivity, a 500 m buffer was established around both location alternatives of the Tailings facility. The noise specialist identified a single noise receptor located within this suggested buffer area for Tailings option 2. Based on the proximity of the noise receptors, Tailings Option 2 was identified to be the preferred choice.

Hydrology

From a hydrological perspective, it was request that all mineral and non-mineral waste infrastructures should be limited to a single catchment area. Furthermore, the Kloof catchment was identified to be a sensitive area and thus tailings Option 2 were identified to be less preferable. To ensure that only catchment D82C is impacted, Tailings Option 2 was identified to be the preferred option.

Visual

Based on preliminary analysis, the visual specialist demonstrated preference to tailings Option 2. Option 2 would also ensure that major infrastructure is consolidated along the southern border of the N14, so as to limit the visual exposure of the project.

Based on habitat sensitivities identified around Option 2 (ie the catchment of the Kloof and downstream users), due consideration was given to both the visual and hydrological sensitivities. Due to the potential extent of potential impacts to downstream users and the regional importance of the Kloof habitat, the hydrological sensitivities were identified to have a greater regional importance.

Summary of Preferred Option

In light of noise and hydrological sensitivities, and further refinements to the location of the Tailings facility to avoid habitat sensitivities, *Option 1* was identified to be the preferred choice.

4.6.3 *Contractor Area and Plant*

Although the original layout plan was based on the SRK Consulting (2000) layout plan, it did not identify alternative locations for the Plant and Contractor Area. For this reason, the option to refine the location of these pieces of infrastructure was considered. Subsequent to the initial sensitivity analysis, the locations of the Plant and Contractor Area was swopped, to achieve greater technical efficiency during the operational phase.

Habitat

Both the Plant and Contractor Area was originally located on habitat identified to contain areas of specialist concern (including irreplaceable habitat). Suggestions were made to shift the location so as to avoid the constrained and irreplaceable vegetation. In order to streamline the technical requirements for the transportation of ore to the Plant, the locations of the Contractor Area and Plant were inter-changed. Furthermore, based on the refinement of design, the footprints of these pieces of infrastructure were subsequently reduced and therefore avoided all botanical sensitivities.

Archaeological/Heritage

No areas of archaeological sensitivities were identified in the locations suggested for the Plant and Contractor Area. Furthermore, the subsequent changes to the location and footprints did not impact any areas of concern and therefore no particular preference was expressed from an archaeological perspective.

Noise

The noise sensitivity map identified a buffer are of 1000m for the Plant. Based on the original location, the Plant was likely to impact road users along the N14 (as the National road fell within the 1000m buffer area). Subsequent to inter-changing the locations of the Plant and Contractor Area, the noise buffer would still result in potential noise impacts to road users of the N14. Although the suggestion was made to shift the Plant closer to the Inselberg, the botanical constraints limited this option and therefore no preference was presented from a noise perspective.

Hydrology

The locations for the Plant and Contractor Area are limited to catchment D82C, and are therefore consolidated into a single catchment together with the proposed water rock dump and tailings dam. Therefore, no specific preference was identified. However, due to the presence of various drainage lines in the immediate area, a suite of mitigation measures would be required to limit impacts to all watercourses. This is detailed further in the Impact Assessment below.

Visual

Due to the proximity of the Plant and Contractor Area to the N14, the visual specialist confirmed that the suggested locations would result in a large visual impact. From a visual perspective, the specialist requested for all infrastructure to be consolidated closer to the inselberg, thereby reducing road user visibility along the N14.

Based on habitat sensitivities, as were with the tailings dam and waste rock location, the relocation of the Plant and Contractor area was not considered viable from an ecological perspective.

Summary of Preferred Option

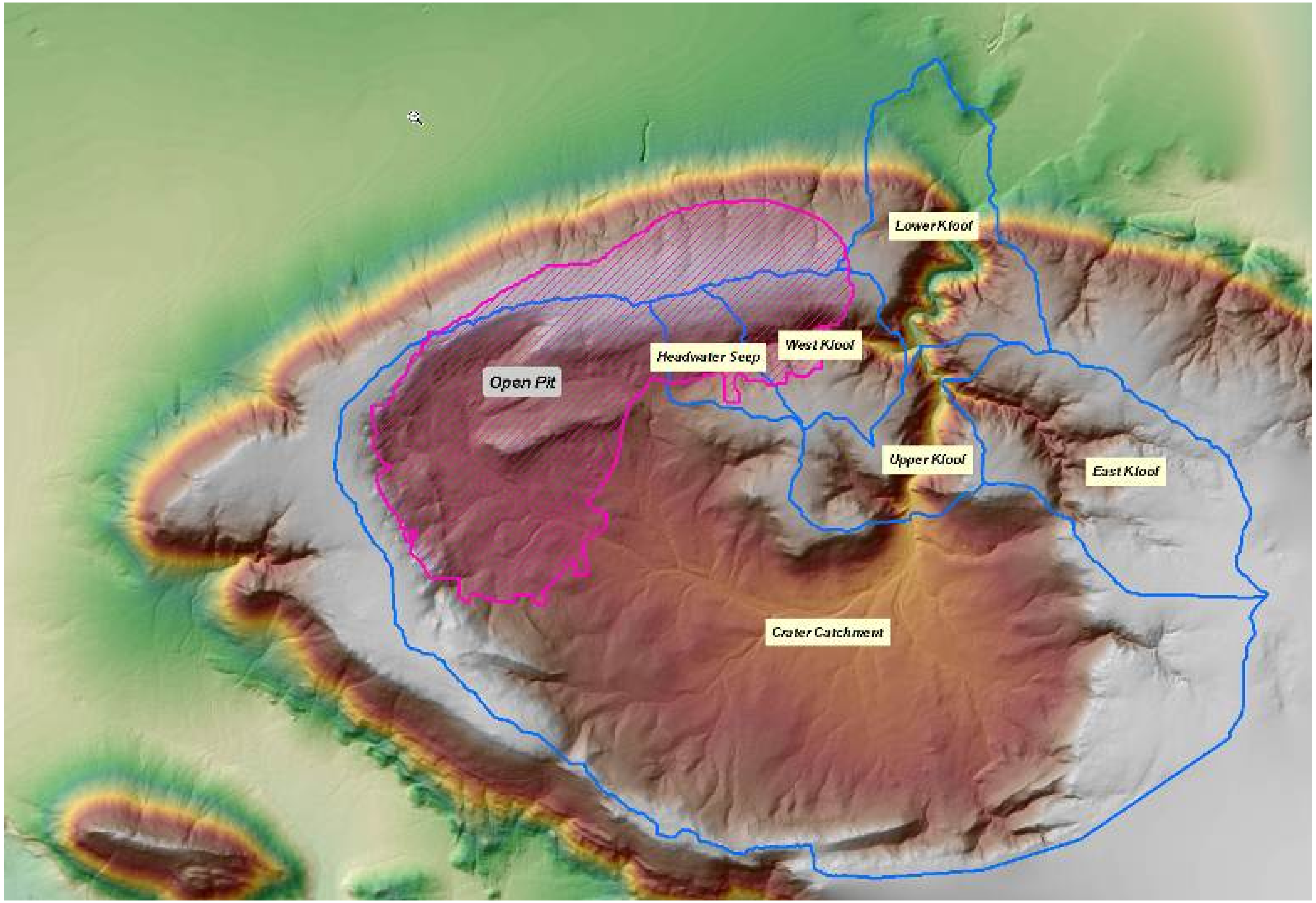
The proposed locations for the Plant and Contractor Area, as per the original layout plan, was subsequently swopped and was taken forward for detailed impact assessment.

4.6.4 *Open Pit*

Habitat

The original sensitivity mapping identified patches of irreplaceable vegetation and headwater seepland within the expected footprint of the open pit. Furthermore, the proposed open pit would also infringe on the surface catchment area of the Kloof. The expected footprint of the open pit is based on the dimensions of the ore body as well as technical requirements to access the reserve. Due to the technical limitations of the proposed open the Botanist requested due consideration for the shifting of the open pit in a southerly direction, so as to avoid the physical catchment of the open pit area, and possible the headwater seepland wetland (refer to *Figure 4.5* below).

Figure 4.5 Consideration of Setback Lines for Open Pit (Desmet, 2013)



Based on the location of the headwater seep, creating a setback line to avoid the wetland boundaries would limit the ability to access the reserve and thus result in the sterilisation of parts of the ore body. This technical limitation would reduce the financial viability of the Project and was therefore screened out. However, the design engineers have explored the potential to limit the extent of the proposed open pit so as to avoid the catchment area of the Kloof, as far as reasonable possible.

As the Kloof serves as the only permanent water source in that immediate region, protection of its integrity remains an important aspect for supporting on-going ecological processes. The design engineers have confirmed that, due to technical reasons for accessing the ore body, part of the western surface catchment area of the Kloof will be impacted. The remaining parts of the surface catchment area for the Kloof will not be impacted (refer to Final Layout *Figure 4.6* below).

Archaeological/Heritage

The archaeological specialist has not identified any specific areas of concern with regard to the location of the proposed open pit. Apart from various artefacts identified, there were not heritage or archaeological limitations identified.

Noise

A 2000m noise buffer was identified for the proposed open pit area. Based on the initial identification of sensitive receptors, the open pit is unlikely to impact adjacent receptors. The noise specialist has therefore not expressed any objections to the initial layout.

Hydrology

Further to the discussion in the ecological section above, the proposed open pit is expected to infringe on the catchment area of the Kloof. From a hydrological perspective, the proposed open pit would partly fall within catchment D81G (ie feeding into the Orange River), and thus could potentially impact on downstream users. Furthermore, the Project would impact on the two catchment areas that divide the inselberg. Based on the technical and financial feasibility analysis to avoid the Kloof catchment, it was confirmed that part of the western surface catchment area of the Kloof will be impacted.

Visual

The proposed open pit would be located within the inselberg and would therefore not be visible from the N14 or adjacent properties. However, the visual specialist has requested that the open pit must not result in the breaking of the inselberg walls. The specialist also requested that the open pit operations do not exceed the height of the rim of the inselberg, so as to reduce visibility from the N14. These requirements were incorporated into the design and therefore taken forward.

Summary of Preferred Options

In light of the aforementioned comments, together with the technical limitations to the dimensions of the open pit, the location of the pit will not be moved. However, to avoid the catchment area of the Kloof, the proposed setback lines for the Kloof catchment can be partly met (ie impact limited to western catchment area only), while maintaining a technically safe slope angle.

4.7 *ADDITIONAL INFRASTRUCTURE LOCATION ALTERNATIVES*

Upon completion of the initial screening exercise, additional site location alternatives were identified for further analysis. The following project components were also overlaid onto the specialist sensitivity maps to identify potential conflicts and suggest suitable alternatives:

- Main access road onto the inselberg.
- Location of primary ore crusher.
- Location of engineering workshop.

4.7.1 *Access Roads*

BMM originally proposed that the existing access road along the southern slopes of the inselberg will be used for the construction and operational phases. In order to accommodate the size of the vehicles to be used, the existing access road will need to be widened.

Due to the habitat sensitivities identified along the southern slopes of the inselberg, together with the potential site of a historic genocide (archaeological sensitivity), the applicant was requested to consider alternative route options up the northern slopes of the inselberg. The expansion of the existing access road and the associated dust impacts will result in impacts to the biodiversity along the southern end of the inselberg. Based on the sensitivities identified, BMM agreed to construct a new access road up the northern slopes of the inselberg at the operational phase. However, for ease of technical requirements, BMM will utilise the existing access road along the southern slopes of the inselberg for construction only. Due to the size of construction vehicles and slope angle, the existing access road on the southern face of the inselberg would need to be expanded by approximately 12 m.

In summary, it was agreed that during the construction phase, the existing southern access road will be widened and used until a new access road along the northern face of the inselberg is constructed and utilised for the life of mine.

4.7.2 *Location of Primary Crusher*

During initial planning, the potential location of the primary crusher was reviewed in light of specialist sensitivities. The initial location identified was along the southern rim of the inselberg, consistent with the use of the existing access road on the southern slopes of the inselberg. However, this option was screened out, once a decision was made to relocate the access road to the northern slopes of the inselberg (ie was not technically consistent with the newly proposed access road).

Despite the consideration of various alternatives, a location north of the proposed open pit was identified. This location was situated outside of any areas of biodiversity sensitivity.

Based on the potential visibility of the crusher, the visual specialist requested that the proposed primary crusher be situated so as not to be visible from the N14 (ie not higher than the rim of the inselberg). BMM has therefore been requested to ensure that the crusher be located in a low point, thereby reducing visibility from the N14 and adjacent properties. Lastly, the technical requirement for locating the crusher along the northern section of the inselberg was consistent with the proposed access road along the northern face of the inselberg.

4.7.3 Location of Engineering Workshop

Originally, the engineering workshop was identified on the top of the inselberg, due to ease of access for mining equipment (including haul trucks). The potential locations for the engineering workshop were limited to around the open pit area, along its boundaries. Due to biodiversity sensitivities identified, the proposed location on the inselberg was not considered to be ecologically acceptable and BMM was therefore asked to reconsider the location.

The proposed engineering workshop was relocated to the adjacent plains, between the Plant and inselberg. Due to changes in technical requirements resulting from the newly proposed access road along the northern face of the inselberg, the new location was consistent with the technical requirements. Furthermore, the location of the workshop avoids all sensitive habitats, identified by the botanist.

No hydrological and archaeological issues were identified. Although located closer to the N14, the proposed engineering workshop will likely be screened by the Plant and therefore not significantly increase the visual impacts of the entire project.

4.8 SUMMARY OF ALTERNATIVES CONSIDERED

Based on the review of site sensitivities and proposed infrastructure, the following table provides a summary of all alternatives considered and the preferred options taken forward for detailed impact assessment refer to Final Layout Plan included in Chapter 3 as *Figure 3.1*.

Table 4.5 Summary of Alternatives for Detailed Impact Assessment

Alternatives	Preferred Choice	Specialist Comment

1	*Underground VS Open Pit Mining*		
	Underground Mining		• Achieve a mining rate of 6.6 million tons per annum. • Life of mine of 19 years. • Recover 58% of resources and sterilise 42% of resources. • Employ approx. 378 people. • Require 1787 Ml of water per annum. • Require 77 Gigawatts hourly per annum. • Produce 41.8 million tons of tailings. • Produce 7.2 million tons of waste rock. • CAPEX of R4 616 million. • Operational costs of R48 311 million.
	Open Pit Mining	**Preferred Option**	• Achieve mining rate of 10 million tons per annum. • Life of mine of 19 years. • Recover 89% of resources and sterilise 11% of resources. • Employ approx. 504 people. • Require 502 Ml of water per annum. • Require 22 Gigawatts hourly per annum. • Produce 155 million tons of tailings. • Produce 1 690 million tons of waste rock. • CAPEX of R5 122 million. • Operational costs of R50 753 million.
2	*Tailings Dam*		
	Option 1: 1km North East of Inselberg, along southern border of N14		• Result in a high visual impact. • Greater impacts to hydrological sensitivities, (ie stream related to the Kloof) Presence of visual receptors. • Limited botanical and faunal sensitivities. • Larger operational costs due to distance from open pit. • Located in close proximity to adjacent landowners (ie receptors). • This option would not need to cross the N14.
	Option 2: North of inselberg, along northern border of N14	**Preferred Option**	• Result in a large visual impact (Infrastructure would need to cross the N14). • No impacts to the hydrological sensitivities (ie Kloof stream). • Reduced operational costs due to shorter travel distance. • Avoid irreplaceable vegetation and faunal sensitivities. • Reduced number of noise receptors. • No areas of archaeological concern.
3	*Waste Rock Dump*		

	Site 1: Northern face of inselberg (1)	**Preferred Option**	• Avoid irreplaceable vegetation. • Impact faunal habitat along slopes of inselberg. • Lower handling costs (reduced haulage). • Consistent with design of ramp and pit access via northern face of inselberg. • Large visual impact. • No areas of archaeological concern.
	Site 2: South western face of inselberg		• Impact areas of archaeological concern. • Impact sensitive faunal habitats. • Impact irreplaceable vegetation. • Reduced visual impact as infrastructure is consolidated to the south western part of the inselberg. • Limited noise receptors. • Greater operational costs as access road is located along northern slope of inselberg.
	Site 3: Inside the Crater		• Result in sterilisation of mineral resources. • Impact sensitive faunal habitats. • Impact irreplaceable vegetation. • Reduced visual impact (would not be visible from N14). • Limited noise receptors. • Low handling costs (closer proximity). • Technically unsuitable due to proximity to open pit operation.
4	***Contractors Camp***		
	Site 1: North of inselberg, along southern border of N14.		• Large visual impact from N14. • Greater impacts to the hydrological sensitivities (ie kloof stream). • Impacts irreplaceable vegetation. • No faunal sensitivities present. • Reduced number of noise receptors. • No areas of archaeological concern. • Technically not suitable to link the open pit with the Concentrator Plant.
	Site 2: North West of inselberg, along the southern border of N14	**Preferred Option**	• Located outside of catchment of Kloof stream. • Avoids irreplaceable vegetation. • Limited faunal habitat sensitivities identified. • No areas of archaeological concern. • Technically suitable to link the open pit with the Concentrator Plant. • Reduced number of noise receptors. • Large visual impact from N14
5	***Ore Crusher***		
	Site 1: On top of inselberg, north of pit	**Preferred Option**	• Reduced haulage distance to pit and concentrator. • Consistent with future pit and ramp design. • Located within area of proposed open pit (ie no additional loss of sensitive vegetation & faunal habitat). • Larger visual impact (visible from N14).

(1) In order to accommodate the proposed conveyor system to extend from the open pit to the plant, the waste rock dump is presented as two items on the layout plan below.

	Site 2: On the adjacent plains, north west of inselberg		• Increased handling costs. • High visual impact (visible from N14). • Located within sensitive flora and faunal habitats. • No areas of archaeological concern. • Technically not suitable for proposed pit and ramp design.
6	*Engineering Workshop*		
	Site 1: Top of inselberg, west of open pit		• Not consistent with northern access road. • Operational costs are greater. • Impact the Kloof catchment . • Reduced visibility from N14 (due to distance). • Limited noise receptors. • No archaeological sensitivities.
	Site 2: North of inselberg along the adjacent plains, between the waste rock dump and Plant.	**Preferred Option**	• Large visual impact (visible from N14). • Consistent with the access road to open pit. • Avoids Kloof catchment. • Avoid irreplaceable vegetation. • Limited sensitive faunal habitat. • Limited noise receptors. • No archaeological sensitivity.
7	*Access Road to Inselberg (operational phase only)*		
	Option 1: Repair existing road along the southern slope of the inselberg		• Reduced operational costs (ie more direct route). • Impact sensitive faunal habitats. • Impact irreplaceable vegetation. • Impact areas of archaeological concern. • Reduced visibility from N14. • Reduced footprint as expanding an existing road.
	Option 2: New road along northern slope of inselberg	**Preferred Option**	• Avoids irreplaceable vegetation. • Limited faunal sensitivities. • No areas of archaeological concern. • Higher operational costs. • Greater visibility from N14. • Increase in footprint.
8	*Concentrator Plant*		
	Site Option 1: North of inselberg, along southern border of N14	**Preferred Option**	• Reduced haulage costs. • Consistent with conveyor design. • Large visual impact (due to proximity to N14). • Avoids irreplaceable vegetation. • Limited sensitive faunal habitats.
	Site Option 2: North west of inselberg, along southern border of N14		• Greater haulage costs due to greater distance. • Not consistent with conveyor design. • Large visual impact. • Impact irreplaceable vegetation and sensitive faunal habitats. • Infrastructure limited to southern border of N14.

4.8.1 *Refinement of Project Design*

Based on the aforementioned screening process, a project layout was developed and distributed to the specialist team. The specialists undertook their impact assessments based on the initial layout plan (refer to *Figure 4.6* below). Based on the initial findings of the specialist studies, the following changes were recommended by the specialist team, which were subsequently made:

- Relocation of the explosives magazine area from the top of the inselberg to an area located between the N14 and inselberg. Due to the impacts to three watercourses on the inselberg, the explosives magazine area was relocated.
- Increase in size of the waste rock dump from to 270 hectares to 490 hectares. In order to reduce the slope angle of the waste rock dump (i.e. from 45^0 – 35^0 degree slope angle), the footprint of the waste rock dump has subsequently increased.

Note that each specialist has been requested to confirm the aforementioned refinements to the project design, in relation to their specialist impact assessment. Each specialist report contains a section outlining the implications of the above mentioned layout. It was confirmed that all specialist findings and impact ratings were not going to change, as compared to the impacts assessed against the initial layout plan.

The final layout plan, which reflects the relocation of the explosives magazine area and increase in footprint of the waste rock dump was compiled, in which this ESIA Report is based on is included as *Figure 3.1* in Chapter 3 above.

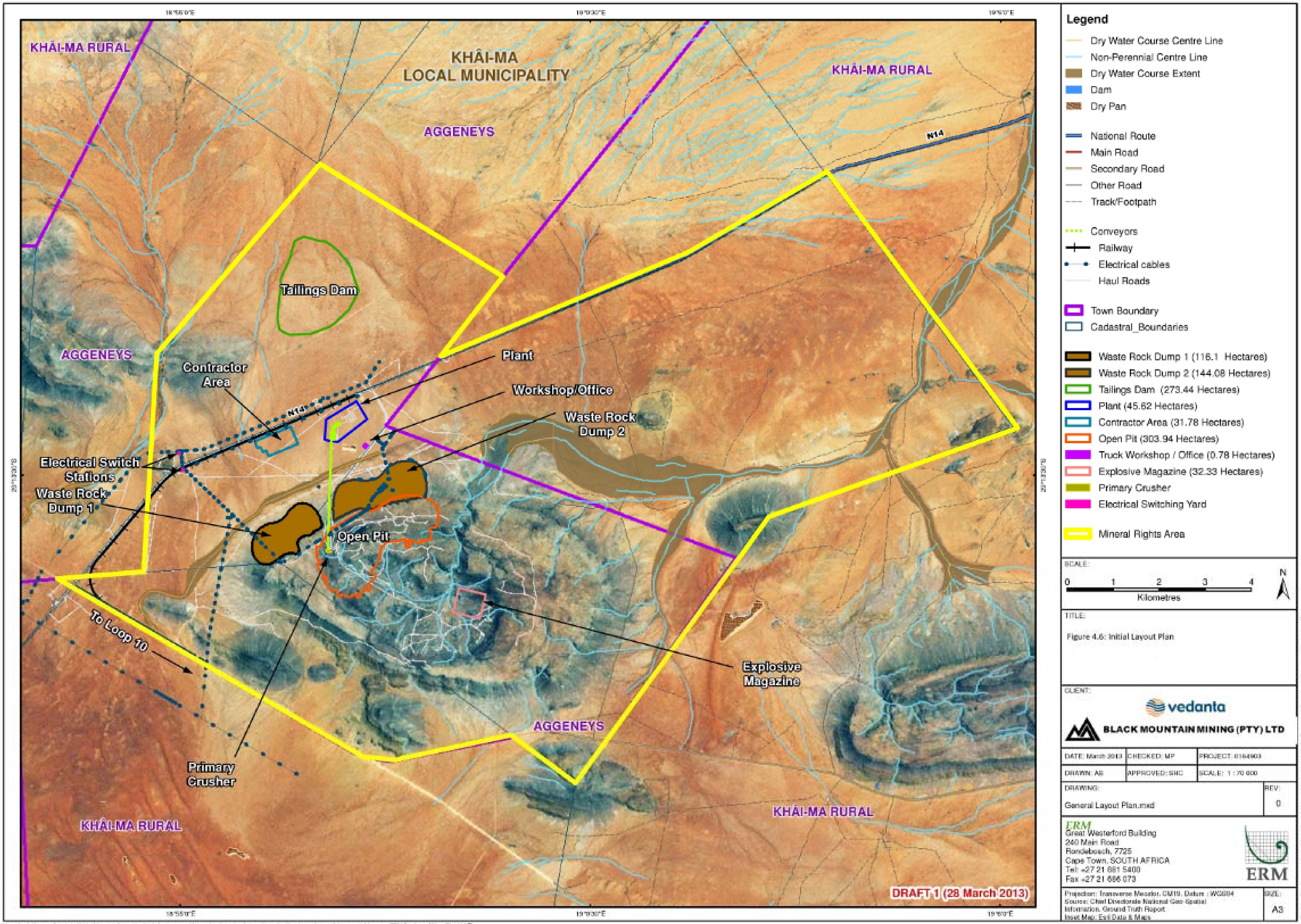


Figure 4.6: Initial Layout Plan

4.8.2 *Comparative Analysis of Alternatives from the Previous and Current ESIA Process*

Based on a review of the alternatives considered during the previous and current EIA process, the proposed location of the following infrastructure is consistent with both EIA processes:

- Open pit;
- Waste rock dump;
- Tailings dam;
- Primary crusher; and
- Access road along the northern slopes of the inselberg.

It should be noted that, based on original design, the location of the engineering workshop was similar. However, in light of the request for the construction of a new access road along the northern slopes, the location of the engineering workshop has shifted to the plains, between the plant and waste rock dump. The biodiversity sensitivities (irreplaceable habitat) have been taken into consideration, when siting the workshop. The new location of the workshop is consistent with the technical requirement of the proposed access road along the northern slope of the inselberg.

Lastly, the initial location for the plant and contractor camp for the current ESIA process was similar to the previous layout plan. However, the location of the plant and contractor camp has now been inter-changed for technical requirements. Locating the plant north of the contractor area facilitates the transportation of the ore from the crusher, via the proposed conveyor, to the Plant.

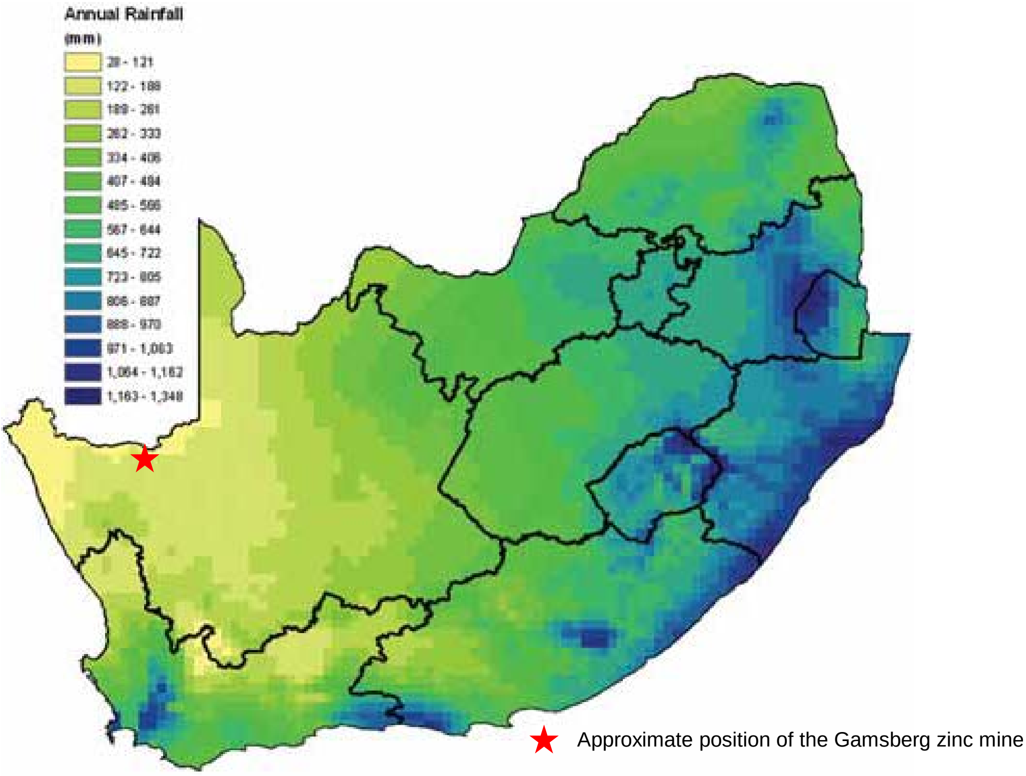
5 BIOPHYSICAL RECEIVING ENVIRONMENT

5.1 CLIMATE CONDITIONS

5.1.1 Precipitations

The proposed Project area is located in the Northern Cape Province of South Africa, a characteristically dry region (refer to *Figure 5.1* below), comprising a portion of the Kalahari Desert. The greater study region falls within both the Bushmansland and Namaqualand areas, which experience summer and winter rainfall respectively. As a result, the proposed Project area experiences both summer and winter rainfall.

Figure 5.1 Average Annual Rainfall over South Africa (1)

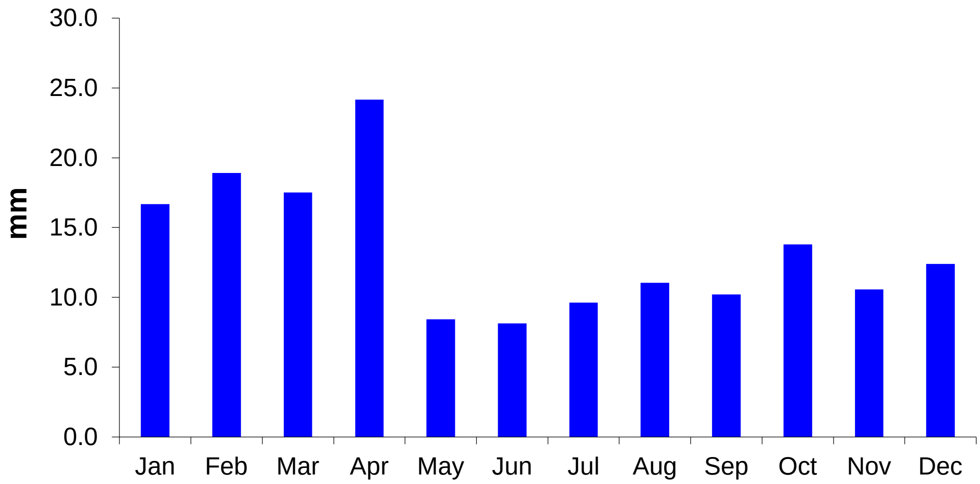


Rainfall patterns for the nearby towns of Aggeneys and Pella (the closest towns to the proposed Project area) are similar, with Springbok (and to a lesser extent Pofadder) receiving relatively higher volumes of monthly average rainfall. Aggeneys receives an average of 98 mm of rainfall per annum (2), while Pella and Pofadder receive an average of 77 and 117 mm of rainfall per annum (3), respectively.

(1) South African Risk and Vulnerability Atlas. Department of Science and Technology (based on data from 1961 -1990).
(2) Based on data from data from 2000 – 2011.
(3) Based on data from 1878 – 1980.

The Gamsberg region receives greater than 75 percent of its annual rainfall between January and June (± 68 mm), with the months of January, February and April receiving the majority of this rainfall [1]. This is illustrated in *Figure 5.2* below, whereby Aggeneys has experienced its highest mean monthly rainfall during April (approximately 24 mm), over a period from 1986 to 2012. In contrast, its lowest mean monthly rainfall has been experienced during May and June, over the same period. In general, annual precipitation in the region is highly variable (refer to *Figure 5.3* below).

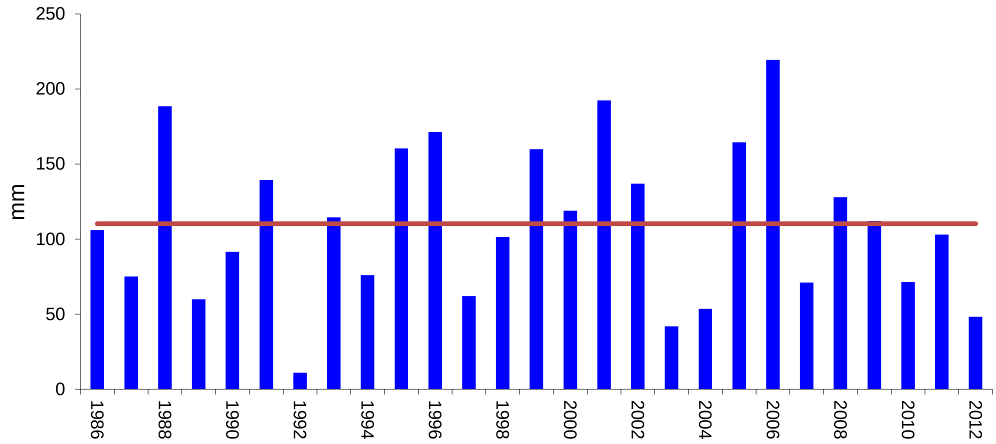
Figure 5.2 Average Monthly Precipitation in Aggeneys (1986 - 2012)



Despite relatively little annual rainfall, flooding of the Orange River (approximately 45 km north-east of the project site) occurs as a result of extreme precipitation inland (refer to *Section 5.1.6* below). In terms of other extreme precipitation events, snow has also been recorded four times (since 1920) within the greater study region, including in Springbok in 1953, 1988 and 1994 and in Upington in 1983. In addition to this, severe hail has been recorded twice since 1920, once in Augrabies in 1991, and once in Upington in 2002.

(1) Information from the Draft Scoping Report.

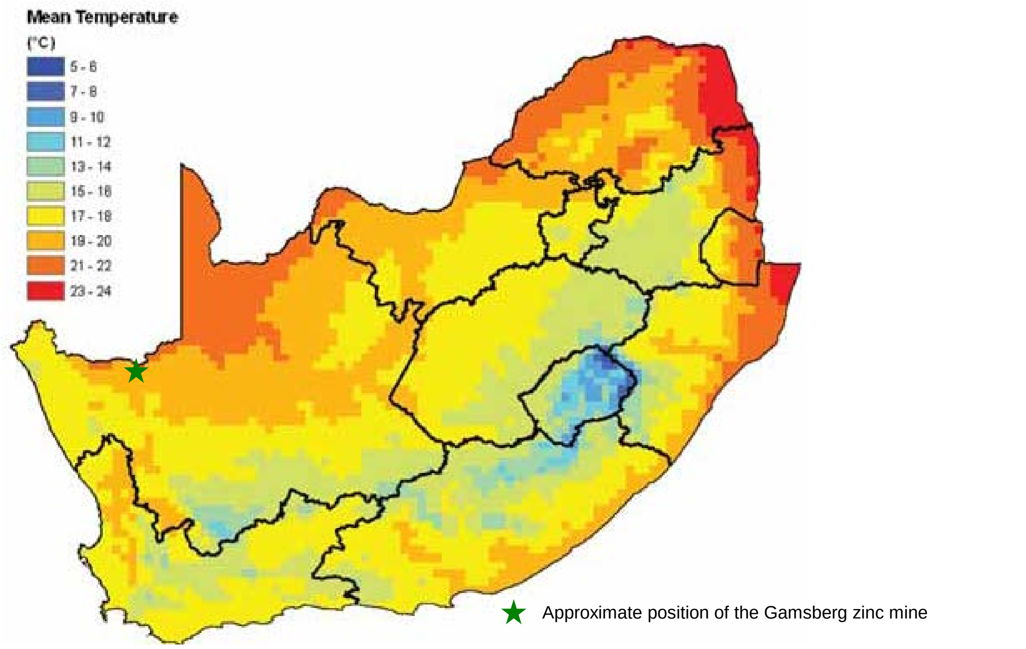
Figure 5.3 Total Annual Precipitation in Aggeneys (1986 - 2012)



5.1.2 *Maximum and Mean Monthly Temperatures*

The temperatures experienced in the Northern Cape are influenced by surrounding topographies, generally characterised with desert and semi-desert conditions. The average temperatures experienced within the broader Project area varies significantly between the summer and winter months, with the highest average temperatures being experienced during the wettest months on the year. Temperatures within the region range from an absolute minimum of -3 °C to a maximum of +40.8 °C based on historic records from 1961 - 1990 and 2000 - 2012. Correspondingly, *Figure 5.4* illustrates that the proposed Mine site is located in one of the hotter regions within South Africa.

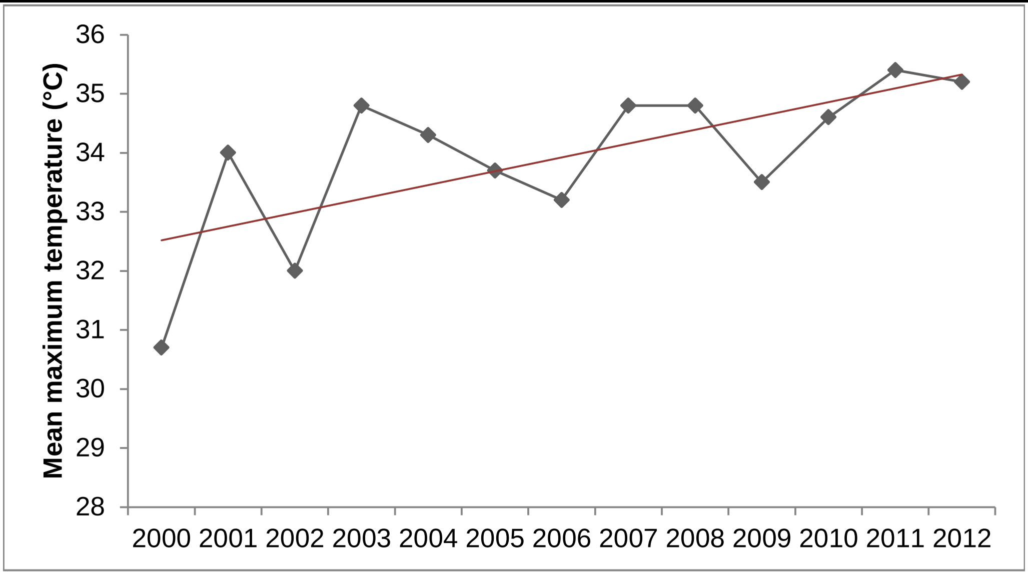
Figure 5.4 Average Annual Temperatures over South Africa[1]



Summers (November to March) are very hot with recorded mean maximum temperatures (from 1961-1990) being in the 30s (°C) (2). January is projected to be the hottest month, with mean maximum temperatures, between 2000 and 2012, ranging from 30.7 to 35.4 °C (*Figure 5.5*). In addition to this, results have shown a general trend of recorded January temperatures increasing by approximately 2.8°C over that period of time (*Figure 5.5*). During the summer months, daily maximum temperatures regularly exceed 30 °C and are greater than or equal to 35°C for approximately 11 days out of each summer month (*Figure 5.6*). Between 1961 and 1990, it was recorded that in January, on average, maximum daily temperatures are greater than or equal to 35 °C, on nine days out of the month (3). Between 2000 and 2012, average January daily maximum temperatures were greater than or equal to 35 °C during 12 days of the month (*Figure 5.6*).

1 South African Risk and Vulnerability Atlas. Department of Science and Technology (based on data from 1961 -1990).
(2) Based on data for Pofadder from 1961 – 1990 (SAWS WB42).
(3) Based on data for Pofadder from 1961 – 1990 (SAWS WB42).

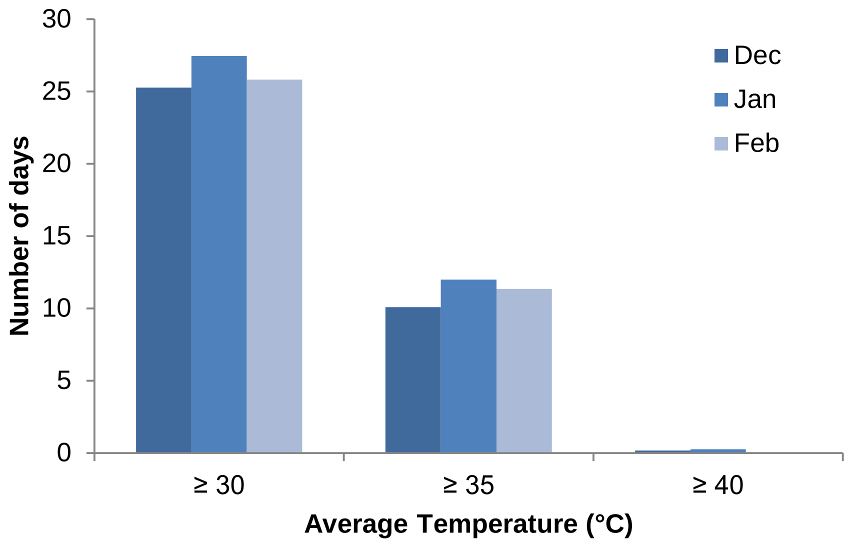
Figure 5.5 Mean Maximum Temperature in Pofadder for January Between 2000 to 2012



During winter, mean maximum temperatures range from 17.8°C to 20°C; days are cool and nights are cold. The minimum winter temperatures experienced in Pofadder and Springbok can vary from -1°C to – 13°C, with significant temperature reductions at night time. June is accepted to be the coolest month with a mean temperature of 12.1°C and a mean maximum temperature of 17.8°C.

Due to a lack of temperature data at the Gamsberg site, temperature data for the town of Pofadder, which is located 60 km east of the Gamsberg site, is used as a representative indication of temperature at Aggeneys. The region generally experiences hot and dry summers, with maximum temperatures in Pofadder ranging from 35 – 39°C during the months of November to March.

Figure 5.6 Average Number of Days Exceeding 30, 35 and 40 °C during the Summer Months (1)



(1) Pofadder, based on data from SAWS for 2000 – 2012.

Ambient air temperature plays an influential role with respect to plume buoyancy. The greater the temperature gradient is between the plume and ambient air temperature, the higher the plume will rise. In addition, ambient air temperature can be used to determine the mixing depth and inversion layer heights, which influence air quality. Updated weather records will be sourced and used for pollution and dust dispersion modelling.

5.1.3 Monthly Mean Wind Direction and Speed

The prevailing winds experienced in the region are southerly and westerly. The southerly winds are experienced mainly during night times, with the westerly wind dominating the day time conditions (SRK Consulting, 2010). The average wind speeds recorded for day and night times are 3.25 m/s and 3.10 m/s respectively.

Wind speeds within the region are typically low, with monthly average wind speeds ranging from 3.3 m/s to 4.3 m/s (11.9 – 15.5 km/h) at 14h00 based on information for Pofadder from between 2000 and 2012. The maximum gust speed recorded in Pofadder between 2008 and 2012 was 30.7 m/s (110.5 km/h) during February. Average gust speed during the year was 11.23 m/s (40.43 km/h).

Based on the seasonal variations, summer and spring seasons experience higher average wind speeds of 3.68 m/s and 3.56 m/s respectively. The winter (2.81 m/s) and autumn (2.75 m/s) seasons are generally cooler, and thus the wind speeds are slower than that experienced in the warmer months (SRK Consulting, 2010). However, prevailing winds are generally similar, with southerly winds experienced during Summer and Spring, and westerly winds experienced during Autumn and Winter.

5.1.4 Evaporation

The mean annual evaporation (MAE) for the proposed Project area is 2,650 mm and average monthly evaporation is set out in *Table 5.1* below.

Table 5.1 Average Monthly Evaporation (mm)

Month	Mean evaporation (mm)
January	355
February	290
March	259
April	184
May	129
June	98
July	101
August	137
September	189
October	253
November	304
December	351

5.1.5 *Relative Humidity*

Relative humidity in the area is highest over the winter months, during which time humidity has been known to reach a maximum of 96 percent (with June being the most humid month on average) in Pofadder (SAWS, 2012). Average humidity is also greatest in the morning with average annual humidity being 59 percent at 08h00.

5.1.6 *Flooding*

Analysis of extreme weather events in the Northern Cape between 1920 and 2011 indicates that severe flooding has been experienced in Upington, Kakamas, Augrabies and Springbok on a fairly regular basis (approximately more than 2.6 times per decade) [(1)]. Of the 50 flooding events that have occurred in the Northern Cape, since 1920, 40 percent of them have occurred in towns situated along the Orange River. Flooding is a rare occurrence in towns further away from the river; however one incident was recorded in Springbok in 1994.

Flooding of the Orange River occurs in this area when there has been significant rainfall inland and the river struggles to contain the flow within its huge catchment (approximately 1 million km^2). The most recent severe event occurred in January 2011. In this case, the river inundated the flood plain and resulted in the devastation of arable land and the evacuation of families from the Upington, Kakamas and Augrabies towns (see *Figure 5.7*, *Figure* 5.8 and *Figure* 5.9).

Figure 5.7 ***The 2011 Flooding of the Orange River Destroyed Hundreds of Hectares of Arable Land in Upington*** [(2)]

(1) SAWS CAELUM Report.
(2) Source: http://www.ofm.co.za/article/73984/Pics-of-yesterdays-Upington-Floods

Figure 5.8 The 2011 Flooding of the Orange River Caused Significant Damage to Infrastructure and Blocked Transport Routes in Upington[1]

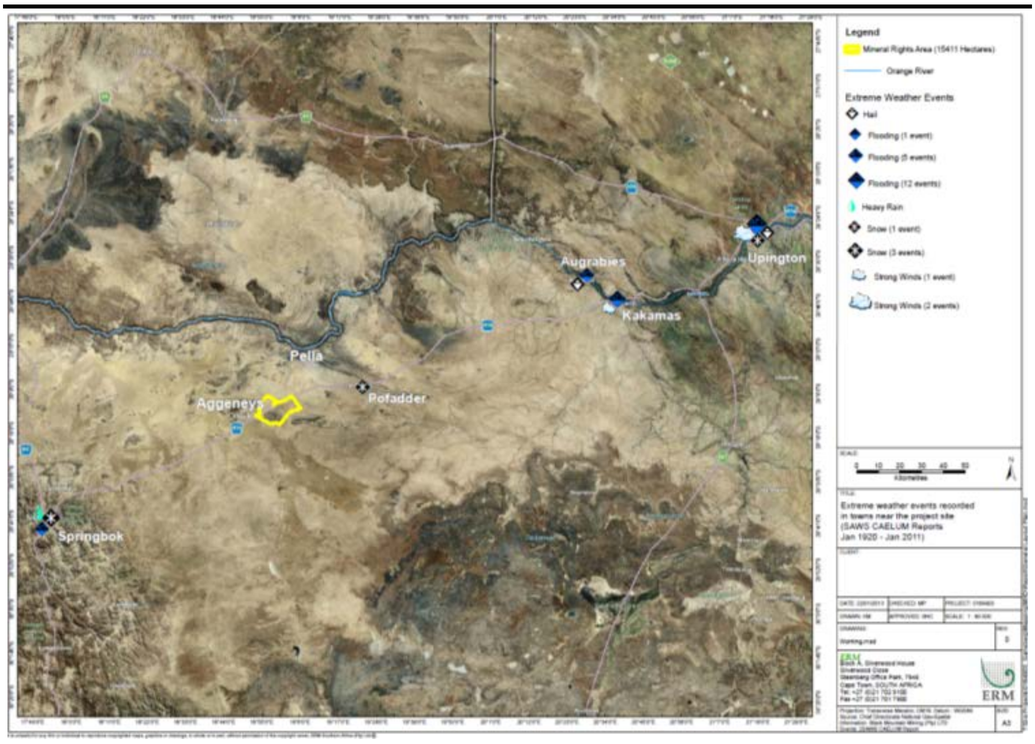
Figure 5.9 The Impact of the 2011 Flooding of the Orange River on the Augrabies Falls[1]

[1]http://playak.com/index.php?option=com_community&view=photos&task=photo&albumid=1525&userid=6877&Itemid=127#photoid=8960.

The incidences of flooding and other extreme weather events in the region are plotted in *Figure 5.10*, which shows recorded events in the Northern Cape between 1920 and 2011. These events are based on information contained in the South African Weather Services (SAWS) CAELUM report. The CAELUM report is a report developed by the SAWS capturing all of the extreme weather events that have been recorded and/or reported within South Africa since 1913. The report contains details of the event, including event type, location, date and any additional information available (eg deaths, rand value associated with the damage of the event, infrastructure damaged etc).

It should be noted that it is possible that not all extreme weather events are captured within the SAWS CAELUM Report as it depends on a SAWS representative experiencing and reporting the event. It is, however, the best available source of data on such events from SAWS. Additionally, although an extreme event, snow for example, was recorded in one town it is likely that the event was also experienced in other, smaller towns within the region in which the proposed Project is situated, but that the event was not recorded in the other towns given their size.

Figure 5.10 ***Recorded Weather Events Around the Project Site (SAWS, 2011)***



5.2 *TOPOGRAPHY*

The local topography is characterised with undulating plains, containing low growing shrubby vegetation and grasses. The surrounding plains are approximately 750 – 900 meters above mean sea level (mamsl), with the highest areas of the Gamsberg inselberg varying between 1100 – 1150 mamsl. The Gamsberg inselberg is approximately 7.2 km east – west and approximately 4.6 km north – south. Erosion along the top of the inselberg has resulted in the creation of a basin within the feature, which subsequently varies between 60 – 70 m below the rim of the inselberg.

5.3 GEOLOGY

5.3.1 *Regional Geology*

The Gamsberg zinc deposit is developed in a medium to high grade metamorphic volcano-sedimentary succession belonging to the Aggeneys Sub-Group of the Bushmanland Group. This Group is bordered to the east by the Hartbees River Thrust, to the north by the Groothoek Thrust and Wortel Belt, and it is overlain Karoo-age rocks to the south. Together these Groups occur within the Namaqualand Metamorphic Complex, which as mentioned above, consists of Precambrian metamorphic rocks and intrusives formed or metamorphosed during the Namaqua Orogeny.

The Bushmanland Group is composed of basement granitic rocks (1 700 to 2 050 Ma), supra-crustal sequences of sedimentary and volcanic origin (1 200, 1 600 and 1 900 Ma) and intrusive charnokite to granitic rocks (950, 1 030 to 1 060, and 1 200 Ma).

5.3.2 *Local Mine Geology*

*Figure 5.11*presents a stylised stratigraphic succession for the proposed Project area, with specific detail of the Gamsberg North ore body that is targeted in this Project.

The succession at Gamsberg comprises of basal quartzo-feldspathic gneiss overlain progressively upwards by siliminite-bearing pelitic schist and metaquartzites of up to 450 m thickness; the Gams Iron Formation (GIF) of 0 to 80 m thickness; and Koeris Formation rocks consisting of quartz-muscovite schist, lenses of conglomerate and amphibolite to a thickness of 400 to 500 m. *Table 5.2* presents key characteristics of the various lithologies that would report as hanging wall, ore zone or footwall material.

Note that the latest phase of structural deformation of the local basin resulted in upturning and buckling, to produce a steep-limbed anticlinal structure on the north side of the inselberg.

Figure 5.11 Stylised Stratigraphic Succession (after AA plc, June 2000)

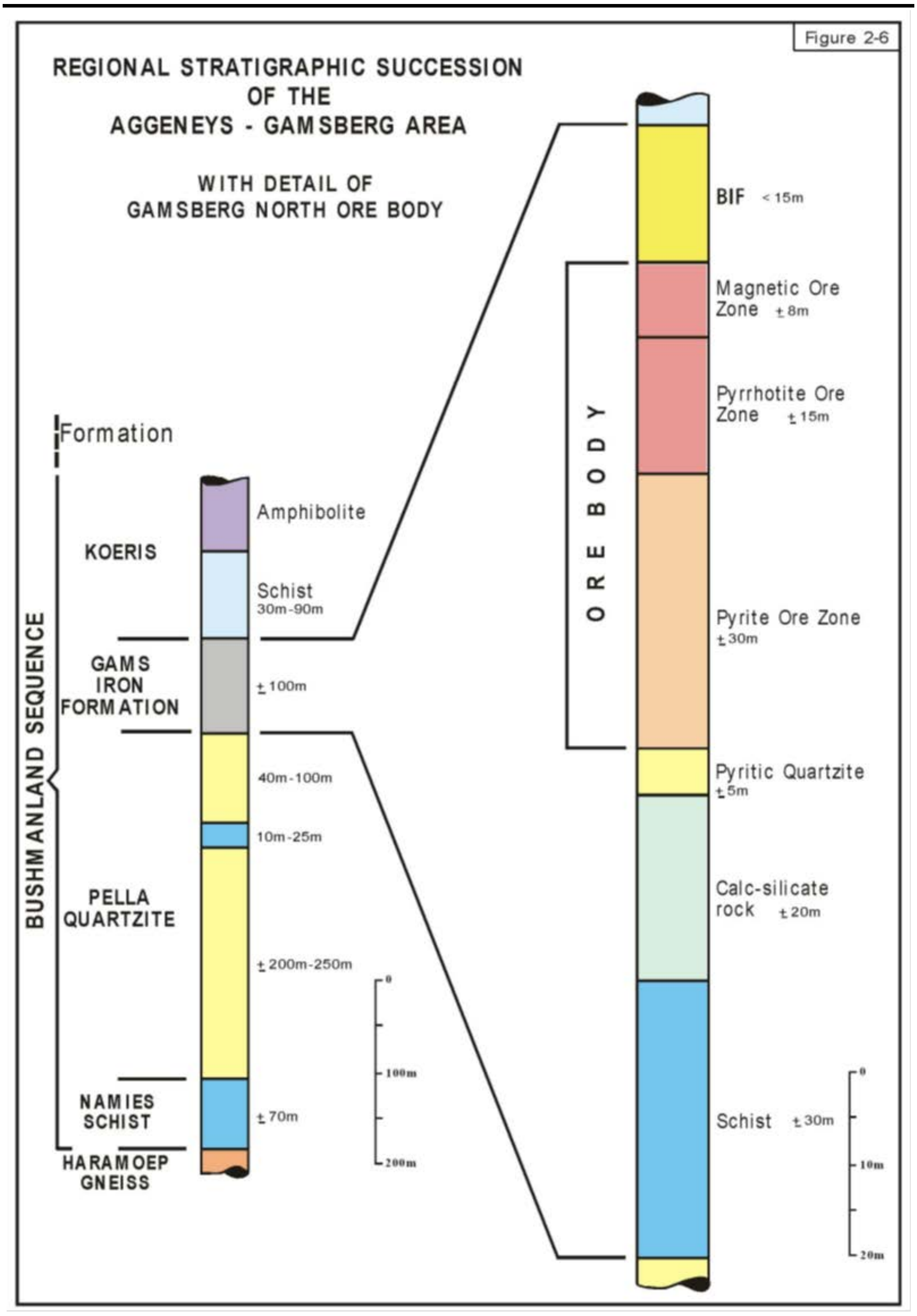


Table 5.2 Key Characteristics of Gamsberg Lithologies, which would be Disturbed by Mining Activities

Formation	**BIF Facies**	**Lithostratigraphy**	**Thickness (m)**	**Description**	**Ore / waste**
Nousees Mafic Gneiss/Koeris	-	Amphibolite	> 500	Amphibolite. Quartz veins in fractures.	Hanging wall waste
		Quartz-Muscovite Schist (plus conglomerate lenses)		Quartz-muscovite schist with interbedded micaceous quartzite and conglomerate (quartzite pebbles in quartz-muscovite matrix).	
Gams Iron Formation (GIF)	Oxide BIF	BIF (C Members)	< 15	Similar silicate mineralogy to B Member, but magnetite and hematite present instead of sulphides. Often absent.	
		Magnetite ore (B)	± 8	Oxide iron formation containing quartz, orthopyroxene, clinopyroxene, grunerite, garnet, pyroxenoid and apatite.	Ore
	Sulphide BIF	Pyrrhotite ore (B2)	± 15	Quartz, sillimanite, muscovite metapelite	
		Pyrite ore (B1)	± 30	Quartz, sillimanite, muscovite, graphite metapelite	
		Pyritic quartzite (A4)	± 5	Not economically mineralised. Upper pyritic quartzite and lower magnetite quartzite layers separated by marble / calc-silicate.	Footwall waste
	-	Calc-silicate rock (A3 & A2)	± 20		
		Quartz, biotite, muscovite, silimanite schist (A1)	30 - 90		
Wortel/Pella Quartzite		Dark quartzite		Dark coloration is due to disseminated magnetite and hematite concentrated along quartz grain boundaries.	
		Schist		Thin irregular marker horizon. Interbedded with dark layers of micaceous quartzite.	
		White quartzite	> 200	Exposed as near-vertical exterior cliffs & flat tops of inselberg.	

5.3.3 *Geochemical Context of the Gamsberg Deposit*

The Gamsberg stratigraphic sequence is believed to have been deposited as an accumulation of fine-grained siliceous and aluminous clastic sediments within a relatively large shallow basin. The connate water in the shallow basin showed a diverse range in pH, redox state and solution chemistry, which Rozendaal (1982) linked to the vertical and horizontal distribution of oxide, sulphide, sulphate and carbonate facies within the sequence. Anaerobic conditions were associated with the formation of metal sulphides, whereas oxidising conditions resulted in the conversion of sulphide to sulphate and the formation of metal oxides such as hematite (Fe_2O_3) and barite ($BaSO_4$).

Opencast mining of the Gamsberg deposit would disturb rocks from the Pella Quartzite, Gams Iron and Koeris Formations. Exposure of these rocks to oxygen and water could lead to oxidation of elements that currently occur in a reduced state. The oxidation of sulphide minerals on exposure could generate metal oxides, sulphate and acidity (H^+). Where base or alkali minerals are present they may neutralise this acidity. If there is sufficient net acidity to lower the pH of water in contact with the rock/mine waste material then metal leaching may occur, because metals are generally more soluble at low pH. The resultant acid rock drainage (ARD) could pose a threat to surface and groundwater resources in the area.

Sulphide minerals are prevalent within rocks of the GIF, particularly within the B2 (pyrrhotite ore), B1 (pyrite ore) and A4 (pyritic quartzite) ore zones. By contrast, sulphides are generally absent from rocks of the Koeris and Pella Quartzite Formations. This suggests that weathering reactions would be predominantly kinetically driven for GIF lithologies, and equilibrium driven for Koeris and Pella Quartzite Formations. In kinetically driven systems the concentrations of chemical elements in surrounding water bodies are more dependent on the degree of contact between the mineral and the water body, and show greater variation over time, than within equilibrium driven systems.

5.4 *SOIL POTENTIAL*

5.4.1 *Soil Forms*

The Project area is characterised by an extensive peneplain. The soils present in the peneplain are predominantly shallow and stony. However, soils found within the inselberg are characterised with bouldery and stony scree slope soils (SRK Consulting, 2010). The scarps and crest of the inselberg are characterised with bare rocks, while the Gamsberg Basin itself is characterised with shallow gravelly soils.

The soils present on the peneplain are generally characterised with reddish sandy topsoil that is shallow in nature. However, a 10cm thick red sandy surface layer is present along the northern section of the proposed site. The western and southern part of the proposed site is characterised with deeper red soils, varying in depth from 30 cm to 60 cm. Along the south western portion of the proposed site, deeper red soils occur.

It should be noted that the Gamsberg inselberg has been managed as a grazing-free site. In doing, the level of land degradation is limited for this inselbergs in contrast to the surrounding farm lands, which have experienced varying degrees of degradation as a result of overgrazing.

The Project area (which comprises of 4 properties) are already zoned for mining, with the exception of Gams 60, Portion 4 which is zoned for farming. However, it must be noted that Black Mountain Mining has an existing surface right to mine Gams 60, Portion 4 and therefore no grazing is currently undertaken on this property.

5.4.2 *Agricultural Potential*

The dry climate is unsuitable for crop production, and livestock farming is the dominant form of landuse in the region. The Project area has an existing mining right, and thus the grazing potential of the site has not been investigated. Furthermore, grazing activities have been prevented on the Gamsberg inselberg, which has indirectly contributed to the conservation of the existing biodiversity on-site.

5.5 *SURFACE WATER*

5.5.1 *Catchment Area Characteristics*

Situated in the Orange River basin, the mine is located at the watershed between two quaternary catchments, being D81G and D82C. The latter is an endoreic catchment, meaning that it is an interior drainage basin that does not drain to the sea. The Gamsberg inselberg is situated within quaternary catchment D81G, which drains in a northerly direction towards the Orange River some 35km away. A third quaternary catchment, D82A was identified in the 2010 baseline report, but being remote from any anticipated mine infrastructure, is not further considered in this report.

The baseline surface water assessment identified 11 sub-catchments totalling roughly 750 km^2. Of these, only two are of particular interest to this study, being affected by proposed mine infrastructure. These are sub-catchments 4 and 9a. *Table 5.3* compares the baseline catchment nomenclature with that adopted for this report. Other baseline sub-catchments that are unaffected by proposed mining infrastructure are not further considered in this report.

For the baseline assessment, no ineffective areas were identified. Runoff was therefore deemed to be generated by the entire sub-catchment, and calculated accordingly. The full development scenario, however, introduced ineffective areas that had a significant impact on peak flows and volumes. Figure 5.13 below illustrates the on-site watercourses, baseline sub-catchments and associated 1:100 year floodlines.

Table 5.3 Catchment Naming Convention

Baseline Hydrology			**Impact Assessment**	
Sub-Catchment No	**Area (km²)**	**Quaternary Catchment**	**Sub-Catchment Name**	**Area (km²)**
1	108.2	D82C		
2	65.9	D82C		
3	52.8	D82C		
4	31.1	D82C	North	38.7
5	0.97	D81G		
6	53.7	D81G		
7	272.7	D81G		
8	21.6	D81G		
9a	13.4	D81G	South	13.1
9b	1.03	D81G		
10	125.7	D82A		
Total	**747.1**			**53.5**

Being situated at the watershed between two quaternary catchments, surface water runoff emanating from the mine leasing area affects downstream catchments. In particular, the likely reduction in Mean Annual Runoff (MAR) is an important consideration in determining the mine's impact on local surface water resources.

The northern section of the Project area drains into the Orange River Basin, whereas the southern section drains into a catchment referred to as an endoreic area, (i.e. an interior catchment that doesn't feed out into the ocean) (SRK Consulting, 2010). The Orange River basin is the largest river basin in South Africa with a total catchment area of approximately 1 000 000 km^2 (www.dwa.gov.za, 2012). Approximately 60 percent of the catchment area is located within the Republic of South Africa (refer to *Figure 5.12* below) with the remainder spread across Lesotho, Botswana and Namibia.

The Orange River, (called the Senqu River in Lesotho), originates high in the Lesotho Highlands, approximately 3 300 m above sea level, where the average annual rainfall exceeds 1 800 mm (www.dwa.gov.za, 2012). The river is approximately 2 300 km long (i.e. from the source in Lesotho to the estuary in Alexander Bay).

According to various sources the average natural mean annual run-off (MAR) from the total basin is more than 12 000 million m^3/a, however, this volume is representative of the natural MAR, and therefore excludes current development activities and storage facilities on the system (www.dwa.gov.za, 2012). The current MAR of the Orange River, at the proposed point of abstraction will be presented in the ESIA Report.

There are three main storage reservoirs within the Orange River basin, namely Gariep Dam, Vanderkloof Dam (located within South Africa) and the recently completed Katse Dam in Lesotho on the Senqu River (www.dwa.gov.za, 2012). The Gariep Dam has a total capacity in excess of 5 000 million m³ while Vanderkloof Dam has a storage capacity of over 3 200 million m³. The storage capacity of the Katse dam is 1 950 million m³.

Figure 5.12 Orange River Catchment (Sourced from www.dwa.gov.za website, 2012)

The Project will require a total of 9,125 million m³/annum of water to fulfil the operational requirements for all Project components.

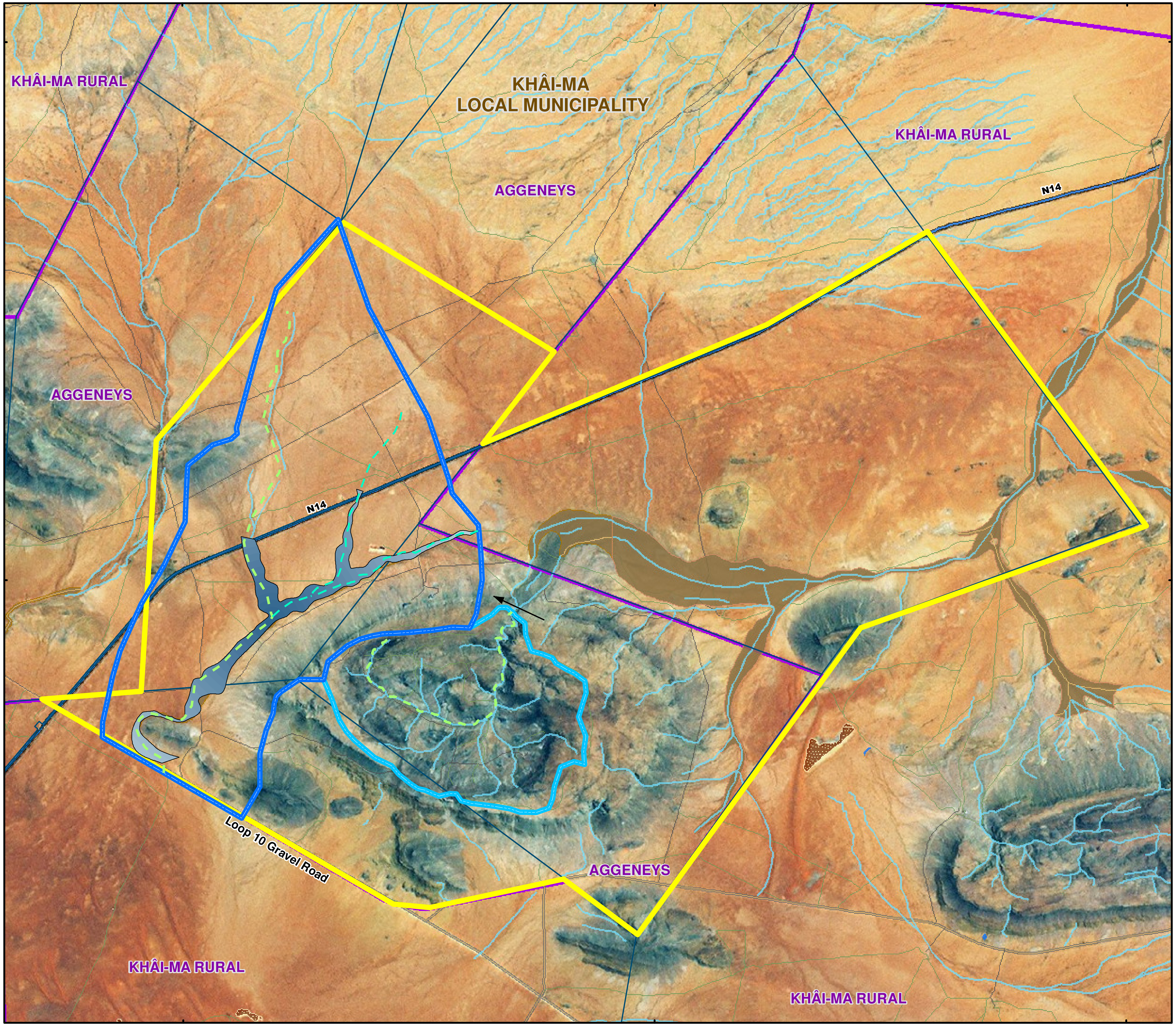
The construction phase is expected to last 30 months. It is the intention of BMM to source the water requirements for the Project from the Orange River during construction and operation. Based on the water requirements for the Project, the suggested volume of water for the operational phase (i.e. 9,125 million m³/ annum) is approximately 0.083% of the natural MAR of the Orange River system.

Due to its length, the Orange River is divided into the upper and lower Orange water management areas. The proposed site falls within the lower Orange Water Management Area, which is further divided into 4 sub-areas. The length of river extending from Pella to Alexandra Bay is part of the fourth sub-area (DWA, 2009). However, there are a number of users identified from downstream of the Pella abstraction point. Approximately 166 km downstream of Pella, the Orange River crosses the Vioolsdrift Weir, where water is pumped to the town of Springbok. Slightly downstream of the Vioolsdrift Weir is a small farming town of Vioolsdrift located along the southern side of the Orange River. Downstream of the town of Vioolsdrift, the Orange River enters the Richtersveld area, which is comprised of many local Nama communities. Due to the migration patterns of the Nama communities, approximately 160 000 hectares of the Richtersveld has been declared a UNESCO World Heritage Site (DWA, 2009). Approximately 145 km downstream of Vioolsdrift, the Fish River (a major tributary) links into the Orange River. Approximately 150km downstream of the Fish River confluence, the Orange River feeds into the Atlantic Ocean, at Alexandra Bay.

5.5.2 *Site Specific Water Resources*

The Project area falls within three quaternary catchment areas, namely, D82C, D82A and D81G. During the hydrology and surface water analysis undertaken by SRK Consulting (2010), the Project area and associated infrastructure is expected to impact on 10 local water catchment areas in the three quaternary catchments.

Based on the previous investigations, the area for each catchment ranges from 0.97 km^2 to 272 km^2. The MAR for each of these catchments were based on area weighting WR2005 data (SRK Consulting, 2010). The area weighted MAR for each of these catchment areas varied from 300 m^3 to 84 000 m^3. However, due to the limited rainfall experienced in the region, most of the water courses identified are ephemeral in nature. Notwithstanding, the small catchment area identified on top of the inselberg does contain a spring, and therefore can experience seasonal to perennial flows. A map reflecting the main watercourses within the mining license, together with associated 1:100 year floodlines are is presented below:



Legend

- Non-Perennial River
- Dry Water Course Centre Line
- Dry Water Course Floodplain
- Dam
- Dry Pan
- National Route (N14)
- Main Road
- Secondary Road
- Other Road
- Track/Footpath
- Town Boundary
- Main Watercourses
- Minor Watercourse
- Northern Sub Catchment
- Southern Sub Catchment
- 1: 100 Year Floodline
- Mineral Rights Area

SCALE:

0 1 2 3 4

Kilometres

N

TITLE:

Figure 5.13:
Location of on-site watercourses and associated 1:100 year floodlines

CLIENT:

vedanta

BLACK MOUNTAIN MINING (PTY) LTD

DATE: Apr 2013	CHECKED: MP	PROJECT: 0164903
DRAWN: AB	APPROVED: SHC	SCALE: 1 : 70 000

DRAWING:	REV:
Location Watercourses Floodlines.mxd	0

ERM
Great Westerford Building
240 Main Road
Rondebosch, 7725
Cape Town, SOUTH AFRICA
Tel: +27 21 681 5400
Fax +27 21 686 073

ERM

Projection: Transverse Mecator, CM19. Datum : WGS84 Source: Chief Directorate National Geo-Spatial Information. HHO Africa. Inset Map: Esri Data & Maps	SIZE: A3

T:\Gis Projects\0164903_Gamsberg\Mapping\MXD\Report\April2013\Location Watercourses Floodlines.mxd

5.5.3 *Water Quality Management and Sources of Contamination*

During the hydrological baseline investigations undertaken by SRK Consulting in 2010, water monitoring stations were set up to determine flow volumes as well as obtain water quality data. However, due to the lack of rainfall during the monitoring period from May – August 2009, data was only collected from three of the ten monitoring stations (in and around the inselberg). Thus the information contained is a reflection of the dry season data for water quality.

The results from the water quality monitoring were compared to the South African National Standards for drinking water (SANS 241 of 2006). This initial analysis confirmed that water from the springs on the Gamsberg inselberg is suitable for domestic use and livestock watering (SRK Consulting, 2010). The concentration levels of Barium found in the water did comply with SANS 241 over the monitoring period. However Barium concentrations did exceed the World Health Organisations standard for drinking water. It must be noted that the nitrate concentrations recorded during the months of July and August were approximately 10 times higher than those during May and June. Although the nitrate levels remain within SANS 241 standards for drinking water, the nitrate concentrations are likely to be linked to fertilizers, sanitation problems and livestock.

5.6 *GROUNDWATER*

5.6.1 *Description of Hydrogeology*

As part of the baseline study, a hydro-census analysis was undertaken by SRK Consulting in 2010 of the Gamsberg region to obtain information related to groundwater. Approximately 41 water sources (including boreholes, wells and springs) were identified, however, only 27 of those were operational with the required equipment.

The baseline study confirmed that no regional aquifers have developed in the Namaqualand Metamorphic Complex. Furthermore, due to thinly developed soils, primary weathered zone aquifers are infrequent and localised.

Groundwater is mainly found within secondary fractured-rock aquifers and tends to be found along fractures within hydraulically isolated rocks of low permeability, which are commonly found in the surrounding areas. According to the baseline report, the transmissivity of the fractured aquifers is considered to be low (SRK Consulting, 2010).

The geology in the Gamsberg area is mainly comprised of dense metamorphic rocks which are characterised with low permeability, and as such, the movement of groundwater in the area is largely influenced by secondary structural features. Features such as shears, thrust faults and fractures will impact on the movement of groundwater. Interconnected features would facilitate a greater movement of groundwater across the region, while unconnected features will limit groundwater flows to the individual faults or fractures. The structural features identified are largely oriented in a north to northwest direction of the proposed Gamsberg site, with a few features present to the east to west and southeast directions.

5.6.2 *Current Groundwater Use*

Groundwater resources in the Namakwa District are more abundant than surface water features. Groundwater serves as a key water source, especially for livestock farmers in the Project area.

Based on estimated projections, a total of ~75 000 m^3/a of groundwater is abstracted, primarily for livestock watering and domestic use. This was calculated based on the hydro-census analysis undertaken in 2010 by SRK Consulting for the various boreholes, wells and springs. The boreholes present in the region are expected to yield between 0.1 and 0.5 ℓ/s, which are likely to experience seasonal variations based on rainfall patterns.

A breakdown of current groundwater abstraction in the surrounding region is presented below.

Table 5.4 Summary of Groundwater Abstraction in the Area (SRK Consulting, 2010)

Groundwater Use	Abstraction (m3/a)	No. of water sources
Domestic	2 700	2
Domestic/Livestock	28 129	6
Drilling Water	19 450	2
Livestock	15 500	13
Monitoring	9461	4
Unused	0	14
Total	**75 240**	**41**

5.6.3 *Groundwater Quality*

Groundwater sampling and analysis was undertaken in 2010 by SRK Consulting. The Electrical Conductivity (EC) and pH levels were measures at locations within and around the Gamsberg inselberg. The EC levels in the water sampled in the Gamsberg inselberg appears to be lower than those sampled from sites adjacent to and surrounding the inselberg. This implies that the Gamsberg inselberg has a higher recharge rate. The pH values of the water sampled varied between 6.15 and 8.45, with a mean of 7.45.

Fluoride concentrations in groundwater samples ranged between 0.2 and 4.2 mg/ℓ, with a mean value of 2.07 mg/ℓ. Majority of the samples tested exceeded the Class two water quality parameters, and is thus considered not suitable for drinking purposes in terms of SANS 241 of 2006. The elevated Fluoride concentrations were limited to samples taken from sources surrounding the Gamsberg inselberg, and could potentially be attributed to evaporation rates, mineralogy of the rock or holding time of groundwater.

Nitrate concentrations found in the groundwater varied from below 0.3 mg/ℓ (below detection limit) to 43 mg/ℓ (sample found at a dug up well) (SRK

Consulting, 2010). The higher levels of nitrate concentration identified exceed the limits outlined in SANS 241 of 2006, and is thus considered unsuitable for drinking purposes.

5.6.4 *Groundwater Levels and Flow Directions*

The mean annual effective recharge from mean annual precipitation in the study area is projected to be approximately 319 000 m^3/a, which equates to an average recharge rate of 0.85 % of mean annual precipitation. However, evaporation rates in the Namakwa region are considered to be high as ~3 500 mm/annum and therefore the area suffers a permanent water deficit (SRK Consulting, 2010). This deficit is highest (in excess of 400 mm) from November to January. The area is categorized as hyper-arid, where potential evapotranspiration is almost 20 times greater than rainfall experienced, thus resulting in slight surface flow but high drought vulnerability.

The depth of groundwater ranges from 0 meters below ground level (mbgl) within the Gamsberg inselberg to approximately 51 mbgl in the surrounding plains.

Based on modelled groundwater contours, subsurface flows are limited to the south west and north east of the Gamsberg inselberg. The groundwater flows are consistent with the general surface topography in the area, which are indicative of an unconfined aquifer condition.

Based on the mean annual effective recharge from mean annual precipitation relative to evaporation rates experienced in the region, groundwater is not seen as a viable source in the affected quaternaries due to an existing deficit in these catchments.

5.7 *GEOCHEMISTRY*

Key findings of a geochemical study of Gamsberg mine waste materials conducted by Wates, Meiring and Barnard (WMB, 2000) and SRK (2009) are presented below.

5.7.1 *Waste rock*

Wates, Meiring and Barnard (WMB) (2000) generated a composite sample to represent overburden material that would report to the waste rock dump. The proportion of each rock type in the composite sample was based on its average ratio in 10 cross-sections across the proposed pit area. The composition was as follows: Micaceous schist (21.4%), Amphibole (25.42%); White quartzite (33.8%), Dark quartzite (4.3%); and a 1:1 mix of GIF A and C Member rocks (8%).

ABA test results indicated the waste rock sample would be net acid-generating due to the sulphide content of the included C Member rocks. By contrast, kinetic test results indicated a neutral (pH 6) leach with low SO_4 (5 to 15 mg/l) and metal content, due to the rate of neutralisation exceeding that of oxidation. WMB characterised the sample as being essentially non-acid-generating, but warned that this could be sensitive to the relative proportion of C Member rocks included in the waste rock dump.

5.7.2 Tailings

WMB Study

WMB indicated that the mineralogical composition of the pilot plant tailings sample that they assessed in 2000 could be expected to reflect that of the hanging wall and footwall gangue material associated with the Gamsberg ore. The tailings were therefore expected to contain quartz, pyroxenoid, amphibole, garnet, magnetite, hematite and clinopyroxene.

XRF results presented by WMB in 2000 (summarised in *Table 5.5*) indicated that the Gamsberg pilot plant tailings sample they received was dominated by Si, Fe, Al and S. With regard to trace elements, the sample was enriched in As, Co, Cu, Ni, Pb and V with minor amounts of Cr, Rb and Zr.

Table 5.5 Composition of Pilot Tailings Samples as Reported by WMB (2000)

Parameter	WMB (2000) Tailings
Major elements by XRF	
SiO_2 (%)	41.28
TiO_2 (%)	0.41
Al_2O_3 (%)	6.00
Fe_2O_3 (%)	30.33
MnO (%)	1.53
MgO (%)	1.21
CaO (%)	0.94
Na_2O (%)	0.60
K_2O (%)	1.28
P_2O_5 (%)	0.39
Cr_2O_3 (%)	0.02
NiO (%)	0.01
H_2O loss (%)	0.67
LOI (%)	13.02
S (ppm)	23.6
Cl^- (ppm)	1565
F (ppm)	< 50
Selected trace elements by XRF	
As (ppm)	518
Co (ppm)	191
Cu (ppm)	191
Ni (ppm)	92
Pb (ppm)	1 537
V (ppm)	79
Cr (ppm)	87
Rb (ppm)	86
Zr (ppm)	140

ABA testing of the tailings samples provided to WMB indicated a high potential for ARD generation as a result of both a high acid potential (AP up to 318 kg CaCO3/t) and a low neutralisation potential (NP < 1.5 kg CaCO3/t).

The tailings were expected to initially generate leachate of neutral pH and relatively low concentrations of SO_4 and metals. However, if the tailings were to be left exposed to air for a month or more on deposition, then WMB anticipated that they would generate enough acidity to consume all neutralising potential and result in an acidic, metal-laden leachate. The latter kinetic test programme generated leachates of 1 000 mg/l SO_4, pH 2.8 and metal concentrations of up to 180 mg/l.

WMB calculated the time to exhaustion of NP at 3 to 5 years compared to exhaustion of AP in approximately 1 200 years. They noted that this represented a conservative (worst case) estimate in that it assumed sufficient availability of oxygen to allow oxidation of all available pyrite/pyrrhotite, as well as assuming that all AP and NP occurred in an available form.

SRK Study

In 2010, SRK Consulting undertook a desktop geochemical analysis of tailings samples in order to characterise the potential to generate acidic, saline and/or metal rich leachates. The following tests and analyses were undertaken for the solid fraction:

- Static acid based accounting test;
- Net Acid Generating (NAG) test; and
- Total Digest.

Based on the liquid fractions obtained, the following analyses were undertaken:

- pH;
- EC;
- Alkalinity;
- major cations and anions; and
- metal/metalloid concentrations.

Based on the results of the total metal concentration, the sample is characterised by iron and aluminium with relatively high concentrations of calcium, lead, magnesium, manganese and potassium. Furthermore, the tailings contained arsenic, cadmium, cobalt, copper, lead, manganese, nickel, titanium, chrome and zinc. The composition of the SRK tailings sample therefore displayed compositional similarity to the WMB 2000 tailings sample.

The static tests conducted by SRK on a zinc rougher tailings sample they received in 2010 showed a high propensity for the tailings to generate acidity, due to its high sulphide content (32% sulphide-S) and limited neutralisation potential. The duration of kinetic testing at the time that SRK drafted the preliminary Memo was insufficient to draw full conclusions. SRK anticipated that subsequent leachates from the humidity cells would be of low pH, high SO_4 and high metal content. The risk and the impact of the tailings would therefore have to be calculated and determined by undertaking longer term kinetic testing (to determine acid and neutralisation potential) and relating the findings to the hydrogeological model.

5.8 FLORA

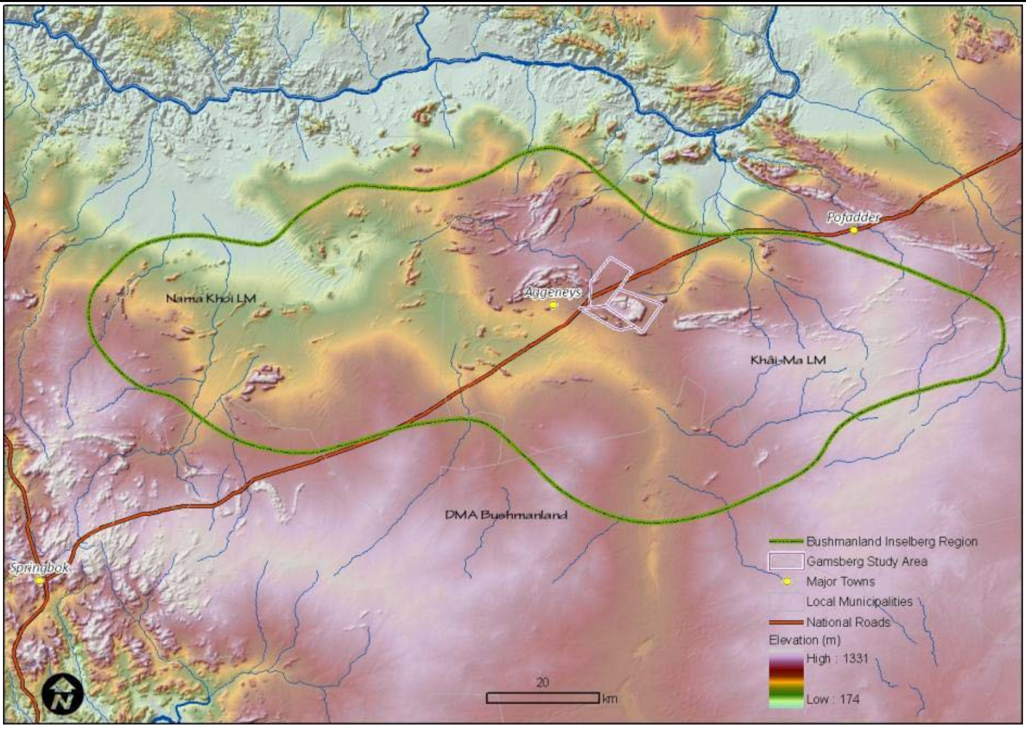
5.8.1 The Gamsberg Inselberg in a Regional Context

The Gamsberg inselberg sits within what is termed the Bushmanland Inselberg Region (BIR), which includes all the large, quartzite-capped inselbergs located in the northern Bushmanland plains in South Africa. The BIR is said to cover a total area of about 6 300 km^2 (Desmet, 2010). The BIR extends through the boundary between summer and winter rainfall systems in Southern Africa. Based on this location, the vegetation found on the plains and along the warmer north-facing slopes is characteristic of the Nama Karoo Biome whereas that of cooler higher-elevation plains and south-facing slopes is characteristic of the Succulent Karoo Biome. The overlap of these biomes makes these inselbergs a unique feature, thus forming the fundamental difference of these inselbergs as compared to other inselbergs found elsewhere in the Nama Karoo. Due to erratic rainfall experienced during different seasons, summer and winter rainfall flora can co-exist in this region, and thus contributing to its unique value.

The vegetation found on these inselbergs forms a distinct centre of plant endemism located within the larger Eastern Gariep Centre of Endemism (Desmet, 2010), which includes the Orange River valley between Vioolsdrif and Pofadder/Onseepkans. As there are a number of species identified that is considered to be endemic to the Bushmanland inselbergs and the BIR itself, the region has been termed "Bushmanland Inselberg Centre of Endemism". The extent of the BIR is reflected below.

A regional investigation undertaken by Dr Phillip Desmet (2000), confirmed that the Gamsberg inselberg is considered to be the most regionally important inselberg in the BIR in terms of its biodiversity and composition. This was based on multiple criteria with which to compare and rank sites with other inselbergs. The Gamsberg inselberg has the highest number of plant species of other inselbergs surveyed, which are representative of the entire regional flora. The plant diversity is unique at a local, regional and global perspective, especially in light of the diversity of species, habitats, presence of rare species and size of specific plant populations.

Figure 5.14 The Extent of the BIR

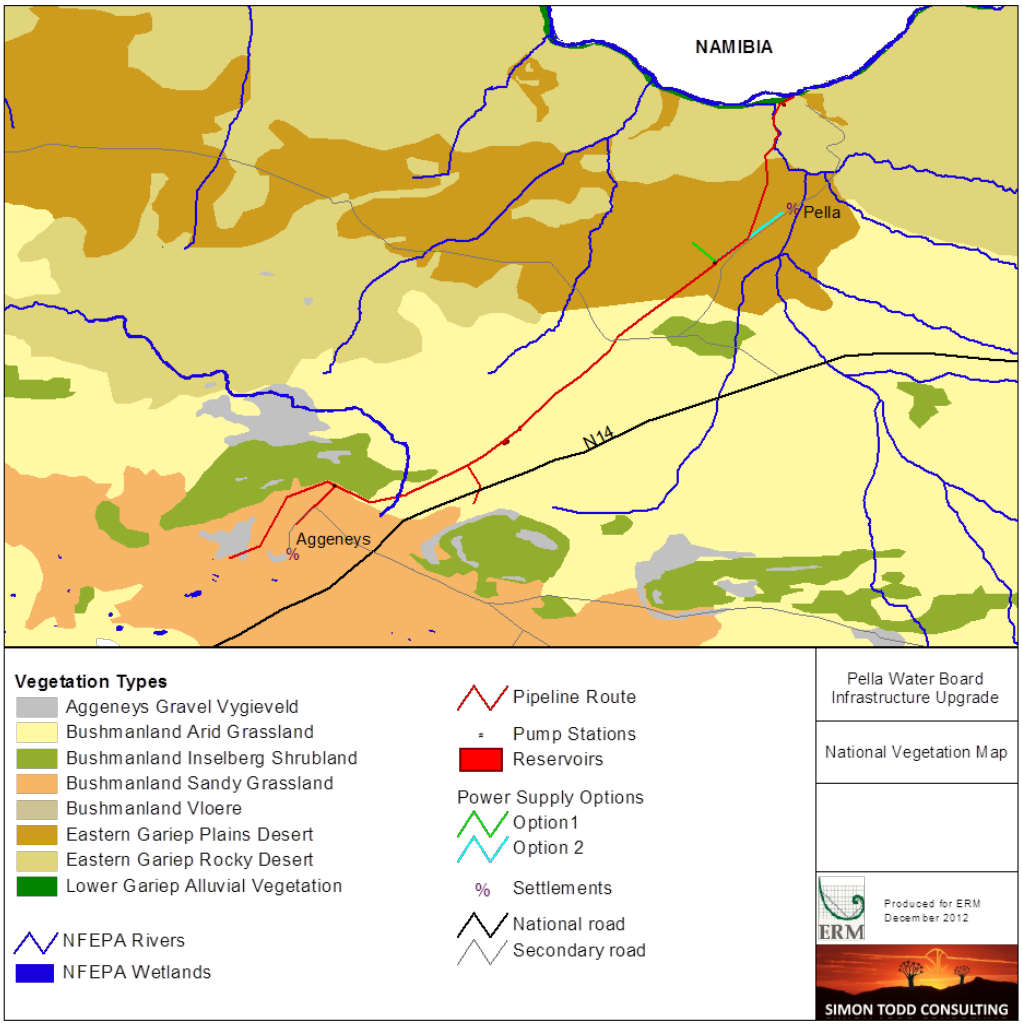


(Sourced Desmet, 2010)

5.8.2 *Regional Botanical Analysis*

The national vegetation map (Mucina & Rutherford 2006) for the Study Area is depicted below in *Figure 5.17*. The area is remarkably heterogeneous for an arid area, with eight different vegetation types present within the broader Study Area. The vegetation diversity reflects the topographic and edaphic diversity of the area, with the Orange River valley with flanking mountain ranges, the open plains of the Bushmanland Plateau and the inselbergs breaking the monotony of the plains. Added to this is a diversity of substrates which include sandy plains, gravel, quartz and calcrete plains, rocky slopes and outcrops and drainage lines. In addition to this, the majority of vegetation types have not been heavily impacted by transformation and are still more than 95% intact (refer to *Table 5.8* below). According to the National List of Threatened Ecosystems, only Lower Gariep Alluvial Vegetation is listed as Endangered on account of the large amount of transformation this unit has experienced owing to intensive agriculture in the area.

Figure 5.15 The National Vegetation Map (Mucina & Rutherford 2006) for the Area Around the Proposed Pella Water Board Pipeline and Associated Infrastructure



5.8.3 *Site Specific Botanical Analysis*

Based on the previous investigations undertaken, together with the baseline study undertaken by Dr Phillip Desmet (2010), a total of 397 plant species were identified and recorded in the study area. These species are found within six vegetation types, comprising four established vegetation types described in Mucina and Rutherford (2006), a fifth vegetation unit, Bushmanland Inselberg Succulent Shrubland described for this report and an azonal unit for specific topographical features of importance within the site (*Table 5.6*).

Table 5.6 Overview of Vegetation Types and Habitat Units within the Study Area

Vegetation Types and Habitat Units	Area (ha)	% of Region (a)	Regional Extent (ha)
Aggeneys Gravel Vygieveld			
Mountains Plateau	583.7	32.6	1,790
Plains Gravel quartz	600.4	7.7	7,800
Plains Gravel quartz intermediate	163.3	12.2	1,340
Plains Gravel quartz plateau	208.8	41.2	507
Bushmanland Inselberg Shrubland			
Mountains	2,545.5	3.2	78,400

Vegetation Types and Habitat Units	Area (ha)	% of Region (a)	Regional Extent (ha)
Plains Rocky	626	3.8	83,000
Bushmanland Arid Grassland			
Plains Sandy flat	2,517.6	0.07	4,470,270
Plains Sandy hummocky	238.9		
Plains Gravel calcrete	211.5	23.7	892
Bushmanland Sandy Grassland			
Plains Sandy mobile dunes	18.5	0.007	258,311
Azonal			
Kloof	176.6	-	-
Wash	1,173.0	-	-
Temporary rock pools	No data	-	-
Bushmanland Inselberg Succulent Shrubland			
Study Area	480.0	10.4	4,600
Gamsberg only	400.0	8.7	4,600
(a) Region is defined as the Bushmanland Inselberg Region (BIR)			

The Aggeneys Gravel Vygieveld (Mucina and Rutherford, 2006), covers a total area of approximately 1 556 hectares within the study area, which is approximately 9% of the regional extent of this vegetation type. This vegetation type is generally found in Northern Cape Province, at elevations exceeding 950 m, and found generally along plateau summits of inselbergs and koppies. The vegetation in the region is characterised with sparse, low-growing species. The species found throughout the year are characterised by small to very small succulent plants, with a general absence of trees and grasses, except along drainage lines. Although the vegetation types can vary, Succulent Karoo vegetation is prominent in the area. This vegetation type has been divided into four habitat units within the study area (*Table 5.6*). The specific habitat unit of Mountains Plateau covers an area of approximately 587 hectares, which is equivalent to 36.7% of the regional extent of this habitat. Furthermore, the Plains Gravel Quartz Plateau habitat is also present, covering a total area of 208 hectares. This equates to 41% of the regional extent of this habitat type.

The Bushmanland Inselberg Shrubland is comprised of two habitat units, covering a total area of just over 3 000 hectares within the study area (*Table 5.6*) and subdivided into two habitat units, namely the Mountains and Plains Rocky. The habitat units present on-site contain between 3,2% and 3,8% of the regional extent of these habitat units. The Bushmanland Inselberg Shrubland is generally found at elevations varying from 850 m – 1 150 m, typically found on the slopes of inselbergs and koppies. The vegetation is characterised with sparse to dense vegetation with varied composition. The vegetation is a mixture of low-growing grasses, leaf-succulent Karoo shrubs, microphyllous and spinescent karoo shrubs and succulent trees.

The Bushmanland Arid Grassland vegetation type is present in the region, and contains three specific habitat units, namely, Plains Sandy flat, Plains Sandy hummocky and Plains Gravel Calcrete, which cumulatively covers a total area of approximately 3 000 hectares (*Table 5.6*). Of the three habitat units, the Plains Gravel calcrete forms the smallest area (ie 211.5 hectares), however equates to 23.7% of the regional extent of this vegetation type and represented by numerous isolated patches. The remaining habitat units form less than 1% of the regional extent of their respective vegetation units. The Bushmanland Arid Grassland vegetation is the dominant vegetation on the sandy plains around the base of the Gamsberg inselberg is and also extends along the plains to the north of the N14. The vegetation is typical of extensive grasses extending along sandy plains, containing a variety of shrubs. Due the arid nature of the unit, which receives between 70 and 200 mm annual rainfall, it has not been significantly disturbed by intensive agriculture and more than 99% of the original extent of the vegetation type is still intact.

Figure 5.16 Example of Bushmanland Arid Grassland Vegetation Type

The Bushmanland Sandy Grassland vegetation type is comprised of a single habitat unit called the Plains Sandy mobile dunes (*Table 5.6*). This habitat type covers a total area of 18.5 hectares, which equates to less than 1% of the regional extent of this vegetation type. The Bushmanland Sandy Grassland is generally found from the south of Aggeneys to the north of Pofadder, along large sand dunes present on the region. The vegetation is characterised as sparse to dense, with loose sandy grassland on dune ridges with a wealth drought-resistant shrubs and trees. Although no endemic flora species are listed for this vegetation unit, it is not very well known suggesting that there may be such species present. This vegetation unit is however the habitat of the Red Lark *Calendulauda burra* which is an endemic species that is listed as *Vulnerable*.

An Azonal vegetation type was identified and is comprised of three vegetation habitat units, namely, Kloof, Wash and Temporary Rock Pools. The vegetation found in these habitats is generally comprised of surrounding vegetation as well as vegetation specific to the features (i.e. springs). The kloof on the northern portion of the Gamsberg inselberg is considered the largest in the BIR, covering a total area of 177 hectares. This Kloof comprises three separate but interlinked kloofs, which are as follows:

- A main south-north kloof draining the basin in the interior of the inselberg;
- An eastern kloof draining the north-eastern plateau; and

- A western kloof, the smallest of the three, draining the north-western plateau.

With respect to vegetation types, the Kloofs contain Bushmanland Inselberg Shrubland along the north-facing slopes, Bushmanland Inselberg Succulent Shrubland along the south-facing slopes and lastly, wash vegetation in the floor of the Kloof. Wash vegetation type contains all drainage lines present in the Gamsberg inselberg and is characterised with many species found in the surrounding area. Due to seasonal rainfall experienced in the region, periodic flooding has created a high natural disturbance habitat, which some species have suitably adapted to. Lastly, temporary rock pools are pan like structures that develop ephemeral pan ecosystems, based on standing water in these rock pools. Generally, perennial plant species are absent in these rock pools, however, the ecosystem is recognised as a unique and complex ecosystem based on the faunal communities and extreme spatial and temporal heterogeneity and dynamics (Desmet, 2010).

Lastly, the Bushmanland Inselberg Succulent Shrubland vegetation type has been defined on site as a distinctive vegetation type but is considered to extend throughout the BIR. This categorisation was undertaken in order to accommodate vegetation found on the upper (>950m) south-facing slopes of the Gamsberg inselberg. The Bushmanland Inselberg Succulent Shrubland is limited to the upper south-facing slopes (above approximately 950m) of the Gamsberg and adjoining inselbergs in the south of the study area. The vegetation is generally characterised with dense coverage of leaf-succulent shrubs, leaf-deciduous shrubs, trailing stem succulents and tree succulents.

Figure 5.17 Typical Composition of Bushmanland Inselberg Succulent Shrubland along Southern Face of Gamsberg Inselberg

A brief census was undertaken to review the relative population size of gravel-patch specialist plant species. A total of 13 patches were identified and assessed, which contained a total number of approximately 40 000 plants (Desmet, 2010).

However, despite the sizes of these gravel patches, the importance of these gravel patches is measured in terms of specie density and habitat size. Further detailed analysis of gravel patches will be presented during the scoping phase.

Figure 5.18 ***Plains Quartz Gravel Patch at northern eastern base of Gamsberg Inselberg***

5.8.4 On-Site Features of Botanical Concern

Based on previous investigations undertaken by Desmet (2000 and 2010), species of biodiversity concern were defined and assessed in terms of botanical sensitivity/ importance. The criteria used to define the species were rare, endemic or threatened plant species. These criteria considered the Gamsberg Centre of Endemism, IUCN threatened status (Red Data Listed species), rare species (restricted to 3 or less inselbergs) and relic species (common in their core range but rare in the BIR and considered relics of past wetter or drier climates). Using these criteria, the following species of conservation concern were identified:

Table 5.7 ***Species of Conservation Concern Present in the Study Area (Sourced Desmet, 2010)***

Species	**Conservation Status**	**Habitat**
Anacampseros bayeriana	Rare	Calcrete gravel patches
Crassula mesembrianthemopsis	Rare	Calcrete gravel patches
Titanopsis hugo-schlechteri var. hugo-schlechteri	Rare	Calcrete gravel patches
Conophytum ratum (plains form)	END & VU	Plains quartz gravel patch
Mesembryanthemum inachabense	END	Plains quartz gravel patch
Trachyandra sp.nov.	END (DD)	Plateau
Tylecodon sulphureus	END	Plateau
Adromischus nanus	END	Plateau quartz gravel patch
Conophytum angelicae subsp. angelicae (dwarf form)	Rare	Plateau quartz gravel patch
Conophytum ratum (dwarf/plateau form)	END & VU	Plateau quartz gravel patch
Aloe microstigma	Relic	South slopes
Conophytum limpidum (dwarf form)	END	South slopes
Othonna sp. nov.	END	South slopes
Sceletium tortuosum	Relic	South slopes
Azima tetracantha	Relic	Springs
Hydrodictyon sp.nov.	END (DD)	Kloof

END – Endemic to the Bushmanland Inselberg Centre of Endemism;

Species	Conservation Status	Habitat
VU – Vulnerable (IUCN Red List); (DD) represent undescribed species (*sp.nov*) and are considered within this report as Data Deficient in terms of the IUCN Red List criteria		

Based on the species of conservation concern identified above, together with habitat rarity, ecosystem functioning and status, habitats of specialist concern were identified. A total of 11 habitats of special concern were identified, as presented in *Table 5.8*.

Table 5.8 ***Habitats of Conservation Value (Sourced Desmet, 2010)***

Habitat name	Criteria notes
Kloofs	Rare habitat, climate refuge, keystone resource (water).
Springs	Very rare habitat, climate refuge, keystone resource (water).
Headwater Seeps	Very rare habitat, keystone resource (forage).
Headwater catchments	Ecological support area.
Temporary Rock Pools	Very rare habitat.
Plateau Quartz Gravel Patches	Endemic species and rare habitat.
Plains Quartz Gravel Patches	Endemic species.
Plateau Calcrete Gravel Patches	Climate refuge and rare habitat.
South Slopes	Climate refuge.
Washes	Conduits for water movement in the landscape.

During the baseline investigation undertaken (Desmet, 2010), it was confirmed that the habitats of conservation value were not rated and ranked in terms of sensitivities. Additional information in the form of detailed and quantitative assessments, together with further data sets to augment the population levels analysis. This exercise will be undertaken as part of the ESIA phase and the findings presented thereto.

A limited amount of off-site infrastructure will be placed within sections of Eastern Gariep Plains Desert. This vegetation unit occupies the gently sloping plain towards the Orange River on sandy, gravel and stony soils. The extent found within the Study Area shows signs of prolonged heavy grazing, and is a relatively restricted vegetation unit which occupies 1578 km^2 of the sloping plains and washes between the mountains of the Orange River from Henkries, Goodhouse, Kabis, Klein Pella to Onseepkans.

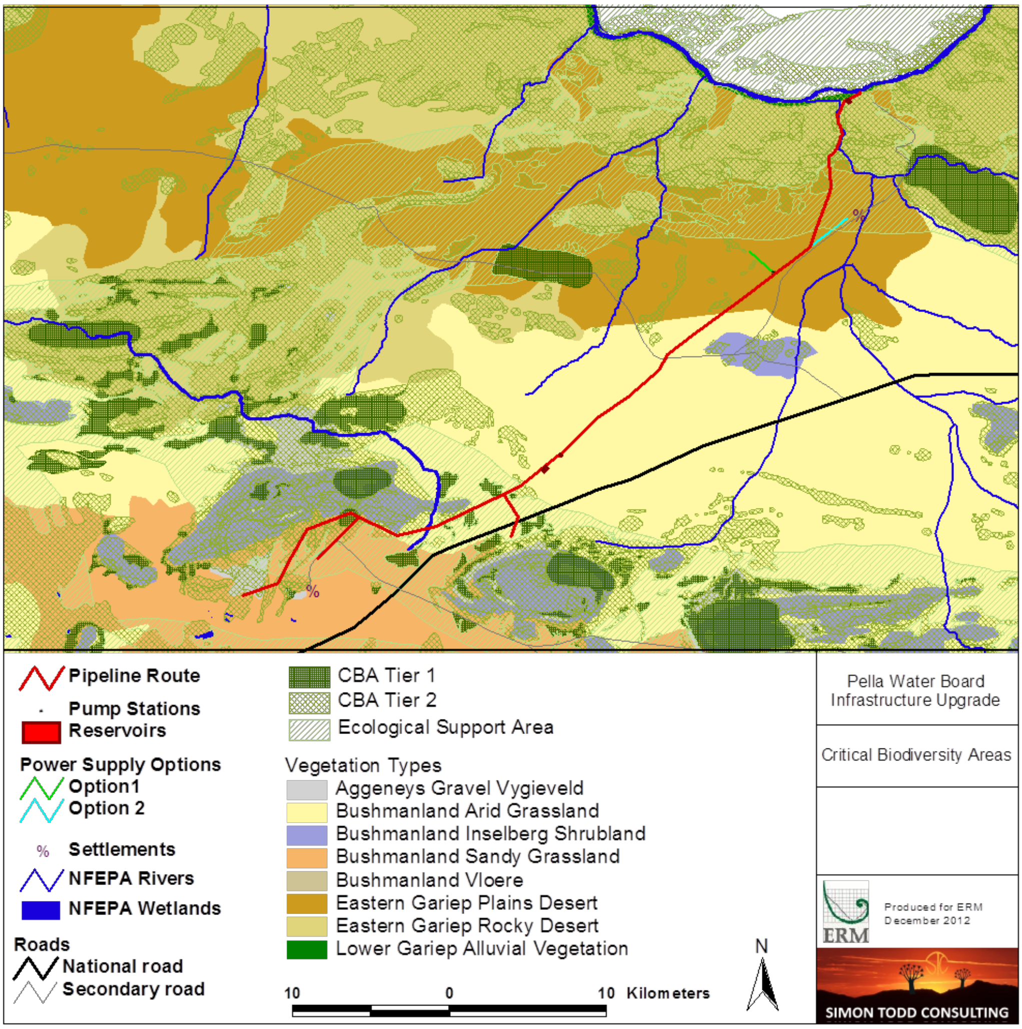
5.8.5 Off-site Features of Botanical Concern

A total of 132 plant species were observed at the site over the two site visits, and is considered representative of the perennial component of the vegetation. Of a total of 550 species known from the area, 30 species are of conservation concern (SANBI, 2012) but only four of these listed species were observed in the development footprint, *Lithops olivacea* (VU), *Acacia erioloba* (Declining), *Aloe dichotoma* (VU) and *Hoodia gordonii* (DDD). None of these species are especially rare or threatened and the loss of some individuals of these species as a result of the development would not be likely to compromise the local or regional populations of these species.

5.8.6 *Critical Biodiversity Areas and Broad-Scale Processes*

The Gamsberg site lies within the planning domain of the Namakwa Biodiversity Sector Plan (Desment & Marsh, 2008). This biodiversity assessment identifies Critical Biodiversity Areas (CBAs) which represent biodiversity priority areas which should be maintained in a natural to near natural state. The CBA maps indicate the most efficient selection and classification of land portions requiring safeguarding in order to maintain ecosystem functioning and meet national biodiversity objectives. As can be seen from the CBA map for the area, depicted below in *Figure 5.18*, the CBAs in the area are complex and reflect the landscape diversity in the area as well as the abundance of specific habitats of conservation significance. Various broad-scale Ecological Support Areas are present and intended to promote the maintenance of the broad-scale connectivity of the landscape. This includes parts of the pipeline route near Pella, after it emerges from the canyon as well as a large proportion of the pipeline between the Horseshoe and Kokerboom reservoirs.

Figure 5.19 Critical Biodiversity Areas Map for the Area Surrounding the Proposed Pella Water Board Pipeline and Associated Infrastructure



Source: CBA map for the Namakwa District as produced by Desment & Marsh (2008)

5.9 *FAUNA*

Faunal baseline studies were undertaken to update the existing faunal assessment previously undertaken during the initial EIA process (2000). Recent baseline studies have been undertaken by GroundTruth (2013) within the Gamsberg concession and by Simon Todd Consulting (2013) for the greater area. The findings of these investigations are presented below.

5.9.1 *Terrestrial Invertebrates*

Based on the field work and observations undertaken, it was confirmed that no Red Listed invertebrate species were identified in the Gamsberg region (Groundtruth, 2010). This was said to unlikely change through further investigations as most of the Red List invertebrates in South Africa are butterfly's, none of which are expected to occur in the Gamsberg region.

A total of 13 ant species were identified during the baseline study in 2010, which was undertaken during the dry season. It is speculated that this number of ant species could increase dramatically should a survey be undertaken during the wet season. Two ant species potentially endemic to the Northern Cape and Southern Namibia were identified during field observations (Groundtruth, 2013), which are as follows:

1. The pale *Messor* species (*Figure 5.19*); and
2. A *Camponotus fulvopilosus*-group species (*Figure 5.20*).

The *Camponotus* species is distinct from the Karoo form of *C. fulvopilosus* commonly occurring in the region. The pale *Messor* species could not be identified using available keys, and currently remains as undescribed.

Figure 5.20 Undescribed Messor Species found in the Gamsberg Basin

Figure 5.21 ***Undescribed Camponotus Fulvopilosus-group Species (left) Compared with the Karoo form of C. fulvopilosus (right) Commonly found at Gamsberg and in the Surrounding Regions***

Scorpions

At least 24 scorpion species are expected to occur in the Gamsberg and surrounding areas, which are well known for exhibiting exceptionally high diversity of this group. A total of eight species have been confirmed present to date, but this is almost certainly an under representation of this group. However the species recorded includes four species that are protected within the Northern Cape.

Figure 5.22 ***Photographs of Parabuthus schlechteri (Left) and Parabuthus laevifrons (Right) Recorded from the Gamsberg Study Area***

A significant observation during the 2012 was the high abundance and diversity observed in the wash area at the mouth of the kloof on the north of the Gamsberg. This may be due to relatively higher soil moisture levels here during the dry season resulting in more growing vegetation and consequently a higher abundance of the associated invertebrate prey on which the scorpions could feed.

5.9.2 *Amphibians*

On-site

Three species of frog were recorded within the study area during the herpetofaunal surveys, namely Paradise Toad (*Vandijkophrynus robonsoni*), Cape Sand Frog (*Tomopterna delalandii)* and Marble Rubber Frog (*Phynomantis annectens*). The Gamsberg may support a slightly greater diversity of frogs in total, with up to nine species possible (Minter *et al*., 2004), however, the site falls within the 'Namqualand Assemblage' (Alexander *et al*., 2004) that supports relatively low amphibian diversity. No Red Data species are known or expected to occur within the study area. All three species of frog recorded within the study area are listed under Schedule 2 of the Northern Cape Nature Conservation Act (Act 9 of 2009) as "Protected".

Figure 5.23 Paradise Toad Identified at Gamsberg Inselberg

Off-site

The site lies within the distribution range of a maximum of 10 frog species. However given the distance of the development sites to fresh water, the greater area is not likely to be important for very many amphibians. Given the likely low abundance of amphibians at the affected sites, the developments are not likely to have a significant impact on amphibians.

5.9.3 *Reptiles*

On-site

The Gamsberg area supports a relatively rich diversity of reptiles, given the diversity of habitats and the presence of mountainous, rocky terrain, which supports a number species that do not occur on the surrounding low-lying plains that make up much of the broader landscape. Twenty-four species of reptile were recorded during the herpetofaunal surveys, including four snakes, 16 lizards, comprising eight species of gecko, and one tortoise. It is likely that the full species richness is closer to 40-50 species.

Several reptile species in and around the Gamsberg inselberg were identified during the dry season investigation undertaken by GroundTruth (2013). The most commonly found reptile specie was the Variegated Skink (*Trachylepis variegata*), which was present in a range of habitats. The diversity of species identified is presented below in *Table 5.10*.

Table 5.9 Reptiles Recorded in the Gamsberg (GroundTruth, 2013)

Reptile Species	
Lizards and Geckos	
Namaqua Dwarf Legless Skink (*Acontias tristis*)	Western Rock Skink (*Trachylepis sulcata*)
Western Three-striped Skink (*Trachylepis occidentalis*)	Variegated Skink (*Trachylepis variegata*)
Ground Agama (*Agama aculeata*)	Anchieta's Agama (*Agama anchietae*)
Giant Ground Gecko (*Chondrodactylus angulifer*)	Bibron's Gecko (*Chondrodactylus bibronii*)
Striped Dwarf Leaf-toed Gecko (*Goggia lineata*)	Spotted Desert Lizard (*Meroles suborbitalis*)
Haacke's Gecko (*Pachydactylus haackei*)	Quartz Gecko (*Pachydactylus latirostris*)
Montane Gecko (*Pachydactylus montanus*)	Rough-skinned Gecko (*Pachydactylus rugosus*)
Plain Sand Lizard (*Pedioplanis inornata*)	Barking Gecko (*Ptenopus garrulous maculatus*)
Karoo Girdled Lizard (*Karusasaurus polyzonus*)	Plain Sand Lizard (*Pedioplanis inornata*)
Namaqua Sand Lizard (*Pedioplanis namaquensis*)	Western Rock Skink (*Trachylepis sulcata*)
Snakes	
Schinz's Beaked Blind Snake (*Rhinotyphlops schinzi*)	Karoo Sand Snake (*Psammophis notostictus*)
Beetz's Tiger Snake (*Telescopus beetzi*)	Coral Shield Cobra (*Aspidelaps lubricus*)
Black Spitting Cobra (*Naja nigricollis woodi*)	Cape Cobra (*Naja nivea*)
Desert Mountain Adder (*Bitis xeropaga*)	
Tortoises	
Tent Tortoise (*Psammobates tentorius*)	

Figure 5.24 Various Geckos Recorded from the Study Area,

To row: Barking Gecko (*Ptenopus garrulous maculatus*); Haacke's Gecko (*Pachydactylus haackei*); Rough-skinned Gecko (*Pachydactylus rugosus*);
Lower Row: Namaqua Mountain Gecko (*Pachydactylus montanus*); Striped Dwarf Leaf-toed Gecko (*Goggia lineata*); Quartz Gecko (*Pachydactylus latirostris*);

Haacke's Gecko *Pachydactylus haackei*, Namaqua Mountain Gecko *Pachydactylus montanus* and Desert Mountain Adder *Bitis xeropaga*, are three other species that are range-restricted endemics confined to the lower Gariep River and adjacent regions, and are habitat specialists, restricted to rocky, mountainous habitat. All three of these species were recorded in the study area during the November 2012 survey (Namaqua Mountain Gecko was also recorded in the 2009 survey).

Off-site

The site lies in or near the distribution range of at least 60 reptile species, comprising 1 tortoise, 25 snakes, 26 lizards and skinks, 12 geckos and 1 chameleon. A significant proportion of these are however associated with the Orange River and the adjacent mountains and not likely to occur within the footprint of the current developments. The habitat diversity within the affected areas is very low and is restricted to lowland sandy habitats and hence the reptile fauna is likely to be restricted to species associated with these habitats. Species observed in these areas include Ground Agama *Agama aculeata*, Spotted Desert Lizard *Meroles suborbitalis*, Plain Sand Lizard *Pedioplanis inornata* and Bushmanland Tent Tortoise *Psammobates tentorius verroxii.* The impacts on reptiles are not likely to be highly significant when considered in the landscape context and the relatively minor habitat loss resulting from the infrastructure. Furthermore, development such as the housing development would create novel habitat that would be utilised by species adapted to homes and gardens such as some geckos and skinks.

5.9.4 *Avifauna*

On-site

A total of 46 bird species have been recorded by GroundTruth (2013) during field surveys. These sightings supplement previous detailed avifaunal surveys conducted in April 1999 (Harrison and Harebottle, 2000) and records from the

South African Bird Atlas Project 2 (SABAP2), to produce a list of 87 bird species for the Gamsberg area. The diversity of birds is thus relatively high within the regional context (~ 35% species representation at Gamsberg), which is driven largely by the diverse range of habitats. The birds recorded at Gamsberg area can broadly be divided into four main communities based on the broader, topographical habitat types, namely Plains, Slopes and kloof, Plateaux and the Basin.

This list includes four Red Listed and 14 range restricted bird species have been recorded within the study area. The Red listed species include Martial Eagle (*Polemaetus bellicosus*) listed as Vulnerable, Lanner Falcon (*Falco biarmicus*) and Secretarybird (*Sagittarius serpentarius*) both listed as Near Threatened. Other raptors observed include Verreaux's Eagle (*Aquila verreauxii*) which nest within the site, Jackal Buzzard (*Buteo rufofuscus*), Southern Pale Chanting (*Goshawk Melierax canorus*) and Greater Kestrel (*Falco rupicoloides*).

Off-site

The bird species richness for the greater area is rather low due to the limited diversity if habitats and the arid conditions, however the site lies within an important area for several listed species as well as many biome-restricted species. The area around Aggeneys, particularly those areas consisting of Bushmanland Sandy Grassland lie within an Important Bird Area (IBA) as defined by Birdlife South Africa. This IBA known as the Haramoep and Black Mountain Mine Nature Reserve IBA (Birdlife South Africa - Bird Area factsheet: SA 035), extends from south of the N14 near Aggeneys to the Orange River in the north and includes both red sand dunes associated with the Koa River valley as well as barren stony plains between Aggeneys and Orange River. Only the western-most section of the pipeline near the Kokerboom Reservoir is actually within the IBA. According to the description provided by Birdlife South Africa for the IBA, this is one of the few sites protecting both the globally threatened Red Lark (*Certhilauda burra*), which inhabits the red sand dunes, and the near-threatened Sclater's Lark (*Spizocorys sclateri*), which occurs erratically on the barren stony plains. The area is also home to 16 of the 23 Namib-Karoo biome-restricted species, as well as a variety of other arid-zone birds. Other significant species in area associated with mountainous areas such as the Haramoep mountains to the north of the site include Black Stork (*Ciconia nigra*), Verreaux's Eagle (*Aquila verreauxii*), Booted Eagle (*Hieraaetus pennatus*), Peregrine Falcon (*Falco peregrinus*), Cape Eagle-Owl (*Bubo capensis*) and Bradfield's Swift (*Apus bradfieldi*).

Table 5.10 Range- and Biome-restricted Species Which Occur Within the Haramoep and Black Mountain Mine Nature Reserve IBA and Their Frequency as Estimated by Birdlife SA for the IBA

Name	Status	Name	Status
Ludwig's Bustard	Common	Karoo Korhaan	Common
Karoo Long-billed Lark	Common	Red Lark	Fairly Common
Sclater's Lark	Uncommon	Stark's Lark	Uncommon
Black-eared Sparrow-lark	Fairly Common	Tractrac Chat	Fairly common
Sickle-winged Chat	Fairly Common	Karoo Chat	Common

Name	Status	Name	Status
Layard's Titbabbler	Common	Karoo Eremomela	Common
Cinnamon-breasted Warbler	Common	Namaqua Warbler	Uncommon
Pale-winged Starling	Fairly Common	Sociable Weaver	Common
Black-headed Canary	Fairly Common		

5.9.5 *Mammals*

On-site

A total of 37 mammal species have been recorded from the Gamsberg area. This includes the 29 species recorded during the Anderson (1999) survey with an additional six species recorded by GroundTruth (2013). *Table 5.12* provides a list of the mammals recorded. The results from these surveys highlights that the Gamsberg area supports over 50% of the expected regional diversity.

Table 5.11 Mammal Species Recorded Within the Gamsberg Study Area (GroundTruth, 2013)

Mammal Species	
Elephant-shrews	**Primate**
Western Rock Elephant-shrew (*Elephantulus rupestris*)	Chacma Baboon (*Papio ursinus*)
Round-eared Elephant-shrew (*Macroscelides proboscideus*)	**Carnivores**
Bats	Brown Hyaena (*Hyaena brunnea*) NT
Cape Horseshoe Bat (*Rhinolophus capensis*) NT, END	Caracal (*Felis caracal*)
Darling's Horseshoe Bat (*Rhinolophus darlingi*)	African Wild Cat (*Felis silvestris*)
Robert's Flat-headed Bat (*Sauromys petrophilus*)	Leopard (*Panthera pardus*) NT
Rabbits and Dassies	Black-backed Jackal (*Canis mesomelas*)
Scrub Hare (*Lepus saxatilis*)	Bat-eared Fox (*Otocyon megalotis*)
Smith's Red Rock Rabbit (*Pronolagus rupestris*)	Cape Fox (*Vulpes chama*)
Rock Dassie (*Procavia capensis*)	Striped Polecat (*Ictonyx striatus*)
Rodents	Small Grey Mongoose (*Galerella pulverulenta*)
Porcupine (*Hystrix africaeaustralis*)	Slender Mongoose (*Galerella sanguinea*)
Springhare (*Pedetes capensis*)	Small Spotted Genet (*Genetta genetta*)
Dassie Rat (*Petromus typicus*) NT	Water Mongoose (*Atilax paludinosus*)
Cape Ground Squirrel (*Xerus inauris*)	**Aardvark**
Namaqua Rock Mouse (*Aethomys namaquensis*)	Aardvark (*Orycteropus afer*)
Striped Mouse (*Rhabdomys pumilio*)	**Antelope**
Short-tailed Gerbil (*Desmodillus auricularis*)	Springbok (*Antidorcas marsupialis*)
Hairy-footed Gerbil (*Gerbillurus paeba*)	Klipspringer (*Oreotragus oreotragus*)
Karoo Bush Rat (*Otomys unisulcatus*)	Steenbok (*Rhaphicerus campestris*)
Littledale's Whistling Rat (*Parotomys littledalii*) NT	Common Duiker (*Sylvicapra grimmia*)
Pygmy Rock Mouse (*Petromyscus collinus*)	
END – Endemic to South Africa; NT – Near Threatened	

Figure 5.25 Examples of Small Mammals Recorded Within the Gamsberg Study Area

Western Rock Elephant-shrew (*Elephantulus rupestris*)	Short-tailed Gerbil (*Desmodillus auricularis*)	Namaqua Rock Mouse (*Aethomys namaquensis*)

Four small mammals listed as Near Threatened were recorded during surveys, while incidental reports of Leopard and Brown Hyaena were received during the 2012 survey by GroundTruth. There was a recent report of a Brown Hyaena in the town of Aggeneys. Two of the mammal species recorded during the 2009 and 2012 surveys are listed as "Specially Protected under the Northern Cape Conservation Act (2009) Schedule 1, namely African Wild Cat and Striped Polecat.

Off-site

The areas surrounding the Gamsberg fall within the distribution range of up to 48 terrestrial mammals and 8 bats, indicating a high potential mammal diversity. The Black-footed Cat *Felis nigripes* (Vulnerable) is likely to occur across the site at low density, but is widely distributed across the arid parts of the country and the possible impacts on this species would be minimal. It was observed that many of the smaller burrowing mammals such as Ground Squirrel were preferentially using the existing pipeline footprint for the burrows. Although large parts of the site consist of relatively soft sand, it is usually not very deep and overlays a hard calcrete or ferricrete hardpan. As the existing pipeline lies within or beneath this layer, the footprint provides an area where the hardpan has been broken and borrows can be constructed with relative ease. Although this is not viewed as an overall benefit of the development, it nevertheless serves to illustrate that the impacts of the disturbance are not exclusively negative and that fauna are quick to adapt and take advantage of the situation.

5.9.6 *Aquatic Biodiversity*

The aquatic baseline may be characterised by two main aquatic ecosystems present within and around the Gamsberg inselberg, namely the springs within the kloof and on the north and northeast of the inselberg, and the river intermittently running through the kloof to the north and a much smaller drainage line on the east of the inselberg.

Springs appear to be artesian and fed by the local groundwater table, and are largely perennial in nature. However, most of the flow from the springs disappears within a short distance from their origin. Pools may be present for lesser or greater periods of the year, particularly within the kloof, and these are maintained to some extent by the springs. During particularly wet periods as a result of thunderstorms or sustained rainfall over the region, surface wash and runoff within the main basin of the inselberg drains out through the kloof. The main channel of these systems is predominantly bedrock in nature and contained within the kloof. The main channel consists of a repeating sequence of bedrock pools and dry riffle/cobble sections. These riffle sections would only activate during intermittent flow periods associated with rainfall within the inselberg main basin.

Besides the springs, the pools are the most persistent aquatic feature within this system and a key feature of the uniqueness of this environment. A number of other ecosystem processes are co-dependent on these water sources; e.g. as a direct water sources but also for food material and as a conduit and resupply route for material on the washout zone to the north of the inselberg.

Diatoms were sampled and taken for analysis from four sites during the May 2009 and November 2012 surveys (Groundtruth, 2013), which included springs located to the south and south east, as well as the Gamsberg River and Gamsberg Spring.

Results of the diatom sampling revealed that the aquatic ecosystems of Gamsberg are generally in a "poor" ecological state. Given that there were no obvious signs of water quality/river heath degradation, it would seem that this is rather a consequence of the sampled systems consisting of stagnant pools. The likely effect of this would be that any nutrients (or other water quality parameters) will accumulate, resulting in these parameters becoming more concentrated. Possible sources of nutrients could include any organic matter that enters into the pools. Diatom indices are designed to reflect a number of potential environmental impacts, the chief of these being plant nutrients, organic matter and salts. An increase in any of these water quality variables is generally deemed to be indicative of some form of pollution. Although diatom indices generally give a good indication of environmental conditions they may show a pollution impact were none exists in the case of naturally highly saline waters or waters with intermittent flow.

One of the four water sources identified had flowing water (i.e. Gamsberg stream) and was suitable for application of the SASS5 method to determine aquatic integrity. This study revealed the ecological conditions of the Gamsberg stream to be "poor", based on the aquatic macro-invertebrates present, the families and their respective tolerances to water quality.

5.9.7 *Assessment of Faunal Species and Species-specific Habitats*

Information of fauna recorded from the study area and their respective species-specific habitats was used to assess the level of dependence of fauna on the available habitats in the area. Habitats were grouped into three categories based on local and regional importance and sensitivity, these being:

- Irreplaceable (H1) – kloof, ephemeral watercourses, springs, seeps and rock pools;
- Constrained (H2) – cliffs, rocky slopes, outcrops, and crevices, mountain plateaux and drainage basin; and
- Flexible (H3) – flat plains.

Key faunal species present within the Gamsberg study area were evaluated according to their dependence on each of the three habitat categories and against the habitats that will be lost, heavily affected and unaffected. All species of invertebrates, frogs and reptiles were evaluated in this manner; whereas only the species of concern (Red Data Near Threatened and Vulnerable species) were evaluated for the birds and mammals.

The information obtained from the evaluation tables highlights key species that are potentially affected by the proposed Gamsberg Project, providing further insight to assessing their degree of sensitivity within the context of the project. *Table 5.12* provides a consolidation of key fauna, assessed on their level of habitat dependence, the significance of impact on each group and their offset potential.

Table 5.12 Overview of the Potential Level of Impact Caused by the Mining Development on Key Faunal Species Present Within the Gamsberg Study Area

Species and Common Name	IUCN Red List Status	Habitat Dependence	Extent of range affected (Impact Intensity)	Impact Significance on Species	Offset potential
Invertebrates					
Camponotus sp.nov. (AFRC-ZA-52)	(DD)	Medium (H1 & H2)	High	Medium	Medium (RR)
Messor sp.nov. (AFRC-ZA-01)	(DD) Possible CR	High (only H2)	Medium	Medium to High	Low - Medium (RR)
Herpetofauna					
Vandijkophrynus robinsoni Paradise Toad		Low (H1, H2 & H3)	Medium	Low	Medium (RR)
Strongylopus springbokensis Namaqua Stream Frog		Medium (H1 & H2)	High	Medium	Medium (RR)
Cacosternum namaquense Namaqua Caco		Medium (H1 & H2)	High	Medium	Medium (RR)
Pachydactylus goodi Good's Gecko	VU	Medium (H1 & H2)	Medium	Medium	Medium (RR)
Pachydactylus haackei Haacke's Gecko		Medium (H1 & H2)	Medium	Medium	Medium (RR)
Pachydactylus montanus Namib Mountain Gecko		Medium (H1 & H2)	Medium	Medium	Medium (RR)
Bitis xeropaga Desert Mountain Adder		High (only H2)	Medium	Medium to High	Medium (RR)
Birds					
Falco biarmicus Lanner Falcon	NT	Medium (H1 & H2)	Low	Low	High
Polemaetus bellicosus Martial Eagle	VU	Medium (H1 & H2)	High	Medium to High	High
Mammals					
Rhinolophus capensis Cape Horseshoe Bat	NT	Medium (H1 & H2)	High	Medium to High	Medium (Endemic)
Rhinolophus darlingi Darling's Horseshoe Bat	NT	Medium (H1 & H2)	High	Medium to High	High
Parotomys littledalii Littledale's Whistling Rat	NT	Medium (only H3)	Medium	Medium	Medium
Petromus typicus Dassie Rat	NT	High (only H1) habitat specialist	Medium	Medium to High	Medium

CR – Critically Endangered; VU – Vulnerable; NT – Near Threatened; LC – Least Concern
H1 – Irreplaceable habitats; H2 – Constrained habitats; H3 – Flexible habitats; RR – Range restricted

5.10 *AIR QUALITY*

5.10.1 *Existing Air Quality Within The Region*

Based on the air quality baseline studies undertaken by SRK Consulting (2010), the following existing sources of emissions were identified:

- Agricultural activities;
- Fugitive dust sources (windblown dust especially during the dry season);
- Vehicle Tailpipe Emissions;
- Household fuel combustion; and
- Mining operations in the region.

Previous dust monitoring revealed the following results:

Table 5.13 Dust Deposition Results for June 2009 to October 2009

Location	Monthly Averaged Concentrations (mg/m²/day)				
	June	July	August	September	October
GAM A1	109	1143	3	288	13
GAM A2	64	990	3	1957	216
GAM A3	73	1673	3	1759	12
GAM A4	161	2733	186	1305	142
GAM A5	246	1262	10	1765	241
GAM A6	6	1978	19	1901	67
GAM A7	679	1357	188	582	28
GAM A8	20	1557	564	1528	320
GAM A9	8	2028	630	665	298
GAM A10	5	2554	836	1796	400
Action Residential [a]	600				
Action Industrial [a]	1200				
Alert Threshold [a]	2400				

[a] SANS 1929:2005

Source: DDA Environmental Engineers.

The dominant form of farming currently undertaken in the region is livestock farming. Due to climatic conditions, crop farming is prevalent along the Orange River. The activity of ploughing is generally limited to small plots of land, and not part of larger commercial farming activities. Due to the scale of farming in the region, agricultural activities are seen as a minor contributor to particulate matter (ie PM10 and Total Suspended Particles) concentrations in the region.

Coal and wood are the dominant fuel source for the rural communities and can be responsible for the airborne particulates. Gaseous pollutants such as sulphur dioxide (SO2), nitrogen oxides (NOx), carbon monoxide (CO) and carbon dioxide (CO2), together with airborne particulate matter are the main emissions from coal and wood combustion. However, as the proposed area is sparsely populated, the expected levels of emissions contribution from wood and coal combustion are likely to be negligible. In addition, vehicle tailpipe emissions can act as a large contributor to air emissions. Vehicle emissions are categorised as primary or secondary pollutants, with the latter a result of chemical reactions in the atmosphere. However, due to the limited number of road users currently in the area, vehicle emissions are likely to contribute minor concentrations of air pollutants.

Fugitive dust sources are generally considered primary pollutants (as they are unlikely to experience any chemical or physical reactions) and are generally associated with the use of gravel roads or windblown erosion. The soil moisture content and density of vegetation cover can influence fugitive dust emissions. Due to limited rainfall in the Gamsberg region, fugitive dust emissions are likely to increase during the dry seasons.

Mining activities are likely to significantly contribute to air emissions in the region. Mining activities are generally associated with the release of sulphur dioxide (SO2), nitrogen oxides (NOx), carbon monoxide (CO) and carbon dioxide (CO2). In addition, fugitive dust emissions such as PM2.5, PM10 and Total Suspended Particles are also characteristic of mining activities such as materials handling, blasting, drilling, haul vehicles, stockpiling and waste management. Taking cognisance of the existing mining operations within Aggeneys, the existing Black Mountain Mine is likely to contribute to the ambient air concentration levels in the region.

Air quality monitoring was undertaken from June to October of 2009 to determine the current ambient air quality concentrations related to PM10, SO2 and NO2 (SRK Consulting, 2010).

The SO2 results obtained for the months of June and September were registered below the 24 hour South African standard of 125 $\mu g/m^3$ and the SANS 1929:2005 24 hour standard of 125 $\mu g/m^3$ for all monitoring points. Furthermore, NO2 levels were obtained from existing monitoring stations, which indicated that the concentration levels are below the South African Standard limit of 200 $\mu g/m^3$ and SANS 1929:2005 limit of 200 $\mu g/m^3$ for both the June and September sampling periods. PM10 data was collected from 28 May 2009 to November 2009. The PM10 monitor was situated at Aggeneys High School, because the high school is the closest human receptor to the Gamsberg inselberg. The average 24 hour PM10 concentration levels were below the South African Standard of 120 $\mu g/m^3$ for all months. There was one 24 hour exceedance above the South African proposed standard of 75 $\mu g/m^3$ during the month of November 2009. The PM10 level of 92 $\mu g/m^3$ was observed in November 2009. However, the PM10, SO2 and NO2 concentration levels in the surrounding area are generally within the requirements outlined in terms of NEM:AQA and SANS.

It should be noted however that dust fallout levels do fluctuate in the area, with higher concentration levels recorded during the dry, windy seasons (ie July and September). Dust concentration levels do exceed SANS 1929:2005 standards during months characterised with less rainfall (July to September) and greater wind speeds. Furthermore, as the dry season is characterised with limited vegetation, the potential for windblown dust is also greater. Due to existing dust concentration levels exceeding SANS 1929:2005 during certain periods of the year, future mining activities would need to ensure that dust generation and suppression is efficiently managed, so as to overcome potential cumulative impacts of a new mine in the region.

Precipitation plays a critical role in terms of air quality, as during the wet season, air pollution and particulate matter concentrations are generally lower. The rainfall not only reduces air pollution concentrations, but also dampens the ground and thus reduces the potential of windblown dust. During the dry period, dust concentration levels increase due to drier conditions and reduced vegetation cover.

5.11 NOISE

The Gamsberg inselberg is located in an area that is sparsely populated, with limited sensitive noise receptors in the immediate area. Sensitive receptors in the area include the town of Aggeneys, adjacent land owners and road users (N14 and Loop 10 gravel road). The proposed Gamsberg zinc mine will result in the generation of noise through the use of diesel equipment, crushing, concentrating and activity of mining (ie blasting and drilling).

Recognising the potential noise sources, the existing ambient noise levels in the area were identified. The N14 National Road and Loop 10 gravel road has been identified as major sources of noise, due to levels of traffic experienced in the area. Furthermore, the town of Aggeneys is characterised with community related activities and thus contributes to the existing ambient noise levels. However, as Aggeneys is approximately 14 km south west of the proposed mine, the town results in minimal noise emissions, relative to the Project area.

A large source of noise identified in the immediate area is the existing Black Mountain Mine. Although the proposed mine is located more than 15 km south west of the proposed Gamsberg mine, the on-site diesel equipment and crusher contribute to the ambient noise levels of the area. However, due to the topography, existing koppies act as a natural screening mechanism to reduce the significance of noise impacts.

Notwithstanding, the establishment of the proposed Gamsberg zinc mine will result in an increase in the ambient noise levels in the immediate surroundings and therefore further investigations is required.

5.12 BASELINE CONDITIONS AT LOOP 10

Loop 10 is the halfway camp along the Sishen-Saldanha railway, aptly known as 'Halfweg'. It is located approximately 150 km to the south east of the Project site.

As discussed in Section 3, BMM has an existing offloading facility at the Loop 10 siding. This section provides a brief description of the baseline environmental conditions associated with the Site.

The site itself was reportedly cleared of all vegetation during the construction of the siding and associated loop infrastructure (include pers comm Mr. P. Venter). As such, the site footprint and the land that immediately surrounds it (ie the rail reserve), is considered to be highly transformed, with only limited areas of relict vegetation occurring in thin strips over this area (SHEcape Environmental, 2008).

Loop 10 is situated in a remote area, with very little residential, commercial or industrial activities being undertaken in close proximity to the Site. In this regard, the surrounding land use is predominantly used as agricultural grazing land. Game farming and karakul farming are also identified as land uses in the vicinity of the Site (SHEcape Environmental, 2008).

Table 5.13 provides a brief description of the biophysical conditions associated with the environment surrounding Loop 10. This description is based on limited information obtained through personal communication with site management, previous environmental studies undertaken (SHEcape Environmental, 2008 & GEOSS, 2012) at the site and GIS data.

Table 5.14 Baseline Biophysical Conditions of Surroundings at Loop 10

Biophysical aspect	**Baseline description**
Temperature	Average temperatures in summer of 30°C to 35°C. Average temperatures in winter of 18°C to 20°C. Maximum temperatures in summer can reach 40°C.
Rainfall	Monthly average rainfall of 10-30 mm in summer and less than 10 mm per month in winter. During periods of summer peak rainfall, daily rainfall events have been recorded to exceed 70mm.
Fauna	No sensitive species identified through review of available information.
Flora	The vegetation type in the surrounding area is predominantly made up of Arid Karoo vegetation, although Bushmanland Arid Grassland and Basin Shrubland were also noted in a study undertaken in close proximity to the site. The vegetation was acknowledged to be in a good functional state where not previously disturbed.
Topography	The topography is considered to be generally flat, with undulating topography which increases in gradient to the north of the Site.
Surface Drainage	As discussed above, the site is bisected by two non-perennial drainage lines typical of the area.
Geology	The Prince Albert Formation (Ecca Group) dominates the surface geology at Loop 10. This formation consists of predominantly shale and siltstone.
Archaeology	No sites of archaeological importance identified through review of available information.
Landscape	Typical Karoo landscape with generally vast and featureless views.

6 SOCIO-ECONOMIC ENVIRONMENT

6.1 INTRODUCTION

The socio-economic baseline report provides a demographic, cultural and economic overview of the Project area and also describes the physical infrastructure and services available in the communities visited. The purpose of collecting this information is to provide a basis upon which the impact assessment can be conducted, and to enable the monitoring and measurement of changes over time.

6.1.1 *Methodology*

This socio-economic baseline is primarily based on a previous socio-economic baseline report undertaken in 2009/2010 for the Project. Where possible, the statistics have been updated along with any material changes to the socio-economic context. Preliminary statistics from the 2011 Census are only available at the Provincial, District and Local Municipal levels. Data for individual towns was not available at the time of the study. The latest available statistics for the individual towns are from the 2007 Community Survey and 2011 Labour Force Survey, from Statistics South Africa. Key secondary sources used were Municipal documents such as the District Municipality's Local Economic Development Framework (2010) and the 2011 and 2012 Integrated Development Planning documents from the Khai Ma Local Municipality (LM).

Two previous baseline studies for the Project Area have been completed in 2000 and 2010. In addition, BMM undertook a Social Closure Plan (SCP) in 2009 for their current operation. The objective of the SCP was to:

- determine the demographic characteristics of employees;
- determine the profiles of employee households in the labour sending areas; and
- assess BMM's interaction with its surrounding regional socio-economic structure (including affected communities).

In addition to these studies, a number of focus group meetings and key informant interviews were conducted to verify the available secondary data. The focus group discussions (FGD) and key informant interviews (KII) are shown in *Table 6.1*.

Table 6.1 Key Informant Interviews and Focus Group Discussions

Interviewee Designation	Place	Date
Key Informant Interviews (KII)		
Nursing Sister	Pofadder Clinic, Pofadder	10 September 2012
Namakwa District Municipality Official	Pofadder	11 September 2012
School Principal	Boesmanland High School, Pofadder	11 September 2012
South African Social Security Agency (SASSA) Official	Pofadder	12 September 2012
Khai Ma LM Official	Pofadder	12 September 2012
Aggeneys Councillor	Aggeneys	12 September 2012
Khai Ma Municipal Official	Pofadder	13 September 2012
Small Business Owner	Pofadder	13 September 2012
Black Mountain Mining Human Resource Manager	Aggeneys	13 September 2012
Black Mountain Mining Community Liaison Officer)	Aggeneys	13 September 2012
Chairperson – Pella Water Board	Aggeneys	13 September 2012
Focus Group Discussions		
Emerging Farmers (10)	Pofadder	10 September 2012
Pofadder Councillors (8)	Pofadder	11 September 2012
Hope for Life (4)	Pofadder	11 September 2012
Pofadder Women (12)	Pofadder	11 September 2012
Pofadder Youth (19)	Pofadder	11 September 2012
Aggeneys Women (16)	Aggeneys	12 September 2012
Aggeneys Youth (3)	Aggeneys	12 September 2012
Police (6)	Pella	12 September 2012
Pella Women (17)	Pella	13 September 2012
Pella Youth (15)	Pella	13 September 2012

6.1.2 *Overview*

Since the original study in 2000 there has not been any significant economic growth in the broader area. The Northern Cape is characterised by an extreme disparity in wealth, with 44.7 % of the population earning less than 9.8 % of the income. The unequal income distribution has severely hampered development [(1)]. Migration patterns suggest that there has been economic decline in the area, as people have been leaving the area in search of opportunities in other Provinces such as the Western Cape, Gauteng and Eastern Cape Provinces. Rapid population growth has given rise to a very young population structure (see *Section 6.4* for further demographic details).

Rising levels of unemployment and the increase in the economically inactive population has resulted in increased pressure on the diminishing employed population and a high dependency on the State for support. The mining sector continues to be the dominant economic sector although recent trends in the sector show the sector to be in decline. This is evident from the mine closures in the District (eg Kleinsee and Steinkopf). Provision of services and

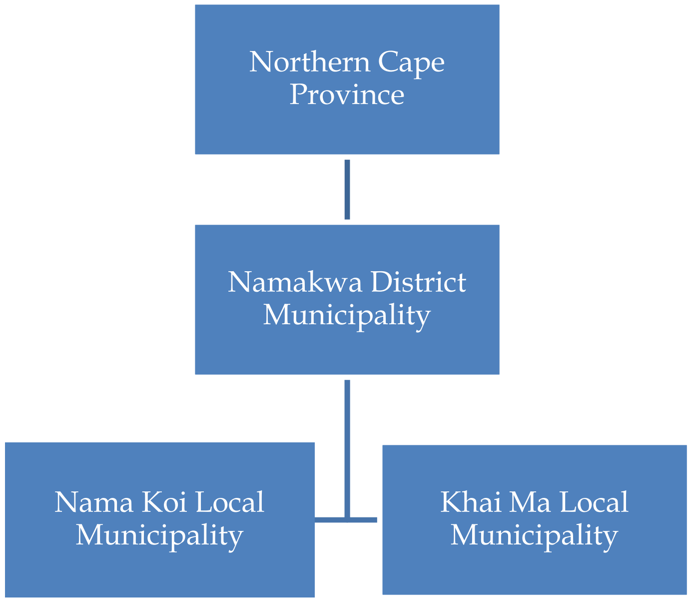
(1) Northern Cape Provincial Growth and Development Strategy (NCPGDS), July 2011.

infrastructure continues to be a challenge. This is exacerbated by the highly dispersed distribution of settlements.

6.2 ADMINISTRATIVE STRUCTURE

This section outlines the administrative structure and spatially contextualises the Project. *Figure 6.1* depicts the relationship between the various spheres of government relevant to the Project. Further detail on each sphere of government is provided below.

Figure 6.1 Administrative Structure



6.2.1 Northern Cape Province

The Northern Cape Province covers the largest area of the nine provinces in the Republic of South Africa. The Northern Cape has five District Municipalities (DMs) comprising Pixley Ka Seme, Frances Baard, Namakwa, Siyanda and Kgalagadi. These five DMs are made up of twenty-six local municipalities. The major towns in these DMs are De Aar, Kimberley, Upington, Springbok, and Kuruman. The executive authority of the Northern Cape rests with the Premier. The Northern Cape Provincial Growth and Development Strategy (NCPGDS) provide the framework for development in the Province. The Province is governed by the following Departments:

- Office of the Premier;
- Department of Agriculture and Land Reform;
- Department of Education;
- Department of Environmental Affairs and Nature Conservation;
- Department of Finance, Economic Development and Tourism;
- Department of Health;

- Department of Cooperative Governance, Human Settlement and Traditional Affairs;
- Department of Roads and Public Works;
- Department of Transport, Safety and Liaison;
- Department of Sport, Arts & Culture; and
- Department of Social Development.

Most pertinent to the Project is the DENC which is the approving authority for the ESIA.

6.2.2 *Namakwa District Municipality*

The Namakwa District Municipality (NDM) is the largest DM in South Africa. The NDM comprises six local municipalities, which include Nama Khoi, Khai-Ma (in which the Mine is located), Richtersveld, Kamiesberg, Hantam and Karoo Hoogland. Prior to the 2011 municipal elections large portions of the NDM were managed as District Management Areas (1) (DMA). The Namakwa DMA has been subsumed by five of the six local municipalities since the local government elections in 2011. Only the Richtersveld LM was not affected by changes to its municipal boundaries (2). The executive authority of the NDM rests with the Executive Mayor.

The regional centre of the NDM is Springbok. Strategic development within the NDM is aligned with the NCPGDS and other national development initiatives. Despite this, the District suffers from a lack of resources and a backlog of service delivery. The developmental focus of the NDM has shifted from the provision of infrastructure and basic services to socio-economic development and the spatial identification of areas with development potential (3).

6.2.3 *Local Municipalities*

Khai Ma Local Municipality

Gamsberg falls into the Khai-Ma Local Municipality (LM). The main town in the Khai-Ma LM is Pofadder, which is both an economic hub and the seat of local government. The Khai-Ma LM is broken up into four wards, with the Mine falling within Ward 4.

The role of the LM is to monitor and manage service delivery to settlements within its jurisdiction, implement plans and policies of the NDM and to carry out the development objectives outlined within the LED.

(1) DMA are defined by the Municipal Systems Act (1998), as areas that forms part of a District Municipality and is governed by a District Municipality alone. DMA are areas of special interest such as state protected areas or special economic areas.
(2) Ministry of Cooperative Governance and Traditional Affairs, 2011, ' Circular to Provinces and Municipalities on Transitional Arrangements for Pre and Post 18 May 2011 Local Government Elections' (www.cogta.gov.za -accessed 8 August 2012).
(3) Namakwa District Municipality, IDP 2006-2011(third revision).

The strategic objectives of the LM are to:

- provide sustainable services to the inhabitants and to maintain existing resources;
- develop the LM as an institution through transformation and capacity building;
- promote local economic development through poverty alleviation, job creation, empowerment of the previous disadvantage people with capacity building in business skills and establish a climate for investment; and
- promote sound financial management and viability (1).

Key priorities for the LM between 2012 and 2017 include:

- services delivery;
- institutional development and transformation;
- local economic development;
- financial management and viability; and
- good governance and public participation.

The total budget for LM for the 2012/2013 financial year was R55,730,000 (2). The various income streams and the contribution to the total budget of the LM are shown below:

- property rates (five percent);
- service charges (21 percent);
- external interest investments (zero percent);
- interest from outstanding debtors (one percent);
- grants and subsidies (70 percent); and
- other income (three percent).

Local government is represented in the communities by seven ward councillors. The number of councillors per area has increased to two since the local government elections in 2011. The exception is Aggeneys which only has one councillor. Pella and Witbank share two councillors who are responsible for both areas. These councillors represent local government in the various towns and work closely with local government departments. The role of the councillors is to monitor and maintain existing service delivery such as water, sanitation and refuse removal and to initiate new projects within the communities.

(1) Khai Ma, Integrated Development Plan, 2012 -2017.

(2) Final Budget of the Khai Ma Local Municipality, 2012/2013 to 2014/2015 Medium Term Revenue Expenditure and Forecasting, May 2012. Available at: http://mfma.treasury.gov.za/Documents/02.%20Budget%20Documentation/2012-13/Adopted%20budgets/02.%20Local%20munic.

Councillors work closely with the Community Development Workers (CDWs). These are local people employed by the Department of Housing and Local Government. There are six CDWs assisting councillors across the LM. The role of these CDWs is to represent their communities at the local and district government level and to identify potential development opportunities and needs. Once a month all CDWs meet with the municipal officials in Pofadder to discuss common issues.

Nama Koi Local Municipality

The Nama Koi LM is the largest of the six local municipalities in the NDM. Springbok is the seat of administration and an important economic hub for the mining industry in the NDM. This town is important to the Project as it will serve as an important labour pool and procurement centre. The mining settlements of Steinkopf and Nababeep may be of relevance to the Project as potential labour sending areas as a result of recent mine closures. The Nama Khoi LM is the largest contributor to the GDP of the NDM, contributing 41.7 % to the District's GDP. Its key sectors are mining and agriculture. The governance structure of Nama Khoi LM is similar to what has been described for the Khai Ma LM above.

6.2.4 Political Administration

The ANC has the majority vote in the municipality, but Cope and the DA have a strong following. According to the results of stakeholder consultations, much of the development in the area is highly politicised. In addition, it was reported that this can affect the role of councillors who allegedly make decisions based on the political mandate of their parties, allegedly affecting levels of information shared and employment opportunities [(1)].

6.3 PROJECT AREA OF INFLUENCE

The Project is located within the Northern Cape Province and the NDM, along the N14 national road [(2)] which bisects BMM's [(3)] mining licence area. The Project is situated wholly in the Khai Ma LM, approximately 45 km to the west of Pofadder and 120 km to the east of Springbok (see *Figure 1.1*). The Gamsberg Inselberg itself is located approximately 33 km south of the Orange River, South Africa's longest river and an important river in the Northern Cape Province.

The Project Area of Influence is defined as the area that is significantly impacted by the Project and associated infrastructure and facilities. The geographic extent of the Area of Influence varies depending on the receptor of the impact being discussed. The Project and associated infrastructure is

(1) Focus group meeting with Pofadder women, 11 September 2012.

(2) The N14 national road connects Upington and Springbok, both of which are important economic centres in the Northern Cape.

(3) BMM is the existing mining right's holder and is a subsidiary of Vedanta Resources Plc.

isolated and located on BMM owned land and is surrounded by private commercial farming land. This has bearing on the way the Area of Influence is subdivided (see *Figure 6.2*).

The Area of Influence is sub-divided as follows:

- immediate Area of Influence;
- direct Area of Influence; and
- indirect Area of Influence.

Immediate Area of Influence

The immediate Area of Influence is the Project footprint and a two kilometre buffer around the Project footprint to include any fence areas and receptors that will be impacted by Project activities.

Direct Area of Influence

The direct Area of Influence is defined in terms of the MPRDA which stipulates that a Project's Area of Influence extends to a 50 km radius from the Project site. The settlements within the Project's direct area of influence include Aggeneys, Pella and Pofadder.

Indirect Area of Influence

The indirect Area of Influence extends to all areas that will be indirectly affected by the Project. Based on this definition the indirect Area of Influence extends to the Port of Saldanha Bay where the zinc will be shipped from. Witbank, Onseepkans and Springbok form part of the Project's area of indirect influence as potential labour sending areas and in the case of Springbok as a regional economic centre.

Figure 6.2 Project Area of Influence

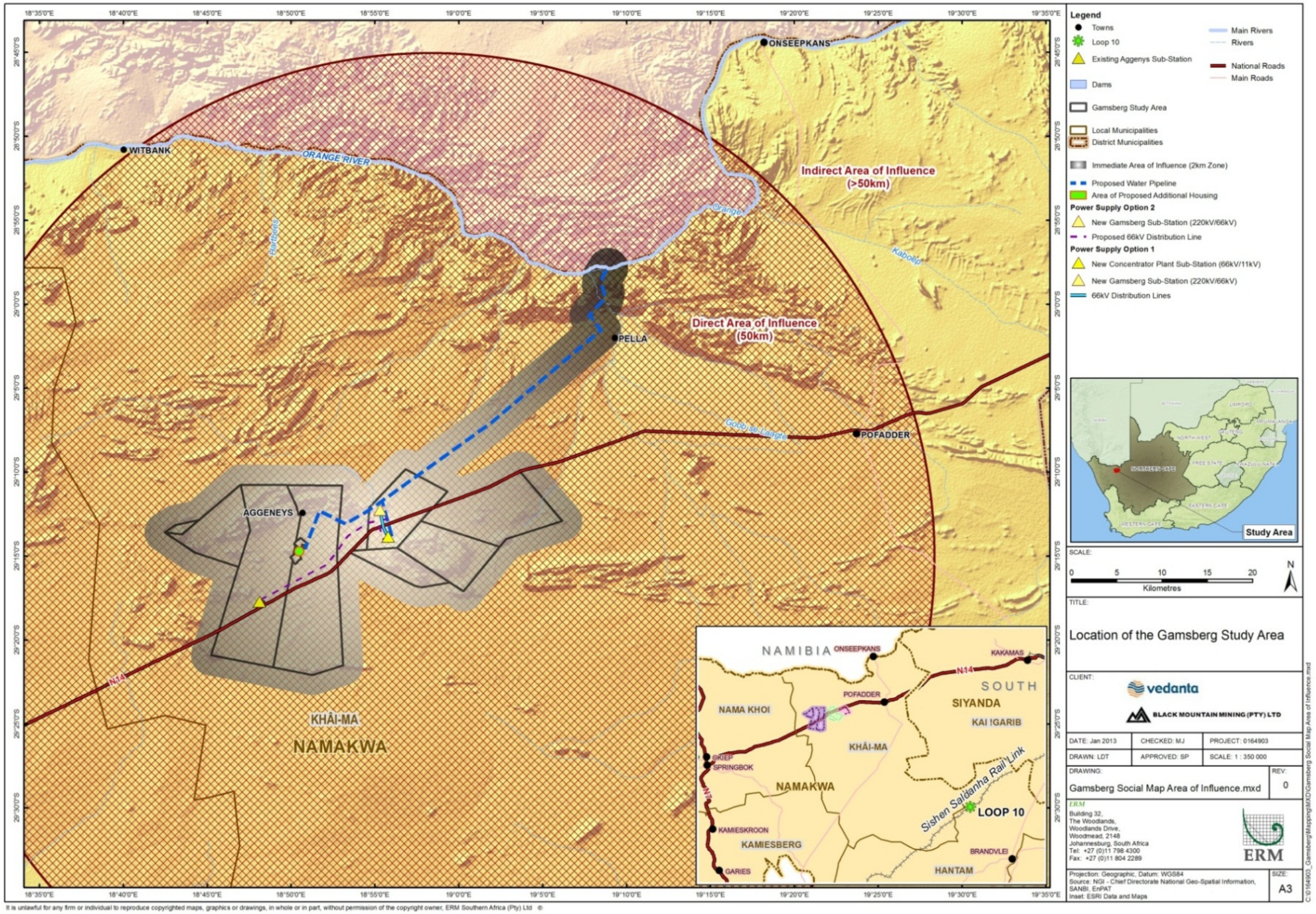


Table 6.2 below lists the settlements located in the direct and indirect area of influence and their proximity to the Project site.

Table 6.2 List of Settlements Included in the Social Impact Assessment

Settlement	Proximity from the Project Site
Aggeneys	20 km
Pella	33 km
Pofadder	45 km
Witbank	84 km
Onseepkans	95 km
Springbok	120 km

6.3.2 Settlements in the Project's Area of Influence

A brief description of each settlement in the Project Area of Influence is outlined in *Table 6.3* below.

Table 6.3 Brief Description of Settlements in the Project Area of Influence

Town	Description
Aggeneys (Rural, Formal)	• Aggeneys is situated 20 km from the project location. It originated as a mining town owned by BMM, to house employees working at BMMs mining operation. The town has recently been incorporated as an official town within the Khai Ma LM. • Aggeneys is the largest concentration of people in close proximity to the project location with an estimated population of 2,500 [(1)] of whom approximately 750 are permanently employed at the mine. The rest of the population include the immediate relatives of those permanently employed as well as people indirectly employed to service the mine. • The key livelihood activity is employment at the mine; however, Aggeneys boasts a small commercial centre which supplies services to the community of Aggeneys. These services include plumbing, electrical, postal and banking services as well as convenience stores amongst others. • BMM supplies the town with the majority of infrastructure and services required including water and electricity, which it procures directly from Eskom for its mining operations.

(1) Black Mountain Mining, 2010, Gamsberg Zinc Project: Final Socio-Economic Baseline Report, Report no.:396036/5 (prepared by SRK Consulting).

Town	Description
Pella (Rural, Formal)	• Pella is 33 km from the project site and 13 km from the N14 national road. Pella was originally a mission station providing refuge for Khoisan people driven out of Namibia. The Cathedral in Pella is a tourist attraction in the town. • According to Stats SA, 2001, the population of Pella is 1,425 (1) although more recent estimates suggest a population of 4,000 people (2) and an estimated 685 households (3). • The key livelihood activities in Pella are in the agricultural sector. People engage in subsistence farming on the banks of the Orange River. There are a number of projects in the area, these include Hoodia and Geranium farming projects, date orchards for export as well as a brick making project which is funded by BMM. • Services and infrastructure are underdeveloped in Pella. The water supply in Pella is drawn directly from the Orange River. This supply is managed by the Pella water board which is in turn managed predominantly by BMM representatives. According to the Khai Ma IDP (2010-2011), Pella has a service backlog of 463 houses, 48 water connections, and 103 sanitation connections with 106 households still using the bucket system.
Pofadder (Rural, Formal)	• Pofadder is the administrative seat of the Khai Ma LM and has developed as an agricultural service centre for the surrounding farming community. It is approximately 45 km from the Project site on the N14. • Pofadder has an estimated 808 households (4) and an estimated population of 6,500 (5). • The key economic activity in Pofadder entails services to the farming community. A number of people are employed as casual workers on surrounding farms and work only when there is demand. • The town is fairly developed with the exception of electricity reticulation. This has been identified as one of the basic service delivery priorities in the area because the system is old and needs to be expanded and upgraded (6).
Witbank (Rural, Formal)	• Witbank is situated on the Orange River and is isolated from other towns in Khai Ma. It is approximately 110 km from Pofadder and only accessed by a gravel road. It is registered in the name of Witbank Development Trust. • The settlement consists of 77 households. • The key livelihood activity is farming along the Orange River. • Services and infrastructure are underdeveloped and limited. Witbank has no electricity reticulation and 17 households have no access to water or sanitation. The settlement has a crèche, clinic and police station. The gravel road used to access Witbank is in a poor condition.

(1) StatsSA, 2001, Population Census. This is the most recent official population estimate for Pella.
(2) Black Mountain Mining, 2010, Gamsberg Zinc Project: Final Socio-Economic Baseline Report, Report no.:396036/5 (prepared by SRK Consulting).
(3) Khai Ma IDP 2010-2011.
(4) Khai Ma IDP 2010-2011.
(5) Black Mountain Mining, 2010, Gamsberg Zinc Project: Final Socio-Economic Baseline Report, Report no.:396036/5 (prepared by SRK Consulting).
(6) Khai Ma IDP 2010-2011.

Town	Description
Onseepkans (Rural, Formal)	• Onseepkans is a small border post settlement situated 95 km from the mine, en-route to Namibia. Onseepkans has three settlements namely Melkbosrand, Viljoensdraai and Sending. • Onseepkans has approximately 345 households (1) with a population of approximately 2,000. • The key livelihood activity is farming which is reliant on the Orange River for irrigation. The agricultural crop Hoodia has recently been introduced in the area. • The services and infrastructure are limited and in poor condition. Onseepkans has a housing backlog of 196 houses. According to the Khai Ma IDP (2010-2011), the number of houses without water, sanitation and electricity are 40, 45 and 53, respectively (2).
Springbok	• Springbok is the major economic centre of the area and is the seat of the Namakwa DM. It is situated approximately 120 km from the site. Springbok forms part of one of four development/transport corridors in the Northern Cape Province identified in the Provincial Government Development Strategy. • The population of Springbok is estimated at 8,400 people (3). • Springbok has been identified as an emerging growth centre and the Local Development focus is currently placed on diversifying the local economy and supporting SMMEs. Springbok provides services to the surrounding mining and farming sectors and it serves as the tourism gateway to Namaqualand. A key issue is to sustain growth in the face of the downscaling of mining in the Springbok area. • Services and infrastructure in Springbok are well developed, although there is growing pressure on services due to increasing population. The main district hospital is found in Springbok and due to the dispersed nature of settlements people come from great distances to visit the sick in hospital. The District Growth and Development Strategy (DGDS) (2008) make provision for housing for families visiting the hospital in Springbok (4).

6.4 *POPULATION STATISTICS*

The Northern Cape covers 372 889 km^2 and has a population of 1,145,861 people (5). Despite having the largest surface area of South Africa's nine provinces, the population of the Northern Cape represents only 2.2 % of the national population. According to the census 2011 data, the Northern Cape experienced out-migration of 69,527 and in-migration of 62,792 resulting in a net loss of 6,735 (6). People mostly migrated to the Western Cape, Gauteng, and Limpopo Provinces in search of employment opportunities. By means of comparison, migration to the Eastern Cape Province increased significantly between 2006 and 2011.

(1) Khai Ma IDP 2010-2011.
(2) Khai Ma IDP 2010-2011.
(3) Black Mountain Mining, 2010, Gamsberg Zinc Project: Final Socio-Economic Baseline Report, Report no.:396036/5 (prepared by SRK Consulting).
(4) Namakwa District Municipality, 2009, 'Local Economic Development', Project Khuli's Unmotho (prepared by UrbanEcon Development Planners).
(5) StatsSA, 2012.
(6) Stats SA, 2012, Digital Census Atlas: Overview Maps, StatsSA online, Available at: <http://geoinfo.statssa.gov.za/censusdigitalatlas/DigitalCensusOverviewMapsTestPage.aspx>, Accessed: 06 January 2013.

Despite the large area covered by the NDM (126,747 km^2), it has a small and dispersed population. The total population is estimated at over 115,842 with a population density of 0.91 people/km [1]. The population distribution for the NDM is shown in *Table 6.4*.

The LM has had a modest population growth but has seen a marginal increase in the proportion it represents of the DMs population. In 2011 it was home to 10.7 % of the District's population compared to 10.6 in 2001. The Nama Khoi LM is home to 40.6 % of the District's population and has had a steady increase since 1996

Table 6.4 Namakwa District Population Distribution

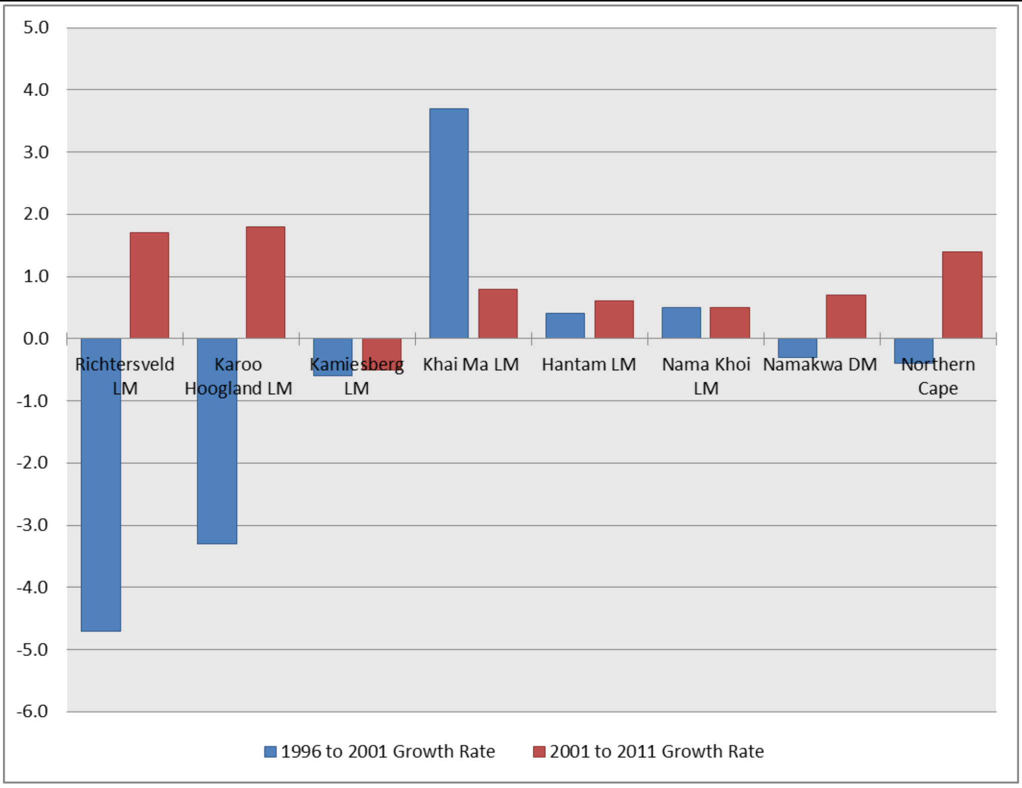
Municipality	**1996 Population**		**2001 Population**		**2011 Population**	
	Number	%	Number	%	Number	%
Richtersveld LM	12,819	11.7	10,125	9.4	11,982	10.3
Karoo Hoogland LM	12,387	11.3	10,512	9.7	12,588	10.9
Kamiesberg LM	11,064	10.1	10,754	9.9	10,187	10.2
Khai Ma LM	9,550	8.7	11,469	10.6	12,465	10.7
Hantam LM	19,942	18.2	20,351	18.8	21,578	18.6
Nama Khoi LM	43,841	40	44,900	41.5	47,041	40.6
Namakwa DM	**109,603**	**100**	**108,111**	**100**	**115,842**	**100**

Source: Sats SA, 2012 [2].

Figure 6.3 shows the growth rates for the LMs in the NDM. Since 2001 all LMs except Kamiesberg LM experienced positive growth. The Khai Ma LM had a growth rate of 0.8 % over the past 10 years, down from 3.7 % between 1996 and 2001.

(1) StatsSA, 2012, 'Census 2011 Northern Cape Municipal Report', Report No. 03-01-51.
(2) Sats SA, 2012, 'Census 2011 Northern Cape Municipal Report', Report No. 03-01-51.

Figure 6.3 ***Growth Rates of Local Municipalities in the Namakwa DM from 1996 to 2011***



Source: Stats SA, 2012 (1).

The population numbers and trends for Aggeneys, Pella, Witbank, Onseepkans, Pofadder and Springbok are provided in *Table 6.5*.

Table 6.5 ***Population Trends for the Affected Towns***

Town	Population (Urban)	Estimated Population (urban)**	Population trend
Pella	1425*	1436	Remained the same
Witbank	300“	248	Decline
Aggeneys	2,500^	2520	Remained the same
Onseepkans	1500“	2016	Growth
Pofadder	6,500*	6552	Remained the same
Springbok	8,400	8442	Remained the same

* Based on 2001 census figures, ^ Based on the Institute of Natural Resources Household Survey
“ Based on the 2009 pre-feasibility socio-economic baseline study
**Based on a 0.8 percent growth rate

Source: Black Mountain Mining, 2010 (2).

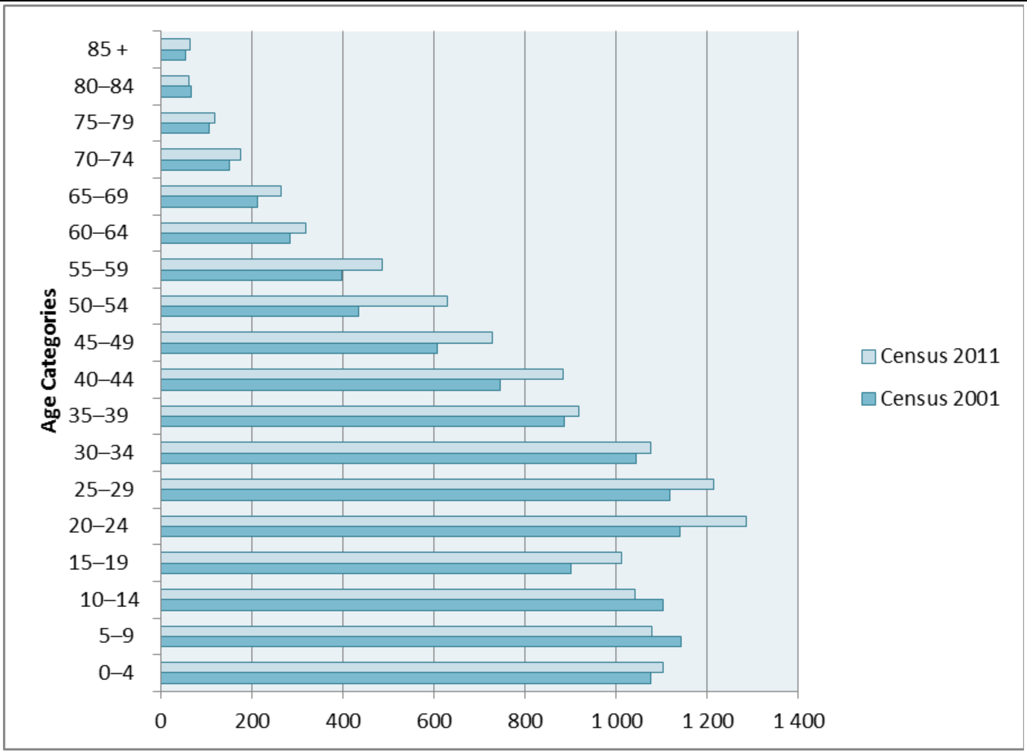
6.4.1 *Age*

Figure 6.4 shows that the proportion of the population under the age of 15 has decreased and the proportion of the population between the ages of 19 and 40 increased for the Khai Ma LM between 2001 and 2011. Over the same period,

(1) Sats SA, 2012, 'Census 2011 Northern Cape Municipal Report', Report No. 03-01-51.
(2) Black Mountain Mining, 2010, Gamsberg Final Baseline Socio-economic Report. Report no.: 396036/5.

the proportion of the population above the age of 65 has grown, resulting in a higher dependency on the diminishing population that is economically active, this is exacerbated by the low levels of employment (see *Sections 6.8.4* and *6.8.6* for further details on employment and household income). The reason for the increase in the proportion of the population over 65 years is not apparent. This increase is however in accordance with the increase in national life expectancy from 56 years in 2005 to 60 years in 2011 (1).

Figure 6.4 *Age Trend of Khai Ma Local Municipality for 2001 and 2011*



Source: Stats SA, 2012 (2).

Approximately 68 % of the population is in the 15-64 age group and is able to contribute to the economic base of the Municipality, provided that the skills base is matched to available employment. This is however not the case, *Section 6.8.5* provides further detail on why there continues to be a high dependency on State support and continued pressure on infrastructure and services.

6.4.2 *Gender*

The gender distribution for the Northern Cape is fairly even with 49.31 % being male and 50.69 % being female. *Table 6.6* shows that there is a slight difference between the Namakwa District and Khai-Ma Municipalities in terms of the gender distribution. Khai-Ma has a greater percentage of males

(1) David Smith, 2012, "Aids drugs increase South African life expectancy by five years", The Guardian (online), 3 December 2012, Available at: http://www.guardian.co.uk/world/2012/dec/03/aids-drugs-south-african-life (accessed: 4 January 2013).
(2) Stats SA, 2012, 'Census 2011 Northern Cape Municipal Report', Report No. 03-01-51.

(52.63 %) than females (47.37 %) compared to Namakwa DM which has a relatively even distribution of males to females. A possible reason for this disparity in the LM is that mining is the biggest employer in the area which, in general, attracts more male workers.

Table 6.6 *Gender Profile of Namakwa DM and Khai Ma LM in 2011*

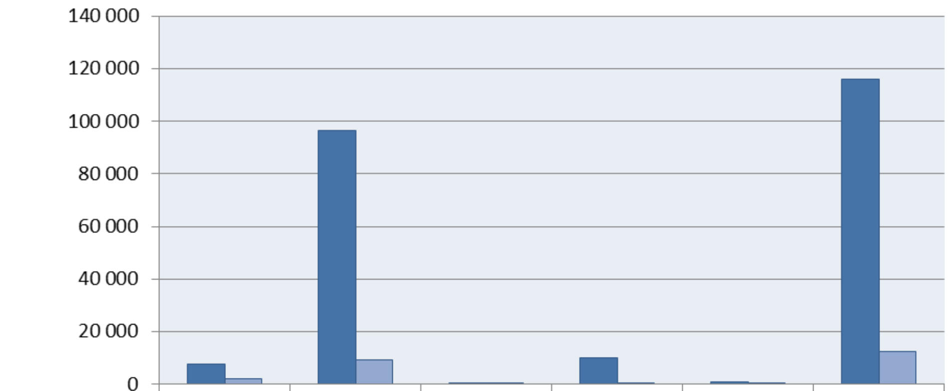
Gender	Namakwa DM		Khai Ma LM	
	Number	Percentage (%)	Number	Percentage (%)
Female	57,568	50.30	5,905	47.37
Male	58,274	49.70	6,560	52.63
Total	**115,842**	**100**	**12,465**	**100**

Source: Stats SA, 2012 (1).

6.5 RACE, ETHNICITY AND LANGUAGE

The racial profile of the Namakwa District and Khai-Ma LM is shown in *Figure 6.5*. The NDM and LM predominantly comprise Coloured South Africans. In the NDM, the White population (13.9 %) is larger than the other minority population groups, while in the LM there are significantly more Black people than White people (2). It is important to note that many of the people who would normally be defined as Coloured are of Nama decent; they are well integrated into the communities, however there are attempts made by members of the community to reaffirm their Nama culture and heritage (3).

Figure 6.5 *Population Distribution by Race According to Census 2011*



	Black	Coloured	Indian/ Asian	White	Other	Total Population
Namakwa DM	7 904	96 360	612	10 113	853	115 842
Khai Ma LM	2 195	9 359	55	754	103	12 465

Source: Stats SA, 2012 (4).

Afrikaans is the most widely spoken language with 90.4 % and 81.3 % of Afrikaans speaking inhabitants in NDM and the LM, respectively (see *Table*

(1) Sats SA, 2012, 'Census 2011 Northern Cape Municipal Report', Report No. 03-01-51.
(2) Sats SA, 2012, 'Census 2011 Northern Cape Municipal Report', Report No. 03-01-51.
(3) Stefanus April, Pella Councillor, 20 June 2012 (Personal Communication).
(4) Stats SA, 2012, 'Census 2011 Northern Cape Municipal Report', Report No. 03-01-51.

6.7). The other widely-spoken language in the LM is Setswana (10.7 %). Nama is spoken in the area but only the older generation still speaks the language. The precise percentage of people speaking Nama cannot be confirmed. Population numbers for the wider study area are provided in below.

Table 6.7 Language Groups of the Namakwa DM and Khai Ma LM

Language	Namakwa DM		Khai Ma LM	
	Number	Percentage (%)	Number	Percentage (%)
Afrikaans	104,772	90.4	10,131	81.3
English	1,365	1.2	144	1.2
isiNdebele	140	0.1	22	0.2
isiXhosa	1,725	1.5	270	2.1
isiZulu	193	1.2	35	0.3
Sepedi	100	0.1	30	0.2
Sesotho	350	0.3	84	0.7
Setswana	1,906	1.6	1,332	10.7
Siswati	55	0.04	21	0.2
Tshivenda	69	0.05	12	0.1
Xitsonga	34	0.03	1	0.01
Sign Language	343	0.3	26	0.2
Other	526	0.5	61	0.5
Not Applicable	4,268	3.7	296	2.3
Total	**115,842**	**100**	**12,465**	**100**

Source: Stats SA, 2012 [1].

6.6 EDUCATION

In 2001 there were 268,591 learners aged between five and 24 years enrolled at school, compared to 289,812 learners [2] enrolled in 2011, an increase of 7.9 %. The 2011 census data shows that 11.3 % of the Northern Cape population aged 20 years and above has no education, 17.1 % has some primary education and approximately 35 % has some secondary education. Only 7.6 % were reported to have higher education in 2011 [3].

In the NDM 39.4 % of the population aged 20 years and above has received some level of secondary education, while a relatively small number (6.6 %) have not received any form of formal education (see *Table 6.8*). Of the communities in the LM 1.2 % of the population aged 20 years and above have no schooling, 8.4 % have completed primary school, 18.1 % have completed Grade 12 and 5.8 % have some form of post-matric qualification [4]. In summary the levels of education and thus the skills base is low and it suggests that only 23.8 % of the population aged 20 years and above would be eligible for employment opportunities that require Grade 12.

(1) Stats SA, 2012, Census 2011 Interactive Data Online, Available at: http://interactive.statssa.gov.za/superweb/loadDatabase.do?db=Language11_wd, Accessed: 06 January 2013.
(2) Sats SA, 2012, 'Census 2011 Northern Cape Municipal Report', Report No. 03-01-51.
(3)Sats SA, 2012, 'Census 2011 Northern Cape Municipal Report', Report No. 03-01-51.
(4)Sats SA, 2012, 'Census 2011 Northern Cape Municipal Report', Report No. 03-01-51.

Table 6.8 *Education Levels Attained by the Population Aged 20 years and above in the Namakwa DM and Khai Ma LM*

Level of Education	Namakwa DM		Khai Ma LM	
	Number	Percentage (%)	Number	Percentage (%)
No schooling	4,794	6.6	314	1.2
Some primary	12,928	17.7	1,404	17.5
Complete primary	7,332	10.0	672	8.4
Some secondary	28,743	39.4	3,712	46.3
Std 10/Grade 12	13,737	18.8	1,449	18.1
Higher	5,396	7.4	462	5.8
Total	**72,930**	**100**	**8,013**	**100**

Source: Stats SA, 2012 [(1)].

A list of schools in Pella, Witbank, Aggeneys and Onseepkans is provided in *Table 6.9.* Pella, Witbank and Onseepkans do not have secondary schools; most of the children living in these settlements attend secondary school in Pofadder and Aggeneys with few attending secondary school in Springbok. *Box 6.1* describes one of the Secondary schools in the area.

Table 6.9 *The Number of Schools in the Areas of Influence*

Settlement	Pre-primary School	Primary School	Secondary/ High School
Direct Area of Influence			
Pella	1	1	0
Pofadder	0	2	1
Aggeneys	2	1	1
Indirect Area of Influence			
Onseepkans	1	2	0
Witbank	1	1	0
Springbok	not known	11	4

Source: Black Mountain Mining, 2010, Gamsberg Final Baseline Socio-economic Report. Report no.: 396036/5.

(1) Stats SA, 2012, 'Census 2011 Northern Cape Municipal Report', Report No. 03-01-51.

Box 6.1 *Boesmanland High School in Pofadder*

The high school services the communities of Pofadder, Pella, Witbank, and Onseepkans (see *Figure 6.7*). It has two boarding houses for learners that do not reside in Pofadder which is highly subsidised by the Department of Education. Learners are required to pay school fees of R180 per year and those that are in boarding school are required to pay an additional R600 per year.

The high school has 518 learners and 16 academic staff members. This translates to a learner-teacher ratio of 32:1. At the time of the study the school was considered as an underperforming school. The Grade 12 pass-rate dropped from 87.8 % in 2005 to 64 % in 2011. It is believed that the decline can be attributed to high staff turn-over and instability in the school governance system, as well as unqualified personnel. According to the school principal, a key factor in the learners' success at school is commitment from parents. The school has initiated a program that involves both parents and learners as a means of supporting the learners.

On average, 180 leaners are enrolled into high school from the feeder primary schools but this compares to 65 Grade 12 learners. This suggests that approximately 70 % high school learners do not complete Grade 12. The school principal believes that the primary reason learners leave school is because of the limited post-school opportunities. Learners from Onseepkans comprise the largest proportion of school dropouts; they are leaving to pursue agricultural job opportunities.

Figure 6.6 *Boesmanland High School*

6.6.1 *Education Bursaries*

There are two education bursaries available for learners in the LM, the BMM Bursary Fund as well as the Namakwa Diamond Trust (NDT). In addition to these bursary funds, the Department of Education support learners through subsidisation for boarding facilities and school fees at State schools such as Boesmanland High School.

The BMM Bursary Fund is perceived to be strictly for students who wish to enter the field of mining engineering. BMM also offers a work-exposure programme for high school learners in Aggeneys and Pofadder annually for 10 learners. Due to the lack of accommodation in Aggeneys and public transport, it means that only learners from Aggeneys high school can benefit from the work exposure programme. According to the Boesmanland High School Principal, the BMM bursary fund is underutilised as many of the learners do not attain the minimum admission requirements for Universities in the fields of science and engineering.

The NDT derives its funding from royalties from State-owned mining company Alexkor for the people of the Namakwa area. This funding is aimed at poverty alleviation projects as well as bursaries to support learners. The NDT bursary fund, provided through the schools, provides support for learners from Onseepkans and Witbank to attend high school. The NDT bursary fund pays for transport, boarding school fees, school uniform as well as school fees. These fees are paid directly to the schools.

Some of the youth claim that access to information on the bursaries is restricted and although they are aware that these bursaries exist they do not know specific details to apply in time in order to benefit from the bursary schemes.

The Northern Cape Department of Education also provides support to learners through State subsidies for school fees and boarding school fees as well as bursaries for learners. For example, those students that benefit from the state bursary only have pay R600 per annum for boarding school, which would not normally cost R5,000 per annum [(1)].

6.6.2 *Options for Post-School Study*

There are significant barriers to further education; including financial, logistical and skills level barriers. Despite the bursaries available, only learners with exceptional school results and those who have maths and science as subjects can apply. As such the bursaries are underutilised.

Those students that can afford it attend Further Education and Training (FET) Colleges in Springbok. Alternatively learners leave the area in search of work.

(1) Ms Van Rooyen, School Principal, 11 September 2012, personal communication.

6.6.3 *Skills*

The skills base in the local communities are low, perpetuating the cycle of poverty and disempowerment and deepening dependency on the state. The low skills base is recognised by the NDM who have plans underway to establish an FET college and Artisan training centre in Aggeneys. According to the Local Economic Development Manager of the NDM, the education system does not equip learners to become active in the key economic sectors of the Province, which include mining and agriculture. Another concern is the skills drain to other Provinces due to the down-scaling of mines in the NDM. Skilled labour is migrating to other areas of the Northern Cape Province, as well as the Western Cape, Gauteng, and Eastern Cape Provinces.

6.7 *HEALTH*

6.7.1 *Health Facilities*

In the Northern Cape Province the provincial hospitals are located in Springbok and Upington. Most settlements in the LM have primary healthcare clinics or mobile clinics (1) which regularly visit communities (2).

In Aggeneys, Pella, Pofadder and Springbok the primary healthcare clinics are functional (see *Figure 6.7*). Where the doctor is unable to assist patients, they are referred to Springbok Hospital. According to women interviewed in Aggeneys, Pella and Pofadder, the health care service provided is inadequate. Their key complaints relate to:

- generally poor quality of service and infrastructure and a lack of appropriate equipment;
- slow referral system leading to further deterioration of health;
- long waiting periods, it is not uncommon for a visit to the clinic to take an entire day waiting in cramped and unhygienic conditions; and
- shortage of medicine and qualified personnel.

(1) The mobile clinics visit the rural communities of Khai Ma LM, such as farm workers who live on farms that would have no access to medical services otherwise.
(2) Black Mountain Mining, 2010, Gamsberg Zinc Project: Final Socio-Economic Baseline Report, Report no.:396036/5 (prepared by SRK Consulting).

Figure 6.7 Pofadder Community Centre which Houses the Clinic and Library

The older members of the communities tend to use medicinal plants to help with chronic illnesses such as high blood pressure and diabetes as they do not completely trust the health care provided. More detail on the various plants utilised is provided in *Section 6.8.7.*

Below is a more detailed description of the health care facilities at the LM.

Pofadder Health Care Services and Facilities

Pofadder has a 12-bed Community Health Centre with a maximum capacity of 18 beds which is in the process of being renovated. A doctor is permanently present at the Community Health Centre. The maternity ward has two beds. There were 44 births from January to September 2012. The mobile clinic provides health care services to the surrounding farms. However, it does not operate as often as it should because of limited health care professionals, thus placing additional burden on the Pofadder clinic. There are currently two nurses and one doctor that services Pofadder. The doctor visits the clinic once a week.

The Community Health Centre in Pofadder has two ambulances, which collect patients from Pella, Aggeneys, Witbank and Onseepkans, however these ambulances are old and often breakdown [1]. Currently only one ambulance is in operation and it only transports patients to Springbok Hospital (see *Figure*

(1) Black Mountain Mining, 2010, Gamsberg Zinc Project: Final Socio-Economic Baseline Report, Report no.:396036/5 (prepared by SRK Consulting).

6.8). Due to the high demand, the ambulance transports multiple patients simultaneously. Once patients have received the necessary medical care at the Springbok Hospital, they have to find their own transport to get back home.

Figure 6.8 ***One of Two Ambulances Servicing Khai Ma LM***

Aggeneys Medical Services and Facilities

Aggeneys has one state clinic and one private clinic. The state clinic does not charge patients a consultation fee nor does it charge for medication, while the private clinic charges patients R180.00 for a consultation and patients have to purchase their medicine from a private pharmacy. There have been complaints that the pharmacy does not always stock medication that is prescribed [(1)].

The state owned clinic in Aggeneys does not receive adequate government support. The clinic is not equipped with a telephone nor does it have cleaning staff. It is also known to run out of basic necessities like toilet paper and stationary, which staff report having to purchase at their own expense. Due to limited government support, the clinic is currently receiving assistance from BMM and the private clinic in Aggeneys [(2)].

Pella Medical Services and Facilities

The clinic at Pella was recently expanded and upgraded. The clinic has two trained nurses who are paid by the Department of Health. All healthcare services are free of charge including the provision of medicine. Every Thursday between 14:00 to 18:00 a doctor from Pofadder Community Health Centre visits the clinic and attends to an average of 30 patients a day [(3)]. This suggests that each consultation with the doctor lasts for 8 minutes.

(1) Aggeneys Women's Focus Group Meeting (Pers. Comm., 12 September 2012).
(2) Black Mountain Mining, 2010, Gamsberg Zinc Project: Final Socio-Economic Baseline Report, Report no.:396036/5 (prepared by SRK Consulting).
(3) Black Mountain Mining, 2010, Gamsberg Zinc Project: Final Socio-Economic Baseline Report, Report no.:396036/5 (prepared by SRK Consulting).

The clinic at Pella is open from 08:00 to 16:00 and closed during the weekends and public holidays. After hours patients either phone the nurse on call or go to Pofadder Community Health Centre. Pella clinic does not have a maternity ward and women resident in Pella give birth at the Pofadder Community Health Centre. On average there are five births per month at the Pofadder Community Health Centre.

Onseepkans Medical Services and Facilities

The clinic at Onseepkans operates in the same fashion as the clinic at Pella, which is visited by the doctor once per week and has the same opening times. Similarly, women from Onseepkans do not have access to a maternity facility locally and have to give birth at the Pofadder Community Health Centre. For any emergencies the community of Onseepkans have to go to Pofadder to seek medical assistance, which is approximately 50 km away via a gravel road.

Witbank Medical Services and Facilities

The clinic at Witbank is only open twice a month by a visiting nurse from Pofadder Clinic. This is usually on the last Tuesday and Thursday of every month.

6.7.2 *State of Health*

The Northern Cape Province is affected by a number of health conditions and infectious diseases, which are primarily caused by poverty, poor nutrition and generally unhygienic living conditions. Some of the key health challenges faced by the Province include malnutrition and Foetal Alcohol Syndrome (FAS), tuberculosis (TB), chronic diseases such as hypertension and diabetes (of which the incidence rate has increased over the past five years), and HIV/AIDS.

Health problems reported to be prevalent in the Project's direct Area of Influence were, hypertension, diabetes, tuberculosis, HIV/AIDS, liver problems, stomach problems (bacterial infections, dysentery), headaches, arthritis and cancer [1]. For women in particular, high blood pressure was identified and anecdotal accounts suggest an increase in cervical and breast cancer. The most prevalent illnesses in children included diarrhoea, flu and measles. Key health issues prevalent in men were high blood pressure, liver problems and diabetes [2].

The primary causes of death in the Northern Cape include HIV/AIDS, hypertensive disorders, obstetric haemorrhage, pregnancy related sepsis and pre-existing medical disorders [3]. The proportion of men receiving treatment for hypertension in the Northern Cape is double that of the national average

(1) Based on information gathered in focus group interviews from the 2010 Gamsberg Socio-economic Baseline Report and the 2012 focus group interviews.
(2) Black Mountain Mining, 2010, Gamsberg Zinc Project: Final Socio-Economic Baseline Report, Report no.:396036/5 (prepared by SRK Consulting).
(3) Northern Cape Provincial Government, 2004.

(21.5 % compared to 10.7 %), while the proportion of women receiving treatment for hypertension is 35 % compared to 27.7 % nationally (1).

The infant mortality rate in the Northern Cape increased from 55.6 per 1,000 in 1996 to 58.8 per 1,000 in 2002 and then decreased to 33,4 per 1000 in 2007 (2). (). These rates are comparable to the national figures; in 2007 the national rate for the country was 70.9 per 1,000. Both the national and provincial rates for infant mortality are higher than the national targets for infant mortality, which is currently set at 15 per 1,000 (3).

6.7.3 *Communicable Diseases (HIV/AIDS, TB)*

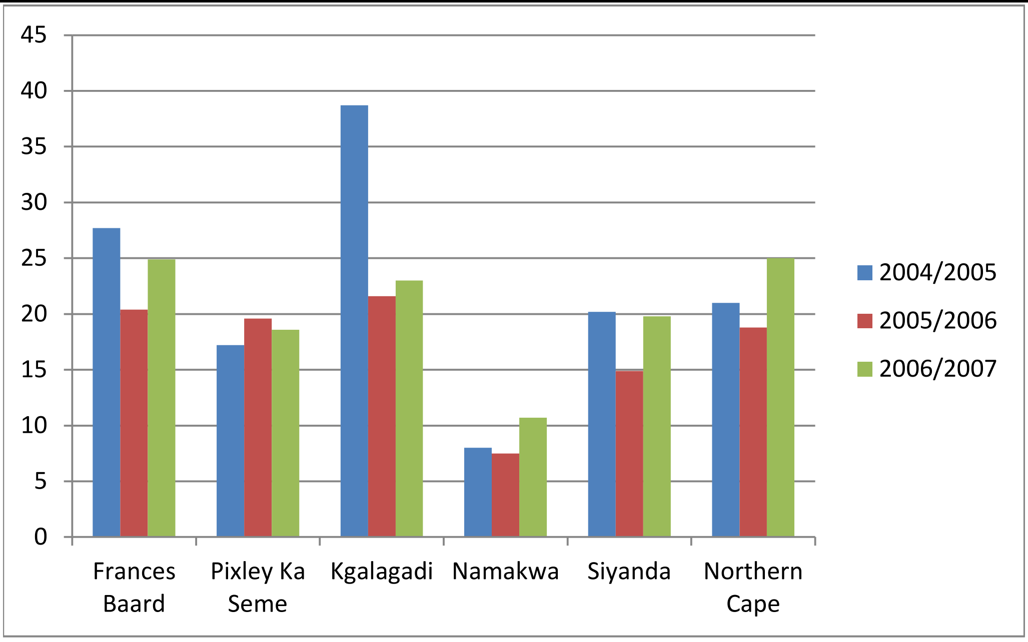
HIV/AIDS

Official HIV/AIDS statistics for the NDM and the LM are inferred from the Provincial statistics. Since 1997 HIV/AIDS has been amongst the ten leading underlying causes of death among individuals aged 15-49 years in the Province. The prevalence rates of HIV/AIDS for the country have increased from 9.4 % in 2001 to 10.6 % in 2011. The prevalence rate for women aged between 15 and 49 is 19.4 %, which suggests that one in five women in South Africa is HIV positive (4). The prevalence rate for men is 13.3 %, which has been deduced from the prevalence rate of 10.6 % for adult males (aged 15 to 19). Although the Northern Cape has followed a similar trend over the same period, the prevalence rates for the Province is now much lower than the national rates (5).

Figure 6.9 illustrates the incidence of HIV/AIDS in the Northern Cape Province according to District Municipalities. The incidence in the NDM increased from eight % in 2004/2005 to 10.7 % in 2006/2007. The incidence of HIV/AIDS in the NDM is lower than other municipalities and the Province.

(1) Northern Cape Department of Health, 2006.
(2) Northern Cape Province Fifteen Year Review 2009.
(3) Northern Cape Department of Health, 2006.
(4) Stats SA, 2011, Mid-year Population Estimates', Statistical Release P0302, Pretoria.
(5) Black Mountain Mining, 2010, Gamsberg Zinc Project: Final Socio-Economic Baseline Report, Report no.:396036/5 (prepared by SRK Consulting).

Figure 6.9 *HIV/AIDS Incidence Rate in the Northern Cape Province (According to Voluntary Counselling and Testing data)*



Source: Black Mountain Mining, 2010, Gamsberg Final Baseline Socio-economic Report. Report no.: 396036/5.

In 2004, as one of the preventative measures against HIV/AIDS, the Department provided 154 facilities with Voluntary Counselling and Testing (VCT) services.

Hope for Life, a Community Base Organisation (CBO) assisting people in Aggeneys, Pella, Witbank and Onseepkans with HIV/AIDS awareness and training, argues that the number of people with HIV/AIDS is much higher than the statistics show. Hope for Life provides home based care for HIV/AIDS patients that are bed-ridden; they also provide care for disabled people and work closely with the Department of Social Services and Population Development. Each of the four Hope for Life workers in Pofadder had six patients at the time of consultation and can have up to 10 patients.

None of the state clinics in Pella, Aggeneys, Witbank and Onseepkans provide antiretroviral treatment (ARVs). Patients are referred to Pofadder Community Health Centre for HIV treatment. It is estimated that 38 people die from HIV/AIDS in NDM per month based on Provincial statistics of 11 deaths daily. It is estimated that four people die of HIV/AIDS in the Khai Ma LM [1].

Tuberculosis (TB)

TB is recognised as a key health concern for the District and Local Municipality. The Department of Health has a TB project underway, but details of this project and the infection rate cannot be confirmed. The nurse at

(1) Khai Ma LM, 2010, Rural Spatial Development Framework/Land Development Plan (prepared by Umsebe Development Planners).

the Pofadder clinic reported that they have cases of multi-drug resistant TB. Discontinuation of TB patient's treatment remains a challenge. It is reported that patients discontinue treatment after three months, by which time they generally feel healthy. They then begin to consume alcohol again.

Figure 6.10 Sign on Clinic Door Raising Awareness about the Spread of TB

6.8 DESCRIPTION OF THE BASELINE ECONOMIC ENVIRONMENT

The significance of impacts is often highly dependent on the economic environment or context within which they occur. For example, job creation in a small local community with a stagnating economy will be far more significant than it would be in a larger community with a healthy economy. With this in mind, this section describes the economic environment focusing on the local area and sub-region where the majority of impacts are likely to be felt. The main information sources used were Census 2001 and 2011 data, 2007 Community Survey data, Integrated Development Plans (IDPs), Locals Economic Development (LED) Strategies and Spatial Development Frameworks (SDFs).

Given the scale of the project, the economic context includes information on the Northern Cape, the Namakwa District, the Khai-Ma Local Municipal areas as well as, where available, the key local areas within the local municipality (eg Aggeneys, Pofadder, Pella, etc.). Note that the currently available Census 2011 data presented in this section only provides data for the four wards within the Khai-Ma Local Municipality and not necessarily for individual towns. The key towns and areas included in these wards are as follows:

- Ward 1: Pella, Onseekkans and surrounds.
- Ward 2: Pofadder and immediate surrounds.
- Ward 3: Klein Pella, Witbank and the nearby areas along the Orange River.

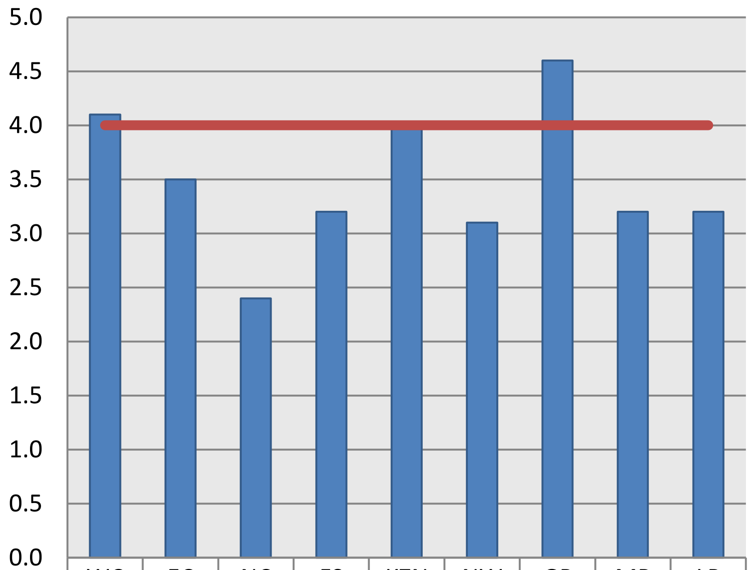
- Ward 4: Aggeneys and the rural area to the south and south east of Aggeneys.

Data is also provided for the neighbouring Nama Khoi Local Municipality area which includes the town of Springbok.

6.8.1 Economic Output, Growth and Development Trends

Figure 6.11 shows that the Northern Cape Province recorded the lowest average annual growth rate between 2001 and 2011. This figure relates to approximately 2.4 %, compared to the national growth rate of 4.0 % over the same period [(1)]. Despite this, the contribution of the Northern Cape economy to the national GDP has remained constant at between 2 and 2.2 %, throughout the period 1996 to 2011. This indicates that the province has kept pace with economic growth in general but has not experienced accelerated economic development.

Figure 6.11 Average Real Annual Economic Growth Rate per Region: 2001 - 2011



	WC	EC	NC	FS	KZN	NW	GP	MP	LP
GDPR 2001 - 2011	4.1	3.5	2.4	3.2	4.0	3.1	4.6	3.2	3.2
SA 2001 - 2011	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0

Source: Stats SA, 2012, ' Gross Domestic Product: Annual Estimates 2002-2011, Regional Estimates 2002-2011 - Third Quarter 2012', Statistical Release P0441, Pretoria.

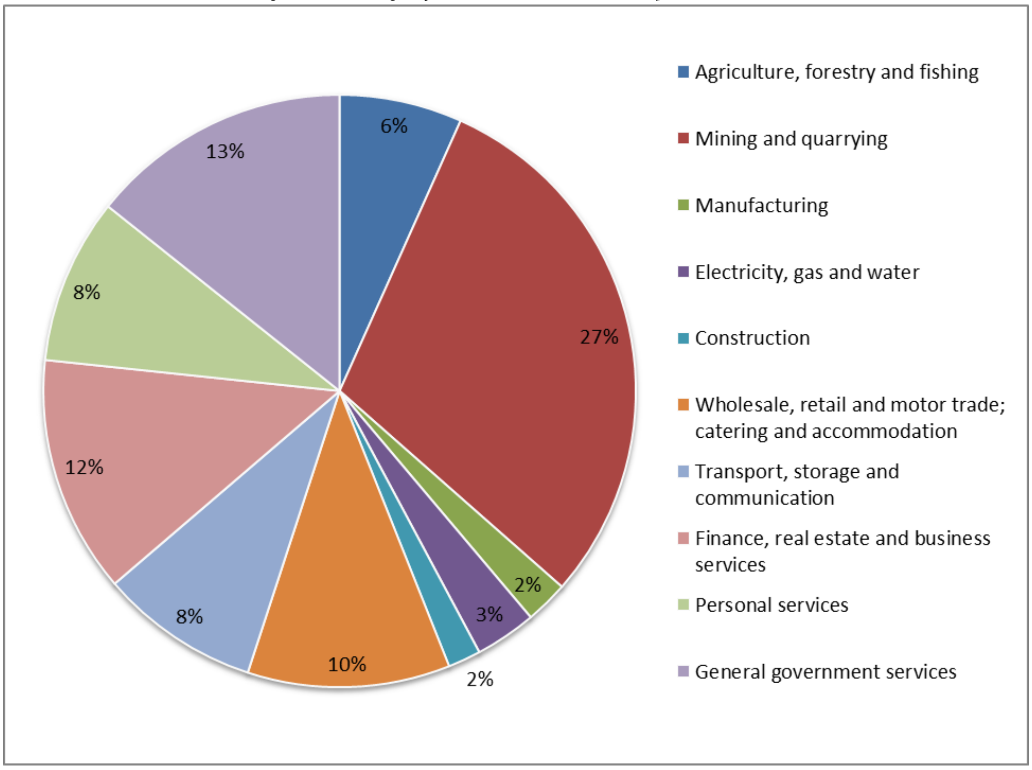
Figure 6.12 provides an illustration of the sectors that contributed to the Province's Gross Geographic Product (GGP) in 2011. Mining was the largest sector with a 27 % contribution to GGP. To illustrate the national importance of the Northern Cape mining sector, in 1998 the Province produced around 37 % of South Africa's diamond output, 44 % of its zinc, 70 % of its silver, 84 %

(1)Stats SA, 2012, ' Gross Domestic Product: Annual Estimates 2002-2011, Regional Estimates 2002-2011 - Third Quarter 2012', Statistical Release P0441, Pretoria.

of its iron-ore, 93 % of its lead and 99 % of its manganese [1]. Mining is followed by general government services at 13 %; finance, real estate and business services at 12 %; and wholesale, retail and motor trade including catering and accommodation at 10 %. Tourism is of growing importance in the NDM with the main attraction being the wild flower displays which occur from August to October annually [2].

Activity in secondary industries in 2011 (such as manufacturing) is low (6.7 %), when compared to other provinces (ie 18.2 % in the Western Cape and 20.2 % in Gauteng), with limited manufacturing and construction occurring in the Province [3].

Figure 6.12 *GGP Contribution by Industry of the Northern Cape Province in 2011*



Source: Stats SA, 2012.

The Namakwa District Municipality's regional gross domestic product (GDP) amounted to R3.77 billion in 2007. The Khai-Ma Local Municipality was responsible for roughly 10.3 % of this GDP with mining operations in Aggeneys making the most significant contribution (Urban-Econ, 2009). With regard to the rate of economic growth, *Figure 6.13* presents the GDP growth rates of the Namakwa District municipal area in comparison to the Northern Cape and country for the period 1996 to 2007. It shows that the Namakwa District's economy grew modestly at an annual average rate of 2 % over the

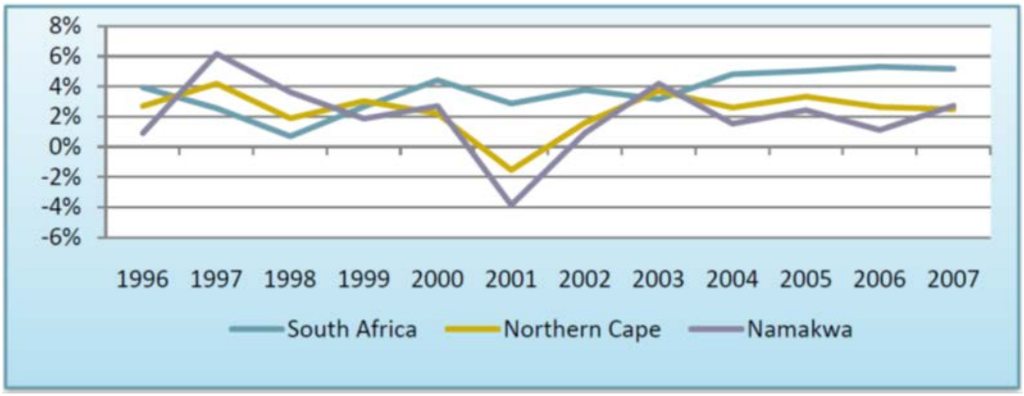
(1) Black Mountain Mining, 2010, Gamsberg Zinc Project: Final Social-Economic Baseline Report, Report no.:396036/5 (prepared by SRK Consulting).

(2) Stats SA, 2012, ' Gross Domestic Product: Annual Estimates 2002-2011, Regional Estimates 2002-2011 - Third Quarter 2012', Statistical Release P0441, Pretoria.

(3) Stats SA, 2012, ' Gross Domestic Product: Annual Estimates 2002-2011, Regional Estimates 2002-2011 - Third Quarter 2012', Statistical Release P0441, Pretoria.

period, whilst the provincial average was 2.4 % and the national average was 4 %.

Figure 6.13 Economic Growth Rates in the Northern Cape and Namakwa District (1996 - 2007)



Source: Quantec data in Urban-Econ, 2009.

Table 6.10 shows each LM contribution to the NDM's GDP in 2007 (1). The largest contributor was Nama Khoi with 41.7 % followed by the Richtersveld LM with 17.3 %. The Khai Ma contribution was relatively low at 10.3 %.

Table 6.10 Contribution of Local Municipalities to Namakwa DM GGP

Municipality	GDP (2007)	Percentage of District GGP (%)
Richtersveld LM	R 652,467.04	17.3
Nama Khoi LM	R 1,573,543.68	41.7
Kamiesberg LM	R 389,601.93	10.3
Hantam LM	R 444,112.48	11.8
Karoo Hoogland LM	R 341,288.30	8.3
Khai Ma LM	R 388,427.06	10.3
Namakwa DMA	R 10,682.84	0.3
Namakwa DM	**R 3,773,123.32**	**100**

Source: Namakwa LED, 2009.

Looking to future development trends, in its consideration for areas of economic opportunity, the Northern Cape Provincial Growth and Development Strategy (PGNC) was revised in 2011, with a view to sharpening its focus. The Strategy emphasises the need for growth, diversification and transformation of the provincial economy and poverty eradication through social development (PGNC, 2011). At the Namakwa District level, the IDP raises concern regarding low economic growth and calls for the establishment of a development – oriented and economically viable region to ensure sustainable growth (NDM, 2006). The 2009 District Municipality Local Economic Development (LED) Strategy also identifies a number of key opportunities including:

(1) The 2011 data is not yet available.

- Institutional Development for Investor Readiness.
- SMME Development.
- Agricultural Sector Development.
- Mining Sector Development (including the beneficiation projects, One-Stop Mining Centre and the implementation of new technologies).
- Industrial Development.
- Renewable Energy Development (including wind, wave, solar, and biogas energy).
- Space Research and Development Spin-offs.
- Tourism Development.
- Quality of Life Improvement.

In a similar vein, the local Khai-Ma Municipality LED strategy has a vision, 'To improve the living standards and conditions of residents through fully utilising its limited resources and to strengthen the local economy by creating an economically sustainable environment.' Its objectives are as follows (KMLM, 2011):

- Poverty relief through effective basic service delivery and job creation.
- Ensure effective service delivery through transformation, capacity building and infrastructure development.
- Form linkages in order to facilitate skills development.
- Promote business and investment attraction and retention.
- Assist with economic interventions in sector development (agricultural, mining, tourism and renewable energy).

6.8.2 Key Sectors of Namakwa District Municipality

Mining and agriculture are the largest employers in the NDM, providing approximately 40 % of the jobs. See *Section 6.8.4* for further detail on employment in these key sectors.

Mining

In 2007, the mining sector contributed 52 % to the District's GDP which made it the largest sector contributor. A key concern however, was that the sector's contribution to employment has been declining as a number of mines have closed. The sector had an annual growth rate of -0.3 % between 2001 and 2007. Figures are not yet available to confirm if there is a change in the growth rate trend.

There are still significant reserves of a range of minerals as well as unexploited deposits in the DM that can sustain the mining industry for years. The on-going challenge is achieving economic diversification however, to reduce the high dependency on mining as well as stimulating increased levels of minerals processing. *Figure 6.14* below depicts current mining activities in the LM

Figure 6.14   Deeps Mine Operated by BMM near Aggeneys

The LM has identified the following activities to support the mining sector as well as to ensure that the local communities derive greater benefits from the industry. These are as follows [1]:

- establish a permanent working group between the municipality and the mine managers responsible for developing plans;
- develop a database of available labour and skills to encourage the employment of local people;
- provide skills training and support programmes;
- instigate mining procurement opportunities in consultation with the mines, develop a database of such opportunities and ensure that this information is made available to local business and communities; and
- develop a small scale mining strategy.

The existing Black Mountain Mine adjacent to Aggeneys is the dominant mine in the area although there are also other minor quarries and diggings (such as the dormant mine nearby the Oase in de Wilderness Lodge about 15km to the north east of the Project). On the site itself, a small mining operation is currently operational roughly half way up the northern slope of the Gamsberg and visible from the N14.

(1) Khai ma LM, Integrated Development Plan, 2012 - 2017.

Agriculture

The area predominantly supports livestock farming due to the semi-arid and arid environment, although large tracts of land are also required to support crop farming. The NDM area is renowned for the quality of meat produced in the Province (ostrich, Karoo lamb, beef and venison). The fertile land along the Orange River supports the production of quality agricultural products such as table grapes (see *Figure 6.15*) and dates for export.

Figure 6.15 Vineyards along the Orange River

Source: Orange River Cellars (http://www.orangeriverwines.com).

Challenges to agricultural production include access to land, especially for emerging farmers, as well as access to water for irrigation. The land available for agriculture is threatened by the mining sector as well as the expansion of conservation areas. Beneficiation of agricultural products could greatly assist in the transformation of the sector and to the empowerment of emerging farmers.

Figure 6.16 Commercial Livestock Farming in Khai Ma LM

The emergent farmers [(1)] in the area have access to communal land owned by the Municipality. Access to this land is controlled by the LM, but the farmers complain that the land is not sufficient. They are of the opinion that the land is being utilised beyond its carrying capacity, but each farmer has a small number of livestock per sheep camp. According to emergent farmers, despite there being no room for expansion some farmers continue to overgraze in a quintessential "Tragedy of the Commons" fashion. *Figure 6.17* shows an emergent farmer using the N14 road reserve as grazing land. As a result of sparse vegetation and limited water, carrying capacities are low reaching 14 to 18 hectares per large stock unit (LSU). Successful farms tend to be particularly large as a consequence of these low carrying capacities.

During consultations, farmers noted that it would be ideal if they could gain access to land owned by the mine for grazing or if they could supply the mine with meat. Attempts to approach the mine with their proposals have allegedly failed to materialise into any type of agreement with the mine. Stock farming by the emergent farmers is entirely for subsistence purposes as they have limited access to markets. In addition, the abattoir costs are high and therefore they struggle to make a profit from selling their sheep.

Other key issues faced by emergent farmers include stock theft, natural predators and lack of support by the local municipality [(2)].

(1) Emergent farmers are small-scale farmers who come from the local community, who historically were unable to farm due to a lack of access to grazing land.
(2) Personal Communication, Emergent Farmers Focus Group Meeting, 12 September 2012, Pofadder.

Figure 6.17 Emergent Stock Farmer Using N14 Highway as Grazing Land

The LM has identified the following activities to support and grow the agricultural sector. These are as follows:

- involve local farmers in led forum;
- invite the Vegetable and Ornamental Plan Institute (VOPI) [1] of the Agricultural Research Centre (ARC) to provide information and assistance to local farmers;
- make land available for agricultural cooperatives and emerging farmers;
- establish informal trading areas for agricultural produce;
- provide skills training and support programmes; and
- investigate the role of Agri-SETA.

6.8.3 *Other Sectors*

Fishing and Mariculture

The Namaqualand coastline is bordered by the Atlantic Ocean, with the Benguela Current. This is known to be one of the most prolific marine eco-systems in South Africa, and very rich in nutrients. The Benguela current supports a large proportion of the South African fishing industry; however it is an industry in decline due to declining fish stocks. An area of opportunity identified in the Rural Spatial Development Framework for the Khai Ma LM (2010), is the establishment of on-shore mariculture industries which entails

(1) The ARC's VOPI is a research institute that promoted technology transfer and conducts research and on vegetables and indigenous plants aimed at commercial and emerging agriculture sectors.

the cultivation of a range of high value marine species. There are indications that mariculture offers sufficient growth potential to replace diamond mining as the principle industry in the coast region of NDM. Development in this area is critically important in the wake of closing mines along the coast [(1)].

Tourism

Tourism as an industry spans several economic sectors ranging from accommodation to catering retail and wholesale, manufacturing, transport and communication, businesses and social services [(2)]. The NDM has experienced growth in tourism and is also identified as an important growth area for the District as well as the Khai Ma LM. The NDM has the tourism potential in the following niche markets:

- eco-tourism due to the vast open land, natural flora and fauna and a number of national parks and conservancies;
- adventure tourism through 4x4 trails as well as hiking and fishing;
- historical and cultural tourism due to the rich local heritage of the Khoi San and Nama people; and
- technological tourism as a result of the South African Large Telescope (SALT), the Square Kilometre Array (SKA) as well as a number of proposed renewable energy projects in the area.

The Khai-Ma Municipality indicated that tourism activity in the Project Area of Influence is very limited, with the main features being a number of 4X4 and hiking trails, the Cathedral at Pella and a few accommodation establishments [(3)]. A number of major new conservation and eco-tourism developments (Ai-Ais Richtersveld and Orange River Mouth transfrontier developments amongst others) have been completed in the Namakwa region. The Northern Cape Economic Development Agency is also currently developing several tourist areas in the Province including the Wildebeestkuil Rock Art site, which is known for its more than 400 rock engravings that are between 800 and 1,200 years old. There is likely to be some growth in tourist facilities with a low investment requirement such as hiking trails, 4X4 trails as well bed and breakfast style accommodation. Adequate marketing and identification of new tourist opportunities to build the tourism sector locally has been identified as a priority in the 2012 -2017 IDP of the LM.

(1) Namakwa District Municipality, 2009, 'Local Economic Development', Project Khuli's Unmotho (prepared by UrbanEcon Development Planners).
(2) Namakwa District Municipality, 2009, 'Local Economic Development', Project Khuli's Unmotho (prepared by UrbanEcon Development Planners).
(3) Black Mountain Mining, 2010, Gamsberg Zinc Project: Final Socio-Economic Baseline Report, Report no.:396036/5 (prepared by SRK Consulting).

Local Businesses

The local businesses in the directly affected towns of Pofadder, Aggeneys and Pella primarily service the agricultural and mining sector. There are a number of businesses in Aggeneys that exclusively service the mine through long standing contracts. As such these have a very high dependency on Black Mountain Mining. The services they offer include transport services, contract miners, replacement parts suppliers and service companies.

The mining sector is seen as a key sector for the development of the Province and the District, both of which support mining activities explicitly in their respective policy documents. A one-stop mining centre aimed at servicing the sector is envisioned for the District as well as a diamond polishing and cutting centre (1).

There are attempts to establish a Small Business Forum in Pofadder to ensure that local business can benefit from procurement contracts from BMM. There is a desire to establish a training centre to train operators and provide support to small business to be in a position to benefit from the opportunities provided by BMM. It is perceived by a small business owner that at present only businesses from Springbok and other LMs in the NDM benefit from BMM.

Renewable Energy

There are four renewable energy projects identified within a 50km radius of the Project site (refer to *Section 11* for a map reflecting the location of proposed renewable energy facilities). The location of three of the four solar farms is concentrated in close proximity to the Project site, due to the existing Aggeneys substation. Four renewable energy facilities have been identified in and around Springbok. One renewable energy facility was identified east of the town of Onseepkans, close to the Orange River.

In general, the solar energy projects are part of a trend in the wider region and province and are in keeping with the earmarking of a wide strip of land along the N14 as a Solar Corridor in Local and District Municipality planning.

The potential to utilise renewable energy to meet the power requirements for the Project was explored. Due to the volumes and reliability of power supply, renewable energy facilities would not be able to meet the base load power requirements for the Project.

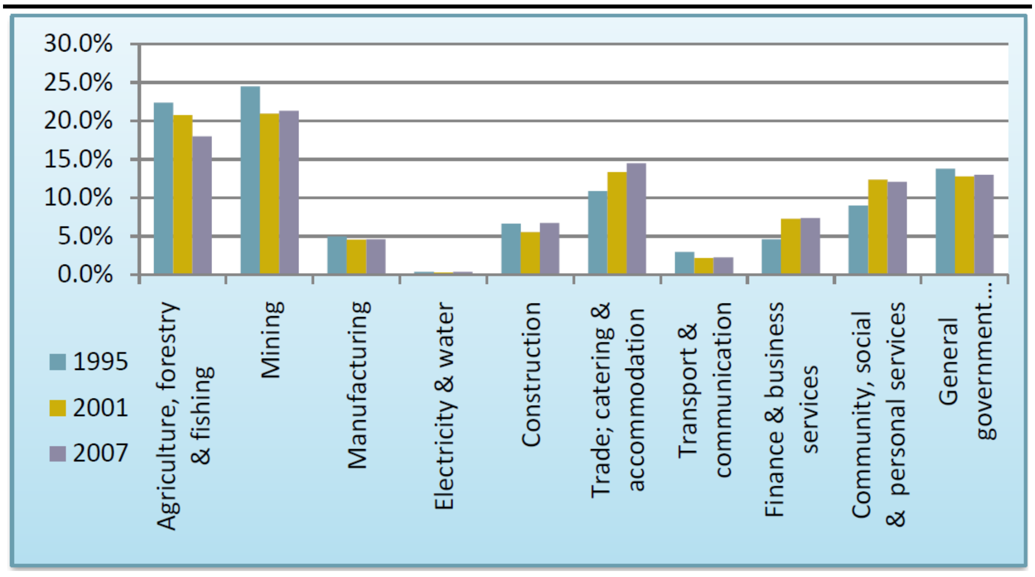
6.8.4 Regional Employment

As with the rest of the country, unemployment is a major challenge in the area. This situation continues to be exacerbated by the current difficult economic climate with low levels of economic growth.

(1) Namakwa District Municipality, 2009, 'Local Economic Development', Project Khuli's Unmotho (prepared by UrbanEcon Development Planners).

The unemployment rate in the Northern Cape decreased to approximately 27.4 % in 2011 compared to 35.6 % in 2001. With regard to the sectoral division of employment opportunities, for the Namakwa District as a whole, the dominant sector in terms of employment is mining which provided 21 % of all employment opportunities in 2007 followed by agriculture and fishing which provided 18 % of all jobs (see *Figure 6.18*). Together, these sectors provide approximately 40 % of all jobs in the NDM. Although these sectors remain major employers, the relative contribution made declined between 1995 and 2007 by roughly 5 % each. The wholesale retail trade, catering and accommodation sector showed the greatest proportional increase in job creation over the period up from 11 % of employment in 1995 to 14 % in 2007.

Figure 6.18 ***Sectoral Employment in the Namakwa District (1995 - 2007)***



Source: Namakwa District Municipality, 2009

The NDM has a shortage of skilled and highly skilled people, where 73.7 % of the economically active population do not have a matric certificate (see *Section 6.6*). The employment rate from 1996 to 2011 is shown in *Figure 6.19*. The rate of unemployment has decreased for the Northern Cape Province as well as the NDM from 2001 to 2011. In 2011, the lowest unemployment rate was recorded for the Province and the NDM. However, this trend is not the case for the Khai Ma LM, which experienced a significant increase in the unemployment rate from 15.3 % in 2001 to 22.1 % in 2011. These averages for the Khai-Ma Municipal area contrast with significantly better figures for the Nama Khoi Municipality, which had an unemployment rate of roughly 8.9% for 2011 (refer to *Table 6.11* below).

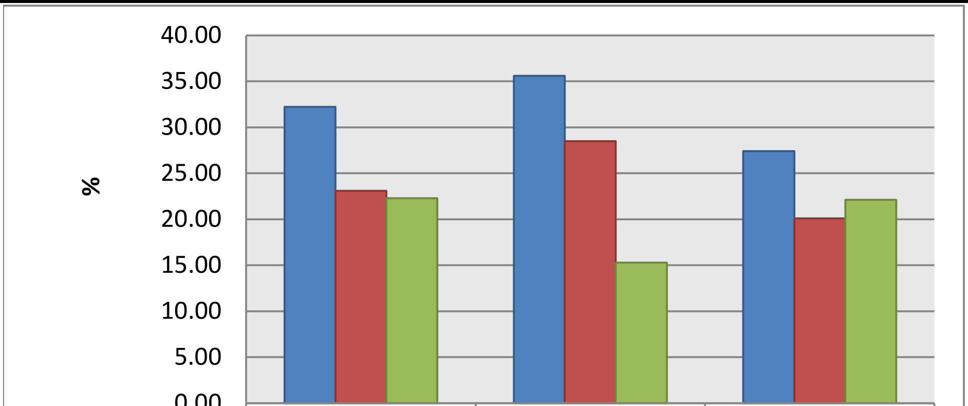
Table 6.11 2011 Unemployment Levels for the Wider Study Area

Employment category	Northern Cape	Namakwa District	Khâi-Ma Municipality	Khâi-Ma Municipality Ward 1	Khâi-Ma Municipality Ward 2	Khâi-Ma Municipality Ward 3	Khâi-Ma Municipality Ward 4	Nama Khoi Municipality
Employed	282 791	33 684	12 351	4 600	1 737	443	970	1 450
Unemployed	106 723	8 471	3 665	1 304	416	483	263	141
% unemployed	*27.4%*	*20.1%*	*22.9%*	*22.1%*	*19.3%*	*52.2%*	*21.3%*	*8.9%*
Discouraged work-seeker	39 913	4 040	1 935	322	24	121	113	64
% unemployed including discouraged work-seekers	*34.1%*	*27.1%*	*31.2%*	*26.1%*	*20.2%*	*57.7%*	*27.9%*	*12.4%*

Source: Census 2011

Due to the high unemployment rate and the quality of jobs (in relation to the skills levels) a significant proportion of the Khai Ma LM population falls below the poverty line. This leads to a reliance on state support. In 2007, 36 % of households registered as indigent and 25 % of the population received State grants [1]. It is likely that there is an increase in the number of people receiving State support. Participants in focus group discussions claim that 80 % of households in the Khai Ma LM are recipients of State grants.

Figure 6.19 Unemployment Rate from 1996 to 2011 at the Provincial and Municipal Level



	1996	2001	2011
Northern Cape	32.20	35.60	27.40
Namakwa DM	23.10	28.50	20.10
Khai Ma LM	22.30	15.30	22.10

Source: Stats SA, 2012.

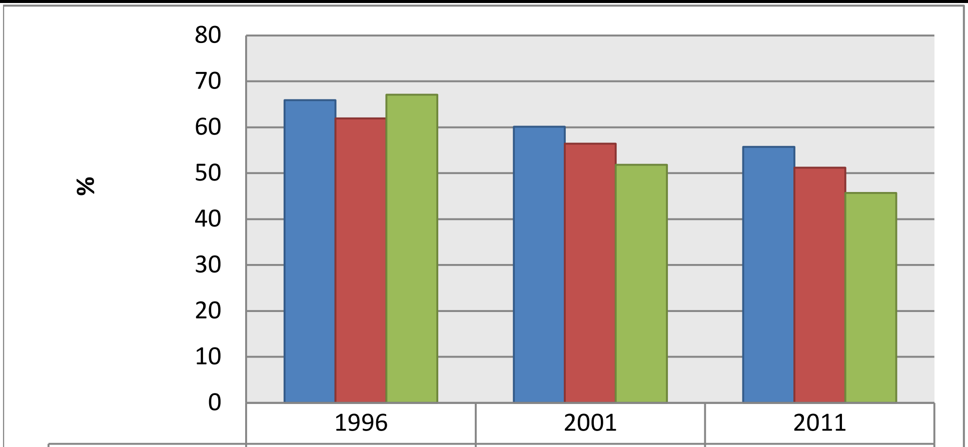
6.8.5 *Dependency*

Figure 6.20 illustrates the dependency ratios at the NDM and the LM between 1996 and 2011. The dependency ratios have consistently decreased since 1996 for the Province as well as the NDM and LM. The decrease in the dependency ratio of the LM from 51.8 % in 2001 to 45.7 % in 2011 is possibly related to the

(1) Namakwa District Municipality, 2009, 'Local Economic Development', Project Khuli's Unmotho (prepared by UrbanEcon Development Planners).

change in the population structure with an increase in the number of people that are economically active (see *Section 6.4.1*).

Figure 6.20 Dependency Ratios at the Provincial and Municipal Levels from 1996 to 2011



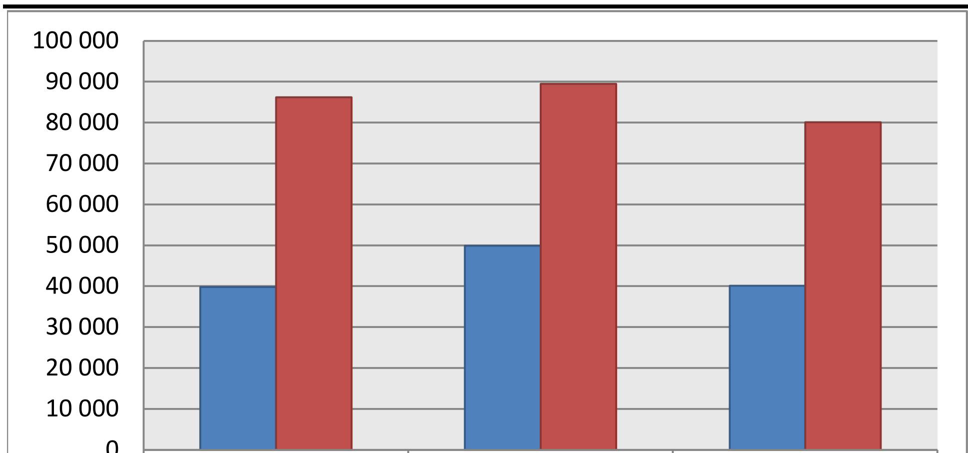
	1996	2001	2011
Northern Cape	65.9	60.1	55.7
Namakwa DM	61.9	56.4	51.2
Khai Ma LM	67.1	51.8	45.7

Source: Stats SA, 2012.

6.8.6 *Income Levels*

Figure 6.21 shows the trend in annual household income levels at the Provincial and Municipal levels between 2001 and 2011. There has been a significant increase in the average household income, observed across all levels. The income levels have increased by between 80 and 100 % over the past decade. Despite this, the average income level is still fairly low. The monthly average household income is approximately R 6,600 for the Khai Ma LM which has an average household size of 3.2.

Figure 6.21 Average Household Income for 2001 and 2011



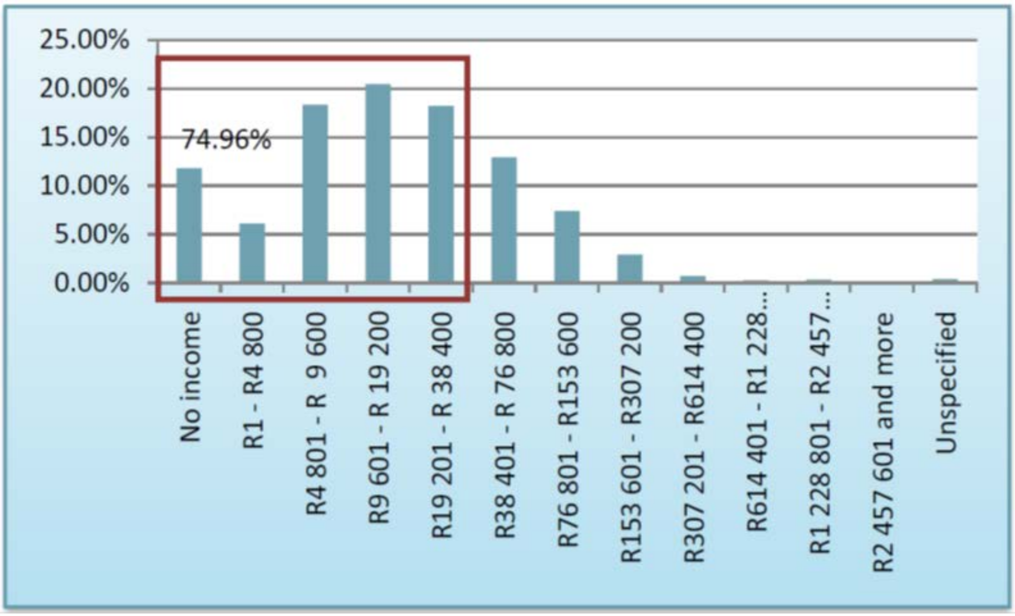
	Northern Cape	Namakwa DM	Khai Ma LM
2001	39 757	49 900	40 067
2011	86 158	89 460	80 114

Source: Stats SA, 2012.

Figure 6.22 shows the annual household income levels within the Namakwa District municipal area for 2001. The following key trends can be identified from this information (Urban-Econ, 2009):

- 11.8% of households in the District earned no income making them dependent on state grants, charity and possibly extended family/social networks for survival.
- 75% of households in the District earned below R 38,400 per annum.
- Very few households had high spending power – just 1.8% of the households were classified as high-income.

Figure 6.22 Household Incomes for the Namakwa District (2001)



Source: Census 2001 in Urban-Econ, 2009.

According to *Table 6.12*, approximately 36% of households in the Namakwa District and 34% of households in the Khai Ma Municipality had incomes below R 19,600 per year in 2011. Furthermore, roughly 9% of households had no income at all. Aside from very low income levels, the situation in the local area and district with regard to grants gives further credence to high levels of poverty. Roughly 36% of households in the Namakwa District are registered as indigent and an even larger portion (65% and the highest in the District) are registered as indigent in the Khai-Ma Local Municipality as measured in 2005 (Urban-Econon, 2009).

Table 6.12 Percentage of Household per Income Category in the Wider Study Area for 2011

Annual income level	Northern Cape	Namakwa District	Khâi-Ma Municipality	Khâi-Ma Municipality Ward 1	Khâi-Ma Municipality Ward 2	Khâi-Ma Municipality Ward 3	Khâi-Ma Municipality Ward 4	Nama Khoi Municipality
No income	12%	9%	9%	8%	6%	14%	10%	5%
R 1 - R 4800	4%	3%	3%	3%	3%	4%	3%	1%
R 4801 - R 9600	6%	5%	5%	5%	5%	7%	7%	2%
R 9601 - R 19 600	19%	19%	17%	18%	22%	19%	23%	7%
R 19 601 - R 38 200	21%	22%	21%	22%	28%	25%	23%	13%
R 38 201 - R 76 400	15%	17%	18%	19%	24%	16%	22%	12%
R 76 401 - R 153 800	10%	12%	13%	13%	8%	14%	9%	24%
R 153 801 - R 307 600	7%	8%	8%	7%	2%	2%	2%	20%
R 307 601 - R 614 400	4%	4%	4%	4%	2%	0%	1%	12%
R 614 001 - R 1 228 800	1%	1%	1%	1%	0%	0%	0%	2%
R 1 228 801 - R 2 457 600	0%	0%	0%	0%	0%	0%	0%	1%
R 2 457 601 or more	0%	0%	0%	0%	0%	0%	0%	0%
Total	100%	100%	100%	100%	100%	100%	100%	100%

Source: Census 2011

6.8.7 *Natural Resource Use*

Wood Collection

Wood is an important source of energy and is primarily used for cooking (see *Section 6.10.4*). The wood is collected from the surrounding communal land and sold to locals. This serves as an important source of income as they have limited access to any other form of income generation. It must be noted that the Project site is an existing mining site and access into the inselberg is currently restricted. The existing mining operation at Gamsberg has no public access points and therefore surrounding communities have not developed a dependency on wood collection from the inselberg or surrounding mining license area.

Medicinal Plants

In the Project study area, people use medicinal plants to treat high blood pressure, diabetes, stomach aches, headaches, cancer and flu as mentioned in *Section 6.7*. These medicinal plants include; Kalkoentjiebos (see *Figure 6.23*), Klipsweet, Gamostahoe, Dasiepis, Baarbos, Loesering, Agdag geneesbos, Hoedia, Skaapbos and Wymryk. There are no conservation programmes to protect or manage the collection of medicinal plants, which are found in the veld surrounding the settlements. It is generally the elderly that consume medicinal plants and advise on which medicinal plants to use to treat ailments. It must be noted that the Project site is an existing mining site and access into the inselberg is currently restricted. The existing mining operation at Gamsberg has no public access points and therefore surrounding communities have not developed a dependency for medicinal plants from the inselberg.

Figure 6.23 Kalkoentjiebos (Sutherlandia frutescens) is used as a Remedy for Several Ailments

6.9 SOCIAL CHALLENGES AND VULNERABILITY

The quality of life of people in settlements within the Project's area of influence is considered to be generally poor with limited access to social services and infrastructure. Key social challenges include:

- high incidence of poverty;
- high unemployment rate;
- dependency on state grants;
- lack of food security;
- inability to meet basic social needs; and
- lack of access to opportunities.

This is exacerbated by the geographic isolation in most of the settlements in the area of influence and the general lack of access to economic opportunities.

6.9.1 *Social Challenges*

Alcoholism

Alcoholism has been identified as pervasive in the affected communities. Alcohol abuse is thought to be the root of most social pathologies in the communities and delinquent behaviour amongst the youth [1]. Underage drinking is a serious problem; children start drinking as early as ten years old. High school girls are particularly vulnerable to early sexual activity in order to access alcohol. Aggeneys in particular is reported to have a very high alcohol abuse rate [(2)].

1) Community Safety Officer Focus Group Meeting, 12 September 2012, Pella, Personal Communication.
(2) Constable Kaarstens, 12 September 2012, Aggeneys, Personal Communication.

The extent of substance abuse in the NDM, alcohol and drug abuse is rife within the NDM [1]. A study by the Northern Cape Department of Social Services sampled several LMs in the NDM. Key findings related to alcohol abuse are as follows:

- each community sampled has illegal outlets of alcohol;
- child neglect is rife as most mothers in the sampled communities abuse alcohol or drugs or both; and
- approximately 40 % of respondents said that they used alcohol [2].

Domestic Violence

Domestic violence is pervasive in all the local communities in the Khai Ma LM. According to an Aggeneys Community Safety Officer, a high incidence rate of domestic violence is reported in Aggeneys in particular. It is believed that the high rate of domestic violence is attributed to the high alcohol abuse rates.

Drug Abuse

Drug abuse is also a problem amongst youth [3]. Drug abuse is believed to start at the age of 13 and it is reported that in many instances, drugs such as Marijuana and Tik are brought into the communities by outsiders who move into the area with other developments/projects for seasonal or temporary work [4]. Anecdotal evidence gathered during initial field visits and stakeholder interviews suggest that petty crime levels are increasing, which may be linked to the rising levels of drug abuse. Hope for Life, noted that they were currently working with members of the community to help stop the sale of alcohol and drugs to minors. Early addiction and substance abuse further perpetuates the cycle of poverty; youth are not learning to meaningfully contribute to society.

Teenage Pregnancy

Teenage pregnancy is common [5]. The Boesmanland High School Principal noted that seven learners in Grade 12 are pregnant. Early sexual activity amongst youth is pervasive and girls as young as 12 years old have given birth. This places an additional burden on the grandmothers who usually become the care givers because the young mothers either go back to school or are not mature enough to provide adequate child care. Single female headed households are common in the surrounding communities except for Aggeneys

(1) Based on a study conducted in 2007 by the Northern Cape Department of Social Services to assess substance abuse.
(2) Namakwa District Municipality, Integrated Development Plan (IDP), 2006 - 2011, Third Revision, Springbok.
(3) Personal Communication with several stakeholders including Hope for Life, Pofadder Women's Focus Group and the Community Safety Officer's Focus Group.
(4)Community Safety Officer Focus Group Meeting, 12 September 2012, Pella, Personal Communication.
(5) Personal Communication, Boesmanland School Principal and Hope for Life community workers, 11 and 12 September 2012, Pofadder.

where the family unit seems to remain intact despite the high levels of domestic violence.

Neglect of Children

It is reported that the high levels of alcohol and drug abuse leads to neglect of children (1). There are incidences where the State is forced to intervene and place children into foster homes. Children are also seen as access to income from the State and care-givers allegedly resist having children taken away from them as it will result in their child-grant being revoked (2).

Crime

The leading crimes in the area include rape, statutory rape, stock theft and domestic violence (3). There have been anecdotal reports of prostitution, however the Community Safety Officer did not think it was a significant issue in the community.

6.9.2 *Vulnerability*

Vulnerability is defined as the ability of individuals or groups to respond to, cope with, adapt to or recover from an external stress or change that will affect their livelihoods and well-being. This approach to defining vulnerability allows for a focus on socio-economic and institutional constraints that limit individuals' or groups ability to respond to change (4).

The above issues and associated poor quality of life give rise to vulnerabilities in the communities in the settlements within the Area of Influence. Specific vulnerable groups include:

- unemployed;
- elderly;
- children and youth (including orphans);
- women (especially single women); and
- disabled and chronically ill.

Unemployed

There is a general sense of hopelessness within the communities because of the lack of economic opportunities and associated high unemployment rate. It is believed that socially deviant behaviour such as alcohol and drug abuse is prevalent in the area because people have nothing to occupy their time with; thereby creating a cycle of poverty and crime.

(1) Khai Ma LM, 2010, Rural Spatial Development Framework/Land Development Plan (prepared by Umsebe Development Planners).
(2) SASSA Officials focus group meeting 12 September 2012, Pofadder, Personal Communication.
(3) Community Safety Officer Focus Group Meeting, 12 September 2012, Pella, Personal Communication.
(4) Kelly PM and WN Adger, 2000, Theory and Practice in Assessing Vulnerability to Climate Change and Adaption, Climate Change, Vol 47: 325-352.

Elderly

There is only one old age home in the direct area of influence which is in Pofadder. The old age home is accessible to only those that can afford it, primarily White community members. The pension grant is often the only source of household income. This places an immense burden on the elderly as they are forced to financially support households typically comprising of three generations. According to feedback from elderly women during focus group meetings, it is not uncommon that their pension grant is taken from them by their family members or members of the community.

Children and Youth

Children and youth are particularly vulnerable as they are exposed to alcohol and drug abuse at a very young age. Their vulnerability is exacerbated by poor access to education in terms of the quality of education provided; the limited employment opportunities available to inspire them to study and alleged limited interest by their care-givers. With minimal employment opportunity and significant barriers to further their education, the youth generally have a sense of hopelessness. According to feedback from the youth during focus group discussions, it is not uncommon for those that have managed to pass Grade 12 to be unemployed for two to three years or longer. Focus groups with the youth in Pella, Pofadder and Aggeneys revealed a high expectation from BMM to provide the training needed to be more employable and to ensure that they are given preference for employment.

Women

Women are vulnerable for various reasons. They perceive that they have fewer opportunities for employment than men. In a focus group discussion with councillors, the jobs identified for women included cleaning and security work at the mine. Other employment opportunities included seasonal work on farms and municipal cleaning projects.

As described in *Section 6.9.1*, women in the area become mothers and grandmothers at an early age and are primarily responsible for child care thus limiting their availability to work. They are vulnerable to HIV/AIDS and other sexually transmitted diseases as a result of poor access to health care and high incidences of alcohol and drug abuse. The prevalence rates between men and women in South Africa reported in *Section 6.7.3* alludes to this trend. Similarly, they are vulnerable to abuse and domestic violence. Key crimes in the area such rape and statutory rape suggests that women are victimised and marginalised.

The women of Aggeneys, who were mostly spouses of BMM employees, noted that although many had access to medical aid and the private clinic, they still do not have access to specialist medical services such as physiotherapy. The women interviewed noted that cervical cancer and breast cancer was on the increase and not spoken about. These are detected very late and appropriate medical treatment is simply not available to women in the LM.

Disabled and Chronically Ill

There is limited availability of information about people with disabilities in the community. However, in general disabled people are hardly seen in the community. Within the socio-economic context as described in previous section, it is likely that they are unable to access any employment opportunities due to physical barriers such as lack of transport amongst others. Health care is such that people have a limited chance of health improvement. Care for the disabled and chronically ill is usually done by the family of the disabled or by NGO workers such as Hope for Life who provide home based care for a small monthly stipend. The disability grant is one of the highest paying grants which trap people in a life of morbidity in order not to lose their disability grant. The nurse at the local clinic noted that a key health problem is commitment from people to look after their health and to take their chronic medication as prescribed.

The disabled and chronically ill are marginalised and vulnerable to abuse as they are seen as a means to additional income from the State.

6.9.3 Vulnerability per Community

The vulnerable groups outlined above are indicative of all the communities within the Project's area of influence, although different communities have access to various resources which results in varying coping mechanisms. Examples of these coping mechanisms are outlined below.

- Pella's access to water and agricultural land provides an opportunity to grow their own food and thereby improves their food security. Pofadder is the seat of administration of the Khai Ma LM and thus the Pofadder community have greater access to services and infrastructure compared to the other communities.

- The community of Aggeneys is materially privileged by association and proximity to the mine.

- The communities of Witbank and Onseepkans are the most vulnerable due to their isolation; however, their proximity to the Orange River and agricultural land does provide some opportunity.

6.10 BULK SERVICES AND INFRASTRUCTURE

The bulk services and infrastructure in the Khai Ma LM is generally in poor condition. A number of services require upgrading such as the bulk sewerage system, the electricity reticulation system, access to water, as well as the waste management services. Upgrades to these services remain a priority for the

NDM as well as Khai Ma LM. A number of infrastructure needs have been identified as reported in the NDM IDP:

- efficient and effective maintenance of existing infrastructure;
- minimise existing infrastructure backlogs;
- the development of additional or alternative water sources;
- increased maintenance investment for roads in order to maximise economic benefits eg tourism and agriculture;
- achieve and maintain developmental balance between infrastructure and social economic development;
- eradication of the bucket system; and
- unblock housing projects and address existing housing backlog.

Table 6.13 gives an indication of the basic service backlog in the Khai Ma LM.

Table 6.13 Basic Service Backlog

Community	Number of HHs	Water	Electricity	Sanitation	Bucket	Refuse	Housing
Pofadder	808	48	230	48	0	0	205
Pella	685	48	0	103	166	0	463
Onseepkans	345	40	53	45	0	0	196
Witbank	77	17	77	17	0	77	86
Aggeneys	556	-	-	-	-	-	-
Total Households	**2471**	**1053**	**360**	**213**	**166**	**77**	**950**

Source: Khai Ma IDP 2012 – 2017.

The lack of finance is an important factor affecting the LM's ability to deliver basic services. Key factors that have had an impact on the LM's finance is the Eskom tariff increases (1) as well as the increase in the personnel costs (2).

6.10.1 Housing

In the Northern Cape Province there are approximately 301,406 households of which 65 % are found in urban areas. Approximately 82 % of the households live in formal structures, 13.2 % in informal and the remainder and traditional structures. The average household size for the Province is 3.7 compared to 3.3 for the District and Local Municipalities (3). The average size of households has been steadily decreasing since 1996 at all levels.

It is estimated that there are 33,856 households in the NDM. Of these, 93.8 % are formal dwellings, 2.5 % are informal dwellings and two % are traditional (4).

(1) According to the Khai Ma LM IDP, the price of Eskom bulk electricity supplied to municipalities increased by 27.06 per cent on 1 July 2012.
(2) Khai Ma LM, IDP, 2012 - 2017.
(3) Sats SA, 2012, 'Census 2011 Northern Cape Municipal Report', Report No. 03-01-51.
(4)Sats SA, 2012, 'Census 2011 Northern Cape Municipal Report', Report No. 03-01-51.

It is estimated that the LM consists of 3,796 households. Of these 77.3 % of households reside in formal dwelling structures, 3.5 % of these households reside in informal dwellings and 8.9 % in traditional huts [1]. The number of informal dwellings has increased in the municipality from 40 in 2001 to 131 in 2011, which is a threefold increase.

According to Khai Ma Rural Spatial Development Framework/Land Development Plan (2010), there is a serious backlog in housing in the LM and there have been significant challenges in addressing this backlog. Lack of funding has been identified as the main limitation as well as the lack of economic stimulation to improve the tax base to address the housing back log and other service delivery challenges. There is currently a housing backlog in all of the communities in the Khai Ma LM.

As illustrated in *Figure 6.24* the dwellings in Pofadder are either brick structures on separate stands, living quarters that are not housing units, traditional dwellings or flats in backyards [2].

Figure 6.24 Example of Houses in Pofadder

(1)Sats SA, 2012, 'Census 2011 Northern Cape Municipal Report', Report No. 03-01-51.
(2) Black Mountain Mining, 2010, Gamsberg Zinc Project: Final Socio-Economic Baseline Report, Report no.:396036/5 (prepared by SRK Consulting).

Similarly, in Pella there are a diverse range of housing structures as illustrated in *Figure 6.25.*

Figure 6.25 Example of Houses in Pella

In Witbank most houses are RDP houses, with a small proportion of people having built their own houses in the town. Onseepkans consists of brick houses and traditional structures (built using locally sourced reeds and mud).

In Aggeneys most dwellings are brick structures on separate stands, living quarters that are not a housing unit, a flat in a block of flats, and caravan/park homes [1].

(1) Black Mountain Mining, 2010, Gamsberg Zinc Project: Final Socio-Economic Baseline Report, Report no.:396036/5 (prepared by SRK Consulting).

Figure 6.26 Typical House in Aggeneys

The houses provided in Aggeneys are supplied by the mine, which also supplies all bulk services at a fraction of the cost. The residents of Aggeneys pay R15 – R30 per month for rates and services. These houses are strictly allocated to permanent mine workers. Once employees are no longer in the employ of BMM they are required to vacate the premises. Only the immediate family of the employee may live in the house provided. There is a shortage of housing stock in Aggeneys. Those that are affected are people that are not permanently employed by the mine, subcontractors to the BMM, and those that are not employed by the mine but work in Aggeneys.

6.10.2 Water Supply

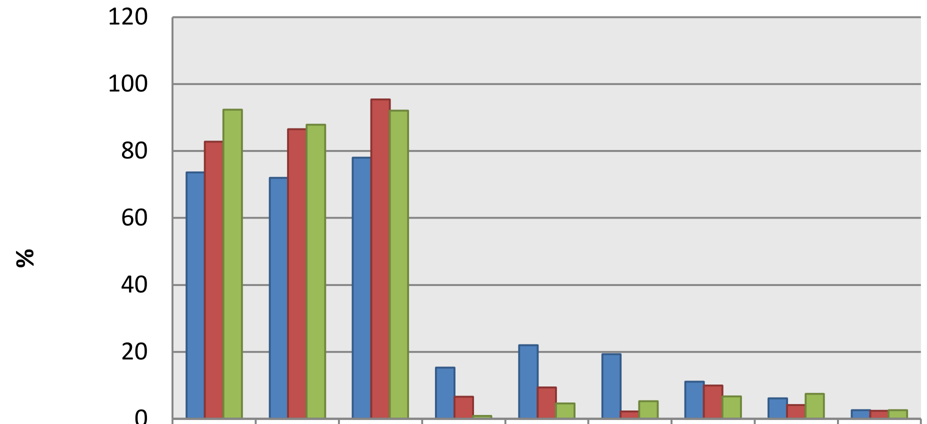
The Northern Cape Regional Office of the Department of Water Affairs (DWA) is responsible for managing water resources in the Province. The Province is an arid to semi-arid region with low summer rainfall, apart from a small strip of winter-rainfall which occurs in the area along the west coast. Rainfall variability results in periodic episodes of severe and prolonged drought.

Approximately 2.6 % of households in the Northern Cape have no access to clean piped water. According to the Department of Water Affairs' standard requirements for adequate access to water, households must have at least 20 to 30 litres of clean safe water per person per day, available within 200 m of the household [1]. Improving access to clean piped water remains a priority for the Provincial Government.

In the NDM 95.4 % of households have access to piped water in their dwellings and 2.2 % have access to piped water from a communal stand.

Of the households in the Khai-Ma LM area 92 % have access to piped water inside their dwelling or yard. *Figure 6.27* shows that significant progress has been made to improve access to water in the Province as well as the DM and LM. There has been a continuous increase in the number of people that access water from a tap inside their dwelling or yard at all levels.

Figure 6.27 ***Water Provision Methods from 1996 to 2011 for the Province and Municipalities***



	Piped (tap) water inside dwelling/ yard			Piped (tap) water on a communal stand			No access to water		
	1996	2001	2011	1996	2001	2011	1996	2001	2011
Northern Cape	73.6	72	78	15.3	22	19.3	11.1	6.1	2.6
Namakwa DM	82.8	86.5	95.4	6.6	9.4	2.2	10	4.1	2.4
Khai Ma LM	92.3	87.8	92.0	0.9	4.6	5.3	6.7	7.5	2.6

Source: Stats SA, 2012.

All households in Pella, Pofadder and Aggeneys are serviced by the Pelladrift Water Board, which was established in 1974. The Pelladrift Water Board is currently being managed and maintained by BMM, which is the largest consumer of water in the area. The Water Board comprises several members of the Municipality management and BMM. Thus the Pelladrift Water Board is a public private partnership, which according to the CDW in Aggeneys is being run efficiently. The Pelladrift Water Board has a water use license to abstract 16,060,000 m^3 from the Orange River, which translates into approximately 44 million litres per day. Pelladrift Water Board is responsible for water purification and distribution to its key clients including, BMM, Khai

(1) These are based on the RDP criteria, which define adequate access to water as households having 25 litres of water per capita per day within a maximum distance of 200m.

Ma LM, and individual farmers. The Khai Ma LM supplies water to the towns of Pofadder and Pella, which consume approximately 1.9 million litres of water per day.

The water board is in the process of acquiring Blue Drop classification from the Department of Water Affairs. Blue Drop Accreditation is a flagship status programme to encourage and monitor water quality across the country.

BMM consumes 94 % of the water supplied to the area for both mining activities as well as to supply the town of Aggeneys with potable water. All households in Aggeneys are supplied with free water by BMM and have piped water inside their dwellings.

Figure 6.28 Water Pipe Supplying BMM and Aggeneys

In Pofadder, 99 % of households have access to piped water within their residence or yard. In addition, 92 % of households have access to clean piped water inside their residence or yard, while seven % have access to a municipal tank.

Occasional water shortages occur in the more isolated towns of Witbank and Onseepkans. Both towns source their water from the Orange River using small pumping stations. Shortages primarily occur when the pumps breakdown.

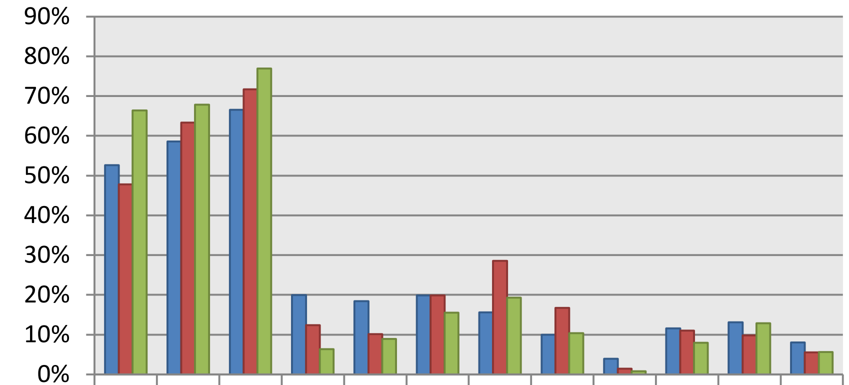
Groundwater

Stock farmers in the surrounding areas depend on ground water sources to supplement water supply for domestic and livestock use. The groundwater quality is not suitable for human consumption due to the presence of fluorides, however, there are instances were groundwater is consumed directly, which could result in health impacts.

6.10.3 Sanitation

The percentage of households that have access to flush or chemical toilets has increased since 1996. The LM has shown the greatest increase between 2001 and 2011 and also had the highest percentage (77 %) of households across all levels. Significant progress has been made to eradicate bucket toilets. In 2011 four % of households in the Province still used a bucket toilet, which is down from 10 % in 2001. The NDM and Khai Ma LM both had one % of households use a bucket toilet, which is down from 17 % and 10 %, respectively since 2001. Despite this progress there is still work to be done to provide sanitation to all. In 2011 eight % of households in the Province had no access to sanitation and six % of households did not have access to sanitation for both the NDM and Khai Ma LM (See *Figure 6.29* and *Figure 6.30*).

Figure 6.29 Distribution of Households by the Type of Sanitation Facilities between 1996 and 2011 for the Province, DM and LM



	Flush or chemical toilet			Pit latrines			Bucket toilets			None		
	1996	2001	2011	1996	2001	2011	1996	2001	2011	1996	2001	2011
Northern Cape	53%	59%	67%	20%	18%	20%	16%	10%	4%	12%	13%	8%
Namakwa DM	48%	63%	72%	12%	10%	20%	29%	17%	1%	11%	10%	6%
Khai Ma LM	66%	68%	77%	6%	9%	16%	19%	10%	1%	8%	13%	6%

Figure 6.30 Ventilated Pit Latrines in Pofadder

6.10.4 Refuse Removal

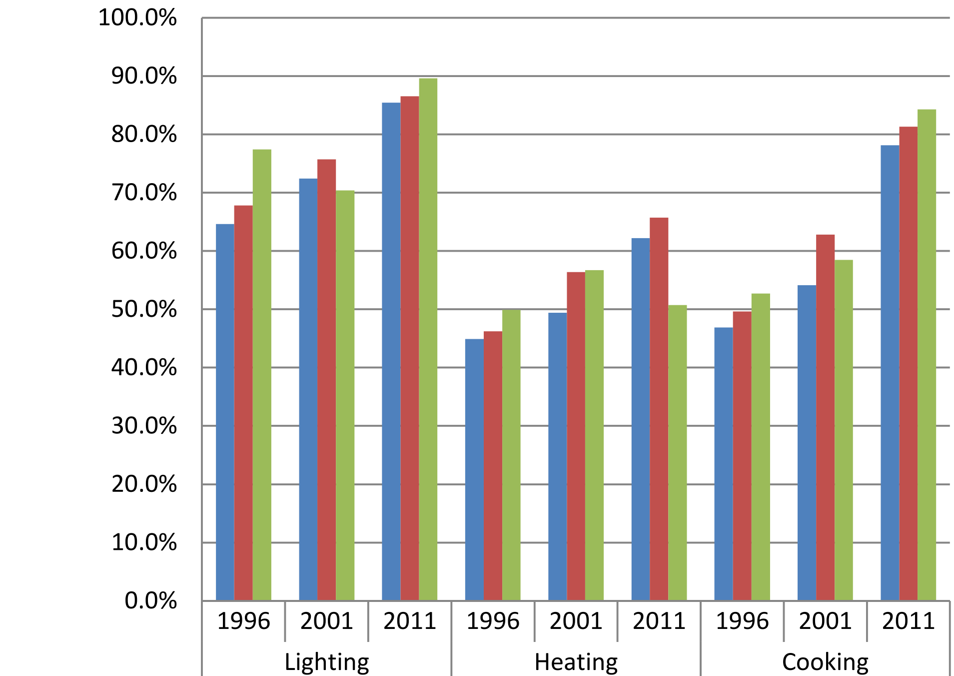
There is a shortage of landfill sites in the LM. Five landfill sites are currently operation in the settlements of Aggeneys, Onseepkans and Pofadder. The settlements of Aggeneys and Onseepkans both have two registered landfill sites. The landfill site in Pofadder is not registered although operational.

6.10.5 Power Supply

Figure 6.31 shows that the use of electricity for lighting, heating and cooking has steadily increased between 1996 and 2011 for the Northern Cape Province as well as the NDM and Khai Ma LM.

Khai Ma LM has the highest increase in the use of electricity for lighting and cooking where 89.6 % of households used electricity for lighting in 2011 compared to 70.4 % in 2001. Similarly, the use of electricity for cooking increased approximately 26 % in the LM from 58.5 % in 2001 to 84.2 % in 2011.

Figure 6.31 Distribution of Households That Use Electricity for Lighting, Heating and Cooking from 1996 to 2011



	Lighting 1996	Lighting 2001	Lighting 2011	Heating 1996	Heating 2001	Heating 2011	Cooking 1996	Cooking 2001	Cooking 2011
Northern Cape	64.6%	72.4%	85.4%	44.9%	49.4%	62.2%	46.9%	54.1%	78.1%
Namakwa DM	67.8%	75.7%	86.5%	46.2%	56.4%	65.7%	49.6%	62.8%	81.3%
Khai Ma LM	77.4%	70.4%	89.6%	49.9%	56.7%	50.7%	52.7%	58.5%	84.2%

In the NDM, Eskom is primarily responsible for the distribution of electricity. An exception is Aggeneys, where BMM is responsible for electricity distribution, they supply all households with free power [(1)].

According to the Khai Ma LM Spatial Development Framework and the Khai Ma IDP (2006 – 2011) upgrade of electricity networks in Pofadder and Onseepkans as well as the provision of electricity in Witbank is a high priority for the Khai Ma LM. The estimated cost for the upgrade in the three communities is approximately R44 million. These upgrade projects are considered to be urgent by the LM because the poor electricity infrastructure is seen to limit the development of other sectors in the municipality [(2)].

6.10.6 Transport, Roads and Rail

Transport

In the Northern Cape where unemployment is high, individuals have little or no access to transport services. Most people in the Northern Cape resort to walking as a mode of transport. Public transport is very limited with approximately 9.4 % making use of taxis and 0.3 % making use of busses

(1) Focus Groups with Aggeneys Women, 11 September 2012.
(2) Khai Ma LM, 2011, Project Prioritisation Matrix.

where they are available. As a result of the lack of public transport, the private vehicle is often the only form of transport available, although only 17.5 % have their own vehicle.

Improvements to public transport have been identified in the Khai Ma IDP as a key priority for improving the living standards in the Khai Ma LM [(1)]. Lack of public transport is a key inhibitor for people in the communities of Pofadder, Pella, Onseepkans and Witbank. The nearest major economic centre is Springbok. There are daily taxis available to Springbok at a cost of R120 per single trip, a cost that many simply cannot afford. BMM provides busses for workers on a Friday which transports them to Springbok to do their weekly shopping.

Roads

The Northern Cape currently contains a network of tarred and gravel roads. Although the extent of tarred roads is the lowest in the country, the Province has the largest network of gravel roads (see *Table 6.14*).

Table 6.14 Extent of Provincial Road Networks (2006)

Province	Surface roads (km)	Gravel roads (km)	Access roads (km)	Total kilometres	Total number of vehicles	Road densities (vehicle/km)
Eastern Cape	5,493	34,692	7,631	47,816	480,059	10,040
Free State	6,310	22,046	20,000	48,356	416,029	8,603
Gauteng	3,357	1,771	2,410	7,538	2,893,665	383,877
KwaZulu-Natal	7,216	19,373	10,571	37,160	1,023,368	27,540
Limpopo	4,973	11,631	10,578	27,182	352,906	12,983
Mpumalanga	6,144	10,752	7,479	24,375	432,313	17,736
Northern Cape	**3,013**	**53,725**	**12,023**	**68,761**	**160,113**	**2,329**
North West	5,691	19,161	10,017	34,869	400,098	11,474
Western Cape	6,621	24,991	7,822	39,434	1,236,809	31,364
Total	48,818	198,142	88,531	335,491	7,395,360	22,043

Source: Black Mountain Mining, 2010, Gamsberg Final Baseline Socio-economic Report. Report no.: 396036/5.

Despite having the largest network of gravel roads, the Northern Cape has the lowest road infrastructure expenditure of any province. Due to limited resources the road network is at risk of deteriorating to such an extent that some roads might become impassable for light vehicles. Two major national routes are found in the Namakwa region, namely the N7 linking Cape Town to Namibia, which runs through the town of Springbok; and the N14 linking Johannesburg with Upington, Pofadder, Springbok (see *Figure 6.32*). While the N14 and N7 national roads are well maintained and roads to Aggeneys and Pella are tarred, transport to and from the more isolated settlements (ie

(1) Khai Ma LM, 2010, Rural Spatial Development Framework/Land Development Plan (prepared by Umsebe Development Planners).

Witbank and Onseepkans) is a lot more difficult and requires 4X4 vehicles. Both Witbank and Onseepkans are accessed via lengthy (50-70km) gravel roads, which are poorly maintained in places.

Figure 6.32 ***N14 Highway Connecting Pofadder to Springbok***

Rail

The dedicated mineral-ore railway line, which runs from the iron ore and manganese mines around Hotazel, Sishen and Postmasburg to the Port of Saldanha Bay, forms a major transport route for the local mining industry. Although Loop 10, which is a railway line, runs through the study area the project site is not linked to this railway network. BMM is currently transporting zinc, copper and lead concentrate from Loop 10 to the Port of Saldanha Bay for export.

6.10.7 Traffic

The traffic flows on the N14 are shown in the following table which highlights the Average Daily Traffic (ADT) at 1,166 vehicles per day with 588 eastbound to Pofadder and 578 westbound to Springbok.

Table 6.15 ***Traffic of N14 between Pofadder and Springbok (SANRAL Year Book, 2011)***

N14	To Pofadder	To Springbok	Total
Total number of vehicles/yr	214,762	210,959	425,721
Average daily traffic (ADT)	588	578	1166
Average daily truck traffic	43	41	84
Percentage of trucks	7.3	7.1	7.2
Average speed (km/h)	98.5	108.4	103.4

Average speed – light vehicles	99.7	109.8	104.7
Average speed – heavy vehicles	82.8	90.2	86.4
15th centile speed (km/h)	79.8	85.8	81.7
85th centile speed (km/h)	119.9	132	126
Total number of heavy vehicles	15,694	14,993	30,687
Estimate of number of axles	4.3	4.4	4.4
Estimated truck mass (Ton/truck)	25.1	25.6	25.4
Estimated Average E80/truck	1.5	1.5	1.5
Estimated daily E80 on the road			128

Intersection of N14 and Aggeneys Access Road

The intersection of N14 and Aggeneys access road has relatively few turning vehicles as per field observation under typical operating conditions. Turning vehicles at the intersection are defined as low volumes with fewer than 50 vehicles turning per hour. The intersection is stop controlled on the Aggeneys minor approach to the N14. The access road is surfaced to Aggeneys and the existing BMM Deeps Mine.

Intersection of N14 and Loop 10 Road

The intersection of N14 and Loop 10 carries even fewer vehicles with extremely low volumes at present with fewer than 10 turning vehicles per hour. The road is 147 km in length and will need to be graded constantly or reconstructed with an asphalt riding surface to accommodate the additional traffic from the Gamsberg Zinc Mine project.

The baseline output of BMM mineral production is roughly 125,000 tons per annum which is currently carried by road and rail in the following proportions:

1. Road 35,000 tons per annum (28%)
2. Rail 90,000 tons per annum (72%)

Currently, 90 000 tons of mineral product is transferred on the Loop 10 gravel road to the loop 10 siding, per annum. Due to the existing traffic volumes, BMM currently maintains and upgrades the Loop 10 road, as and when required.

6.11 LAND TENURE AND REFORM

6.11.1 Land Ownership

Land management and distribution in the Northern Cape is governed by the Department of Agriculture, Land Reform and Rural Development. Almost all the land in the Northern Cape is privately owned. The land tenure and ownership system in the Khai Ma LM is briefly summarised as follows:

- most of the land in Khai Ma is privately owned;

- a large portion of Pella is owned by the Pella community;
- BMM owns the land around Aggeneys, including Gamsberg;
- the Khai Ma LM owns land in Pofadder, Onseepkans and farm portions to the west of Aggeneys and south of Pofadder;
- the Republic of South Africa owns the land along the Orange River and in the vicinity of Witbank; and
- the Witbank Development Trust owns the land at Witbank (1).

6.11.2 Land Reform

The land reform process is currently in progress in the Province and consists of land restitution, redistribution and tenure reform.

Land Restitution

The Restitution of Land Rights Act (22 of 1994) addresses the restitution of land rights lost by South Africans as the result of discriminatory laws passed since 1913. The Act governs the establishment of the Commission on Restitution of Land Rights as well as the Land Claims Court. By the end of 2003, the Northern Cape had processed 2,606 land claims out of a total 2,773 (2).

Land Redistribution

Land redistribution entails making land available for agricultural production, settlement and non-agricultural enterprises. In the past, state agricultural land was made available to emerging commercial farmers, via leasing, outright sale and access to grazing land. This was undertaken through the Settlement Land Acquisition Grant (SLAG) and Land Redistribution for Agricultural Development (LRAD). SLAG was a R16,000 cash grant for which poor landless Black South Africans could form a group to apply to buy and develop farm land. The SLAG programme ended in 2000 and LRAD was introduced later that year. The LRAD programme is designed to reduce rural poverty by helping previously disadvantaged people to manage their own farms effectively.

Tenure Reform

Tenure Reform refers to laws introduced after 1994 to give people security of tenure over both house and the land where they work and stay (especially farm workers and labour tenants). Surplus Peoples Project was appointed by the NDM to facilitate the process of land tenure reform.

The land reform projects and land claims in the Khai Ma LM are as follows:

(1) Khai Ma LM, 2010, Rural Spatial Development Framework/Land Development Plan (prepared by Umsebe Development Planners).
(2) Black Mountain Mining, 2010, Gamsberg Zinc Project: Final Socio-Economic Baseline Report, Report no.:396036/5 (prepared by SRK Consulting).

- Land claims have been registered on the farms Bloemhoek, Katko, Gariepdale and Karee Plaat. These claims are in the "research" phase; and
- In terms of the Transformation of Certain Rural Areas Act (94 of 1998) the Minister of Land Affairs granted approval of five areas in Namakwa to be transferred to the legal entities of the community's choice. These are:
  - Pella;
  - Concordia;
  - Richtersveld;
  - Steinkopf; and Leliefontein (1).

In Pella, the community elected for the land to be transferred to a Communal Property Association (CPA), however, a CPA was never established and the land is currently being managed by the Municipality as an interim measure (2)

6.12 *PALEONTOLOGICAL, ARCHAEOLOGICAL AND HERITAGE RESOURCES*

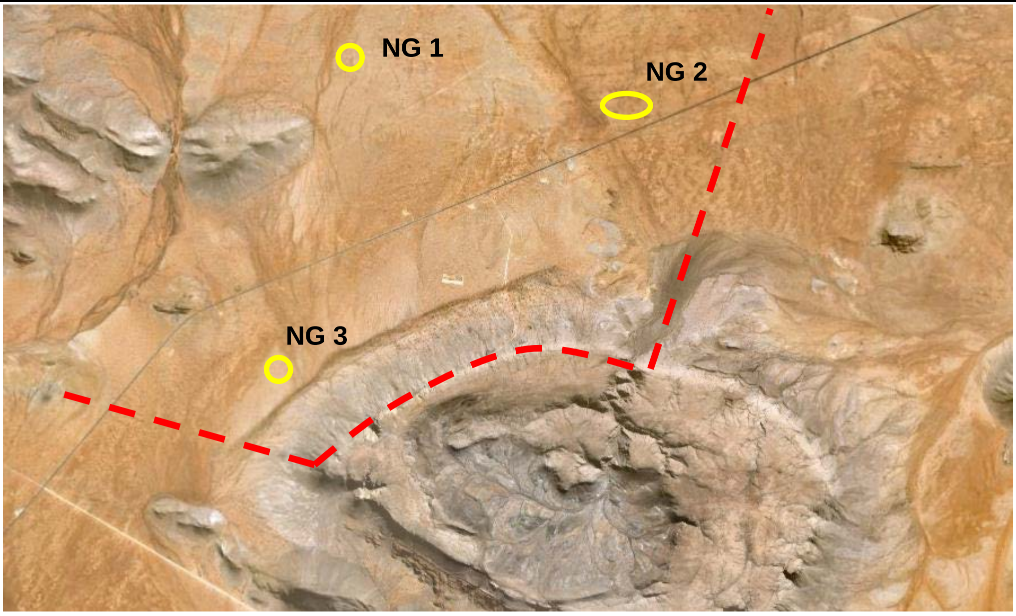
A Heritage and Archaeological Impact Assessment was undertaken by Dr David Morris (refer to *Annex C* for the report). In order to outline the nature of paleontological artefacts (fossils) in the subsurface of the Project area, which may potentially be affected by construction and operational activities, Mr John Pether was appointed to undertake a desktop Paleontological Impact Assessment (refer to *Annex D*).

Heritage and Archaeology

Survey of land surfaces north of Gamsberg and on the northern slope of the inselberg itself on the farms Gams and Aroam revealed extremely minimal archaeological traces, namely a very few isolated stone flakes (refer to *Figure 6.33*). Where erosion had cut into the surface there was no indication of any artefacts below the surface there either (refer below).

(1) Khai Ma LM, 2010, Rural Spatial Development Framework/Land Development Plan (prepared by Umsebe Development Planners).
(2) Personal Communication, Pella Community Leaders, 21 June 2012.

Figure 6.33 The Red Dashed Line Indicates the Northern Slope of Gamsberg and the Adjacent Plain Extending Northwards Across the N14 Road. Yellow Circles and Ellipses Represent Heritage Sites or Features



A description of the three sites of archaeological importance is tabulated below, for ease of reference.

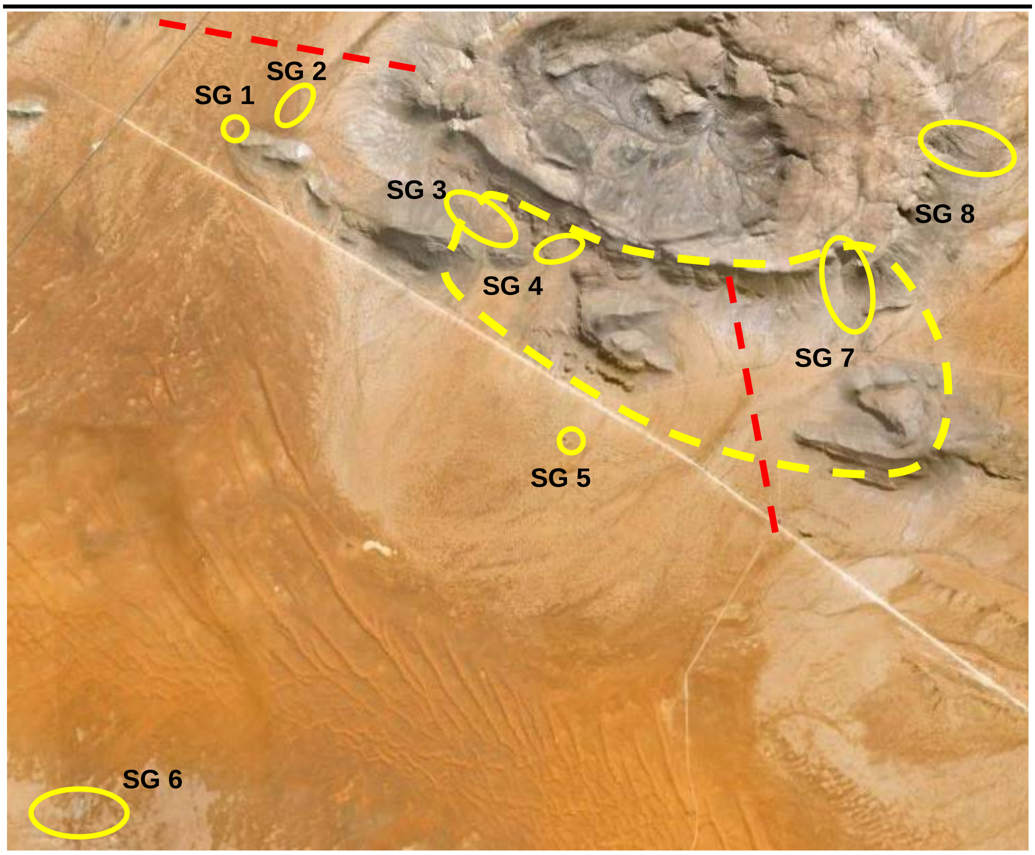
Table 6.16 Archaeological Observations: North of Gamsberg

Locality	Description	Heritage Significance
NG 1 29.18247 S 18.94130 E	Apparent stone structure: mid-twentieth century drilling site (water or mine prospecting). Cement capping has code '2293 /54'. Bottle glass and wire found in the vicinity. A similar feature occurs further north at 29.18235 S 18.94446 E (P Desmet pers comm). Ostrich eggshell fragments on nearby rise are possibly indicative of Later Stone Age activity, but no stone artefacts found.	Low
NG2 29.19924 S 18.98100 E	A series of dome-shaped bedrock outcrops around which are clustered an abundance of Ceramic Later Stone Age artefacts (stone artefacts, pottery, ostrich eggshell). Elongated grinding grooves were noted on the outcropping bedrock. These features occur on other similar sites in the wider landscape. Hollows in the bedrock occur, which hold water for a time after rains (known locally as !Gorras the Nama word for these natural reservoirs). The sites probably represent repeated short-duration encampments by transhumant herders or hunter-gatherers with pottery, probably mainly in the last millennium. Transhumant farmers of the colonial era	High

	evidently used such sites in similar manner (leaving broken glass and porcelain).	
NG3 29.236 S 18.932 E	Isolated Earlier Stone Age (ESA) cleaver found on the plain below the inselberg, noted by P. Desmet. Such isolated finds indicate off-site activity. Small clusters of ESA artefacts have been found in the basin. This single instance lacks context and is hence of limited archaeological significance.	Low

Compared with the northern side of Gamsberg (above), the survey reveals that the south western and southern side is richer in sites and is consequently more sensitive (refer to *Figure 6.34*).

Figure 6.34 ***Archaeological Observations: South of Gamsberg. The Dashed Red Line Indicates the South Western and Southern Slopes of Gamsberg and the Adjacent Valleys and Plains Extending Southwards to and Beyond the Loop 10 Road. Yellow Circles and Ellipses Represent Heritage Sites. The Dashed Yellow Line Represents a Sensitive Portion of the Landscape Implicated in Documentary and Oral Evidence of Genocide Against the San***



Higher sensitivity stems further from evidence that the southern/south eastern side of Gamsberg was the site (indicated by a yellow dashed line) of an incident in which a group of San were cornered and shot – part of what historians now characterise as a genocide against the indigenous people of the region (Morris, 2013). Some evidence suggests that this most likely took place in the kloof indicated as SG 7, known as 'Inkruip' ('Creep in'). The occurrence of sites is focused on features such as watercourses and waterholes that would be activated by rain, and sheltered places. Colonial era stone-walling, as dwelling space and kraals, is evident at sites SG 5 and SG 8.

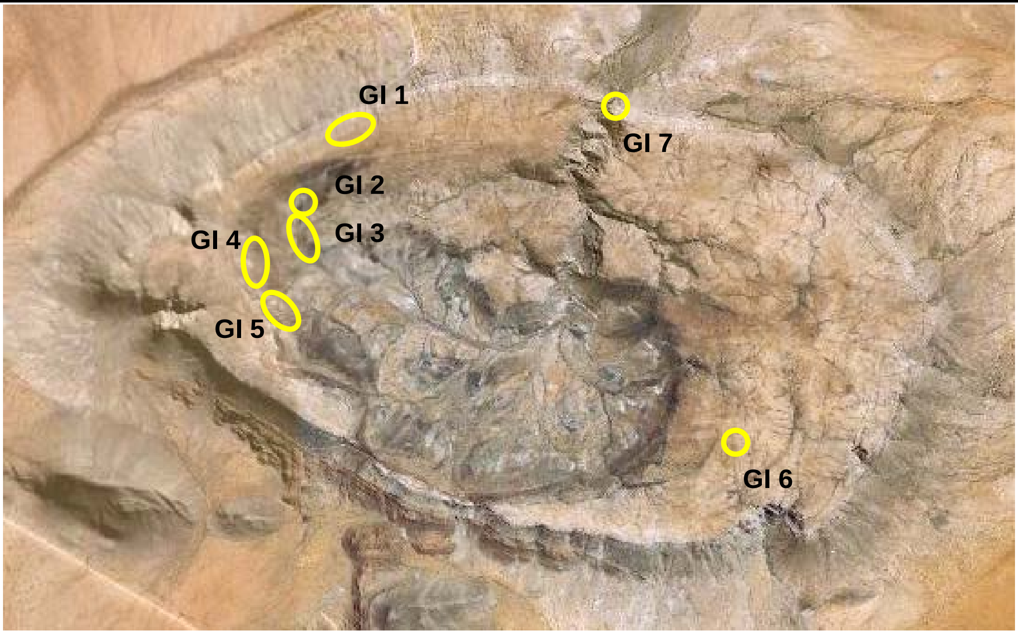
Table 6.17 Archaeological Observations: South of Gamsberg

Locality	Description	Heritage Significance
SG 1 29.24859 S 18.90780 E	A possible grave site on the lower slope of a dune flanking a dry watercourse south west of the Gamsberg, consisting of two small mounds of stone (diameter 0.5 m), two disturbed mounds of stone and a patch of somewhat less concentrated stones. It could not be stated with certainty that these were graves but if they are they do not reflect colonial/missionary-influenced rectangular grave form. Broken bottle glass was the only artefactual material in the vicinity, not necessarily associated.	High subject to verification that they are graves.
SG2 29.24849 S 18.91609 E	A surface scatter of Ceramic Later Stone Age material on a flat sandy area upslope from a dry watercourse. Artefacts include fragments of ostrich eggshell, pottery (including decorated sherds and a lug fragment), stone tools made on quartz and river-rounded pebbles. In addition there is bottle glass and porcelain. Bone is preserved in places. The assemblage is consistent with late herder sites in the region, with an over-printing of proto-colonial traces. There is a stone cairn similar to that noted at the alleged grave site SG 1 mentioned above. The site reflects sub-recent Later Stone Age activity in the area. It appears that people of this period were exploiting resources mainly on the outer edges of the inselberg and to a lesser extent on the mountain or within the basin.	High
SG3 In vicinity of 29.26006 S 18.94331 E	A diffuse low density spread of archaeological traces of different ages including Later Stone Age pieces of ostrich eggshell, clay pot sherds, a lower grindstone (29.25710 S 18.94368 E); a colonial frontier era 'tierhok' (trap made of stone for capturing predators) (29.25734 S 18.94684 E); and twentieth century traces relating to prospecting (29.26144 S 18.94392 E).	Medium
SG4 29.26318 S 18.95436 E	A rich surface spread of Later Stone Age artefacts including stone tools, clay pottery and ostrich eggshell fragments on a sandy bank in a sheltered valley adjacent to a watercourse descending from the mountain.	High

Locality	Description	Heritage Significance
SG5 29.28555 S 18.95608 E	A small hill south of the Loop 10 road on the farm Bloem Hoek, with colonial era stone walling and a possible grave on the south west side. Later Stone Age artefacts occur in the shelter of a large boulder, with a grinding groove in bedrock nearby.	High
SG6 29.33326 S 18.87970 E 29.32940 S 18.88654 E 29.33251 S 18.90108 E	Well clear of the mining area but instructive in terms of the regional archaeological context, three adjacent bedrock exposures on the farms Aggeneys and Bloem Hoek with !Gorras (hollows where water collects during rains). In each case, variable quantities of Later Stone Age artefacts.	High
SG7 29.26467 S 18.99574 E	A kloof known to at least one local farmer as 'Inkruip' (Creep in) because according to legend this was where the last San of the area were cornered and shot. No archaeological traces were found in the kloof, however.	High
SG8 29.25135 S 19.01461 E 29.25209 S 19.01595 E	Colonial era rectangular stone walling (two kraals) on the east side of the inselberg, downslop from a spring, representing farming history in the area.	High

The survey also revealed a remarkable paucity of tangible archaeological or heritage traces on the inselberg itself and within the basin (refer to *Figure 6.35*). The terrain is, in general, highly eroded: it is extremely rocky, often with minimal or no topsoil, making it a hostile environment for preservation of archaeological traces, and indeed for human occupation in the first instance.

Figure 6.35 ***Archaeological Observations: Gamsberg Inselberg and Basin. Yellow Circles and Ellipses Represent Heritage Sites on the Inselberg and in the Basin of the Mountain***



The outer rim of the Gamsberg and the broader eastern plateau was found on the whole to have extremely minimal archaeological traces, with occurrences being mostly in the form of occasional isolated flakes (exemplified by the locality GI 6). Attention was focused on several parts of the broad eastern rim and within valleys and kloofs sloping eastwards off the Gamsberg and westwards into the basin. The kloof areas, settings of high energy run off during heavier rains, were found to be largely devoid of artefacts. Small shelters/overhangs at various places in the sides of the basin and kloofs were examined for evidence of possible Later Stone Age occupation within the Gamsberg basin, eg stone tool scatters in driplines or on a shelter talus, or where finger paintings or engravings might feature on rocks or shelter walls. Again, evidence was generally lacking.

Table 6.18 Archaeological Observations: Gamsberg Inselberg and Basin

Locality	**Description**	**Heritage Significance**
GI 1 29.23450 S 18.95805 E	A Middle Stone Age workshop site identified previously by Deacon (1995), of high regional significance. It had been quarried for the making of a landing strip on the top of Gamsberg. The *in situ* remainder of the occurrence is estimated to extend over an area of >150 x 50m, and was revealed in a scraped section to have a depth of at least 100 mm in at least that part of the site. The significance of the site is partly in relation to the raw material source at that point in the landscape.	High
GI 2 29.23668 S 18.95275 E	A small shelter on the northern side of the basin. While it was expected that there might be evidence of Later Stone Age (LSA) or earlier use, there were minimal traces of archaeological material: a single LSA quartz flake was found. The shelter was disturbed by previous mining-related activity.	Low
GI 3 In vicinity of 29.24339 S 18.95494 E	Scatters of varying but generally low density Middle Stone Age and Acheulean material, sometimes mixed, in and alongside the dry watercourse draining the western interior of the inselberg. Erosion and high energy run-off in heavy rains would account for what would essentially be a secondary depositional context, lacking in archaeological integrity.	Low
GI 4 In vicinity of 29.24162 S 18.95041 E	On the inner slopes of the Gamsberg basin several places with isolated or weakly clustered artefacts of Pleistocene age were noted. One of these in the approximate location indicated suggests an Acheulean (Earlier Stone Age) workshop site focussed on what was apparently a favoured raw material source outcropping there.	Low

Locality	Description	Heritage Significance
GI 5 In vicinity of 29.24649 S 18.95346 E	South east of Site GI 4, a further low density clustering of Acheulean artefacts. In an eroded setting on the sloping side of the basin, there is no depth of deposit and hence no likelihood of stratigraphy.	Low
GI 6 29.25676 S 18.99313 E	On a flat and slightly less rocky area, an extremely low density of probably Middle Stone Age artefacts (up to 20 m apart from one another).	Low
GI 7 29.230614 S 18.98044 E	A rock shelter near the northern exit of the kloof with some deposit but no clear evidence of archaeological material. Discolouration on the shelter wall may constitute a faded finger painting but this seemed equivocal. The shelter is beyond the planned mine layout.	Medium

Palaeontology

The Study Area is situated in the northern part of the Bushmanland Plateau where inselbergs and ridges of bedrock project steeply above the sandy plains. These are rocks of the **Namaqua Metamorphic Province** and the specific strata comprising Gamsberg belong to a meta-volcanosedimentary succession named the **Aggeneys Subgroup** of the **Bushmanland Group**. The age of the Bushmanland Group is between 1640 and 1200 Ma. The mining of the zinc ore in unfossiliferous Bushmanland Group bedrock strata does not have an impact on fossil heritage.

The fossils most commonly seen in aeolianites are land snails and tortoises. Closer inspection reveals the incisors, skulls and bones of moles. Other small bones occur sparsely such as bird and micromammal bones. This is the ambient fossil content of dunes and it includes the bones of rodents, lizards, snakes, birds, ostrich eggshell and small mammals (hares, mongooses, cats etc.). The bones of larger animals are generally very sparsely scattered. Notwithstanding, concentrations of bones are found in specific contexts.

Watercourses are present at a variety of scales, from small, ephemeral, braiding-stream courses on alluvial fans to more entrenched, integrated drainage sustems. The fossil potential of small-scale systems is very low. In larger drainages fossils such as abraded bone fragments and loose teeth occur sparsely in channel lags. These drainages must have been more active during periods of wetter climate such as occurred during the Quaternary. Finds such as the snail *Melanoides*, clam *Corbicula* and freshwater oyster *Etheria* attest to more perennial freshwater availability in the larger, now seldom-flowing drainages. The latter will also have hosted waterhole and pan deposits in places, with improved fossil potential.

No areas of particular paleontological sensitivity are identified within the area of direct influence. Due to the sparse, very patchy distribution of fossils in the subsurface, the probability of an important fossil find is considered unlikely.

6.13 VISUAL QUALITY OF THE AREA

Newtown Landscape Architects (NLA) were commissioned to carry out a Visual Impact Assessment (VIA) for the Mine and associated infrastructure (refer to *Annex G* for the full report).

It can be concluded from this study that the Project area has a *high* visual quality and a strong sense of place, even though its visual characteristics may be common within the region. The desolate, arid plain, punctuated by rugged koppies against the blue sky backdrop creates a sense of expansive vastness that can easily be recalled, especially by touristic travellers that would generally be interested in their surroundings. The sections that follow provide a brief summary of the visual quality associated with the Project area. This information is specifically based on the VIA undertaken by NLA (Cilliers & Young, 2013).

6.13.1 Landscape Character

Dominant landform and land use features (eg hills, rolling plains, valleys and urban areas) of similar physiographic and visual characteristics, typically define landscape character types.

The study area is characterised by two broad landscape types. Flat expansive plains with gentle rolling topography and a series of inselbergs (and other smaller rocky outcrops, referred to as 'koppies') that protrude above these plains. These landscape types are typical of large portions of the Northern Cape Province. The panorama photographs in *Figure 6.36* illustrate the striking and vast nature of the landscape when viewed from the N14 and a small koppie to the north of the road. The lack of tall vegetation and the flatness of the plain emphasises the ruggedness and the verticality of the inselberg and the surrounding koppies.

Figure 6.36 *Landscape Character*

View 1A: Along N14 looking south-west towards Gamsberg, the proposed plant would be in the foreground

View 1B: Along N14, looking north-west towards proposed tailings dam location

View 4: Along local dirt road looking north, note the open, flat plains with koppies and sparse vegetation

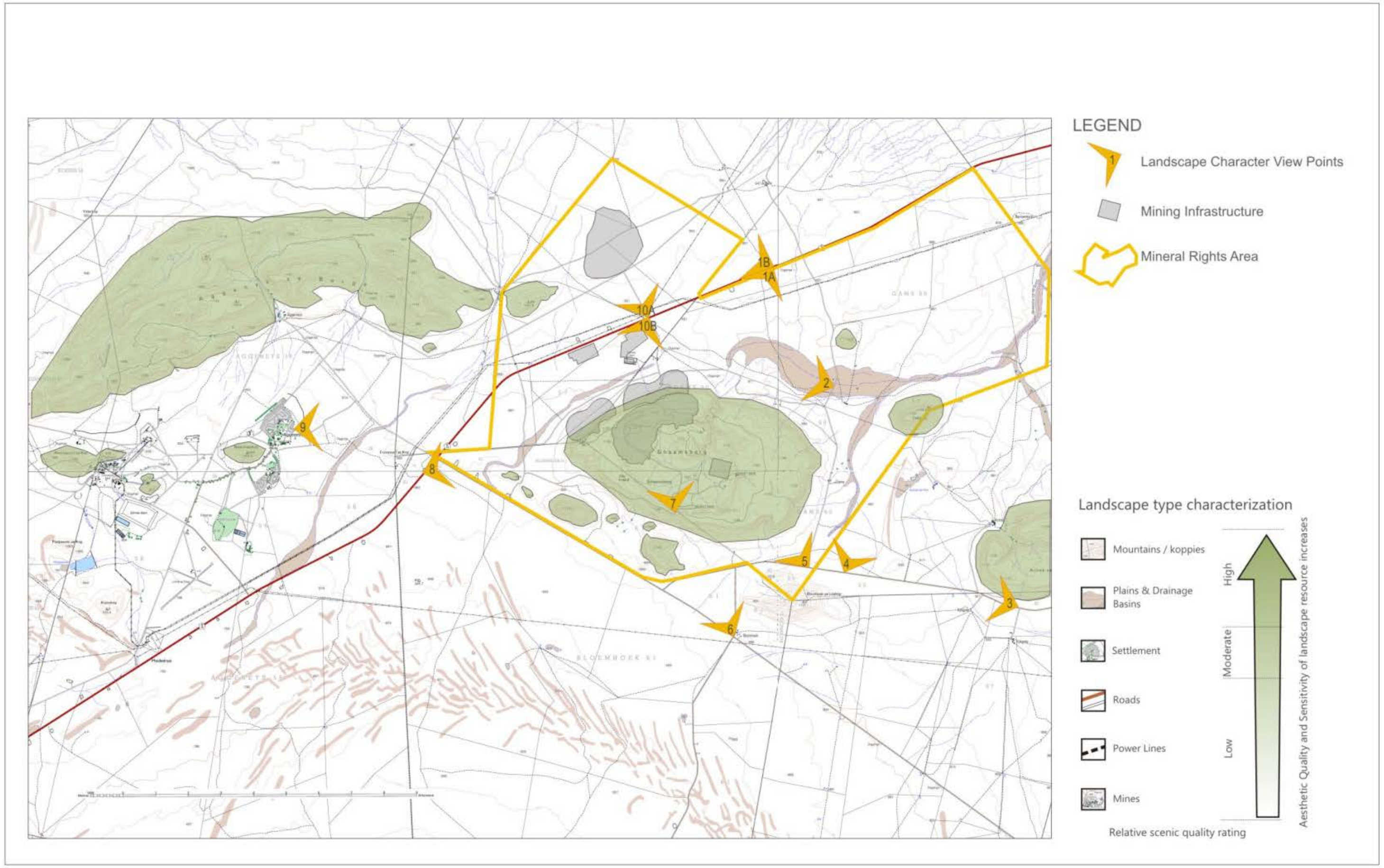
View 5: Along local dirt road, looking north-west, note the rugged koppies and sparse vegetation

The southern slopes of the Gamsberg inselberg support a greater variety of vegetation than the northern slopes. These slopes also have a rugged beauty which is characteristic of the typical Northern Cape landscape. The interior of the Gamsberg inselberg is made up of rocky terrain with associated bowl shaped topography, covered by low growing grasses and shrubs. This is also the location of a rare occurrence, a kokerboom forest. These trees dot the landscape and are a noticeable feature of the landscape.

6.13.2 *Visual Resource Value / Scenic Quality*

Scenic quality ratings were assigned to predominant landscape types, including '*Koppies and the Gamsberg Mountain*', '*Farmsteads and the town of Aggeneys*' and '*Existing Mining Infrastructure and Power Lines*'. The highest value is assigned to the topographical features including the koppies and the Gamsberg Mountain, as well as the dry water courses. The farmstead and town of Aggeneys were rated as being moderate. The lowest scenic quality rating was assigned to mining infrastructure and power lines. *Figure 6.37* rates the relative scenic quality of each type and its landscape sensitivity.

Figure 6.37 Visual Resource and Views



The overall study area can be regarded as having a high visual resource value with its relatively unspoilt, vast, arid pains and rugged, rocky koppies contrasting dramatically with the blue skies. A summary of the visual resource values is tabulated in *Table 6.19* below.

Table 6.19 Value of the Visual Resource

High	Moderate	Low
Koppies and Gamsberg	*Farmstead and Town of Aggeneys*	*Mining Infrastructure and Power Lines*
This landscape type is considered to have a *high* value because it is a: Distinct landscape that exhibits a very positive character with valued features that combine to give the experience of unity, richness and harmony. It is a landscape that may be considered to be of particular importance to conserve and which has a strong sense of place.	This landscape type is considered to have a *moderate* value because it is a: Common landscape that exhibits some positive character but which has evidence of alteration /degradation/erosion of features resulting in areas of more mixed character.	This landscape type is considered to have a *low* value because it is a: Minimal landscape generally negative in character with few, if any, valued features.
Sensitivity: It is sensitive to change in general and will be detrimentally affected if change is in appropriately dealt with.	**Sensitivity:** It is potentially sensitive to change in general and change may be detrimental if in appropriately dealt with.	-

6.13.3 Sense of Place

The sense of place for the study area is derived from a combination of all landscape types and their impact on the senses. Most people who live near or pass through the study area approach it along the N14 national road. They travel through an open dry landscape that is frequently 'punctuated' by curious koppies. It is this vast, desolate landscape with its hues of brown and backdrop of magnificent skies that give the area its unique character. It is this image that will leave a visual impression that can easily be recalled, in the mind. Although the study evokes a distinct sense of place, it is not unique to the district or region. Nevertheless, the landscape quality or visual resource of the study area is considered to be *high*.

6.13.4 Views

The vast majority of the views of the Project will be experienced from the N14 as motorists travel past the site in an easterly or westerly direction. One of the tourist attractions of the Northern Cape Province and an event that increases the volume of traffic on the N14, is the natural spring flower display that extends up the west coast and inland to the east of Springbok. This makes views from the N14 road important and perhaps the most sensitive to the proposed intervention. The total volume of the N14 is however relatively low. Other views of the Project would be from the mining town of Aggeneys, to the west of the proposed project, and the farmstead of Achab, to the east of the proposed project (refer to *Figure 6.38*).

6.13.5 Sensitive View Locations

Sensitive viewer locations would be views from tourist type travellers along the N14 and views from the farmstead of the farm Achab. Views from the town of Aggeneys would not be regarded as being sensitive since it is a mining town and most residents are employed by a mining company.

In accordance with *Table 6.20* below, the potential sensitivity of visual receptors has been rated as being *high*.

Table 6.20 Potential Sensitivity of Visual Receptors

High	Moderate	Low
Visitors of Game Farms/Lodges and travelling along local routes, whose intention or interest may be focused on the landscape.	People engaged in outdoor sport or recreation (other than appreciation of the landscape, as in landscapes of acknowledged importance or value).	Visitors and people working in mining / prospecting activities and travelling along local mining roads whose attention may be focused on their work or activity and who therefore may be potentially less susceptible to changes in the view.
Communities where the development results in changes in the landscape setting or valued views enjoyed by the community.	People travelling through or past the affected landscape in cars, on trains or other transport routes.	-
Occupiers of residential properties with views affected by the development.	-	-

6.14 ECOSYSTEM SERVICES IMPACTS

6.14.1 Introduction

The IFC Performance Standard 6 defines ecosystem services as "*the benefits that people, including businesses, obtain from ecosystems*. Ecosystem services are organized into the following four major categories:

- *Provisioning ecosystem services* include *inter alia* (i) agricultural products, seafood and game, wild foods and ethno-botanical plants; (ii) water for drinking, irrigation and industrial purposes; (iii) areas which provide the basis for many biopharmaceuticals, construction materials, and biomass for renewable energy.

- *Regulating ecosystem services* include *inter alia* (i) climate regulation and carbon storage and sequestration; (ii) waste decomposition and detoxification; (iii) purification of water and air; (iv) control of pests, disease and pollination; (v) natural hazard mitigation.

- *Cultural services* include *inter alia* (i) spiritual and sacred sites; (ii) recreational purposes such as sport, hunting, fishing, ecotourism; (iii) scientific exploration and education.

- *Supporting services* are the natural processes that maintain the other services such as (i) nutrient capture and recycling; (ii) primary production; (iii) pathways for genetic exchange.

Note that ecological/biophysical processes are not to be confused with ecosystem services unless an identifiable beneficiary is directly benefiting from that process as well.

6.14.2 *Approach to Prioritisation and Assessment Ecosystem Services*

A selection of the ecosystem services commonly assessed and having possible relevance to the project area has been compiled. Background data to provide a brief understanding of these services is presented. Thereafter the ecosystem services have been prioritised based on three variables, namely sustainability, importance to beneficiaries and replaceability.

Sustainability is assessed in an ecological context, and is relevant to the provisioning ecosystem services only. Quantitative data is not available, but relevant services are subjectively assessed as either not used, sustainable or not sustainable.

Importance of ecosystem services to beneficiaries is assessed according to the following criteria and assigned a rating from *low to essential*:

- Intensity of use eg daily, weekly or seasonal use; quantitative data will be used if available and relevant;

- Scope of use eg household versus village level, commercial use only, subsistence only or both;

- Degree of dependence eg contribution of wild fish to total protein in the diet; contribution of fishing to employment in the community; and

- The importance expressed by beneficiaries, including cultural / historical importance.

The weight given to each of these components will vary slightly depending upon the service, but stakeholder values should take precedence over other criteria where the rating is not clear. Finally, where a service may be of greater or lesser importance to different stakeholder groups, two (or more) ratings should be assigned so that impacts on these groups can be assessed individually. Ecosystem services are rated on importance as low, moderate, high or essential.

Replaceability (or availability of alternatives): The 'replaceability' of a service is assessed according to the following criteria and assigned a rating from *low to high*:

- Existence of spatial alternatives, including both natural replacements (eg the replacement of one type of wild food with another) and man-made substitutes (eg availability of man-made drugs as an alternative to medicinal plants);

- Accessibility, cost and sustainability of potential alternatives, including a consideration of other users and the existing status and threats to the resource(s) providing natural alternatives to the service; and

- Preference/appetite for and cultural appropriateness of alternative services.

Non-sustainable ecosystem services are not prioritised in accordance with the approach adopted with the IFC. Other services are prioritised as Low, Medium, High or Critical priority based on the matrix presented in *Table 6.21* .

Table 6.21 Matrix to Determine Ecosystem Priority Based on Replaceability and Importance to Beneficiaries

		Replaceability of Service		
		High (many spatial alternatives)	Moderate (some spatial alternatives)	Low (few to no spatial alternatives)
Importance of service to beneficiaries	Low	Low	Low	Medium
	Moderate	Low	Medium	**High**
	High	Medium	**High**	**Critical**
	Essential	**High**	**Critical**	**Critical**

6.14.3 *Determination of Mine Dependencies on Ecosystem Services*

A summary of ecosystem services is provided in *Table 6.21* with an assessment of their priority. A brief description and discussion of each ecosystem service is provided below.

- **Wild-caught foods:** This service is defined as the capture, killing, trading and/or consumption of wild vertebrate fauna (not including fish). No evidence is available that local beneficiaries depend on wild-caught foods from the project area.

- **Capture fisheries:** Baseline surveys by faunal specialists have revealed that aquatic ecosystems are limited and do not support any fish species (GroundTruth, 2013).

- **Other Wild foods:** This service is defined as fruit, nuts, wild plants, etc. collected in natural areas for consumption or sale. Subsistence communities existed in the area historically, but no longer depend on natural resources there. Access to the Project site has been restricted for approximately 40 years and no known harvesting of wild foods is taking place, and there is no community of people currently dependant on this service.

- **Fuel wood:** Wood is an important source of energy and is primarily used for cooking (see *Section 6.10.4*). The wood is collected from the surrounding communal land at the closest town Pofadder and sold to local beneficiaries. This serves as an important source of income as they have limited access to any other form of income generation. Limited availability of fuel wood exists due to the dry climate and slow growth of woody plants. It must be noted that the Project site is an existing mining site and access into the inselberg is currently restricted. The existing mining operation at Gamsberg has no public access points and therefore surrounding communities have not developed a dependency on wood collection from the inselberg or surrounding mining license area.

- **Natural medicines:** Communities in Pofadder and Pella use a range of medicinal plants to treat high blood pressure, diabetes, stomach aches, headaches, cancer and flu as mentioned in Section 6.7. Some of the known medicinal plants include Kalkoentjiebos (*Sutherlandia frutescens*), Hoedia (*Hoodia gordonii*), Skaapbos (*Tripteris sinuata*) Gamostahoe, Baarbos, Loesering, Agdag geneesbos, and Wymryk. The following medicinal uses are known:

  - Kalkoentjiebos (*Sutherlandia frutescens*) is claimed to be a natural cure for Cancer.

  - *Hoodia gordonii* has long been known by the indigenous populations of Southern Africa, who infrequently use these plants for treating indigestion, small infections and to suppress appetite.

  - Non-floral medicines include Klipsweet / Dassiepis, which is an accretion of urine and dung of rock hyraxes (also known as rock Dassies) which occur in the Project area, when fossilized with age, is used locally and elsewhere in South Africa for the traditional treatment of epilepsy.

  There are no conservation programmes to protect or manage the collection of medicinal plants, which are found in the veld surrounding the settlements. It is generally the elderly that consume medicinal plants and advise on which medicinal plants to use to treat ailments. It must be noted that the Project site is an existing mining site and access into the inselberg is currently restricted. The existing mining operation at Gamsberg has no public access points and therefore surrounding communities have not developed a dependency for medicinal plants from the inselberg.

- **Freshwater:** The Project area is located in an arid low rainfall zone where access of freshwater resources is limited. The Project area includes a number of freshwater springs and an aquatic system through the Kloof Habitat. It must be noted that the Project site is an existing mining site and access into the inselberg is currently restricted. The existing mining operation at Gamsberg has no public access points and therefore surrounding communities have no dependency on these water resources. However, the surrounding farmers are dependent on groundwater resources for stock farming and consumption.

- **Crops:** The arid climate of the study area is not suitable to crop production and no crop production takes place within the mine site.

- **Livestock farming:** The dominant land use of the greater area surrounding the Project site is livestock farming with sheep and goats. Livestock farming is dependant on the grazing and browsing of natural vegetation. Unsustainable livestock production has resulted in widespread occurrence of overgrazing in the surrounding areas with reduced floral diversity. Access to the site for livestock farming has been prohibited for many years, and as a result the Gamsberg is currently considered to be the key biodiversity feature underpinning ecological processes/ function in the area. Emergent livestock farmers have indicated that they want access to unused BMM-owned land for grazing their stock.

- **Air quality and climate regulation:** The Gamsberg does not support lush vegetation with low levels of photosynthesis taking place due to the arid climate. The site is therefore expected to provide a very limited contribution towards Carbon sequestration and climate regulation.

- **Disease and pest regulation:** A diversity of predatory birds and mammalian carnivores are present within the Gamsberg, which provides an important refuge for these animals. Rock dassies have the potential to modify their habitats through overpopulation but are effectively controlled by Verreaux's Eagles, their primary predator which nest within the Gamsberg. Few pest or disease regulating functions can be defined, however, it is expected that some may occur.

- **Pollination and seed dispersal:** Invertebrates and birds are important pollinators or various plants and are thus important for maintaining floral and thus habitat diversity within the Gamsberg and surrounding areas.

This is an important service, however there is limited evidence of direct human beneficiaries of these services.

- **Religious, sacred or spiritual sites/purposes:** The Gamsberg has historically been an important site for spiritual purposes. Access to the site has been limited for almost two generations and from interviews with community members in Pella and Pofadder it is understood and accepted that access to the Gamsberg site is restricted. There are attempts to reinvigorate people's sense of their Nama culture, but there is little evidence to show that the present communities of Pofadder and Pella have a spiritual connection to the Gamsberg site

- **Aesthetic value:** The Gamsberg is a prominent feature of the landscape. The topographical features including the hills, *koppies* and the Gamsberg inselberg as well as the dry water courses are rates as having the highest scenic quality ratings. The farmstead and town of Aggeneys are rated as being moderate. The lowest scenic quality ratings were assigned to the mining infrastructure and power lines. The overall study area can be regarded as having a high visual resource value with its relatively unspoilt, vast, arid pains and rugged, rocky outcrops contrasting dramatically with the striking blue skies. The aesthetic value is linked to the tourism potential of the area.

- **Tourism:** Tourism as an industry spans several economic sectors ranging from accommodation to catering retail and wholesale, manufacturing, transport and communication, businesses and social services. The Namakwa District Municipality has identified tourism as an important growth area for the District as well as the Khai Ma Local Municipality. The Namakwa District Municipality has the tourism potential in the following niche markets:

    - Eco-tourism due to the vast open land, natural flora and fauna and a number of national parks and conservancies;

    - Adventure tourism through 4x4 trails as well as hiking and fishing;

    - Historical and cultural tourism due to the rich local heritage of the Khoi San and Nama people; and

    - Technological tourism as a result of the South African Large Telescope (SALT), the Square Kilometre Array (SKA) as well as a number of proposed renewable energy projects in the area.

    Tourism is a fast growing sector and has had a significant impact on accommodation and catering sectors of the district economy. The tourism potential in Khai Ma LM is not fully realised.

- **Pathways for genetic exchange and maintenance of biodiversity:** Inselbergs within the Bushmanland Inselberg Region represent an archipelago of rocky islands within a vast expanse of sand, and serve as stepping stones for many species that hop from one inselberg to another. They also provide important ecological refugia for species that are important from an evolutionary/climate adaptation perspective. The inselbergs form a sequence that represents an ecological corridor defined by the Namakwa District Map of Critical Biodiversity Areas. The Gamsberg is located midway along this corridor and its position is key to the east-west movement of species. The Gamsberg inselberg is considered to be the key biodiversity feature underpinning ecological processes/function in this system.

6.14.4 Prioritisation of Ecosystem Services

Ecosystem services described above are assessed below in terms of their importance to beneficiaries, replaceability and sustainability in the project area. Their priority is assessed based relationship between importance and replaceability using the matrix presented in *Table 6.22.*

Table 6.22 Priority Determination of Ecosystem Services for the Proposed Gamsberg Mine and Surrounding Environs

Ecosystem Service	Importance to beneficiaries	Replaceability	Sustainability in the project area	Priority Rating
Provisioning Services				
Wild-caught foods	None	Not applicable	Not applicable	-
Capture fisheries	None	Not applicable	Not applicable	-
Other Wild foods	None	Not applicable	Not applicable	-
Fuel wood	Low	Moderate	Not used	Low
	This service is available but communities do not have access.			
Natural medicines	Low	High	Not used	Low
	This service is available but communities do not have access.			
Freshwater availability	High	High	Sustainable	Medium
	Groundwater is the primary source of water, which will be adversely affected by the mine.			
Crop production	None	Not applicable	Not applicable	-
Livestock farming	Low	High	Not used	Low
	Natural grazing is available, however communities do not have access to this resource.			
Regulating Services				
Air quality and climate regulation	None	Not applicable	-	-
Disease and pest regulation	Low	Moderate	-	Low
Pollination and seed dispersal	Low	Moderate	-	Low
Cultural Services				
Religious, Sacred or spiritual sites	Medium	Moderate	-	Medium
Aesthetic value	Medium	Low	-	High
Tourism	Low	Low	-	Medium
Supporting Services				

Ecosystem Service	Importance to beneficiaries	Replaceability	Sustainability in the project area	Priority Rating
Genetic pathways and maintenance of biodiversity	Medium	Low	-	High

6.14.5 *Summary of Ecosystem Services Assessment*

Most ecosystem services are not applicable or of low relevance to the project as the project site has not been accessible to local communities for many years and access to the site is likely to become more restrictive with mining activities. The areas surrounding the project area consist mostly of private commercially-owned farms and there are no communities depending on subsistence livelihoods.

Only ecosystem services with a high or critical priority are considered relevant for assessment of the impact of the mining development. As can be seen from *Table 6.21,* only two ecosystem services have a high priority, namely tourism and pathways for genetic exchange and biodiversity maintenance. The tourism industry is discussed in the Social baseline, the mining development is not considered to present a major threat to the industry. Pathways for genetic exchange and maintenance of rare and threatened species has been assessed as high due to potential loss of endemic and threatened succulents. The impacts of biodiversity loss are assessed in *Section 9.3.*

7 PUBLIC PARTICIPATION PROCESS

7.1 INTRODUCTION

Consultation with Interested and Affected Parties (I&APs) forms an integral component of an ESIA process. It enables *inter alia* directly affected and neighbouring landowners, authorities, civic groups, stakeholders and the general community to raise and/or identify issues and concerns relating to the proposed activity, which they feel should be addressed in the ESIA process.

This Section provides an overview of the Public Participation Process (PPP) and describes what engagement activities have been undertaken to date and includes the next steps in the public engagement process.

7.2 OBJECTIVES OF THE PUBLIC PARTICIPATION PROCESS

The PPP has been designed to achieve the following objectives:

- To ensure that stakeholders are well informed about the proposed development;
- To provide a broad set of stakeholders sufficient opportunity to engage and provide input and suggestions on the Project;
- To verify that stakeholder issues have been accurately recorded;
- To draw on local knowledge in the process of identifying environmental and social issues associated with the Project and to involve stakeholders in identifying ways in which these can be addressed; and
- To comply with the legal requirements and international good practice.

7.3 PHASES OF THE PUBLIC PARTICIPATION PROCESS

The PPP has been designed around five phases within the ESIA process, namely:

Initial Consultation

- Identification of additional stakeholders;
- Engagements with key stakeholders including representatives from the local municipalities, farmer's association and environmental NGO's;
- Providing information of the Project and the associated processes to stakeholders;

- Obtain issues of concern, comments and suggestions from key stakeholders; and

- Invite stakeholders to register as I&APs.

Pre-scoping Phase

- Officially initiates, and notifies the public of, the formal ESIA process;

- Distribution of a Project Background Information Document (BID), placement of statuary adverts and site notices;

- Engagements with key stakeholders including representatives from the local and district municipalities, farmers association, directly affected landowners and environmental NGOs;

- Obtain issues of concern, comments and suggestions from stakeholders; and

- Invite stakeholders to register as I&APs.

Scoping Phase

- Acknowledge and forward suggestions for enhanced Project benefits and reasonable alternatives to the applicant;

- Verify that issues raised by stakeholders have been accurately recorded; and

- Record and address concerns, suggestions and comments about the Project, the Draft Scoping Report and the Draft Plan of Study for EISA phase.

Impact Assessment Phase

- Provide the draft ESIA Report and ESMP for I&AP review;

- Allow I&APs to comment on findings of the impact assessments as well as in the development of appropriate mitigation measures; and

- Verify that issues raised by stakeholders have been accurately recorded.

- Finalise ESIA Report and distribute for 21 day public comment period and simultaneously submit to the DENC.

Decision Making Phase

- Notifying I&APs of the outcome of the decision by the relevant authorities; and

- Notifying I&APs of the appeals process and how they can engage this process.

7.4 *WHO ARE THE STAKEHOLDERS OR I&APS*

Given the sensitivities around the biodiversity associated with the Project location and high rate of unemployment in the region, it is important that stakeholders from the district and local municipalities, environmental bodies and landowners are given the opportunity to participate in the process. Notification activities have been designed to ensure that stakeholders are invited to be involved in the process.

Stakeholders are grouped into the following categories:

- Government: National, Provincial, District and Local authorities;
- Landowners: Directly affected and surrounding landowners;
- Communities: Surrounding communities;
- Adjacent Landowners: Neighbouring farm owners and communities;
- Non-Governmental Organisations (NGOs): Environmental organisations and social focused organisations;
- Business: small medium enterprises and formal organisations; and
- Unions.

A stakeholder database has been compiled and will continue to be updated throughout the PPP. The existing full stakeholder database is appended as *Annex C*.

7.5 *PUBLIC PARTICIPATION ACTIVITIES UNDERTAKEN DURING THE SCOPING PHASE*

Table 7.1 below provides details of the public participation activities that were undertaken during the scoping phase, as part of the ESIA process. For specific details (eg meetings minutes, stakeholders present at meetings, specific issues raised etc.) on each of the public participation activities listed below please refer to the Final Scoping Report.

Table 7.1 ***Public Participation Activities during the Scoping Phase***

Activity	Details
Initial consultation	
Meeting with authorities.	Provision of information and general discussion around the Gamsberg Project. The following authorities were consulted on 10 July 2012: • Department of Mineral Resources (DMR); • Department of Environment and Nature Conservation (DENC); and • Department of Water Affairs (DWA).

Meeting with key stakeholders.	Provision of information and general discussion around the Gamsberg Project. The following key stakeholders were consulted on 20 and 21 June 2012: • Pella Local Municipality and community leaders (20 June, Pella); • South African National Botanical Institute (SANBI) (20 June, Springbok); • Khai-Ma Local and Namakwa District Municipalities (21 June, Pofadder); and • Pofadder Landbou Vereniging (21 June, Pofadder).
Identification of stakeholders.	Stakeholder database which includes interested and affected parties from various sectors of society including directly affected and adjacent landowners in and around the Project area.
Pre-Scoping Phase	
Distribution of Project announcement letter and Background Information Document (BID).	BID and announcement documentation emailed and posted to stakeholders on 30 July 2012. (Registration period of 30 days: 30 July – 29 August 2012).
Placing of adverts.	Afrikaans adverts were placed in the Die Plattelander (3 August 2012), Die Namakwalander (3 August 2012), Eland (8 August 2012), Die Burger West (5 August 2011) newspapers and English adverts were placed in the Die Gemsbok (3 August 2012).
Putting up of site notices.	Eight Afrikaans and eight English site notices were put up at the Project area, local libraries, municipal offices and frequently visited shops or recreational venues Pella, Aggeneys and Pofadder: • Gamsberg Project area; • Aggeneys Kaffee; • Aggeneys Recreation Hall; • Black Mountain Main Building Aggeneys; • Pella Library; • Pella Municipal Office; • Pofadder Library; and • Pofadder Municipal Office.
Meetings with relevant stakeholders.	Meetings and telephonic consultations were conducted with the following stakeholders in mid-August 2012: • Landowners/farmers telephonic consultations (27 July); • Environmental NGOs telephonic consultations (8 August); • Pofadder Landbou Vereniging meeting (15 August, Pofadder); • Conservation South Africa, SANBI and NAGO meeting (16 August, Springbok); and • Khai-Ma Local Municipality meeting (16 August, Pofadder).
Obtained comments from stakeholders.	Comments, issues of concern and suggestions received from stakeholders are included in the Final Scoping Report.
Scoping Phase	
Announcement of DSR.	Draft Scoping Report announcement letter sent to all I&APs on the database on 9 November 2012. An English and Afrikaans adverts was placed in the following newspapers: • Die Gemsbok; • Die Plattelander; • Die Namakwalander;

	• Eland; • Die Burger West; and • Express Northern Cape.
Making Draft Scoping Report available to I&APs.	Draft Scoping Report in English, a Non-Technical Summary in English and Afrikaans accompanying documents were placed at the following public places within the Project area: • Pofadder Public Library; • Pofadder Local Municipal Offices; • Springbok Municipal Offices; • Springbok Library; • Aggeneys Public Library; • Pella Public Library and Local Municipality; and • Project website.
Draft Scoping Report available for I&AP review	The Draft Scoping Report was made available for a 30 day period for I&AP review from the 9 November – 14 December 2012.
Stakeholder meetings to present Draft Scoping Report.	Details of public meetings undertaken during the Scoping Phase are as follows: - **Pofadder Community Hall** **27 November 2012** **16:00 – 18:00** - **Pella Community Hall** - **28 November 2012** - **16:00 – 18:00** - **Aggeneys Recreational Club** - **29 November 2012** - **16:00 – 18:00** Details of focus group meetings undertaken during the Scoping Phase are as follows: - **Pofadder Landbou Community Hall** - **Pofadder Farmers Association** **28 November 2012** **10:00 – 12:00** - **Conservation South Africa Offices** - **Social and Environmental Non-Governmental Organisations** - **28 November 2012** - **16:00 – 18:00**
Obtain comments from stakeholders on the Draft Scoping Report.	Comments, issues of concern and suggestions received from stakeholders during the Draft Scoping Report public review period were captured in the Comment and Response Report. These comments were addressed in the Final Scoping Report, which was distributed for a public comment period.
Making Final Scoping Report available to I&APs	The Final Scoping Report was simultaneously submitted to the competent authority and made available to I&APs for a 21 day comment period (from 14 January 2013 to the 4 February 2013). During this time the public could submit their comments directly to DENC.

Figure 7.1 and *Figure 7.2* below are pictures taken from the public meetings held in the towns of Pella and Pofadder.

Figure 7.1 ***Pictures taken during the Public Meeting held in Pella (dated 28 November 2012)***

Figure 7.2 ***Pictures taken during the Public Meeting held in Pofadder (dated 27 November 2012)***

7.6 PUBLIC PARTICIPATION DURING THE IMPACT ASSESSMENT PHASE

Public participation during the impact assessment phase of the ESIA revolves around a review of the findings of the ESIA, presented in the ESIA Report, and associated specialist studies. As such, stakeholder engagement activities are generally undertaken during this phase of the project in order to meet the following objectives:

- To provide further information on the project and to inform I&APs of where new/updated information can be found;

- To provide I&APs with information on the key findings from specialist studies conducted; and

- To involve I&APs in identifying mitigation measures proposed to reduce these impacts (or to maximize positive impacts).

In order to meet such objectives, the ESIA Report and associated EMPr (attached as Annex D) have been made available for public comment. This period extends until the 23 May 2013.

I&APs were notified timeously of the availability of this report, of how to obtain it, and of the date and venue of the meetings where the content of the reports would be presented for comment. In addition to this, stakeholders were encouraged to comment either in writing (mail or email), by attending the stakeholder meetings or by telephonic consultation. These notifications took the form of advertisements as shown in *Table 7.2* below.

In addition to this, an announcement letter was sent to all I&APs listed on the above mentioned stakeholder database on 22 April 2013. Refer to Annex C for the full list of stakeholders included in the above mentioned stakeholder database.

Specific information on the PPP activities that were undertaken during the ESIA phase of the Project, are provided in *Table 7.2* below.

Table 7.2 Public Participation Undertaken during the ESIA Phase

Activity	Details
ESIA Phase	
Announcement of Draft ESIA report.	A Draft ESIA report announcement letter was sent to all I&APs on the database on 22 April 2013. Adverts placed in the following newspapers: • Die Gemsbok; • Die Plattelander; • Die Namakwalander ; • Eland; • Die Burger West; and • Express Northern Cape. Copies of the adverts are contained in Annex E.
Making Draft ESIA report available to I&APs.	The Draft ESIA report in English, a Non-Technical Summary in English and Afrikaans accompanying documents were placed at the following public places within the Project area: • Pofadder Public Library; • Pofadder Local Municipal Offices; • Springbok Municipal Offices; • Springbok Library; • Aggeneys Public Library; • Pella Public Library and Local Municipality; • Project website. (Draft ESIA public review period ends 23 May 2013).

Making the Draft ESIA Report available to I&APs	The Draft ESIA report and associated documents were placed on the following website: http://www.erm.com/gamsberg-ESIA
Stakeholder meetings.	Details of public meetings undertaken during the ESIA phase are as follows: - **Pella Community Hall** **14 May 2013** - **Aggeneys Recreational Club** **15 May 2013** - **Pofadder Community Hall** **16 May 2013** Details of focus group meetings during the ESIA phase are as follows: - **Pofadder Landbou Community Hall** - **Pofadder Farmers Association** **16 May 2013** - **Conservation South Africa Offices** - **Social and Environmental Non-Governmental Organisations** **15 May 2013**
Obtain comments from stakeholders.	Comments, issues of concern and suggestions received from stakeholders on the Draft ESIA Report will be captured in the Comment and Response Report (in the Final ESIA), which will also be made available to I&APs. The Comment and Response Report will also be distributed to all I&APs who submitted comment.
Making ESIA Report available to I&Ps	The Final ESIA Report was simultaneously submitted to competent authority and made available to I&APs. A public review period of 21 days was provided for I&APs to provide comments directly to DENC.

7.7 *COMPETENT AUTHORITY'S DECISION*

Once the DENC has taken a decision about the ESIA process in terms of NEMA, the public participation office will immediately notify I&APs of this decision and of the opportunity to appeal. This notification will be provided as follows:

- A letter will be sent out, personally addressed to all registered I&APs, summarising the authority's decision and explaining how to lodge an appeal should they wish to; and

- An advertisement to announce the Competent Authority's decision will be published in the relevant newspapers.

Please note that National Department of Environmental Affairs decision on the waste management license application will be advertised, together with the decision made by DENC on the ESIA process. The requirements for the National Heritage Resources Act (59 of 208) are met within the ESIA process. However, SAHRA will grant a Record of Decision prior to the issuing of the Environmental Authorisation.

Upon issuing, the environmental authorisation will be submitted to the DMR for decision making on the amendment of the existing EMPr. The decision on the EMPr amendment is expected within 4 months of issuing of the environmental authorisation.

Upon issuing of the environmental authorisation and amended EMPr, the DWA will make a decision on the water use license application. Once satisfied, the DWA will issue their decision on the water use license application.

Lastly, once the aforementioned decisions are issued and construction phase is complete, the DENC will then issue a decision on the atmospheric emissions license application, within 6 months of the operational phase.

7.8 *NEXT STEPS IN THE ESIA PROCESS*

The next steps in the process include:

- This Final ESIA was sent out to I&APs for a 21 day comment period and submitted to the competent Authority who will make a decision on the application.
- I&APs will be notified of the decision of the competent Authority
- I&APs will be given an opportunity to appeal the decision. They will be notified of the decision and commencement of the appeal period by advertisement in the newspapers used during the EIA process.

8 *WASTE MANAGEMENT AND CLASSIFICATION*

8.1 *INTRODUCTION*

This Section identifies the different types of waste that will be generated during the construction, operation and decommissioning phases of the Project. These waste types are classified and various 'preferred' and 'alternative' management options are provided for each.

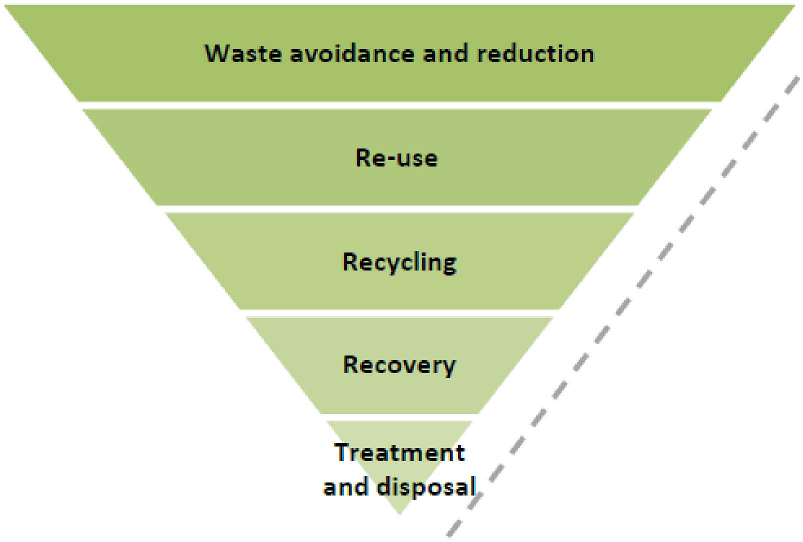
Following this, potential impacts that such waste streams pose to human health and the environment are assessed and presented in tabular format. Finally, a number of mitigation measures/recommendations are provided that seek to minimise/avoid the environmental and health impacts identified.

The concept of 'Waste Management Hierarchy', which is aligns with principles set out in terms of key National Waste Legislation, is applied throughout the Section. This approach is discussed in further detail in the following section. These recommendations are intended to inform final Waste Management Plans (WMPs) that will be developed as part of this process (refer to EMPr attached as *Annex D*) to ensure that all waste generated at the Project site is collected, handled, transported and disposed of in an environmentally sustainable manner.

8.2 *APPLICATION OF A WASTE HIERARCHY APPROACH*

The primary focus of the National Waste Management Strategy (NWMS) (DEA, 2011), which aims to meet the key objectives of the National Environmental Management: Waste Act (NEMWA) (No. 58 of 2008), is implementing the 'Waste Management Hierarchy', which is depicted in *Figure 8.1* below.

Figure 8.1 Waste Management Hierarchy



Source: NWMS, 2011.

The waste management hierarchy consists of options for waste management during the lifecycle of waste, arranged in descending order of priority. The foundation of this hierarchy and the first choice of measures in the management of waste are waste avoidance and reduction. In this regard, waste that cannot be avoided should be recovered, reused, recycled and treated (with recovery, re-use and recycling being preferred management options to the treatment of waste). Furthermore, waste should only be disposed of as a last resort.

The NEMWA and the NWMS also place an emphasis on Industry Waste Management Plans (WMPs), which are the central element in this co-regulatory system. These WMPs are expected to report on, amongst other things, how the site is going to manage its waste and to provide targets for achieving waste hierarchy issues, particularly with regard to waste reduction and recycling. As such, it is essential to introduce the principles of clean technology and the waste hierarchy during the design phase of the project.

Table 8.1 below details the types of waste generated by the Project and provides some preferred management options that speak to the waste hierarchy concept as described above. Further application of the Waste Hierarchy is given in *Section 8.5.2* below, whereby specific recommendations to minimise, reduce, recycle and re-use certain types of waste generated by the Project are listed. These recommendations will inform the Waste Management Plan (WMP) developed as part of this process (refer to Annex D)

8.3 *WASTE GENERATION AND CLASSIFICATION*

The Project will generate two primary waste streams, which can be categorised as *mineral* and *non-mineral* wastes.

Mineral Wastes

Mineral wastes that will be generated by Project activities will include waste rock (predominantly comprised of amphibole, quartz-muscovite-schist, silicified and spongy gossan, and white quartzite) and a waste stream generated from ore processing (tailings).

Non-mineral Wastes

Non-mineral wastes (domestic, non-hazardous and hazardous) are generated during construction works and mine operations, particularly at maintenance workshops, administrative offices, processing plants and staff housing facilities. Specific types of that will be generated as a result of the Project are listed in *Table 8.1* below.

In addition to listing the types of wastes generated, *Table 8.1* also provides 'preferred' and 'alternative' management options for each waste stream identified.

Table 8.1 Types of Non-mineral Wastes that will be Generated by the Project and Possible Management Options

Unit / Source	Description	Waste Type/Composition	Preferred Management Option(s)	Alternative Management Option(s)
1.Construction Phase				
Construction Wastes	Metal Scrap	Steel, wood, rubber & plastic & tyre scrap Electrical cable scrap.	Recycle/Recover.	Dispose to General Waste Landfill.
	Building Rubble	Cement Bags, bricks, cut-offs, hardened cement etc.	Recycle, reuse, if possible.	Dispose to General Waste Landfill.
	Paint	Waste Paint, "Empty" Containers.	Recycle to "Collect-a-Can".	Dry out/Solidify and Dispose to General Waste Landfill.
	Fuels	Spillage, Contaminated Soil.	See Sections 6 and Below	
	Lubricating Oil and Grease	Used oil and grease, oil filters, oily rags, etc.		
	Sewage Treatment	Activated Sludge.		
	Health care risk waste	Used bandages, plasters, syringes, Sanitary Towels, and Pads etc.		
	Hazardous Packaging:	Drums, Plastic and Paper Bags, "Empty" Containers of Cleaning Agents.		
	Batteries	Vehicle Batteries. Batteries from electrical equipment, eg cell phones, torches.		
2. Mining				
Waste Rock	Residue Rock, Soil, etc.	Natural material from the mining area.	Dispose to Rock Dump in accordance to Requirements.	Use to back fill open pit workings, if permitted.
Drilling Oils	Soluble petroleum oils	Soluble oil can be considered potentially hazardous if it enters the ground and surface water.	Temporary storage on-site followed by disposal at Vissershok, Cape Town.	Dispose any residual Oil and packaging to an HH Landfill.
Explosives	Ammonium Nitrate Fuel Oil (ANFO)	Classed as SANS 10228/GHS 10234 Class 1 Waste, Explosive, when not de-sensitized.	The spilled over explosives would be collected and used in the void bore hole (stemming) just above the ANFO fill.	Small amounts can be treated with water and disposed to hazardous waste landfill.
Crusher Dusts	Rock dusts	Spillage, Dust from extractors.	Process in flotation plant if possible.	Dispose to Tailings Dam.
Petroleum Wastes	Diesel, Petrol	Spillage, Contaminated Soil.	See Section Below	

Unit / Source	Description	Waste Type/Composition	Preferred Management Option(s)	Alternative Management Option(s)
Oil and Grease	Vehicle lubricants	Used oil, oil filters, oily rags, empty oil cans, etc.		
3. Processing – Flotation Plant				
Carbon Flotation:				
Depressants	1. Zinc Sulphate 2. Calcium Cyanide	Solid Residues and dissolved Zn and Cyanide.	The spillage will be transferred to PCD. Liquid will be recycled suitably and the solid part will be taken back into the circuit.	
Frothers	Anionic or non-ionic Detergents	Waste material, spillages, empty containers and tailings.	The spillage will be transferred to PCD. Liquid will be recycled suitably and the solid part will be taken back into the circuit.	See text.
Lead Flotation				
Frother	Anionic or non-ionic Detergents	Waste material, spillages, empty containers and tailings.	The spillage will be transferred to PCD. Liquid will be recycled suitably and the solid part will be taken back into the circuit	See text.
Collector	Sodium ethyl xanthate	Waste material, spillages, empty containers and tailings.	The spillage will be transferred to PCD. Liquid will be recycled suitably and the solid part will be taken back into the circuit.	See text.

Unit / Source	Description	Waste Type/Composition	Preferred Management Option(s)	Alternative Management Option(s)
Zinc Flotation and Zinc Concentrate Flotation				
Activator	Copper sulphate	Waste material, spillages, empty containers and tailings.	The spillage will be transferred to PCD. Liquid will be recycled suitably and the solid part will be taken back into the circuit.	See text.
pH Modifier - lime	Calcium oxide/hydroxide	Waste Lime, spillages, empty bags, etc.	Utilise to raise pH of tailings before discharge to dam.	High pH wastes, pH>12, should not be disposed to landfill. Can be used to neutralise acid wastes at an HH landfill.
Collector	Sodium ethyl xanthate	Waste material, spillages, empty containers and tailings.	Oxidise xanthate using hydrogen peroxide: Effluent to tailings dam and solid residues to HH Landfill.	
Ore (in Open) and Concentrate (under Cover) Stockpile Pads				
Spillage and Sweepings??		The ore and concentrate both contain heavy metals and sulphides: spillages, sweepings, etc.	Recover values or dispose to Tailings Dam.	
4. Flotation Plant - Other				
Chemicals	Redundant Chemicals, Reject Products,	Various – see above.	Recycle, if possible.	Dispose to Hazardous Waste Landfill, if permitted.
Laboratory	Laboratory Waste	Waste Samples. Waste or redundant chemicals.	Dispose to HH Landfill.	See text.
5. Maintenance including Vehicle Wash Bay				
Effluent Treatment System	Oily Sludge	Oily waste from Workshops, Maintenance Yard, Sludge from Vehicle Wash Bay.	Oil recovery – ROSE foundation.	Treatment/Disposal to Hazardous Waste

Unit / Source	Description	Waste Type/Composition	Preferred Management Option(s)	Alternative Management Option(s)
			Waste to Energy: 1) Cement Kiln; or 2) Dedicated On-Site Facility.	Landfill, if permitted.
	Oily Wastes	"Empty" oil cans, oily rags.	Oily Cans to Recycling, Oily Rags to Landfill, if permitted or alternatively to Vissershok.	
	Scrap Tyres and rubber waste	Scrap tyres from cars, trucks plus conveyer belt waste.	Utilise/Recover to manufacture rubber product. Waste to Energy: 1) Cement Kiln; or 2) Dedicated On-Site Facility.	Landfill of tyres whole or quartered may be prohibited: see text.
Fuel Storage	Diesel, petrol	Spillage, Contaminated Soil.	Bio-remediate in-situ or Compost.	Dispose to HH Landfill, if permitted.
6. Tailings Dam				
Tailings	Residues from flotation process.	Contains heavy metals, iron, cadmium, zinc, lead, copper, manganese, etc. plus high amount of sulphur as the sulphide. Classed as significant environmental risk.	Dispose to tailings Dam, ensure pH of 8 to 9 to minimise possibility of acid mine drainage.	
7. Effluent Treatment System				
	Bio Sludge	Activated Sludge.	Agricultural Use. Compost.	Treatment/Disposal to Landfill, if permitted.
	Water Treatment Sludge	Mainly Inorganic Solids.	Could be used in the manufacture of clay bricks.	Treatment/Disposal to HH Landfill, if permitted.
7. Plant and Office Buildings				
	Office waste	Non-hazardous Paper, packaging waste, plastics.	Recycle where possible.	Treatment/Disposal of Residues to General

Unit / Source	Description	Waste Type/Composition	Preferred Management Option(s)	Alternative Management Option(s)
				Waste Landfill.
	Garden waste	Green waste from gardens.	Compost.	Excess and non-compostable material, dispose to General Waste Landfill.
	Empty Metal Containers	Soft drink cans, paint cans, empty oil cans, etc.	Recycle to Collect-a-Can.	Dispose to licensed to General Waste Landfill, if permitted.
	Batteries	1) Lead-acid Batteries from Vehicles. 2) Dry Batteries, eg from cell phones, torches and other equipment.	1) Lead-Acid Batteries recycle. 2) Dry Batteries recycle if possible.	Treatment/Disposal of Residues to Landfill, if permitted: see text.
	Waste Electric and Electronic Equipment (WEEE)	1) Lamps. 2) Other, eg computers, Cell Phones.	Recycle through licensed WEEE management company.	Incinerate.
	Cleaning Materials	Hazardous Packaging: Drums, Plastic and Paper Bags, "Empty" Containers of Cleaning Agents, Aerosols, Pesticides, etc.	Clean and recycle if possible. Use principles of the Responsible Packaging Management Association of South Africa (www.rpmasa.org.za).	Dispose to Licensed General or Hazardous Waste Landfill.

8.4 *ASSESSMENT OF POTENTIAL ENVIRONMENTAL IMPACTS*

Table 8.2 below provides an assessment of the impacts associated with the handling, storage and disposal of the different waste types identified above.

From this table, it is evident that there are a number of potentially significant risks (particularly related to human health, air quality, pests and fire) that may be associated with the handling, storage and disposal of waste, both on- and off-site. Furthermore, it illustrates how the use of innovative technology/designs can create instances where the management of a particular waste stream can result in a positive impact (eg recycling initiatives that create new job opportunities and composting which provides additional nutrients for the soil).

Section 8.5 provides some important management approaches/activities to the mitigation of the environmental and health risks identified in this section. Furthermore, a number of best practice management options are provided for consideration. This specifically relates to the use of cleaner design and production options that relates to an improvement in a company's environmental efficiency and the subsequent improvement of their financial bottom line

As discussed before, these waste management measures/recommendations have been incorporated into Waste Management Plans (WMPs) developed for the construction, operation and decommissioning phases of the Project (refer to *Annex D*). These WMPs will then inform management procedures to ensure environmentally friendly and safe collection, transport, handling, storage and disposal of waste generated at the Project site.

Table 8.2 Waste Management Impacts that May Occur During Construction, Operation and Decommissioning

Activity	Nature of Impact/Aspect	Intensity Potential	Extent	Duration	Probability	Impact significance
Collection of general non-hazardous waste.	Air - diesel/petrol fumes.	Low (-)	Local	Long Term	Likely	Moderate
Handling and storage of builders rubble, soil, etc.	Air – dust.	Low (-)	Local	Long Term	Likely	Moderate
Re-use of builders rubble.	Positive impact – reduction of waste to landfill. In line with government waste minimization policies. Decrease in use of resources.	Low (+)	Local	Long Term	Likely	Minor
Handling and Storage of general waste, including office waste, garden waste and recyclable wastes including paper, tins, glass and plastics at Salvage Yard.	Possible contamination due to bulking at salvage yard. Wind-blown litter	Low (-)	Site	Long Term	Likely	Minor
Recycling or re-use of packaging material and other recyclables.	Positive impact – reduction of waste to landfill. In line with government waste minimization policies. Protection of a natural resource.	Low (+)	Site	Long Term	Likely	Minor
Handling and storage of scrap tyres and rubber waste.	Storage - fire hazard. Storage – provide receptacles for the collection of rain water which stagnates. Provides receptacle for living and breeding of vermin.	Low (-)	Site	Long Term	Likely	Minor
Disposal to landfill of scrap tyres and rubber waste.	Difficulty in handling on landfill – non compactable, fire hazard, vermin breeding receptacles, damage to landfill equipment and do not remain buried.	Low (-)	Site	Long Term	Likely	Minor

Activity	Nature of Impact/Aspect	Intensity Potential	Extent	Duration	Probability	Impact significance
Utilisation of scrap tyres and rubber waste in a cement kiln or on site facility.	Positive Impact – energy recovery, decrease in use of natural resources, and reduction in amounts of solid waste disposed to landfill.	Low (+)	Site	Long Term	Likely	Minor
Recycling or re-use of scrap tyres and rubber waste.	Positive impact – reduction of waste to landfill/incineration. In line with government waste minimization policies. Decrease in use of resources.	Low (+)	Site	Long Term	Likely	Minor
Disposal to landfill of general waste.	Reduction in landfill airspace.	Low (-)	Site	Long Term	Likely	Minor
Disposal to landfill of general waste, including office waste, greens/garden waste and paper, tins, glass and plastic waste, scrap tyres and rubber waste.	Wind-blown litter. Production of leachate.	Low (-)	Site	Long Term	Likely	Minor
Composting of vegetation from site.	Positive – reduction of waste to landfill. In line with government waste reduction policies. Addition of nutrients to soil.	Moderate-Low (+)	Site	Long Term	Likely	Minor
Re-use of clean storm water run-off.	Positive impact – in line with government waste minimization policies. Protection of a scarce natural resource.	Moderate-Low (+)	Site	Long Term	Likely	Minor

8.5 *WASTE MANAGEMENT*

8.5.1 *Hazardous and Non-hazardous Solid Waste Disposal*

Disposal is viewed as the last option in the management of waste and should only be undertaken if the avoidance, re-use or recycling of the waste in question is not practical. In such instances, only transport operators or companies that are licensed (by the competent authorities) shall be contracted to remove waste from the Project site. General waste which cannot be either re-used or recycled; shall be sent to a licensed landfill that may accept that category of waste. There are no licensed hazardous waste management facilities in Northern Cape Province. As such, all hazardous wastes shall be transported to EnviroServ's Vissershok HH Waste Management Facility Landfill in Cape Town. Removal of waste materials at end of mine will be handled as part of the mine rehabilitation closure plan.

8.5.2 *Cleaner Production and Design*

Cleaner Production and design are possible mechanisms, which could be used to enhance the Projects efficiency particularly during the beneficiation of ores. This would assist any company in attaining an improved environmental efficiency and subsequent improved financial bottom line. The long-term objective for waste prevention, minimisation and recycling is to ensure that minimisation and recycling procedures and practices are adopted by all sectors of society as part of a broader initiative focusing on cleaner production. This includes measures to:

- Harness renewable materials and energy sources or reduce the use of natural resources by using them more efficiently and productively.
- Reduce or eliminate pollution and toxic wastes.
- Deliver equal or superior performance compared with conventional offerings.
- Provide investors, companies, and customers with the promise of increased returns, reduced costs, and lower prices.
- Create quality jobs in management, production, and deployment.

Clearly, for a project of this size and nature, the proponent has the opportunity to select the technologies for each part of the process that that would be more efficient, thereby minimising waste production.

8.5.3 *Waste Management Infrastructure*

Certain waste management infrastructure will be required in order for waste to be appropriately managed throughout the lifecycle of the Project. Specific infrastructure and facilities that are applicable to the Project are detailed in *Table 8.3* below. The waste storage facilities required for the Project will be housed within the confines of the Concentrator Plant (see *Annex H* for facility illustrations).

Table 8.3 Potential Waste Management Infrastructure/Facilities Required

Waste Infrastructure/ Facilities	Description
Chemical and Waste Storage Facilities.	Storage facilities will be necessary for hazardous chemicals and any hazardous wastes used and generated during the construction, operation and decommissioning phases of the Project. Note that storage facilities will require either a basic assessment or possibly a full EIA assessment, although these can be included in the final authorisation for the whole facility: (Draft NEMWA Amendment, Government Gazette 33880, 14th December 2010). Specific requirements that must be considered when designing such facilities include: • They must be built in accordance with requirements from the Department of Environmental Affairs and will include linings, bunds, roofing (except for large stockpiles such as ore, rock and tailings). • A hazardous chemical and waste storage facility should include a low permeability surface, preferably concrete, that is protected from the ingress of storm water from surrounding areas to ensure that accidental spillage does not pollute local soil or water resources. • All storage areas must also be properly demarcated and, if the material is hazardous, there should be adequate labelling and security at the facility. • A facility must provide for separate storage of incompatible chemicals or wastes (ie acids and bases; calcium cyanide and acid) and for flammable materials. • The migration of spillage into the ground and groundwater regime around storage areas must be prevented. This is particularly important for temporary storage areas that may be required during construction. • Flammable materials must be kept separate from other hazardous materials and be well ventilated in order to prevent build-up of explosive vapours and gases.
Licensed General Waste Site.	Note that there are two authorised (ECA permitted) general waste sites (GCB- Landfill) at the BBM site with sufficient capacity to accommodate the general waste generated by the Project. Should these facilities require expansion in future, the appropriate NEM:WA permits will be obtained.
A Disposal Facility for Uncontaminated Construction Waste.	Uncontaminated construction waste (Inert waste or very low risk waste) can be disposed of at a Class D site. Alternatively, the material could be used to landscape the Project area to ensure the correct run-off of rainfall from clean areas and its diversion from potentially contaminated areas to a holding dam. In addition, construction waste could be used as cover material in the General Waste Site or be crushed and used as backfill or building bunds, etc.

Waste Infrastructure/ Facilities	Description
Water Containment Dam(s).	Dams for storage of potentially contaminated water prior to analysis and discharge to water course; to the activated sludge water treatment facility or oxidation pond; or used as process water will be required. As indicated in the text the Facility will utilise significant amounts of water which will be stored in pollution control dams and reused in processing.
Activated Sludge Treatment Plant or Oxidation Ponds.	An activated sludge plant or oxidation pond for treatment of sewage, contaminated storm water and, possibly, selected plant effluents will be required.
Storage Areas for General Waste and a Central Recycling and/or Reclamation Yard.	Storage Areas for General Waste and a Central Recycling and/or Reclamation will be necessary. A Central Recycling area would recycle and recover general waste materials and possibly collect and store selected generic hazardous wastes such as used oil, fluorescent tubes, batteries and electronic wastes for bulking and final collection for recycling or possibly disposal.
Lubricating oils from workshops and other areas.	Lubricating oils from workshops and any other areas can be stored on-site and the waste collected for recycling by a company approved by the ROSE (Recycling Oil Saves the Environment) Programme. Up to 80% of South Africa's recoverable oil is already collected by this country wide programme. An area at the central recycling/reclamation yard would be required for storage.
On-site health care risk waste.	As the amount of health care risk waste, including sanitary waste generated at the proposed Facility, is expected to be very low, it is recommended that the licensed removal service be used to collect and remove this waste from the site.
Treatment Area for Potentially Contaminated Soil.	A Treatment Area for Potentially Contaminated Soil should be made available. Soil that is inadvertently contaminated with petroleum hydrocarbons, eg lubricating oil, can be treated by biodegradation technologies to a standard that would be acceptable for using as a fill, as landfill cover or even to bulk compost. A central facility is normally preferable to using in-situ technologies where less control can be maintained over the processing. Bioremediation of contaminated soil will be undertaken at the BMM facility unless quantities exceed the carrying capacity of the site, in which case, this soil will be transported to HH facility.

8.5.4 *Implementing the Waste Hierarchy*

Methods to Minimise Waste Production

- Specifications of construction material quantities for contractors are to be as accurate as possible to avoid the over-ordering of materials and the potential for excess waste.

- The ordering of stock during the operation of the mine will be regularly reviewed to ensure efficient stock control and to avoid wastage.

- The use of degreasers is regulated in workshop areas to ensure the efficiency of the oil-water separator.

- All waste areas are to be clearly identified and marked as waste storage areas. This includes bins and other receptacles for domestic waste, which would be marked according to the type of waste being accepted (eg scrap metal, oil filters and oily rages, other recyclables, general waste, etc.).

- Clear written instructions are to be erected at appropriate locations detailing recycling and waste separation information. There shall be no long term storage of any waste materials on the Project site.

Recycling

- Facilities should be provided for recycling paper and cardboard.

- Used metals should be stored for reuse or recycled as scrap metal and placed into large skip bins, which shall be collected by a metal recycler as sufficient quantities are available.

- Waste Oil should be collected within bunded fuel storage, refueling and maintenance areas and stored within waste oil bins once it has passed through an oil-water separator. The waste oil shall be removed from site by a licensed waste oil contractor for recycling.

- Batteries are removed from site for delivery to a facility able to despatch them to an appropriate recycling facility.

- The Environment Control Officer shall undertake regular inspections of waste storage locations to check that appropriate separation and collection of waste is being undertaken.

- BMM will maintain a register of recycled material at the Mine site.

Reuse

- Opportunities for the re-use of materials on site should be evaluated on a regular basis. Investigations shall be undertaken for the use of effluent from the site office, bathhouse and other amenities once treated to be re-used as irrigation water on rehabilitation and landscaped areas in accordance with relevant standards.

8.5.5 Other Recommendations

Training and Awareness

- Waste management requirements are incorporated into existing induction and awareness training systems.

- Additional waste specific communication will be included in Tool Box Talks and rolled out across the site on an as required basis.

- The site requirements for waste management are displayed at prominent positions across the mine in the form of charts outlining the correct disposal methods for the different waste streams.

Waste Inventory

- A comprehensive waste inventory containing information on all wastes generated, handled and disposed of, whether on or offsite is maintained by the Environment and Community Officer. The waste inventory is a database that focuses on the procedures for safe storage, handling, treatment, recycling and disposal of non-mineral wastes. This inventory will be further developed and updated over the first year of mine operation.

Monitoring

- Waste handling and storage facilities shall be managed by operational staff within each department. Waste quantities, including hazardous materials (eg waste oil/grease), are monitored accordingly by operational staff and collection schedules are arranged as required.

Facility Inspections and Audits

- Onsite waste storage, treatment and disposal facilities are inspected on a regular monthly basis to ensure compliance with procedures. These facility inspections are incorporated into existing workplace inspections and carried out by the relevant area personnel.

Emergency Response

A suitable emergency response procedure must be in place (eg provision of appropriate absorbents) for the clean-up of any accidental spills. Note that spilled materials are classified as wastes.

With respect to this, the following should be noted:

- Nearly all processes in the ore beneficiation plant require the use of reagent chemicals, many of which are hazardous;

- Separation of incompatible materials (so that they cannot come into contact with one another) is essential (eg alkali and acid materials). The following standard is available - SANS 310-1:2007, Storage Tank Facilities for Hazardous Chemicals P1, Above Ground facilities for Non-flammable Substances; and

- SABS approved tanks should be utilised in all cases. These tanks should have installation certificates, as well as annual certificates when they are inspected.

Complaints

- Any complaints as to the management regarding waste generated at the site will be directed to the relevant Department Manager and the Environment Control Officer for investigation and rectification. Complaints and actions arising from a complaint will be recorded in a complaints register to be maintained by the Environment Control Officer.

8.6 CONCLUSION

From an environmental point of view, the Project could pose a significant risk to human health and the environment, if the wastes are not managed in an environmentally sustainable manner. Some key risks identified in terms of this Section include:

- Incorrect storage of hazardous waste could result in contamination of air, soil and water resources.
- Disposal of hazardous waste to landfill will result in a reduction in landfill airspace, the production of leachate and reduction in quality of leachate.
- Emissions from incinerator are likely to impact on air quality.
- Health risks associated with personnel exposure to hazardous, infectious and/or toxic wastes.

Although significant risks have been identified, these are generally associated with poor management practices and the absence of mitigation measures to reduce the chance of such impacts occurring. As such, should the prescribed mitigation measures, identified in the previous Section, be suitably implemented, the residual risk that waste streams generated at the Site would pose to the environment and human health should be dramatically reduced or avoided altogether. In addition to this, should BMM decide to employ/implement some of the innovative design/technologies presented in this Section (ie clean technologies, energy recovery measures, recycling practices etc), it is possible that a number of a positive impacts could stem from the Project.

9 BIOPHYSICAL IMPACT ASSESSMENT

9.1 IMPACT ON AIR QUALITY

This section describes the predicted air quality impacts associated with the Project determined through air dispersion modelling. The main air quality impacts associated with the Project from mining operations, ore crushing and screening, ore loading and offloading, as well as the transporting of ore include the following:

- Fugitive dust emissions from general works, wind erosion of exposed areas, aggregate handling, ore crushing and screening and storage piles.
- Dust generation from vehicle activities, such as haul trucks and traffic on unpaved roads (including Loop 10).

The impact assessment described below considers sensitive receptors in terms of human health. However dust deposition associated with the Project may impact sensitive vegetation and ecological functioning. While the modelled concentrations outlined below are relevant to the consideration of the impact on sensitive vegetation the impact is assessed in *Section 9.3.2* below.

Impact Assessment

The emissions that will be generated by Project activities, along with meteorological parameters provided input into an air dispersion model which provided ambient air pollution and dust deposition concentrations for the Project site. The modelled concentrations were then used in the impact assessment described below for human health and in *Section 9.3.2* on biodiversity.

Figure 9.1 and *Figure 9.2* below show the predicted concentration isopleths for the maximum annual concentration of PM_{10} and dust deposition, respectively. The annual guideline of 40 $\mu g/m^3$ (as applicable from 2015) was exceeded at the mining area and the access roads. The exceedances occur approximately between 200 m and 500 m around the N14, and approximately between 500 m and 1 km around the Loop 10 road.

The daily dust deposition, averaged over a 30-day period, around the Gamsberg mine and the access roads is shown in *Figure 9.2* below. It can be seen that the dust deposition was light (< 250 $mg/m^2/d$) around the N14, and moderate (250-500 $mg/m^2/d$) around the Loop 10 road. Heavy dust fall (> 500 $mg/m^2/d$) occurred mainly within the mining area and internal haul roads.

Figure 9.1 PM$_{10}$ Annual Maximum Concentration (Guideline: 40 µg/m^3)

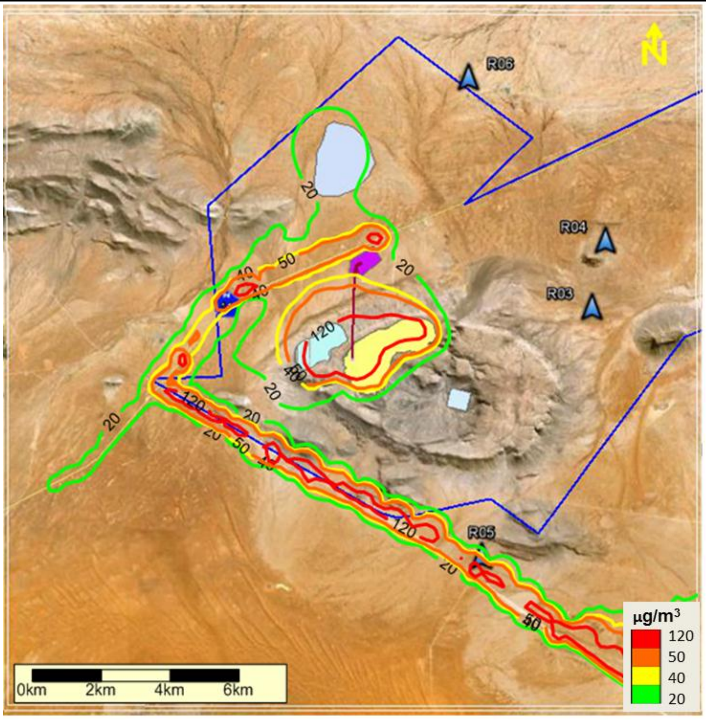


Figure 9.2 Averaged Daily Dust Deposition (Guideline: 600 mg/m^2/d)

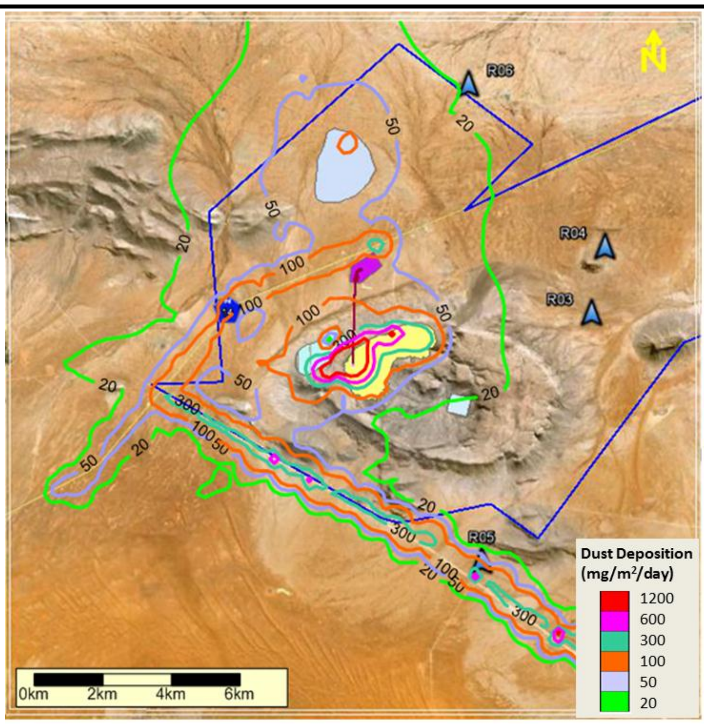


Table 9.1 below shows the modelled concentrations at the sensitive human receptors around the Gamsberg mine. It can be seen that the maximum 24-hr PM$_{10}$ concentration at receptors R04 and R05 exceeded the SA guideline. However, only at R05 the exceedances per year were above the permissible number of 4.

The average daily dust deposition at all receptors was within the residential guideline of 600 (mg/m²/day).

Table 9.1 *Modelled Air Quality Results at Sensitive Human Receptors*

Receptor	Description	PM_{10} Max 24-hr Concentration (µg/m³)	PM_{10} 24-hr Guideline Exceedances (No.)	PM_{10} Annual Concentration (µg/m³)	Dust Deposition (mg/m²/day)
R01	Farm House	18.1	0	1.0	4.8
R02	Farm House	19.8	0	1.6	5.8
R03	Farm House	28.3	0	2.4	9.8
R04	Farm House	100.0	1	3.1	10.5
R05	Farm House	88.5	5	66.9	159.2
R06	Farm House	52.7	0	4.1	18.7
R07	Aggeneys	19.2	0	2.7	6.3
R08	Farm House	< 20	0	< 7	< 20.6
R09	Farm House	< 20	0	< 7	< 20.6
R10	Farm House	< 20	0	< 7	< 20.6
R11	Farm House	< 20	0	< 7	< 20.6
R12	Farm House	< 20	0	< 7	< 20.6
R13	Farm House	< 20	0	< 7	< 20.6
R14	Farm House	28.8	0	24.6	94.5
R15	Farm House	< 20	0	< 7	< 20.6
R16	Farm House	24.4	0	12.4	37.3
R17	Farm House	22.4	0	10.7	28.2
R18	Farm House	< 20	0	< 7	< 20.6
Guideline		**75**	**5**	**40**	**600**

*Guideline exceedances shown in red.

9.1.2 *Impact on Air Quality (Human Health)*

The air quality impacts associated with the Project in relation to human receptors are discussed below.

Table 9.2 *Impact Characteristics: Impact on Air Quality*

Summary	Construction	Operation	Decommissioning/ Post Closure
Project Aspect/ activity	Dust and particulate matter PM_{10} generation through site clearance, road upgrade and establishment of the camp, laydown and assembly areas.	Mining operations, including drilling, blasting, hauling, crushing and ore processing.	The removal of operational infrastructure, equipment and waste management of hazardous substances.
Impact Type	Direct	Direct	Direct
Stakeholders/ Receptors Affected	Local ambient air quality.	Local ambient air quality.	Local ambient air quality.

Construction

During construction operations, dust is generated during land clearing and topsoil removal, road grading, material loading and hauling, travelling on unpaved roads and wind erosion from exposes areas.

The sensitivity around the mining area was considered to be **low**, since there are only few local dwellings in the area, and these are located more than 4km away from the mining pit and processing plant. The closest community, which is Aggeneys, is located more than 10 km from the mining pit. The Gamsberg mine extends over a large area (an approximately 4km radius), and due to the temporal nature of the construction activities, the dust emission impact will most probably be contained within the site (**local**). The construction duration is expected to be **short-term**. The ambient air quality will be **negatively** affected, with **possible notable changes** within very close proximity to the construction face. The frequency of the impact is expected to be **once off**. With implementation of "good practice" mitigation measures, the impact significance will be **Negligible**. It should be noted that it was assumed that the "good practice" dust suppression measures indicated as essential in the recommendations section will be applied during construction. The impact ratings for the construction phase are summarised in Box 9.1, below.

Box 9.3 Construction Impact: Impact on Air Quality

<u>Nature</u>: Construction activities would result in a **negative direct** impact on existing ambient air quality in the mining area.

<u>Sensitivity/Vulnerability/Importance of Resource/Receptor</u>: **Low.**

<u>Impact Magnitude</u>: **Small.**
<u>Extent:</u> The extent of the impact is **local**.
<u>Duration:</u> The expected impact will be **short-term**.
<u>Scale:</u> The impact will result in **notable** changes to the receptor.
<u>Frequency:</u> The frequency of the impact will be **once-off.**
<u>Likelihood</u>: Ambient air quality will possibly be affected, in terms of increased dust fallout and ambient PM_{10} concentrations.

IMPACT SIGNIFICANCE (PRE-MITIGATION): **NEGLIGIBLE.**

<u>Degree of Confidence</u>: The degree of confidence is **high**.

Mitigation

Wet suppression or application of chemical dust suppressants will be used to mitigate dust and particulate matter generation during general construction and site preparation.

Operational Phase

The operational phase of the Gamsberg mine will last approximately 17 years. Dust and PM_{10} are expected to be the main air emissions due to the mining operations.

The air quality impact during the operational phase of the Gamsberg mine was quantified via dispersion modelling, and the cumulative effects of all emission sources were taken into consideration. The impact ratings for the operational phase of the mine are summarised in *Box 9.2* below.

The main emission sources were the haul trucks travelling on unpaved roads, the mining activities within the mining pit (including drilling and blasting), the crushing and stockpiling of ore, as well as wind erosion at exposed areas and stockpiles. From the above-mentioned sources, the haul trucks and wind erosion were the main contributors to the total emissions. Therefore, during the operational phase the main effort in reducing the project's impact on the ambient air quality should be focused primarily on minimising the emissions from the haul roads, blasting and reducing dust generation from erodible areas.

The sensitivity around the mining area was considered to be **low**, as the mine is located away from residential areas. In addition, the sensitivity around the Loop 10 road is also **low**, since there are only a small number of dwellings in close proximity to the road.

As shown by the dispersion modelling results, the dust fallout and elevated PM_{10} levels occur mostly within the mine and in close proximity to the Loop 10 road. Therefore, the extent of the impact is considered **local**. The duration of the impact will be **long-term**, as the mine is expected to be in operation for 17 years. The ambient air quality is **likely** to be **negatively** affected, with possible **notable changes**. The frequency of the impact is expected to be **periodic**. With implementation of the wet suppression measures incorporated into the daily operations, the impact significance will be **Minor**.

Box 9.2 Operational Impact: Impact on Air Quality

<u>Nature</u>: Construction activities would result in a **negative direct** impact on existing ambient air quality in the mining area and surrounding areas, including along the Loop 10 road.

<u>Sensitivity/Vulnerability/Importance of Resource/Receptor</u>: **Low.**

<u>Impact Magnitude</u>: **Small.**
<u>Extent:</u> The extent of the impact is **local**.
<u>Duration:</u> The expected impact will be **long-term**.
<u>Scale:</u> The impact will result in **notable** changes to the receptor.
<u>Frequency:</u> The frequency of the impact will be **periodic.**
<u>Likelihood</u>: Ambient air quality will likely be affected, in terms of increased dust fallout and ambient PM_{10} concentrations.

IMPACT SIGNIFICANCE (PRE-MITIGATION): **MINOR.**

<u>Degree of Confidence</u>: The degree of confidence is **high**.

Mitigation Measures

The Project will implement the following mitigation measures:

- Phasing operational management of the working face to minimise the exposure of the working face to prevailing winds.

- Wet suppression or chemical dust suppressants will be used at the crusher, on haul roads, at materials handling and stockpile areas to reduce dust emission.

- A speed limit of 40km/hr on haul roads for trucks within the mining area.

- Blasting during periods of high wind velocity (>5m/s in a north westerly direction) will require approval by the Environmental Manager and these instances will be recorded in the annual environmental audit report.

Monitoring

Dust deposition and PM_{10} monitoring should be continued at the same positions as the baseline locations before the commencement of the project, in order to collect additional background data.

During the operational phase of the project, bi-annual monitoring should take place for dust deposition at six selected locations around the site and two locations along the Loop 10 route. The PM_{10} concentrations should be monitored at one selected boundary location, as well as at the closest residential dwellings.

Decommissioning

The air quality impacts associated with decommissioning are anticipated to be similar to construction impacts associated with movement of vehicles.

Localised impacts due to decommissioning activities are addressed through the implementation of appropriate mitigation detailed below:

- avoiding unnecessary disturbance of exposed surfaces and minimising areas of exposed ground;
- wet suppression to control dust;
- minimising drop heights for dusty materials and fitting shields to control windblown dust;
- cleaning dirty equipment, such as excavators, dump trucks and drilling equipment to avoid excessive build-up of dirt and mud;
- operation of a speed limit of 40km/hr for on-site vehicles moving in un-surfaced areas and restricting vehicle movements outside designated areas; and
- maintaining all vehicles and equipment in good working order to prevent excessive exhaust emissions.

Residual Impact

Pre-mitigation impacts were rated negligible for construction, minor for operational and negligible for decommissioning phases of the project. There is no anticipated loss of irreplaceable resources as a result of air quality impacts. The pre- and post-mitigation impacts are compared in *Table 9.3* below.

Table 9.4 Pre- and Post- Mitigation Significance: Impact on Air Quality (Human Health)

Phase	Significance (Pre-mitigation)	Residual Significance (Post-mitigation)
Construction	**NEGLIGIBLE (-ve)**	**NEGLIGIBLE (-ve)**
Operation	**MINOR (-ve)**	**MINOR (-ve)**
Decommissioning	**NEGLIGIBLE (-ve)**	**NEGLIGIBLE (-ve)**

9.2 IMPACT ON GROUNDWATER

Potential groundwater impacts from the Project will be associated with impacts on groundwater level changes associated with drawdown cones resulting from dewatering. Groundwater quality impacts are anticipated as a result of possible contamination resulting from mining sources or activities.

The impacts associated with drawdown or groundwater level changes are subdivided into two categories, namely (see Sections 9.2.1 and 9.2.2):

- Impact of groundwater level changes on the groundwater resource; and
- Impact of groundwater level changes on private users.

The impact drawdown may have on base flow dependant habitats is discussed in relation to biodiversity impacts in *Section 9.3.3*.

The impacts associated with groundwater quality are assessed by considering the following (see *Sections 9.2.3* and *9.2.4*):

- The groundwater quality impact on the resource; and
- The groundwater quality impact on private users.

9.2.1 *Impact of Drawdown on the Groundwater Resource*

Background

The topography is the dominant control on groundwater levels and the groundwater flow direction. The hydrocensus undertaken indicates that currently groundwater levels under the Gamsberg are higher than on the plains. As mining progresses dewatering will be required to ensure that the pit is kept dry. A groundwater model was used to predict groundwater level changes (drawdown cones) associated with mining activities. At the end of mining, the groundwater level will be at the base of the pit resulting in a maximum drawdown of approximately 500m.

Figure 9.3, Figure 9.4, and *Figure 9.5* show the change in groundwater levels in plan view (negative values show a drop in water level or drawdown and positive show an increase or groundwater mounding). These are presented at the end of mining, 50 years post closure and 100 years post closure. Existing (known) farm-boreholes are indicated with crosses, and labelled with the borehole ID given during the hydrocensus.

The drawdown cone induced by the planned mining activities develops from the pit towards the north-east, east, south and south-west. Drawdown is not expected to expand towards the west due to the increased recharge on the WRDs.

Groundwater mounds (increase in groundwater levels) develop under both the tailings storage facility (TSF) and the waste rock dumps (WRDs) due to increased recharge. However, the TSF will be drained during mine decommissioning and modelling results indicate that groundwater levels under the TSF will return to pre-mining levels approximately 80 years post closure. It is anticipated that the mound underneath the WRDs will remain as infiltration will continue indefinitely.

Figure 9.3 Hydraulic Head Change at 19 Years (End of Mining)

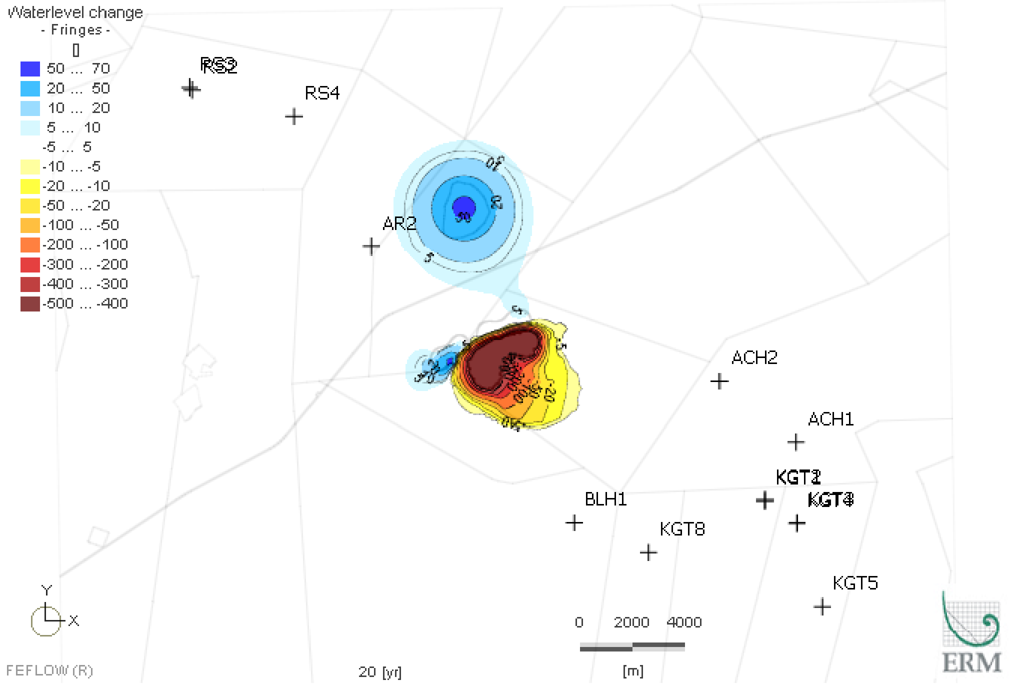


Figure 9.4 Hydraulic Head Change at 69 Years (50 Years after Mine Closure)

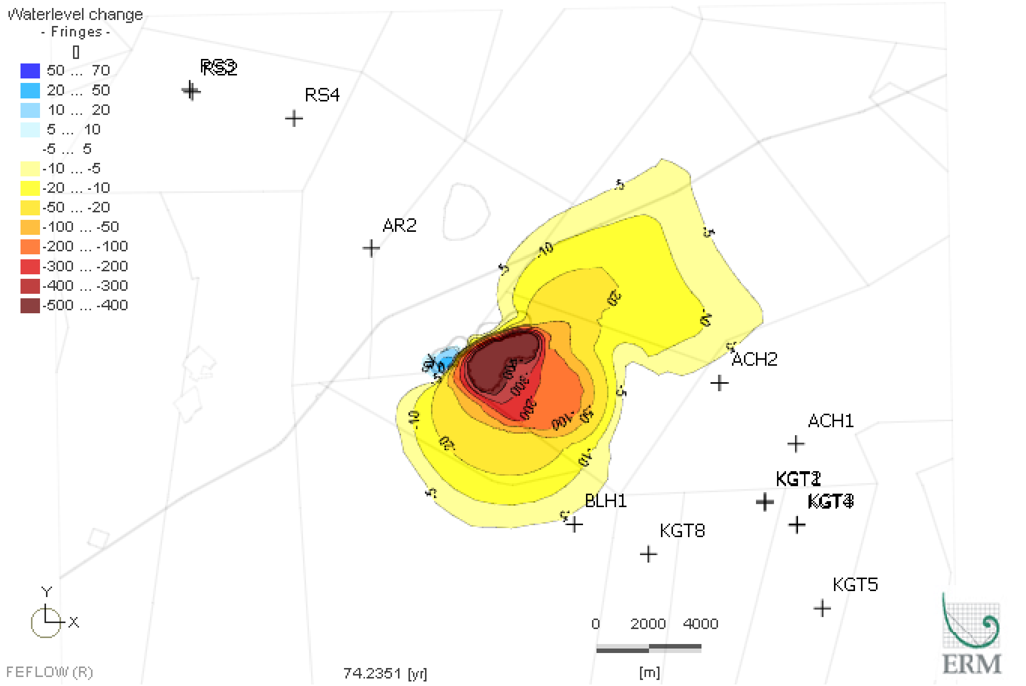
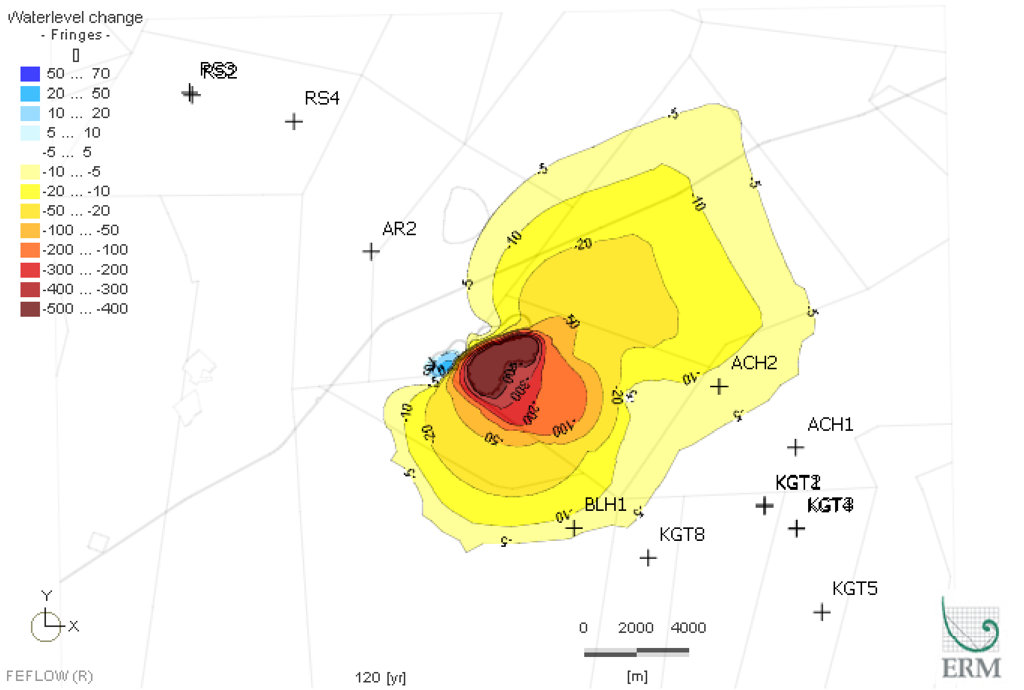


Figure 9.5 Hydraulic Head Change at 119 Years (100 Years after Mine Closure)



Groundwater modelling suggests that 100 years after mine closure drawdowns in excess of 5m can be expected to reach approximately 11km to the north-east and east of the pit and between 4-7km to the south-west, south and south-east.

The groundwater mound underneath the TSF is expected to disappear within 2-3 years after mine closure and groundwater levels are expected to reach pre-mining levels approximately 80 years post-closure. The mound underneath WRDs will remain as infiltration continues indefinitely.

Impact Assessment

The impact of groundwater level changes on the groundwater resource is considered in this section while the impact of these groundwater level changes on groundwater users is considered in Section 9.3, below.

Table 9.5 Impact Characteristics: Drawdown on the Groundwater Resource

Summary	Construction	Operation	Post-Closure
Project Aspect/Activity	Groundwater may be used for construction however this is not anticipated to result in significant changes in groundwater levels.	Open pit mining will dewater the aquifer and a drawdown cone will develop. Groundwater levels will rise (mounding) underneath tailings storage facility (TSF) and waste rock dumps (WRDs).	Abandoned pit will remain a groundwater sink and drawdown cone will continue to expand. Groundwater mounds underneath TSF will seep away, but will remain underneath the WRDs.
Impact Type	Direct.	Direct.	Direct.

Summary	Construction	Operation	Post-Closure
Stakeholders/ Receptors Affected	Groundwater Resource.	Groundwater Resource.	Groundwater Resource.

Construction Phase Impacts

It is anticipated that groundwater will be used during the construction phase which may result in localised groundwater level drawdown. This is, however, not expected to have noticeable impact on the groundwater resource. The significance rating is therefore **NEGLIGIBLE**.

Operational Phase Impacts

The planned open pit mining operation will dewater the aquifer on and around the Gamsberg and a drawdown cone will develop predominantly towards the north-east, east, south and south-west. Increased recharge from the WRDs will prevent the drawdown cone propagation towards the west and north-west.

Groundwater modelling suggests that at the end of mining drawdowns in excess of 5m can be expected to reach approximately 1km to the north-east and south-west of the pit and between 2-3km to the east and south-east. The maximum drawdown in close proximity of the pit is approximately 500m.

Groundwater levels will rise (mounding) underneath tailings storage facility (TSF) to approximately 25 metres above surface (mas) and underneath waste rock dumps (WRDs) to surface level.

Groundwater is used in the area and represents the sole source of water for a number of farmers despite groundwater quality in the study area being considered unsuitable for domestic use or livestock watering when compared to South African Water Quality Guidelines (Department of Water Affairs and Foresty , 1996). Farm boreholes closest to the planned Project are located in between 5.5 and 7km away from the planned open pit and remain unaffected during operation as the drawdown cone will be confined to the Project site. The Sensitivity/Vulnerability/Importance of the groundwater resource was rated as **Medium** since the groundwater resource is an important water supply in the area. The planned activity will result in the loss of an irreplaceable resource with regards to the groundwater resource.

Hydraulic head change is expected to be limited to the Project site and adjacent properties belonging to the client, and is on site and **local** in extent. Groundwater levels are not expected to recover after mine closure, since the pit will continue to act as a sink to groundwater based on the elevated evaporation rate, which results in a **permanent** impact. Lowering of the hydraulic head due to the proposed mining activities will result in drawdowns of up to 500m in the vicinity of the pit reducing to levels in line with natural fluctuations within 1 to 2km from the pit. The frequency is classified as **continuous** due to the nature of the project and the likelihood is **certain**.

The impact magnitude is therefore rated as **Medium** and the impact significance (pre-mitigation) is **MODERATE**. The groundwater model is currently based on a number of conservative assumptions and is not calibrated to aquifer stresses of a similar order of magnitude to those applied to it. This implies that reliability of the model predictions is relatively low. However, the model confidence is deemed sufficient to assess conservative impacts and make appropriate mitigation recommendations at the EIA stage of the project. The degree of confidence in this assessment is **medium**.

Box 9.3 Summary of Operational Impact: Groundwater Level Changes on Groundwater Resource

Nature: Operational activities would result in a **negative direct** impact the groundwater resource in the Project Area.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Medium.
Irreplaceability: The activity will result in the loss of **irreplaceable** resources since in the groundwater levels onsite will not recover to a pre-mining state.

Impact Magnitude – Medium.

- Extent: The extent of the impact is **local.**
- Duration: The expected impact will be **permanent (ie irreversible).**
- Scale: The impact will **severely alter** the resource.
- Frequency: The frequency of the impact will be **continuous.**
- Likelihood: The likelihood of the impact is **certain.**

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MODERATE.

Degree of Confidence: The degree of confidence is **medium**.

Operational Phase Mitigation

Groundwater level change (drawdown) cannot be mitigated. It is therefore recommended that groundwater levels in the vicinity of the pit, in radially increasing distance, as well as in each of the known farm boreholes, are monitored on a regular basis throughout the operational phase. The monitoring data should be stored in an appropriate data management tool/database.

Targeted monitoring, to provide data on key areas of uncertainty, allows the assumptions in predictive models to be reduced and thus the reliance of such models improves. Groundwater models should therefore be validated and updated using the monitoring data such that drawdown predictions can be updated. This will lead to models with a higher confidence level that can be used as management tools throughout the operational phase (ie update predicted impacts in order to be proactive etc) and for planning of the post-closure phase of the Project to ensure appropriate provisions are made.

Post-Closure Phase Impacts

Groundwater levels are not expected to recover after mine closure because the pit will continue to act as a groundwater sink due to the high evaporation rates, which will result in the expansion of the drawdown cone. The maximum drawdown in close proximity of the pit remains at approximately 500m.

Two farm boreholes located between 6 and 7km away from the planned open pit are expected to experience drawdowns of between 5 to 10m approximately 100 years after mine closure. These groundwater level changes match natural fluctuations currently experienced. The Sensitivity / Vulnerability / Importance of the groundwater resource remains **Medium** as the resource is an important water supply and is currently used. The planned activity will result in the loss of irreplaceable resource with regards to the groundwater resource.

Groundwater level change is expected to be limited to the Project site and adjacent properties, and remains **local** in extent. Groundwater levels are not expected to recover after mine closure, since the pit will continue to act as a sink to groundwater based on the elevated evaporation rate, which results in a **permanent** impact. The frequency is classified as **continuous** due to the nature of the project and the likelihood is **certain**.

The impact magnitude is therefore rated as **Medium** and the impact significance (pre-mitigation) is **MODERATE**. The degree of confidence in this assessment is **medium**.

Box 9.4 Summary of Post-Closure Impact: Drawdown on the Groundwater Resource

Nature: Operational activities would result in a **negative direct** impact the groundwater resource in the Project Area.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Medium.
Irreplaceability: The activity will result in the loss of **irreplaceable** resources as groundwater levels onsite will not return to pre-mining levels.

Impact Magnitude – Medium.

- Extent: The extent of the impact is **local.**
- Duration: The expected impact will be **permanent (ie irreversible).**
- Scale: The impact will **severely alter** the resource.
- Frequency: The frequency of the impact will be **continuous.**
- Likelihood: The likelihood of the impact is **certain.**

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MODERATE.

Degree of Confidence: The degree of confidence is **medium**.

Post-Closure Phase Mitigation

Higher confidence groundwater models (developed/updated using monitoring data collected throughout the operational phase) should be used for post-closure planning and to determine the extent and frequency of post-closure groundwater level monitoring.

Residual Impact

The impact cannot be mitigated and therefore the impact significance for operational and post-closure phases remain unchanged. The pre- and post-mitigation impacts are compared in *Table 9.5* below.

Table 9.6 Pre- and Post- Mitigation Significance: Drawdown on the Groundwater Resource

Phase	**Significance (Pre-mitigation)**	**Residual Significance (Post-mitigation)**
Construction	**NEGLIGIBLE (-ve)**	**NEGLIGIBLE (-ve)**
Operation	**MODERATE (-ve)**	**MODERATE (-ve)**
Post Closure	**MODERATE (-ve)**	**MODERATE (-ve)**

9.2.2 *Impact of Drawdown on Groundwater Users*

The impact of groundwater level changes on groundwater users is considered below.

Table 9.7 Impact Characteristics: Impact of Drawdown on Groundwater Users

Summary	**Construction**	**Operation**	**Post Closure**
Project Aspect/Activity	None	Open pit mining will dewater the aquifer and a drawdown cone will develop. Groundwater levels will rise (mounding) underneath tailings storage facility (TSF) and waste rock dumps (WRDs).	Abandoned pit will remain a groundwater sink and drawdown cone will continue to expand. Groundwater mounds underneath TSF will seep away, but stay underneath the WRDs.
Impact Type	N/A	Indirect.	Indirect.
Stakeholders/ Receptors Affected	N/A	Private Groundwater Users.	Private Groundwater Users.

Construction Phase Impacts

The Construction Phase of the Project is not expected to negatively impact on groundwater users in the Project Area and its significance is **NEGLIGIBLE**.

Operational Phase Impacts

Private groundwater users are not expected to be impacted during mining as the drawdown cone remains at a distance of more than 4km from the closest existing (known) farm boreholes being BLH1 and ACH2 and remains on site.

Groundwater is used in the area and represents the sole source of water for a number of farmers. Private groundwater users are not expected to be significantly impacted during mining as the drawdown cone remains at a distance of more than 4km from the closest receptors being BLH1 and ACH2 (see *Figure 9.3*).

Therefore, the Sensitivity/Vulnerability/Importance of the groundwater resource was rated as **Medium**. The planned activity will not result in the loss of an irreplaceable resource with regards to private groundwater users.

Drawdown cone is expected to be limited to the Project site and is therefore on-site and **local** in extent. Groundwater levels are not expected to recover after mine closure, since the pit will continue to act as a sink to groundwater based on the elevated evaporation rate, which results in a **permanent** impact. Lowering of the groundwater level due to the proposed mining activities will not extend off site and therefore groundwater users are not anticipated to be impacted. The frequency is classified as **continuous** due to the nature of the project and the likelihood is **likely**. The impact magnitude is therefore rated as **Negligible** and the impact significance (pre-mitigation) is **NEGLIGIBLE**. The degree of confidence in this assessment is **medium**.

Box 9.5 Summary of Operational Impact: Drawdown on Groundwater Users

Nature: Operational activities would result in a **negative direct** impact the groundwater resource in the Project Area.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Medium.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Negligible.

- Extent: The extent of the impact is on-site and **local.**
- Duration: The expected ground level change will be **permanent (ie irreversible).**
- Scale: The drawdown cone is not anticipated to impact groundwater users off-site.
- Frequency: The frequency of the impact will be **continuous.**
- Likelihood: Groundwater drawdown is **likely.**

IMPACT SIGNIFICANCE (PRE-MITIGATION) – NEGLIGIBLE.

Degree of Confidence: The degree of confidence is **medium**.

Operational Phase Mitigation

Groundwater level change (drawdown) cannot be mitigated. However, it is further recommended that groundwater levels in each of the known farm boreholes are monitored on a regular basis throughout the construction and operation phases.

Should monitoring confirm that any of the private boreholes are affected by lowering the groundwater table, rendering boreholes unusable (ie loss of water supply source), the client will compensate affected famers for their loss, replacing the lost water supply source. This can be achieved for example by drilling new boreholes for the affected farmers outside of the drawdown cone, by increasing the depth of the existing boreholes or by providing an alternative good quality water source.

Post-Closure Phase Impacts

Modelling results suggest that two private boreholes located to the south-east of the Gamsberg (BLH1 and ACH2) will experience drawdowns of between 5 and 10m approximately 100 years post closure. Other existing (known) private boreholes will not experience any significant drawdowns (ie less than 5m). However, since the drawdown cone extends to additional farms located adjacent to the Project, this may impact future groundwater users.

The Sensitivity/Vulnerability/Importance of the groundwater resource remains **Medium**. The planned activity is not expected to result in the loss of irreplaceable resource with regards to private groundwater users.

Hydraulic head change is expected to extend off site but remains **local** in extent. Groundwater levels are not expected to recover after mine closure, since the pit will continue to act as a sink to groundwater based on the elevated evaporation rate, which results in a **permanent** impact. Lowering of the hydraulic head due to the proposed mining activities is likely to extend to groundwater users in the vicinity of the site. The frequency is classified as **continuous** due to the nature of the project and the likelihood is **likely**. The impact magnitude is therefore rated as **Medium** and the impact significance (pre-mitigation) is **MODERATE**. The degree of confidence in this assessment is **medium**.

Box 9.6 Summary of Post-Closure Impact: Drawdown on Groundwater Users

Nature: Operational activities would result in a **negative direct** impact on groundwater users in the vicinity of the Project, post-closure.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Medium.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Medium.
- Extent: The extent of the impact is **local.**
- Duration: The expected ground level change will be **permanent (ie irreversible)**Scale: The drawdown cone is anticipated to impact two groundwater users off-site.
- Frequency: The frequency of the impact will be **continuous.**
- Likelihood: Groundwater drawdown is **likely.**

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MODERATE.

Degree of Confidence: The degree of confidence is **medium**.

Post-Closure Phase Mitigation

Higher confidence groundwater models (developed/updated using monitoring data collected throughout the operational phase) should be used for post-closure planning and to determine the extent and frequency of post-closure groundwater level monitoring.

Should monitoring confirm that any private boreholes are affected by lowering the groundwater table, rendering boreholes unusable (ie loss of water supply source), the client will compensate affected famers for their loss, replacing the lost water supply source. This can be achieved for example by drilling new boreholes for the affected farmers outside of the drawdown cone, by increasing the depth of the existing boreholes or by providing an alternative good quality drinking water source.

Residual Impact

Compensation of impacted farmers, where impact is confirmed through monitoring data, would result in the operation and post-closure impacts of **NEGLIGIBLE** and may even change the **negative** impact to a **positive** impact (ie if the quality of the alternative water source provided by the project exceeds the existing one which does not meet drinking water or stock-watering standards).

The pre- and post-mitigation impacts are compared in *Table 9.5* below.

Table 9.8 Pre- and Post- Mitigation Significance: Private Groundwater Users

Phase	Significance (Pre-mitigation)	Residual Significance (Post-mitigation)
Construction	NEGLIGIBLE (-ve)	NEGLIGIBLE (-ve)
Operation	NEGLIGIBLE (-ve)	NEGLIGIBLE (-ve)
Post Closure	MODERATE (-ve)	NEGLIGIBLE (-ve)

9.2.3 *Impact on Groundwater Quality*

Background

Figure 9.6, *Figure 9.7* and *Figure 9.8* show the sulphate plumes emanating from WRDs and TSF for different time stages (end of mining, 50 years post closure and 100 years post closure). The figures show groundwater concentrations above the SANS 241-1:2011 (2011) drinking water limit of 400 mg/L.

The plumes grow over time due to the continued leaching and combined dispersion and diffusion processes. SO_4 concentration of leachate released from the TSF is increasing over time and is higher than the SO_4 concentration of leachate from the WRDs. Therefore, the maximum SO_4 concentration modelled is observed underneath the TSF at 10 500 mg/L, at the end of mining. Thereafter, the SO_4 concentrations in groundwater underneath the TSF will decrease slowly (refer *Figure 9.8*) and the plume will start to move eastwards.

Figure 9.6 Sulphate Plume in Year 19 (End of Mining)

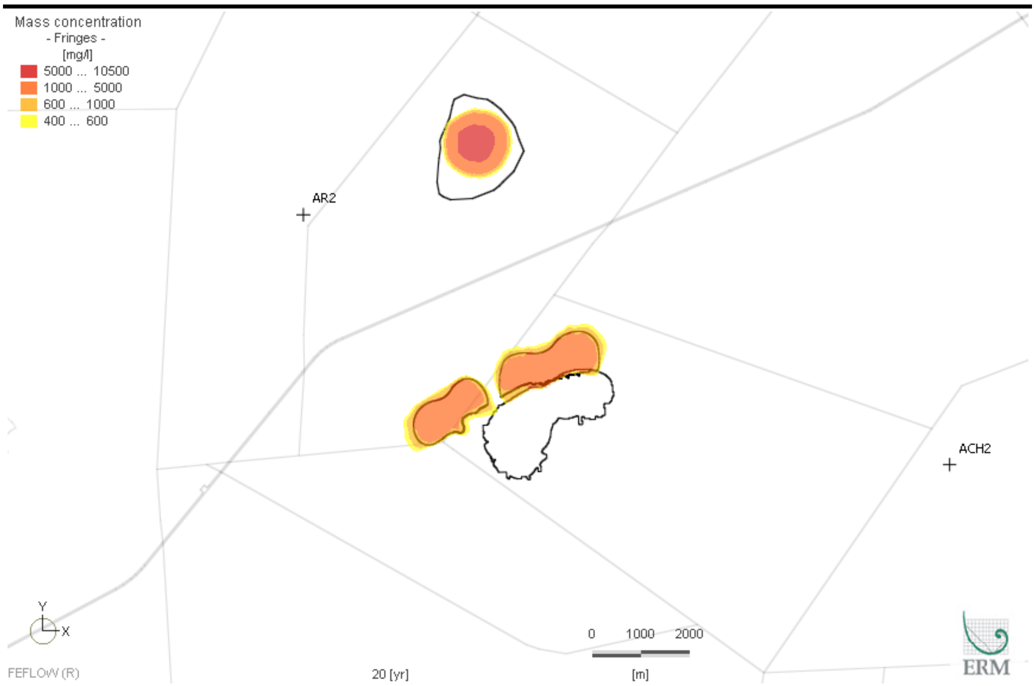


Figure 9.7 Sulphate Plume in Year 69 (50 Years after Mine Closure)

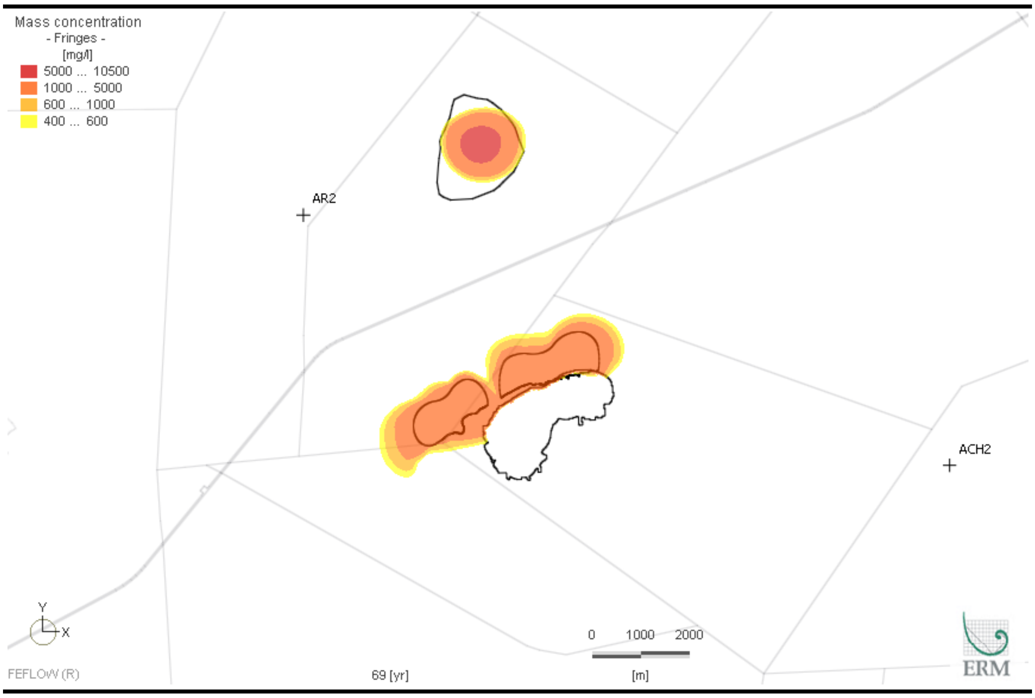
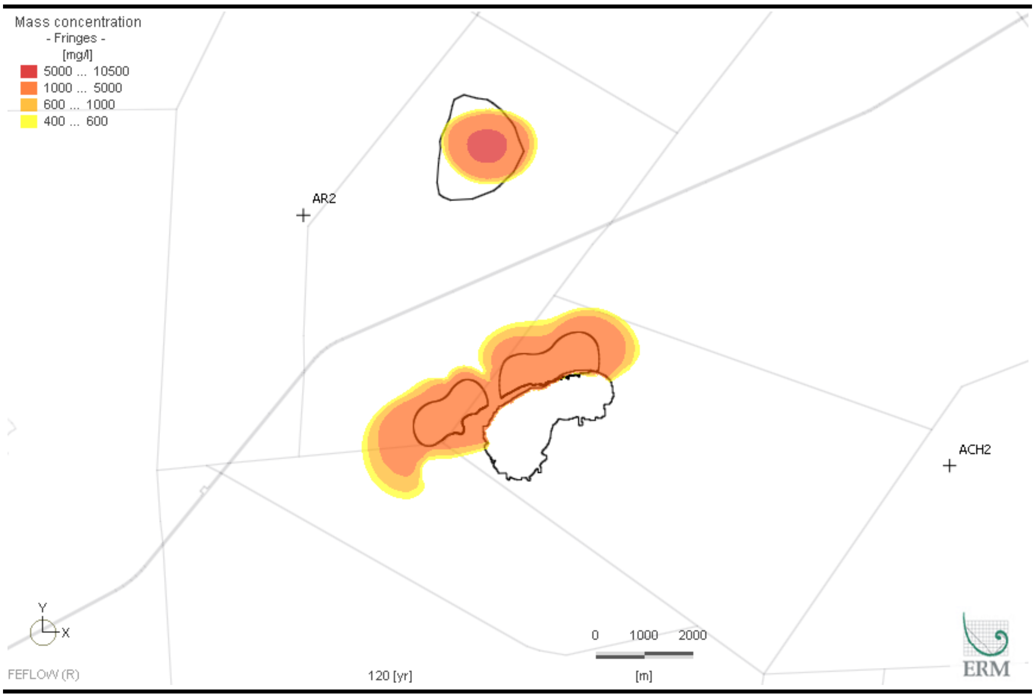


Figure 9.8 Sulphate Plume in Year 119 (100 Years after Mine Closure)



The impact on groundwater quality in this section is considered with respect to the groundwater resource while the impact this will have on groundwater users is considered in *Section 9.2.4*, below.

Table 9.9 *Impact Characteristics: Groundwater Quality*

Summary	Construction	Operation	Post Closure
Project Aspect/Activity	Accidental spillage from construction equipment and chemicals storage areas.	Contaminated leachate from tailings storage facility (TSF) and waste rock dumps (WRDs). Spillage from mining equipment. Contamination through residuals of explosives used in the mining process.	Contaminated leachate from tailings storage facility (TSF) and waste rock dumps (WRDs).
Impact Type	Direct.	Direct.	Direct.
Stakeholders/ Receptors Affected	Groundwater Resource.	Groundwater Resource.	Groundwater Resource.

Construction Phase Impacts

Accidental spillage of hydrocarbons or other chemical substances used and stored during the Construction Phase can potentially contaminate groundwater locally.

The sensitivity and vulnerability of the groundwater resource to contamination is rated **Medium**.

It is anticipated that large volumes of chemicals, that have a potential to contaminate groundwater, will be stored/used on site during the construction phase however the impact magnitude is **Small** and it is not anticipated that the activity will result in the loss of an irreplaceable source. The impact significance (pre-mitigation) is **MINOR** and the degree of confidence is **Medium**.

Box 9.7 *Summary of Construction Impact: Groundwater Quality*

Nature: Construction activities could have a **negative direct** impact on groundwater quality.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Medium.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Small.

- Extent: The extent of the impact is **on-site.**
- Duration: The expected impact will be **permanent.**
- Scale: The resource/ receptor will remain **unaltered.**
- Frequency: The frequency of the impact will be **once off.**
- Likelihood: Likelihood for accidental spillages is **possible**.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MINOR.

Degree of Confidence: The degree of confidence is **medium.**

Construction Phase Mitigation

A construction environmental management plan (EMP) needs to be in place including, but not limited to:

- Adhere to best practice principles;
- Construction equipment should be up to standards and serviced regularly to prevent oil spills;
- A spill response plan should be in place and construction workers should be trained accordingly; and
- On-site storage areas for hydrocarbons and other chemicals should be constructed in a way that potential tank failures can be contained including bunds and surface hardstanding.

Operational Phase Impacts

Contaminants of Concern (CoCs) related to the mining operation were identified during the geochemical assessment and include sulphate (SO_4), iron (Fe), manganese (Mn), zinc (Zn), copper (Cu), cadmium (Cd), lead (Pb), arsenic (As) and nitrate (NO_3). Further, due to blasting activities it is expected that large amounts of NO_3 will be released and possibly diesel depending on the explosives used.

SO_4 leachate concentrations for tailings storage facility (TSF) and waste rock dumps (WRDs) were quantified using geochemical modelling for input into the groundwater model. SO_4 groundwater contamination emanating from TSF and WRDs was quantified using numerical solute transport modelling. SO_4 is a conservative tracer, providing an indication of conservative contaminant extent.

At the end of mining modelled SO_4 plumes at concentrations exceeding the SANS 241-1:2011 drinking water standard of 400mg/L are mainly confined to within the immediate footprint (250m) of the contaminant sources. The plumes are expected to impact areas of 1.6km^2 (TSF) to 3.8km^2 (WRDs) and not extend off-site.

WRDs are located immediately adjacent to the mine pit and contaminated seepage from the WRDs is expected to partly flow into the pit. It is unlikely that water will be visible in the pit except following heavy rain events. Due to the high evaporation rate, salts and other contaminants are expected to accumulate in the pit and can be dissolved and mobilised during rain events. Pumped water from the pit following rain events could therefore be heavily contaminated. Further, toe seepage is expected to occur at the base of the WRDs following rain events and continuously at the base of the TSF. This seepage is expected to be contaminated.

The Sensitivity/Vulnerability/Importance of the groundwater resource was rated as **Medium** since the groundwater is an important resource even though groundwater quality does not meet drinking water or stock watering standards. The planned activity will not result in the loss of irreplaceable resource with regards to the groundwater resource.

Sulphate leaching from the TSF is predicted to steadily increase in concentration to a maximum of about 12 000 mg/L on closure. This is significantly higher than sulphate concentrations measured in groundwater sampled from hydrocensus boreholes during the current study which range from 22 mg/L to 1706 mg/L. However, water quality impacts are expected to be limited in extent to the footprints of the TSF and WRDs and are therefore on-site and **local** in extent. Groundwater quality is not expected to improve after mine closure, hence it will be a **permanent** impact. Leaching of contaminated water from TSF and WRDs will severely alter the groundwater quality within the footprint of these facilities. The frequency is classified as **continuous** due to the nature of the project and the impact on groundwater quality is considered to be **likely**. The impact magnitude is rated as **Medium** and the impact significance (pre-mitigation) is **MODERATE**. The degree of confidence in this assessment is **medium**.

Box 9.8 Summary of Operational Impact: Groundwater Quality

Nature: Operational activities would result in a **negative direct** impact the groundwater resource in the Project area.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Medium.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Medium.

- Extent: The extent of the impact is confined to the footprint of the TSF and the WRDs and is therefore on-site and **local.**
- Duration: The expected impact will be **permanent (ie irreversible).**
- Scale:The impact will **severely alter** the groundwater quality within the footprint of the TSF and WRDs.
- Frequency: The frequency of the impact will be **once off.**
- Likelihood: The likelihood of the impact is **certain.**

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MODERATE.

Degree of Confidence: The degree of confidence is **medium**.

Operational Phase Mitigation

In keeping with the mitigation hierarchy, the priority in mitigation is to apply mitigation measures to the source of the impact, main sources being the TSF and WRDs.

Modelling results indicate that the TSF and WRDs will produce acid rock drainage (ARD) which is expected to seep into groundwater. This will result in a moderate significance rating based on the assumptions made during modelling. Detailed geotechnical and geophysical investigations will be undertaken prior to construction to refine and confirm assumptions made in respect to the current studies around the integrity of the subsurface beneath the TSF. Mitigation measures required to reduce the impact on groundwater quality include the following:

- Prior to construction of WRDs and TSF, the ground of the facility's footprint should be prepared to reduce the hydraulic conductivity of the material, ie through means of compaction, so that seepage water is forced out of the facility at ground level rather than infiltrating into groundwater.

- Toe drains (interception trenches) along the base of both TSF and WRDs to intercept drainage and convey to a return water dam. Toe seepage from these facilities is expected to be contaminated and suitable management measures should be in place to prevent the release of this contaminated water into the environment. It is recommended to recycle as much water as possible and re-use it.

Management options specifically for the TSF include the following:

- Short deposition cycles should be followed by regularly covering fresh tailings soon after deposition to prevent them drying out and oxidising on placement. Cladding the TSF side slopes with inert waste rock, concurrently with deposition, to minimise both oxygen ingress and side-slope erosion.

- Further addition of additives such as lime or slaked lime could help to increase the alkalinity of the Gamsberg tailings prior to deposition. The WMB (2000) results suggest, however, that the liming requirement to offset the acid potential of the tailings would be high. Note also that neutralising materials introduced during tailings amendment may dissolve and be flushed from the TSF system prior to reacting with acidity generated by the oxidation of sulphides in the tailings.

To decrease quality impact on the groundwater resource in the vicinity of the TSF, a mineral liner system as specified by the design engineers is required to be installed beneath the TSF (see details included in *Annex B*). The detailed specifications of the TSF liner system requirements will be agreed upon by the Department of Water Affairs and be in line with the conditions of the IWULA.

The present numerical groundwater flow and transport model is based on a number of conservative assumptions and should be updated/validated as additional information becomes available (ie SEEP/W model results, geophysics results and hydraulic conductivity of tailings material) prior to construction to ensure assumptions made during the development of the model remain valid.

Pumped water from the pit following heavy rain events is expected to be contaminated and will need to be contained, or treated to applicable standards if it is to be released into the environment, in accordance with the water use licence requirements.

It is further recommended that these mitigation measures be complemented with groundwater quality monitoring in the vicinity of contamination sources and in radially increasing distance from them. Monitoring should be carried out on a regular basis throughout the construction and operational phases. The monitoring data should be stored in an appropriate data management tool/database.

Targeted monitoring, to provide data on key areas of unknown, allows the assumptions in predictive models to be reduced and thus the reliance of such models improves. Groundwater models should therefore be validated and updated using the monitoring data such that transport model predictions can be updated (ie plume extent, modelled concentrations). This will lead to models with a higher confidence level that can be used as management tools throughout the operational phase (ie update predicted impacts in order to be proactive etc) and for planning of the post-closure phase of the Project to ensure appropriate provisions are made.

Post Closure Phase Impacts

The seepage from WRDs is controlled by increased recharge from rainfall due to the disruption of natural material, increase in hydraulic conductivity and the higher porosity of the dumps reducing the amount of surface runoff and increasing the amount of infiltration. Therefore the seepage from WRDs is not expected to stop after mine closure and is therefore expected to expand further.

The TSF will be drained at the end of mine and is not expected to continue releasing contaminants, assuming that due to the fine texture of the tailings material any rainfall would not result in infiltration but rather surface run-off. The plume emanating from the TSF is expected to remain in proximity of the footprint of the facility.

Impact on the groundwater resource is therefore expected to be more significant as a result of seepage from the WRDs, although seepage from the TSF has higher SO_4 concentrations. Modelled areal extent of SO_4 plumes 100 years after mine closure are 2.4km^2 for the TSF and 8.8km^2 for the WRDs which represents increases of 50% and 140% respectively. The maximum travel distance of 1.2km is observed from the WRDs in south-westerly direction.

The Sensitivity/Vulnerability/Importance of the groundwater resource was rated as **Medium**. The planned activity will not result in the loss of irreplaceable resource with regards to the groundwater resource.

Water quality impacts are expected to be limited to the footprints of the TSF and WRDs, and are on-site and **local** in extent. Groundwater quality is not expected to improve after mine closure, hence it will be a **permanent** impact. Leaching of contaminated water from TSF and WRDs will severely alter the groundwater quality within the footprint of these facilities. The frequency is classified as **continuous** due to the nature of the project and the likelihood is **certain**. The impact magnitude is rated as **Medium** since the SO_4 concentrations are high however the extent of the plume is confined to the mine lease area. The impact significance (pre-mitigation) is **MODERATE**. The degree of confidence in this assessment is **medium**.

Box 9.9 Summary of Post-Closure Impact: Groundwater Quality

Nature: Operational activities would result in a **negative direct** impact the groundwater resource in the Project Area.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Medium.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Medium.
- Extent: The extent of the impact is on-site and **local.**
- Duration: The expected impact will be **permanent (ie irreversible).**
- Scale: The impact will **severely alter** the resource.
- Frequency: The frequency of the impact will be **continuous.**
- Likelihood: The likelihood of the impact is **certain.**

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MODERATE.

Degree of Confidence: The degree of confidence is **medium**.

Decommissioning and Post Closure Phase Mitigation

Operational mitigation measures have to be maintained post closure. Further, final profiling of the TSF and WRDs should be aimed at reducing erosion and minimising further water infiltration.

Higher confidence groundwater models (developed/updated using monitoring data collected throughout the construction and operational phases) should be used for post-closure planning and to determine the extent and frequency of post-closure groundwater level monitoring.

Residual Impact

The implementation of the mitigation measures outlined above would reduce the construction impacts from **Minor** significance to **Negligible** and the operation impacts from **Moderate** to **Moderate-Minor**. The implementation of the decommissioning phase mitigation measures would not reduce the significance rating, and thus remain **Moderate**. The pre- and post-mitigation impacts are compared in *Table 9.5* below.

Table 9.10 Pre- and Post- Mitigation Significance: Groundwater Quality

Phase	Significance (Pre-mitigation)	Residual Significance (Post-mitigation)
Construction	MINOR (-ve)	NEGLIGIBLE (-ve)
Operation	MODERATE(-ve)	MODERATE (-ve) to MINOR(-ve)
Decommissioning and Post Closure	MODERATE (-ve)	MODERATE (-ve) to MINOR (-ve)

9.2.4 *Impact of Water Quality on Groundwater Users*

This section considers the potential impact of water quality on groundwater users.

Table 9.11 Impact Characteristics: Groundwater Users

Summary	Construction	Operation	Post Closure
Project Aspect/Activity	N/A	Contaminated leachate from tailings storage facility (TSF) and waste rock dumps (WRDs). Spillage from mining equipment. Contamination through residuals of explosives used in the mining process.	Contaminated leachate from tailings storage facility (TSF) and waste rock dumps (WRDs).
Impact Type	N/A	Indirect.	Indirect.
Stakeholders/ Receptors Affected	N/A	Groundwater Users.	Groundwater Users.

Construction Phase Impacts

The Construction Phase of the Project is not expected to negatively impact on groundwater users in the Project Area and its significance is therefore **NEGLIGIBLE**.

Operational Phase Impacts

SO_4 groundwater contamination emanating from TSF and WRDs was quantified using numerical solute transport modelling. SO_4 is a conservative tracer, providing an indication of conservative contaminant extent.

At the end of mining modelled SO_4 plumes at concentrations exceeding the SANS 241-1:2011 drinking water standard of 400mg/L are mainly confined within the immediate footprint (250m) of the contaminant sources and are not expected to affect any private groundwater users (farm boreholes).

The Sensitivity/Vulnerability/Importance of the groundwater resource was rated as **Medium**. The planned activity will not result in the loss of irreplaceable resource with regards to the groundwater resource.

Water quality impacts are expected to be limited to the footprints of the TSF and WRDs, and are **on-site** in extent. Groundwater quality is not expected to improve after mine closure, hence it will be a **permanent** impact. Leaching of contaminated water from TSF and WRDs will remain **unaltered** the groundwater quality outside of the footprint of these facilities. The frequency is classified as **continuous** due to the nature of the project and the likelihood is **certain**.

The impact magnitude is therefore rated as **Negligible** and the impact significance (pre-mitigation) is **NEGLIGIBLE**. The degree of confidence in this assessment is **medium**.

Box 9.10 Summary of Operational Impact: Groundwater Users

Nature: Operational activities would result in a **negative direct** impact the groundwater resource in the Project Area.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Medium.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Negligible.

- Extent: The extent of the impact is confined to the site and is **local.**
- Duration: The expected impact will be **permanent (ie irreversible).**
- Scale: The groundwater resource is expected to remain **unaltered** outside of the footprint of TSF and WRDs.
- Frequency: The frequency of the impact will be **continuous.**
- Likelihood: The likelihood of the impact is **certain.**

IMPACT SIGNIFICANCE (PRE-MITIGATION) – NEGLIGIBLE.

Degree of Confidence: The degree of confidence is **medium**.

Operational Phase Mitigation

Groundwater quality should be monitored at the existing (known) private boreholes in regular intervals to confirm modelling results. Should monitoring data confirm impact on private users, the client will compensate affected famers for their loss, replacing the lost water supply source.

Post Closure Phase Impacts

The seepage from WRDs is not expected to stop after mine closure and will therefore continue to expand post-closure. The plume emanating from the TSF is expected to remain in proximity of the footprint of the facility.

Modelled areal extent of SO_4 plumes 100 years after mine closure are 2.4km^2 for the TSF and 8.8km^2 for the WRDs which represents increases of 50% and 140% respectively. The maximum travel distance of 1.2km is observed from the WRDs in south-westerly direction. Private groundwater users are not expected to be impacted by groundwater contamination as plumes remain within farms owned by the client.

The Sensitivity/Vulnerability/Importance of the groundwater resource was rated as **Medium**. The planned activity will not result in the loss of irreplaceable resource with regards to the groundwater resource.

Water quality impacts are expected to be limited to the footprints of the TSF and WRDs, and remain on site and **local** in extent. Groundwater quality is not expected to improve after mine closure, hence it will be a **permanent** impact. Leaching of contaminated water from TSF and WRDs will remain **unaltered** the groundwater quality outside of the footprint of these facilities. The frequency is classified as **continuous** due to the nature of the project and the likelihood is **certain**.

The impact magnitude is therefore rated as **Negligible** and the impact significance (pre-mitigation) is **NEGLIGIBLE**. The degree of confidence in this assessment is **medium**.

Box 9.11 Summary of Operational Impact: Groundwater Users

Nature: Operational activities would result in a **negative direct** impact the groundwater resource in the Project Area.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Medium.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Negligible.

- Extent: The extent of the impact is confined to the site and is **local.**
- Duration: The expected impact will be **permanent (ie irreversible).**
- Scale: The groundwater resource is expected to remain **unaltered** outside of the footprint of TSF and WRDs.
- Frequency: The frequency of the impact will be **continuous.**
- Likelihood: The likelihood of the impact is **certain.**

IMPACT SIGNIFICANCE (PRE-MITIGATION) – NEGLIGIBLE.

Degree of Confidence: The degree of confidence is **medium**.

Operational Phase Mitigation

Groundwater quality should be monitored at the existing (known) private boreholes in regular intervals starting prior to or during construction to confirm modelling results (see the groundwater management plan in *Section 10*). Should monitoring data confirm impact on private users, the client will compensate affected famers for their loss, replacing the lost water supply source.

The present numerical groundwater flow and transport model will be updated at regular intervals starting prior to construction as additional information becomes available to ensure assumptions made during the development of the model remain valid and that model predictions remain current.

Residual Impact

Pre-mitigation impacts were rated **NEGLIGIBLE** for construction, operational and post-closure phases of the project, maybe change the **negative** impact to a **positive** impact (ie if the quality of the alternative water source provided by the project exceeds the existing one). The pre- and post-mitigation impacts are compared in *Table 9.11* below.

Table 9.12 Pre- and Post- Mitigation Significance: Groundwater Users

Phase	Significance (Pre-mitigation)	Residual Significance (Post-mitigation)
Construction	**NEGLIGIBLE (-ve)**	**NEGLIGIBLE (-ve)**
Operation	**NEGLIGIBLE (-ve)**	**NEGLIGIBLE (-ve)**
Post Closure	**NEGLIGIBLE (-ve)**	**NEGLIGIBLE (-ve)**

9.3 IMPACTS ON BIODIVERSITY

Impacts to biodiversity are described in this Chapter. Impacts to priority Ecosystem Services are presented in *Section 6.14*.

Background

The Gamsberg lies at the heart of what is termed the "Bushmanland Inselberg Region", which includes all the large, quartzite-capped inselbergs located in the northern Bushmanland plains in South Africa. This region is located on the boundary between winter and summer rainfall systems of southern Africa, and the overlap of two biomes is a unique feature and sets these inselbergs apart from other inselbergs elsewhere in the Nama Karoo.

The Bushmanland inselbergs effectively comprise an archipelago of rocky islands within a vast expanse of sand. These rocky islands share common floristic affinities that are fundamentally distinct from the surrounding sandy plains. The flora of these inselbergs forms a distinct centre of plant endemism located within the larger Eastern Gariep Centre of Endemism. There are many species endemic to the Bushmanland Inselbergs and the region is defined as a distinct centre of endemism termed the "Bushmanland Inselberg Centre of Endemism". This centre of endemism is sometimes referred to as the "Gamsberg Centre of Endemism" as this inselberg lies at the floristic centre of this region and is the key biodiversity feature underpinning ecological processes/function in this system. The endemism is associated with the inselbergs and not the sandy Bushmanland plains that comprise 90% of the region.

Impact Assessment

Baseline Assessments presented by Desmet (2013) have mapped and classified the vegetation from five vegetation types into 19 habitats. These have been rated on a nationally accepted sensitivity scale as either irreplaceable (unique), constrained or flexible (widespread) habitats. The habitats have not been classified as modified, natural or critical habitats as required by the Vedanta Standard (based on the IFC standards) for Biodiversity. For the purpose of this impact assessment, the following classification of habitats as per the Vedanta Standards is used:

- The Gamsberg is a Greenfields site, and no modified habitats of sufficient extent have been mapped.

- The constrained and flexible habitats shall be considered natural habitats. The standards require that mitigation measures are implemented to achieve no net loss of biodiversity.

- The irreplaceable habitats are considered critical habitats based on the critical habitat requirements of the Vedanta Standard (Criteria 4: Highly threatened and/or unique ecosystems). These standards require that mitigation measures are implemented to achieve "on the ground" net gain in biodiversity values, which can be referred to as a "no net loss plus" approach.

The Vedanta Standards recommend assessment of the following generic impacts typically associated with development projects:

- Habitat loss;
- Habitat fragmentation;
- Human influx (sometimes referred to as Third party access); and
- Spread of alien and invasive species.

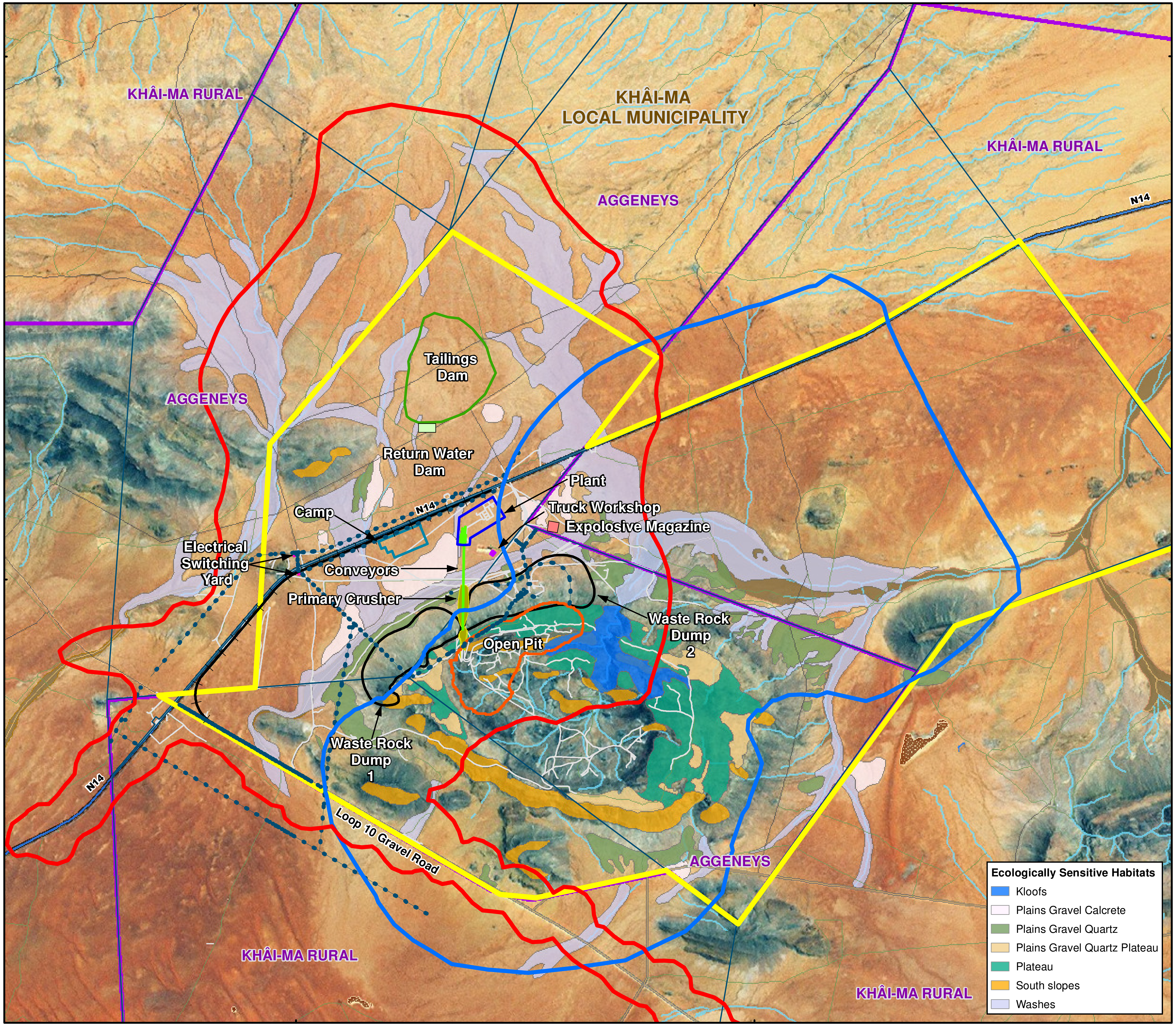
The above impacts are assessed from an ecological perspective, together with the following impacts to comprehensively assess the situation faced by the current project:

- Habitat degradation as a result of dust deposition and groundwater drawdown impacts and include associated impacts from altered surface runoff, acid rock drainage and groundwater quality; and

- Loss of species diversity and species of conservation concern.

Habitat loss and degradation are the primary impacts on the biodiversity as a result of the proposed mining activities; the mine footprint, dust deposition and drawdown of the groundwater level being the principal drivers of habitat loss and degradation. Habitats have been mapped and their sensitivity assessed by Desmet (2013) as illustrated in *Figure 9.9*.

Figure 9.9 presents the proposed infrastructure footprint, extent of the modelled dust deposition zone (20mg/m^2/day) and groundwater drawdown relative to the sensitive vegetation units identified by Desmet (2013). These sensitive habitats are presented in *Table 9.12* with the calculated areas of overlap from the mine footprint, dust deposition and loss of groundwater impact zones. Details of these impacts are discussed in the sections that follow; the areas of significant impact on the sensitive habitats have been indicated by orange shading in *Table 9.12*.



Legend

- Non-Perennial River
- Dry Water Course Centre Line
- Dry Water Course Floodplain
- Dam
- Dry Pan
- National Route (N14)
- Main Road
- Secondary Road
- Other Road
- Track/Footpath
- Railway
- Electrical cables
- Haul Roads
- Town Boundary
- Cadastral Boundaries
- Open Pit
- Contractors Camp
- Conveyor
- Electrical Switching Yard
- Explosive Magazine
- Plant
- Primary Crusher
- Return Water Dam
- Tailings Dam
- Truck Workshop
- Waste Rock Dump 1
- Waste Rock Dump 2
- Mineral Rights Area
- Groundwater 100 year drawdown zone
- Dust deposition zone (20mg/sqm/day)

SCALE: 0 1 2 3 4 Kilometres N

TITLE:
Figure 9.9:
Sensitive Habitats, Infrastructure, Dust Deposition and Groundwater Drawdown Zones

CLIENT:
vedanta
BLACK MOUNTAIN MINING (PTY) LTD

DATE: Apr 2013	CHECKED: MP	PROJECT: 0164903
DRAWN: AB	APPROVED: SHC	SCALE: 1 : 72 000

DRAWING: Sensitive Habitats Infra Dust GW.mxd
REV: 0

ERM
Great Westerford Building
240 Main Road
Rondebosch, 7725
Cape Town, SOUTH AFRICA
Tel: +27 21 681 5400
Fax +27 21 686 073

Projection: Transverse Mecator, CM19. Datum : WGS84
Source: Chief Directorate National Geo-Spatial Information. Black Mountain Mining (Pty) LTD
Inset Map: Esri Data & Maps
SIZE: A3

T:\Gis Projects\0164903_Gamsberg\Mapping\MXD\Report\April2013\Sensitive Habitats Infra Dust GW.mxd

Table 9.13 Overview of Habitats and Extent (ha) of Impact through the Mining Footprint, Dust Deposition and Groundwater Loss

Vegetation Types, Habitat Units, Sensitivity & Ecosystem Status (including residual impact	Mine footprint	Dust Deposition 50 mg/m²/day	Dust Deposition 20 mg/m²/day	Groundwater Drawdown	Extent of Impact
Aggeneys Gravel Vygieveld					
Mountain plateau; Irreplaceable (EN)	123.2	58.5	117.1	280.8	181.7
Plateau quartz gravel; Irreplaceable (EN)	10.2	39.5	1.8	98.5	**51.5**
Plateau quartz gravel (fine grain); Irreplaceable (CR)			49.1		**49.1**
Plains quartz gravel; Irreplaceable (VU)	115.9	179.9	110.9	325.5	406.7
Plains quartz gravel intermediate; Flexible (LC)		56.5	231.0	240.4	56.5
Plains feldspar gravel; Irreplaceable (EN)		17.4	73.8		91.2
Plains rocky; Flexible (LC)	71.8	160.6	559.0	237.6	232.5
Bushmanland Inselberg Shrubland					
Mountains; Flexible (LC)	535.4	335.5	751.3	1 314.5	871.0
Bushmanland Arid Grassland					
Flat sandy plains; Flexible (LC)	447.5	1 947.0	2 083.6	3 038.3	2 394.5
Hummocky sandy plains; Flexible (LC)	17.2	316.8	447.4	0.0	334.0
Calcrete gravel plains; Irreplaceable (CR)	20.3	154.1	229.4	44.6	**403.7**
Bushmanland Sandy Grassland					
Mobile sandy dunes; Flexible (LC)		5.3	29.6	18.1	5.3
Eastern Gariep Plains Desert					
Plains Rocky; Flexible LC			252.1	120.7	
Bushmanland Inselberg Succulent Shrubland					
Southern Slopes; Irreplaceable (VU)	58.1	40.3	133.4	246.0	98.4
Azonal Habitats					
Kloof; Irreplaceable (CR)	27.8			148.9	**176.7**
Freshwater springs & Head-water Seep; Irreplaceable (CR)	-			-	**-**
River (Wash with sub-surface flow); Constrained (LC)	11.9			1 010.2	1 022.1
Wash; Constrained (LC)	39.9	442.4	928.9	276.5	482.3
TOTAL IMPACTED AREA (ha)					**6 857.1**

(a) Mine footprint includes pit, waste rock dumps, tailings, explosives magazine, plant, dams, administrative buildings, buffers on previous, roads and road buffers.
(b) Dust deposition is modeled extent of 50 mg/m²/day and 20 mg/m²/day. Habitats where dust exceeds 25% (50 mg/m²/day) of normal baseline are considered significantly impacted, similarly habitats where a high proportion of available habitat is affected by the 20 mg/m²/day dust zone.
(c) Groundwater drawdown based on the extent of the 10m drawdown after 100 years.
(d) Extent of Impact = sum of areas of affected habitats. (**Note:** Above areas exclude overlap and can be added)
LC – Least Concern; VU – Vulnerable; (VU) - VU implied by level of threat; EN – Endangered habitat.

Key to shading:	Habitat affected by respective impact	High proportion of available habitat affected	**Very high proportion of available habitat impacted**

9.3.1 *Habitat Loss Caused by the Mine Footprint and Associated Activities*

The footprint of the mine includes the opencast pit, waste rock dumps, crushers, concentrator plant, explosives magazine, tailings facilities (TSF), roads, pipelines, conveyors, electrical infrastructure, dams and administrative buildings. Development of this infrastructure is considered to result in the loss of habitat covering approximately 1480 ha. This figure includes impact buffers developed by Desmet (2013) on the infrastructure and road networks. Nineteen percent of this area has been mapped as important or conservation significant habitat (*Table 9.12*) and represents 6% of the mapped extent of these habitats within the vicinity of the proposed operation (Desmet, 2010).

The Housing Development and Waste Water Treatment Works in Aggeneys and the powerline from the Gamsberg mine pass through the Bushmanland arid and sandy grasslands that are widespread and are not considered sensitive. Habitat loss as a result of these developments is therefore not considered significant.

Table 9.14 ***Impact Characteristics: Habitat loss caused by the mine footprint and associated activities***

Summary	**Construction**	**Operation**	**Decommissioning/ Post Closure**
Project Aspect/ activity	Development of plant and infrastructure. Stripping of overburden prior to excavation of the pit.	Excavation of pit and growth of Waste Rock Dump and TSF.	Presence of pit, TSF and Waste Rock Dump.
Impact Type	Direct Negative (all phases of mine).		
Sensitive Receptors Affected	Irreplaceable and highly significant habitats (*Table 9.12*).		

Box 9.12 Summary of Impact: Habitat Loss Caused by the Mine Footprint and Associated Activities during all Mine Phases

Nature: The construction, operation and decommissioning of the above mentioned facilities and infrastructure will have a **direct negative** impact on the loss of ecological habitat.

Sensitivity/Vulnerability/Importance of Resource/Receptor: **Medium to High.**
Irreplaceability: The infrastructure footprint extends over some highly significant and irreplaceable habitats, and the loss of this habitat will be permanent.

Impact Magnitude: **High.**
Extent: The extent of the impact is **Local**, as the mine footprint is contained within the site boundary with the exception of some developments outside.
Duration: The expected impact will be **Permanent** (ie irreversible). The irreplaceable habitats cannot be restored through rehabilitation efforts.
Scale: The impact will result in **Notable** changes to the receptor with the greatest extent of loss of any particular habitat being 15.8% (*Table 9.12*).
Frequency: The frequency of the impact will be permanent and continuous once the habitat is displaced.
Likelihood: Habitat loss will occur through planned activities, and is thus **Definite**.

IMPACT SIGNIFICANCE (PRE-MITIGATION): **MAJOR** (for all phases of the mine).

Degree of Confidence: **High** - Sensitive habitats have been accurately mapped and there is definite overlay by the mining infrastructure.

Mitigation Measures

Measures to avoid and reduce at source:

- Chapter 4 provides a detailed assessment of alternative mining options, which have included ecological considerations. Many of the ecologically least destructive options have been adopted. These include:
  - Placement of the tailings facility away from the inselberg and avoiding any irreplaceable habitats;
  - Location of the waste rock dump adjacent to the pit with minimal overlap of irreplaceable habitats, as opposed to the top of the inselberg;
  - Concentrator plant located away from the inselberg basin;
  - Placement of the contractor's camp in non-sensitive habitat.
- The extremities of the waste rock dump may still be adjusted, where technically feasible through discussions with the botanist and engineering team. The results of this will not change the significance ratings on the impact assessment and may require some fine adjustments to the residual impact and resultant offsets. This will be finalised in the offset report.
- Consider designing and constructing a rock dump comprising only quartzite rock to fill the remaining portion of the western kloof thereby

shielding the main kloof from any direct impacts of mining activities in the pit. Careful placement of this barrier must be defined with input from a qualified botanist prior to the placement of the rock.

- Consider designing and constructing a rock-dump (or berm), where technically feasible, in the crater to the south and south-eastern side of the pit to shield the remainder of the basin/crater from mining activities. The berm should be constructed to the same elevation as the plateau comprising a non-acid leaching rock core and a quartzite rock outer layer. Careful placement of this barrier must be defined with input from a qualified botanist and the engineering team prior to the placement of rock.

- Associated with the two above mitigations, the botanist will work with the engineering team to consider the design and construction of appropriate structures to deal with erosion, storm water and dirty water within the crater.

- A detailed Biodiversity Management Plan (BMP) (1) will be developed to ensure that the proposed onsite (excluding offsets) avoidance, minimisation and rehabilitation measures associated with mine construction, operation and closure are consolidated for effective implementation and subsequent auditing. (2) Aspects of this plan are discussed throughout this impact assessment, however the plan will, in broad terms, include:

    - Optimal approach to management of the mine property and mine controlled areas including setting aside a large conservation area within these areas;

    - Approach towards implementing controlled access to the mine property and mine controlled areas;

    - Management measures to ensure protection and appropriate management of the biodiversity features on the mine property and mine controlled areas involving:
        - Avoidance of any forms of fire within the area;
        - Wildlife management plan focused on management of the medium to large faunal species and their habitat requirements to avoid habitat destruction through overgrazing;
        - Flora and fauna translocation plan from areas prior to disturbance when appropriate;

    - An ecological rehabilitation programme for impacted areas;

(1) Black Mountain Mining may already have an existing BMP which could be expanded or consolidated with the above requirements.
(2) An offset plan and associated management requirements would be prepared separately if required.

- o Independent monitoring and ongoing inventory development of the mine property's biological and physical environments to inform adaptive management measures and/or corrective action as required;
- o Alien and invasive species control program;
- o General awareness training will be done as part of the mine induction to inform all staff and contractors of the sensitivities of the biodiversity aspects of the mine and surrounds and appropriate environmental work-place etiquette;
- o The BMP will consider means of avoiding and mitigating "foot print" creep; and
- o Measures to manage emergency, accident or upset conditions where biodiversity may be adversely affected.

- All operational waste will be contained and disposed of in accordance with the Waste Management Plan. All waste, rubble and debris will be kept clear of the kloof, wash out and inselberg basin and confined to designated areas within already degraded areas, as illustrated in *Figure 9.9*.

Measures to abate at site:

- Topsoil must be stockpiled where practical and used for rehabilitation purposes.
- Search and Rescue operations will be conducted to capture and translocate faunal species that are not able to escape prior to any land clearing exercises. Translocations will be in accordance with the BMP and as discussed in Section 9.3.5.
- Design and construct the southern approach road within the available flat surface, cutting of the slope should be limited to areas where the available surface does not allow for the required surface width. Berms should be constructed with materials cut from the slope and rocks rolling down the slope are to be kept to a minimum.
- Areas of high conservation need to be clearly demarcated with appropriate barriers and signage to ensure not further encroachment. Any infringements will be reported and appropriate penalties are to be enforced on the staff member or contractor (a suggested fine of R10 000 for infringements is proposed and should go towards a fund for small projects to improve conservation of the Gamsberg).
- Efforts will be taken to minimise the footprint of short-duration activities during construction, operation and decommissioning phases of the mine and the projects outside of the BMM concession. Efforts to minimise the

footprint will involve advance planning, demarcating on the ground and informing staff and contractors of the need to constrain activities to the predetermined footprint, which include parking, vehicle turning areas, materials and equipment laydown zones, toilet facilities etc.

- Linear infrastructure should be grouped where possible and appropriate to minimise the footprint of these disturbances, eg roads, powerlines and pipelines should follow the same route adjacent to one another.

Measures to repair or remedy:

- Rehabilitation measures are to be central to the decommissioning phase of the mining operation. The arid environment does restrict the potential for rehabilitation, but a Rehabilitation Plan will be designed by a competent restoration ecologist as part of the BMP. The Rehabilitation Plan will include erosion control structures and re-vegetation measures of damaged areas using indigenous shrubs and grasses only. These areas will provide habitat for fauna to re-colonise the area. Special attention will be paid to ensuring that critical topography is reconstructed as far as practical.

- A progressive rehabilitation of impacted sites will be implemented as appropriate during all phases of the mine, ie construction, operation and decommissioning.

Residual Impact

Prior to the application of mitigation, the significance of habitat loss resulting from the mine footprint was assessed as MAJOR (*Table 9.14*) primarily due the loss of irreplaceable habitat, ie the Kloof and Headwater Seep. Key mitigation measures listed above include:

- Setbacks of the eastern edge of the pit to avoid encroachment onto the catchment (slopes) of the main kloof and similarly to avoid populations of *Conophytum* species on the inselberg foot-slopes.

- A well implemented BMP, including conservation of a set aside area within the mine site, will reduce the impact from loss of habitat and general biodiversity during all phases of the mine, and remaining habitats are expected to improve with protection and proactive management of the mine property.

Habitat loss will still occur as a residual impact but could be reduced to MODERATE/MAJOR significance with effective mitigation (*Table 9.14*). Based on the estimated areas of loss (*Table 9.12*), approximately 232 ha of irreplaceable habitat and 234 ha of constrained habitat will be lost to the mine infrastructure footprint. Even with mitigation, mining will result in a permanent and irreversible loss of habitat. For non-irreplaceable habitats effective mitigation will reduce the impact to MODERATE significance. For irreplaceable habitats, even with effective mitigation, the impact will remain MAJOR (*Table 9.14*).

It may not be possible to create a biodiversity offset to compensate for the loss of irreplaceable habitats. Although the Headwater Seep supports no unique species, the habitat itself is unique to the Bushmanland Inselberg Region. Up to 82% will be permanently lost, whereas for the Kloof habitat, there is only one other similar kloof elsewhere in Bushmanland. Several other habitats will be impacted beyond the conservation targets that have been set for them as described in the offsets specialist report (see *Annex F* by M. Botha, 2013).

Table 9.15 Pre- and Post- Mitigation Significance: Habitat loss caused by the mine footprint and associated activities

Phase	Significance (Pre-mitigation)	Residual Significance (Post-mitigation)
Construction	**MAJOR (-ve)**	**MODERATE (-ve) to MAJOR (-ve)**
Operation	**MAJOR (-ve)**	**MODERATE (-ve) to MAJOR (-ve)**
Decommissioning and Post Closure	**MAJOR (-ve)**	**MODERATE (-ve) to MAJOR (-ve)**

9.3.2 Impacts Resulting from Habitat Degradation from Dust Deposition

Dust will be generated within the project area primarily from the blasting, pit excavation works, crushing, stockpile, conveyor transfer points, TSF and traffic on unpaved roads. Dust from the pit blasting and excavation, stockpile, conveyor and TSF will be of a dark brown/black colour and is expected to have acid forming properties. Dust generation resulting from construction and operation of the Project has been estimated, and the zone of dust deposition has been modelled based on prevailing winds and climate variables (refer to *Section 6* above).

There is a high ambient dust deposition within the natural environment, which is a fine red dust of calcareous origin. Baseline ambient dust levels show a massive range depending on prevailing climatic conditions, with a median dust deposition rate of 200 $mg/m^2/day$. The surrounding ecosystems would have a relatively high tolerance for dust and that deposited dust will remain highly mobile. However, the ecological impacts from dust deposition are considered significant if the dust input from mining exceeds a 25% change in the baseline dust deposition. All habitats exposed to 50$mg/m^2/day$ are therefore considered impacted by dust (*Table 9.12* and *Figure 9.9*). More importantly, habitats in which a high proportion of their available extent (within the Bushmanland Inselberg Region) occurs within the 20$mg/m^2/day$ dust deposition zone are also considered significantly impacted. These habitats have been rated as affected on two levels (*Table 9.12*) based on the extent of available habitat affected.

Of concern relating to the dust impact is not the volume of dust but the colour and chemical properties of the dust produced from the mining operations. The ecosystems at the site are dominated by dwarf leaf-succulent plants, some only a few millimetres in size. The micro-climatic properties of quartz patches are a result of the white quartz reflecting sunlight and thereby insulating the soil. This may change with a layer of darkly covered dust leading to increased surface temperatures. Moisture derived from mist is the dominant moisture source for the winter-rainfall component of the local flora and affects the soil surface only. Altered chemical properties on the soil surface from acid-generating dust could have adverse consequences on small shallow-rooted species. There is concern that even small changes in the chemical and physical properties of background dust could impact upon sensitive plant species (eg *Conophytum ratum*, *Conophytum angelicae* "dwarf form") over an important part of their restricted range.

Most of the impacts from dust will be reversible within a period of time after mine closure, however these small succulent species have a short lifespan (2 to 5 years) and depend on reproduction through seed production. Approximately 80% of the populations of the above *Conophytum* species are focussed around the fine grain quartz gravel patches. These species are thus at high risk of extinction in the wild within the period of the mine operation as a result of the dust despite the fact that habitats may restore themselves. A cautious approach is therefore followed with regard to analysis of the dust impact in this assessment, which is in line with requirements of the South African legislation and the IFC performance standards

Uncertainties

There are many unknowns regarding the impacts of dust on these habitats. The following uncertainties are highlighted:

- The mobility of the dust once settled is uncertain, and whether there will be a net accumulation of mine-generated dust over a period of time remains to be determined.

- The available dust model does not distinguish between different sources of dust. The dust generated from roads and other sources should not lead to the negative consequences of concern as described above. The geology of the area to be excavated for the pit is varied and not all of the rock will necessarily produce darkly coloured dust with acid-generating properties. Blasting, excavation and processing of the Gamsberg Iron Formation (GIF) is expected to generate a black dust with potential acid-generating properties. The severity, duration and extent over which this dust will be generated are currently unknown.

- The extent to which dark acid-generating dust will lead to long-term impacts on the sensitive receptors (small succulent species) is unknown.

A conservative approach is followed in this assessment due to the many uncertainties and the highly sensitive habitats involved.

Table 9.16 Impact Characteristics: Habitat degradation from Dust Deposition

Summary	Construction	Operation	Decommissioning/ Post Closure
Project Aspect/ activity	Construction activities, driving on unpaved roads.	TSF, pit excavation, blasting, stockpiles and conveyors, driving on unpaved roads.	TSF, driving on unpaved roads.
Impact Type	Direct Negative (all mine phases).		
Sensitive Receptors Affected	Plains Gravel Quartz habitat; Plains Gravel Calcrete habitat; Kloof and South Slopes habitats (*Table 9.12*).		

Box 9.13 Summary of Impact: Habitat Degradation from Dust Deposition for all Phases of the Mine

Nature: The deposition of acid-generating dust causing increased soil temperatures is a **Direct** and **Indirect Negative** impact on sensitive habitats.

Sensitivity/Vulnerability/Importance of Resource/Receptor: **High.**
Irreplaceability: Numerous **Irreplaceable** habitats will potentially be degraded or lost.

Impact Magnitude: **Medium to High.**
Extent: The extent of the impact is **Local**, as many irreplaceable habitats that are important on a regional scale may be irreparably damaged.
Duration: The impact is expected to last the duration of the life of mine, ie **Long term**.
Scale: The impact will result in **Widespread** changes to the affected habitats.
Frequency: The frequency of the impact will be **Frequent to Continuous** due to the dry climate and regular winds.
Likelihood: The likelihood of the impact occurring is **Definite**.

IMPACT SIGNIFICANCE (PRE-MITIGATION): **MAJOR.**

Degree of Confidence: **Low.**

Mitigation Measures

Measures to abate at site:

- Mitigation measures for suppression of dust from blasting and haulage activities in the pit, on the waste rock dumps and along unpaved roads will reduce dust-related impacts on the environment, as discussed in *Section 9.*
- Dust monitoring programmes will be implemented and actions taken when threshold levels are exceeded, as discussed in *Section 9.*

Measures to abate at receptor:

- Monitoring of sensitive ecological receptors will be implemented and include the following considerations:
    - Permanent monitoring plots will be established within sensitive habitats at high risk of loss of important plant species from dust deposition;
    - A competent botanist will be contracted to oversee the monitoring programme; and
    - Threshold levels of loss of individual plants will be determined and actions to be followed in the event of exceeding these levels.
    - If thresholds are exceeded, corresponding increases in terms of the Offset metrics will need to be implemented by the mine, and reported to the competent authority.

Residual Impact

Prior to the application of mitigation, the significance of habitat degradation resulting from dust deposition ranged from **MODERATE** to **MAJOR** (*Table 9.16*) due to the large coverage over restricted irreplaceable habitats, primarily the Quartz gravel plains but also the Calcrete gravel plains, the South slopes and the Kloof. Confidence on the assessment of impact significance on the terrestrial ecology is however low due to possible variability in the properties of the dust and uncertain ecological consequences, and few options for mitigation are possible except avoidance measures to reduce dust generation at the source. A monitoring plan to assess the ongoing impact of dust deposition on sensitive receptors will be developed and implemented.

Approximately 805 ha of irreplaceable habitat, 809 ha of constrained habitat and 2 605 ha of flexible habitat could *potentially* be ecologically degraded or lost as a result of dust deposition (*Table 9.12*). Consideration will need to be given to acquiring an offset that protects similar habitats to achieve an "on the ground" net gain in biodiversity values for this impact as required by the Vedanta Standards.

Table 9.17 Pre- and Post- Mitigation Significance: Habitat Degradation from Dust Deposition

Phase	Significance (Pre-mitigation)	Residual Significance (Post–mitigation)
Construction	**MODERATE (-ve)**	**MODERATE (-ve)**
Operation	**MAJOR (-ve)** ***(Low confidence)***	**MAJOR (-ve)** ***(Low confidence)***
Decommissioning and Post Closure	**MODERATE (-ve)** ***(Low confidence)***	**MODERATE (-ve)** ***(Low confidence)***

9.3.3 *Habitat Degradation Impacts Resulting from Groundwater Drawdown*

The large open cast pit will draw groundwater flows from the surrounding areas. Groundwater levels have been modelled based on the underlying geology, rainfall and evaporation rates. Results have revealed that groundwater levels are expected to stabilise 100 years after mine closure, and will result in a large area as illustrated in *Figure 9.9* with a depressed groundwater table in excess of 10 meters below current baseline levels. High evaporation rates as a result of the dry climate are expected to exceed the groundwater flows into the pit, and the pit will remain dry with a permanently depressed groundwater zone (*Annex G2*). Groundwater within the inselberg and immediate vicinity will be reduced to the level of the pit base 100 years post-closure, which is approximately 300 meters below the groundwater of the surrounding plains, but will rise sharply to less than 20 meters below current baseline levels within a short distance from the inselberg. Groundwater levels within the Kloof habitat are expected to remain 100 to 150 meters below current baseline levels 100 years post closure.

A number of seeps, springs and associated vegetation around the inselberg and the riparian plant community, mainly trees, growing in the kloof and mouth of the kloof on the north side of the inselberg are currently dependent on subterranean water sources. Lowering of the water table in riparian areas will result in a die off or reduce the ability of trees to regenerate. The tree species affected are mostly widespread throughout southern Africa although locally they are rare or uncommon being confined to these habitats. These species are a keystone ecological resource so their loss will imply a permanent and irreversible loss of ecological function.

Azima tetracantha (Needle-bush) is a shrub growing in the spring on the eastern slopes of the mountain. It is a widespread species from the Eastern Cape and KwaZulu-Natal but within this landscape is a palaeo-relic from past climates. It is possible that it has been growing in this spot of at least the past 10 000 years and may have developed unique genetic adaptations to survive here. The loss of this spring is likely to result on the demise of this species at this site, and the possible loss of unique genetic material.

The wash area at the mouth of the Kloof where it exits the Gamsberg inselberg has been identified as an important faunal habitat which supports high densities of scorpions and invertebrates in general (GroundTruth, 2013). The groundwater level is typically just below the surface at this point, which may explain their abundance, but also the occasional surface flows bring nutrients and plant material that sustains their prey. These invertebrates provide an important food source for species higher in the food chain. The natural groundwater level will be permanently altered as a result of the groundwater drawdown.

Table 9.18 ***Impact Characteristics: Habitat Degradation from Groundwater Drawdown***

Summary	Construction	Operation	Decommissioning/ Post Closure

Summary	Construction	Operation	Decommissioning/ Post Closure
Project Aspect/ activity	None	Pit excavation.	Presence of pit.
Impact Type	None	Direct Negative.	
Sensitive Receptors Affected	None	Mountains plateau, Kloof and South slopes habitats (*Table 9.12*).	

Box 9.14 Summary of Impact: Habitat Degradation from Groundwater Drawdown

Nature: Excavation of the open cast pit will lead to a groundwater drawdown that will have a **Direct Negative** impact on the functionality of surrounding habitats.

Sensitivity/Vulnerability/Importance of Resource/Receptor: **High.**

Irreplaceability: The entire Kloof habitat and a number of freshwater springs (classified as Irreplaceable) where much of the ecological functionality depends on surface water availability, will be affected. The Wash habitats (classified as constrained) may be affected to a lesser amount.

Impact Magnitude: **High.**

Extent: The groundwater drawdown zone extends beyond the boundaries of the site, however the ecological impacts are **Local**.

Duration: The presence of the large opencast pit will prevent recovery of groundwater levels after mine closure, and the impact will thus be **Permanent** (ie irreversible).

Scale: The impact will result in complete changes to the irreplaceable Kloof and Freshwater Spring habitats.

Frequency: The frequency of the impact will be **Continuous and Permanent.**

Likelihood: Excavation of the pit is a planned event and the resulting impact is thus **Definite**.

IMPACT SIGNIFICANCE (PRE-MITIGATION): **MAJOR.**
(operation and decommissioning phases only)

Degree of Confidence: **High.**

Mitigation Measures

Measures to repair or remedy:

- Water will be provided artificially to maintain selected faunal diversity at least for the duration of the life of mine, and possibly continued by the responsible management authorities post mine closure. The following approaches will be implemented:

    - Provision of artificial drinking water in appropriate areas within the inselberg basin throughout the year for wildlife, such as baboons and antelope, that is currently dependant on the surface water of the Kloof habitat (prior to excavation of the pit).

    - Seasonal provision of water in natural pools in appropriate locations within current wetland habitats for frog species (eg *Phrynomantis annectens, Strongylopus springbokensis, Vandijkophrynus robinsoni* etc.) and aquatic fauna to complete their breeding cycles. The undescribed alga *Hydrodictyon sp.nov.* is likely to depend on these pools.

- These forms of water provisioning will need to be continued after mine closure, and incorporated into the future land management programmes for the Gamsberg post-mining with financial provision secured by BMM.

- The Needle-bush shrub (*Azima tetracantha*) will be cultivated *ex-situ* in a nursery from seeds or genetic material collected within the Gamsberg, and used in landscaping projects around the mine offices and other facilities. This species is well suited to propagation, and this measure will preserve local genetic material.

- A monitoring plan will be developed and implemented to monitor the ecological integrity of all habitats that are ecologically affected by the groundwater drawdown and the effectiveness of artificial water provision. This programme may provide additional options to mitigate the impact or contribute towards the determination of offset metrics. The monitoring programme will start immediately to provide a reliable benchmark against which to measure impacts of the mining operations.

Residual Impact

Prior to the application of mitigation, the significance of habitat degradation resulting from groundwater drawdown was MAJOR due the total inclusion of restricted irreplaceable habitats, primarily the Kloof, Headwater seen and springs. These habitats depend on groundwater for seepage and maintenance of riparian vegetation which provide important ecological functions.

Mitigation measures for impacts on habitats and species include artificial provisioning of water and *ex-situ* cultivation which at best will support a fraction of the species diversity dependent on those habitats. These mitigation measures are not considered effective in alleviating the impact, and the significance of the impact will remain of MAJOR significance (*Table 9.18*). Consideration will need to be given to acquiring an offset for those habitats that are not irreplaceable that protects similar habitats to achieve an "on the ground" net gain in biodiversity values for this impact as required by the Vedanta Standards. Impacts on irreplaceable habitats cannot be offset.

Table 9.19 Pre- and Post- Mitigation Significance: Habitat Degradation from Groundwater Drawdown

Phase	Significance (Pre-mitigation)	Residual Significance (Post–mitigation)
Construction	N/A	N/A
Operation	MAJOR (-ve)	MAJOR (-ve)
Decommissioning and Post Closure	MAJOR (-ve)	MAJOR (-ve)

9.3.4 *Impacts Arising from Habitat Fragmentation*

Inselbergs within the Bushmanland Inselberg Region represent an archipelago of rocky islands within a vast expanse of sand. These inselbergs serve as stepping stones for many species that hop from one inselberg to another, eg birds and wind-blown seed dispersal of plants. They also provide important ecological refugia for species that are important from an evolutionary/ climate adaptation perspective. The inselbergs form a sequence that represent an ecological corridor that has been defined by the Namakwa District Map of Critical Biodiversity Areas. This corridor was recognised to safeguard movement of biota between the Bushmanland inselbergs. The Gamsberg is located midway along this corridor and its position is key to the east-west movement of species. The Gamsberg inselberg is considered to be the key biodiversity feature underpinning ecological processes/ function in this system.

Mining will reduce the Gamsberg's ecological function as a movement /migratory stepping-stone/corridor for species between inselbergs. The mine infrastructure footprint, the dust deposition and the ecologically-affected areas from the groundwater drawdown will adversely affect the ecological corridor's functionality.

A lesser ecological corridor is identified on the Namakwa District Map of Critical Biodiversity Areas to the south of the Gamsberg. This corridor provides an alternative route for migration of various species and genetic material. However this corridor follows the Koa river valley or arid sandy grassland and does not support the irreplaceable habitats present in the Gamsberg corridor and essentially serves non-inselberg dependent species. The design of any accompanying offset would need to cater for retaining as much of an inselberg corridor as possible.

Table 9.20 Impact Characteristics: Habitat Fragmentation

Summary	Construction	Operation	Decommissioning/ Post Closure
Project Aspect/ activity	Combination of activities, but particularly the mine infrastructure, pit and TSF footprints and dust deposition footprint.		
Impact Type	Direct Negative.		
Sensitive Receptors Affected	Ecological 'stepping-stone' corridor through the Bushmanland Inselberg region.		

Box 9.15 Summary of Impact: Habitat Fragmentation during all Mine Phases

Nature: The combined impacts of the mine footprint, dust deposition and groundwater loss will have a **Direct Negative** impact on lowering the functionality of an ecological 'stepping-stone' corridor through the BIR.

Sensitivity/Vulnerability/Importance of Resource/Receptor: **Medium.**

Irreplaceability: The ecological corridor links many habitats, some of which have been classified as **Irreplaceable** or constrained. Significant ecological process depend on the Gamsberg in the inselberg system, and it is identified as the most efficient/ effective configuration for conservation in this landscape.

Impact Magnitude: **Medium.**

Extent: The extent of the impact is **Regional**, as the ecological corridor extends far beyond the project site.

Duration: The expected duration of the impact will be **Long-term to Permanent**.

Scale: The impact will result in **Notable** changes to the receptor (ie the corridor and species that move along it.).

Frequency: The frequency of the impact will be **Continuous.**

Likelihood: The likelihood of the impact occurring is **Definite**.

IMPACT SIGNIFICANCE (PRE-MITIGATION): **MAJOR.**

Degree of Confidence: **Medium -** There is limited means to quantify or demonstrate the functionality of an ecological corridor or the result of the impact.

Mitigation Measures

Measures to avoid at source:

- Set aside a large part of the mine property and mine controlled areas for conservation purposes. Appropriate management and conservation of this set aside conservation area is required through effective implementation of a comprehensive BMP (as discussed in Section 0) to ensure that natural habitats are maintained in the best possible state over the life of mine and thereafter.

- The remaining area of the Gamsberg under the control of the mine must be maintained in a good ecological state through controlled access, prohibition on livestock grazing and proactive management as required through implementation of a BMP (as discussed in Sections 0 and 9.3.7).

- Small areas of natural vegetation will be maintained as islands for the refuge of species wherever possible within the mine footprint, eg strips of vegetation beneath powerlines and between roads. These small patches of natural vegetation will not compensate for the loss of a corridor, but will allow the movement of bird and other faunal species that would otherwise be reluctant to traverse large areas of continuous disturbance.

Measures to abate at site:

- Fencing of the mine properties and mine controlled areas will be maintained in a good state in the form of 4 or 5 strand livestock fences. These fences must allow unrestricted movement of small and medium-sized wildlife in and out of the mine properties and mine controlled areas.

- Artificial barriers to species movements will be minimised, and measures taken to allow movement across unavoidable barriers. Examples include:
    - regular culverts will be installed beneath roads and pipelines, and
    - small gaps incorporated into security mesh fences.

- Night lighting for the plant and security purposes will be kept to a minimum and both inward and downward facing to minimise the disturbance to the movement of nocturnal species. It is recommended that low pressure sodium vapour lights/or LED lights should be used with wavelengths of limited attractiveness to insects.

Measures to repair or remedy:

- Artificial water provision will be provided to maintain selected faunal diversity as described in Section 9.3.3.

- Locally indigenous plant species will be used in landscaping projects around offices and mine facilities.

Residual Impact

The pre-mitigation significance of habitat fragmentation has been assessed as MODERATE to MAJOR due to the interruption of an ecological corridor comprising a sequence of inselbergs. Mitigation measures have been presented to ensure that natural habitats are retained and well managed over much of the Gamsberg inselberg and that efforts are taken to ensure barriers created by the project are permeable to a range of species.

This impact can be reduced to MODERATE significance (*Table 9.20*) through a number of effective mitigation measures presented above. It is not possible to demonstrate the direct dependence on critical habitats, yet the majority of the habitats that would be affected on a regional scale are natural, and the Vedanta Standard for natural habitats would thus apply, ie to show no net loss of biodiversity. However far wider consideration of ecological processes are relevant. The Vedanta standards (based on the IFC PS6) emphasises supporting the ecological processes underpinning patterns of biodiversity.

It will be possible to incorporate a landscape corridor criterion (maintaining functional corridor width within a 5km buffer around the mine impact area) into the design of a biodiversity offset aimed at retaining the landscape connectivity. By maintaining continuous "buffers" of natural habitat north and south of the mining area it would be possible to retain a level of east-west landscape connectivity, albeit reduced in scale.

Table 9.21 Pre- and Post- Mitigation Significance: Habitat Fragmentation

Phase	Significance (Pre-mitigation)	Residual Significance (Post–mitigation)
Construction	MODERATE (-ve)	MINOR (-ve)
Operation	MAJOR (-ve)	MODERATE (-ve)
Decommissioning and Post Closure	MODERATE (-ve)	MINOR (-ve)

9.3.5 *Impacts on Species Diversity as a result of Mining-related Activities*

While the biodiversity impacts have been considered in the previous sections, it is also important to consider the impacts on individual species. The impact on flora and fauna as a result of the project is discussed separately below.

Floral Species Importance

The Bushmanland Inselberg Region straddles the boundary of the winter and summer rainfall systems of South Africa, and thus overlaps two biomes. As a result, the floral composition of this area is unique and the Bushmanland Inselberg Region defines a distinct centre of endemism termed the "Bushmanland Inselberg Centre of Endemism". The endemism is associated with the inselbergs and not the sandy Bushmanland plains that comprise 90% of the region. *Table 9.21* presents a list of conservation important plant species identified in the study area, which includes five species listed on the IUCN Red List of threatened species and nine species endemic to the Bushmanland Inselberg Centre of Endemism. Four species are restricted to three or less inselbergs and three species are considered relics of a past climate.

Table 9.22 Plants Species of Conservation Concern Identified in the Study Area (Desmet, 2010)

Species	Conservation Status	Habitat
Anacampseros bayeriana	VU, Rare	Calcrete gravel patches.
Crassula mesembrianthemopsis	VU, Rare	Calcrete gravel patches.
Titanopsis hugo-schlechteri var. hugo-schlechteri	VU, Rare	Calcrete gravel patches.
Conophytum ratum (plains form)	VU, END	Plains quartz gravel patch.
Mesembryanthemum inachabense	END	Plains quartz gravel patch.
Trachyandra sp.nov.	END (DD)	Plateau.
Tylecodon sulphureus	END	Plateau.
Adromischus nanus	END	Plateau quartz gravel patch.
Conophytum angelicae subsp. angelicae (dwarf form)	Rare	Plateau quartz gravel patch.
Conophytum ratum (dwarf/plateau form)	END & VU	Plateau quartz gravel patch.
Aloe microstigma	Relic	South slopes.
Conophytum limpidum (dwarf form)	NT, END	South slopes.
Othonna sp. nov.	END (DD)	South slopes.
Sceletium tortuosum	Relic	South slopes.
Azima tetracantha	Relic	Springs.
Hydrodictyon sp.nov.	END (DD)	Kloof.

Species	Conservation Status	Habitat
END – Endemic to the Bushmanland Inselberg Centre of Endemism; NT – Near Threatened. VU – Vulnerable (IUCN Red List); (DD) represent undescribed species (*sp.nov.*) and are considered within this report as Data Deficient in terms of the IUCN Red List criteria.		

Faunal Species Importance

Studies of the faunal communities have not revealed any highly threatened species.

Two undescribed ant species (*Camponotus sp.nov.* and *Messor sp.nov.*) were found, but are thought to be endemic to the Bushmanland Inselberg Region, and are thus treated as Data Deficient in terms of the IUCN Red List criteria. There is a possibility that a newly discovered invertebrate sub-order of Heelwalkers (Mantophasmatodea) may occur but has not been confirmed. The study site supports a high scorpion diversity which includes at least four species protected under provincial legislation (GroundTruth, 2013).

Baseline studies have revealed that the Gamsberg supports a high reptile diversity which includes three range-restricted endemic species, namely Haacke's Gecko, Namaqua Mountain Gecko and Desert Mountain Adder and one Red List species (Good's Gecko: Vulnerable). Bird diversity for the Gamsberg is high relative to the greater area and includes one recently confirmed Near Threatened bird, namely the Lanner Falcon. Other Red Listed birds have been recorded in older surveys. Other provincially protected species present in the project area include Greater Kestrel, Jackal Buzzard, Southern Pale Chanting Goshawk and Cape Eagle-Owl. A rich diversity of mammals is present in the area and includes two Bats and two rodents classified as Near Threatened. A mix of medium-sized mammals is present (possibly as a result of a long-term restriction on livestock grazing and limited access to the area), which include four antelope, one primate and 12 carnivores including Brown Hyaena and Leopard. The larger carnivores and raptors exist at the top of their food chains and their numbers are thus typically exist as few wide-ranging individuals worthy of conservation efforts.

Verraeux's Eagles, a provincially protected species appear to have active nest sites in the Gamsberg. Loss of resident Verreaux's Eagle from the Gamsberg could have significant ecosystem-level impacts for vegetation. Rock Dassies have the ability to alter the structure of vegetation where populations explode in the absence of predators, especially Verreaux's Eagle. The impact is reversible once disturbance ceases.

A number of species within the Gamsberg are considered to be at risk due to the proposed mining activities. The species that are at risk based on an assessment by GroundTruth (2013) are shown in *Table 9.22*.

Table 9.23 Faunal Species at Medium to High Risk as a Result of the Proposed Mining Activities in the Gamsberg (GroundTruth, 2013)

Species and Common Name	IUCN Red List Status	Threatened Habitat Dependence	Intensity of Impact	Species Impact Significance	Offset Potential (GroundTruth 2013)
Invertebrates					
Camponotus sp.nov. (AFRC-ZA-52) Undescribed ant	(DD)	Medium (H1 & H2)	High	Medium	Medium (RR)
Messor sp.nov. (AFRC-ZA-01) undescribed ant	(DD)	High (H2)	Medium	**High**	Low (RR & may be CR)
Herpetofauna					
Strongylopus springbokensis Namaqua Stream Frog	LC	Medium (H1 & H2)	High	Medium	Medium (RR)
Pachydactylus goodi Good's Gecko	VU	Medium (H1 & H2)	Medium	Medium	Medium (RR)
Pachydactylus haackei Haacke's Gecko		Medium (H1 & H2)	Medium	Medium	Medium (RR)
Pachydactylus montanus Namib Mountain Gecko		Medium (H1 & H2)	Medium	Medium	Medium (RR)
Bitis xeropaga Desert Mountain Adder		High (H2)	Medium	**High**	Medium (RR)
Birds					
Polemaetusbellicosus Martial Eagle	VU	Medium (H1 & H2)	High	**High**	High
Mammals					
Rhinolophus capensis Cape Horseshoe Bat	NT	Medium (H1 & H2)	High	**High**	Medium (Endemic)
Rhinolophus darlingi Darling's Horseshoe Bat	NT	Medium (H1 & H2)	High	**High**	High
Parotomys littledalii Littledale's Whistling Rat	NT	Medium (H3)	Medium	Medium	Medium
Petromus typicus Dassie Rat	NT	High (H1) Habitat specialist	Medium	**High**	Medium

CR – Critically Endangered; VU – Vulnerable; NT – Near Threatened; LC – Least Concern.
H1 – Irreplaceable habitats; H2 – Constrained habitats; H3 – Flexible habitats; RR – Range restricted.
Offset potential describes the ease with which a species could be included within an offset.

Aquatic Diversity

Aquatic diversity was assessed in four sites covering springs and the Kloof habitat. These aquatic systems are not listed under the national freshwater ecosystem priority areas (FEPA) database of important wetland sites. No sensitive aquatic species were found and both diatom and macro-invertebrate indices indicated the ecological integrity of these systems to be in a poor state. These results are thought to be the result of stagnant pools being assessed and a shortage of flowing freshwater habitats. The aquatic systems are essential to sustaining irreplaceable habitats; but their loss is assessed in Section 9.3.3.

Table 9.24 Impact Characteristics: Loss of Floral and Faunal Species Diversity

Summary	Construction	Operation	Decommissioning/ Post Closure
Project Aspect/ activity	Habitat loss and degradation; dispersal barriers and habitat fragmentation; reduced access to water; uncontrolled collecting and illegal hunting.		
Impact Type	Both direct and indirect negative impacts.		
Sensitive Receptors Affected	Vulnerable, endemic, rare, relic and undescribed plant species (*Table 9.21*) Threatened, endemic, undescribed and protected faunal species, also predators and scavengers at the apex of their food chains. Species at high risk of impacts (*Table 9.22*).		

Box 9.16 Summary of Impact: Loss of Floral and Faunal Species Diversity

Nature: Mining-related activities will have both **direct and indirect negative** impacts on the diverse biodiversity within associated with the Gamsberg.

Sensitivity/Vulnerability/Importance of Resource/Receptor: **Medium to High.**
Irreplaceability: **Yes**, many species are threated and or endemic. The population status of various undescribed species is not adequately understood. These species can be considered **irreplaceable**.

Impact Magnitude: **Medium.**
Extent: The extent of the impact is **Regional**, as populations of threatened, rare and endemic species would be regionally affected.
Duration: The expected impact will be **Long-term** to **Permanent**.
Scale: The impact could result in **Notable** changes to the receptor.
Frequency: The frequency of the impact will be **Ongoing.**
Likelihood: The likelihood of the loss of a threatened, endemic or undescribed species is **Possible**.

IMPACT SIGNIFICANCE (PRE-MITIGATION): **MODERATE to MAJOR.**

Degree of Confidence: **Medium.**

Mitigation Measures

There are a number of measures that will be implemented to minimise the impact on fauna and flora. These actions will be captured as part of a detailed Biodiversity Management Plan (BMP) and include the follows:

Measures to reduce at site:

- Barriers to terrestrial faunal movement, eg fine mesh fences, walls, trenches, a raised concrete base along a conveyor, will be avoided where possible, and measures implemented to reduce their fragmentation impacts, as discussed in Section 9.3.4.
- The following activities will be prohibited by staff and contractors:

- o Hunting of wildlife within the mine property or mine controlled areas;
- o Purchase, sale or transport of any wildlife products from local communities or passing traders;
- o Collection of any plants or animals or products thereof for consumption, medicinal use, cultivation or keeping as pets;
- o Keeping pets within the Gamsberg mine property, either domestic animals such as cats or dogs, or native wildlife; and
- o Intentional killing of any animals including snakes, lizards, birds or other animals.

- All trenches and pits that are excavated for pipelines, caballing etc will be backfilled as soon as practically possible to avoid acting as a trap for small fauna.

- Escape routes for fauna will be provided within pitfall features and concreted drainage lines, and potentially dangerous situations inspected regularly to save trapped species.

- All new power line infrastructure should be bird-friendly in configuration (eg pylon designs that widely separate live wires to reduce electrocution of vultures and other large raptors) and adequately insulated (Lehman *et al.* 2007) (1) to minimise the loss of raptors and other large birds. These activities should be supervised by someone with experience in this field.

- Power lines will be positioned as far as practically possible away from water bodies (including artificial ponds and the waste water treatment works at Aggeneys where flamingos and a diversity of waterbirds are at risk and incorporate visibility devices for birds (eg flappers) on long lengths of exposed lines.

- Redundant infrastructure will be removed at the earliest opportunity and these areas rehabilitated.

- Speed restrictions (suggested maximum of 40km/hr) will be enforced on all roads within the mine properties and mine controlled areas to minimise the incidence of faunal road kills.

- Driver training will be provided to sensitise them to the importance of avoiding faunal road kills and the mine site, within the mine properties and on public roads.

(1) Lehman, R.N., Kennedy, P.L., Savidge, J.A. (2007): The state of the art in raptor electrocution research: A global review. Biolog. Conserv. 136: 159-174.

Measures to repair or remedy:

- Translocation of flora is not viewed as an ecologically viable mitigation measure, as translocation of plants to others areas in the Bushmanland Inselberg Region can lead to genetic pollution that is undesirable. Translocation for trade is not acceptable. Development of a detailed plant translocation plan will form part of the Biodiversity Management Plan (Section 0). Translocation of plants will only be considered under the following circumstances:
-
    - Translocation only from areas about to be destroyed through clearing of vegetation cover;
    - For research purposes (eg to botanical gardens);
    - For landscaping purposes around the mine;
    - Species with very limited numbers and of high conservation value (eg *Aloe microstigma*) will be translocated within the Gamsberg; and
    - In some cases (eg calcrete gravel patches) translocated plants will be used to restore degraded habitat within the offset area.

- Trained mine personnel with capacity to safely capture and translocate dangerous snakes from construction sites and mine operational areas to safe areas of similar habitat within the mine property. Other non-dangerous faunal species at risk form construction activities will be captured and translocated to safe areas as appropriate.

- Ongoing development of an inventory of species diversity within the mine sites will be maintained. BMM will collaborate with competent NGOs or academic institutions with adequate competence to conduct research and monitor unexpected changes to the faunal baseline. Emphasis should be placed on the species considered to be at high and medium risk (*Table 9.22)* although not only restricted to these species. Such research may lead to improved mitigation to conserve the natural environments and species diversity.

- BMM will strive to improve knowledge gaps through a detailed regional study of key fauna and better inform both offset requirements and opportunities. BMM will collaborate with independent NGO's or academic institutions to conduct and interpret regular faunal monitoring studies to both expand on the current baseline study. The following aspects will be considered:
    - There is a possibility that summer-active species of Mantophasmatodea (heelwalkers) may be present, and should be investigated during a well-timed wet season survey; and

- Determine key habitat requirements for and distribution of the undescribed ant species of the *Camponotus* and *Messor* genera to enable formal conservation (IUCN Red List) assessments to be carried out, to allow potential offsets to be evaluated and to allow detailed rehabilitation requirements to be specified.

Additional conservation enhancement measures:

There are a number of measures that BMM could consider in improving the general conservation status of the area. These include the following:

- Efforts will be supported to promote an appreciation of biodiversity features of the mine property and mine controlled areas among staff, contractors and their dependents as mentioned in the BMP.

- Incorporating islands or platforms above the water level within the Waste Water Treatment Works would provide safe refuge for waterbirds and improve the quality of the habitat for them.

- Introduction of catfish (Barbel) to the secondary ponds of the Waste Water Treatment Works would facilitate the consumption of unwanted biotic components and would provide possible prey for fish eagles and cormorants, thereby increasing the diversity of birds attracted to the site. Fishing at the site will be prohibited.

Residual Impact

Prior to the application of mitigation, the significance of loss of species diversity was assessed as MODERATE to MAJOR due to the high diversity of species present, but particularly the very high diversity of endemic, rare, threatened, protected and some undescribed species that are currently not adequately understood. A host of mitigation measures are presented that will improve protection of the biodiversity and raise the understanding of the diversity and abundance of species within the project area and vicinity. Key mitigation measures include a conservation set aside area (Section 0), implementing a biodiversity protection policy and avoiding dangerous situations for fauna.

Effective implementation of these measures will reduce the impact to a MODERATE significance (*Table 9.24*). Biodiversity offsets will be considered to remedy these and other residual impacts on biodiversity. Special consideration needs to be given towards choice of an offset that includes the plant and animal species of conservation concern (*Table 9.21* and *Table 9.22* respectively); offset areas required to remedy residual negative impacts on habitat and flora may be sufficient to address the offset needs of fauna. Rare and undescribed plant and animal species may not be widespread and if not present in an offset, additional precautions to protect their populations *in situ* will be necessary to comply with the Vedanta Standards for natural and critical habitats.

Table 9.25 Pre- and Post- Mitigation Significance: Loss of Species Diversity

Phase	Significance (Pre-mitigation)	Residual Significance (Post-mitigation)
Construction	MODERATE (-ve)	MINOR (-ve)
Operation	MAJOR (-ve)	MODERATE (-ve)
Decommissioning and Post Closure	MAJOR (-ve)	MODERATE (-ve)

9.3.6 Impacts from Encroachment of Alien Species

Threats to biodiversity from alien plant species are currently low. Scattered individuals of the tree *Prosopis glandulosa* (Mesquite) are currently present in the river and wash systems around the mountain but not in the basin or kloof. This tree represents a dormant threat that has the potential to become significant in riparian areas if not eradicated. Russian thistle, *Salsola kali*, is widely present in disturbed places in the veld. This alien shrub is practically naturalised in Karoo vegetation and does not pose a significant threat at this time.

Within the last decade fountain grass (*Pennisetum setaceum*) has become established throughout Aggeneys town, especially within water run-on areas such as road culverts. This species represents a real and significant threat for the aquatic ecosystems of the Gamsberg. Increased traffic movement from Aggeneys to the mountain will increase opportunities for seed dispersal to the site, and increased water availability from dust mitigation activities will create ample opportunities and niches for this species to establish on the mountain. Once established in the physical mining area it is highly likely that this species could colonise the seeps and springs in the kloof resulting in further indirect loss of biodiversity in the kloof, although groundwater losses there may reduce their spread.

Table 9.26 Impact Characteristics: Encroachment of Alien Species

Summary	Construction	Operation	Decommissioning/ Post Closure
Project Aspect/ activity	General Vehicle movements. Land clearing. Watering for dust mitigation along roads and other areas.	Watering for dust mitigation along roads and other areas. Rehabilitation programmes.	Rehabilitation programmes.
Impact Type	Indirect Negative (all mine phases).		
Sensitive Receptors Affected	Kloof habitat and road sides.		

Box 9.17 *Summary of Impact: Encroachment of Alien Species*

Nature: Construction and mine operation activities invariably lead to vegetation clearing and ongoing disturbance of land, which creates opportunities for alien species to establish. This results in an **Indirect Negative** impact on the local ecology.

Sensitivity/Vulnerability/Importance of Resource/Receptor: **Low to Medium.**
Irreplaceability: Disturbed areas where alien plants species are likely to establish are **Not Irreplaceable**, however alien infestations can subsequently spread into vulnerable and irreplaceable habitats such as the Kloof.

Impact Magnitude: **Medium.**
Extent: The extent of the impact is **On-site to Local**, as the dry inhospitable climate is not conducive to infestation from a diversity of species.
Duration: The expected impact will be **Long Term to Permanent** but can be reversed.
Scale: The impact will result in **Notable** changes to the species composition and thus ecological functionality receptor of affected habitats.
Frequency: The frequency of the impact will be **Ongoing.**
Likelihood: The likelihood of the impact occurring is **Possible**.

IMPACT SIGNIFICANCE (PRE-MITIGATION): **MINOR to MODERATE.**

Degree of Confidence: **Medium to High -** Alien species are present in the greater vicinity.

Mitigation Measures

Measures to reduce at source:

- Use only approved indigenous species for all workplace and new housing landscaping projects. The introduction of foreign plant species must be controlled.

Measures to repair or remedy:

- Develop and implement an Alien Plant Control Plan as part of the BMP. This plan will identify all problem alien and invasive plant species and map their distributions. The plan will prioritise the species for control and present the most effective control measures based on available technology and levels of infestation.

- Presence of alien fauna, such as feral dogs and cats that threaten the local ecology will be monitored. Ethical control measures will be implemented if an increase in their presence is detected.

Residual Impact

Prior to the application of mitigation, the significance of alien species encroachment was assessed as MINOR to MODERATE. Mitigation measures are presented to implement alien plant control and avoid the possible introduction of species that may pose a new threat. Effective implementation of these measures will reduce the impact to a NEGLIGIBLE significance (*Table 9.26*). The spread of alien species represents a displacement of naturally occurring species, and effective alien plant control is thus important to achieve the Vedanta Standard for natural habitats.

The construction phase will result in considerable vegetation clearance yet stabilisation and rehabilitation will most likely be delayed. Implementation of an effective alien control programme is similarly expected to be delayed, and therefore no reduction in the significance of the impact during the construction phase is expected.

Table 9.27 Pre- and Post- Mitigation Significance: Encroachment of Alien Species

Phase	**Significance (Pre-mitigation)**	**Residual Significance (Post-mitigation)**
Construction	**MODERATE (-ve)**	**MODERATE (-ve)**
Operation	**MODERATE (-ve)**	**NEGLIGIBLE (-ve)**
Decommissioning and Post Closure	**MINOR (-ve)**	**NEGLIGIBLE (-ve)**

9.3.7 Impacts of Human Influx on Biodiversity

The exclusion of domestic livestock from the Gamsberg for the last three decades has resulted in the mountain currently supporting the best examples of the respective habitats regionally. A comparison of the calcrete gravel plains within the project site to similar habitats outside the site revealed the floral species diversity within the mine site to be in orders of magnitude larger, which was attributed to the long-term absence of high grazing intensity. The healthy natural vegetation cover has similarly encouraged the development of natural wildlife populations, with klipspringer and other small antelope being prominent there. These have in turn supported a carnivore population evidenced by the occasional sightings of leopard and the presence of brown hyaena.

The influx of people during mine construction and operation will be significant and could impact on vegetation if site access outside of the construction/mining footprint area is not regulated. Typical impacts include ad-hoc collecting of rare and endemic plants; illegal hunting of wildlife, litter and creation of off-road tracks. Tracks can have significant impacts for flora as gravel patches are especially attractive to off-road enthusiasts. Natural recovery of the vegetation is extremely slow and evidence of off-road driving can remain from over a hundred years in these gravel habitats.

Historically, the Gamsberg has been a popular botanical destination given the habitats and species present at the site. The effect of illegal collecting on plant populations at the site has not been quantified, but it does have the potential to be significant for some species with very restricted populations or high horticultural desirability.

The Gamsberg has been readily accessible and while avoidance of other land uses has benefited the natural habitats and species, illegal hunting and collection of plants may have resulted in some destruction. Implementing controlled access to the Gamsberg provides an opportunity to alleviate these problems and the potential for a positive port-mitigation impact.

Table 9.28 Impact Characteristics: Human influx Impacts on Biodiversity

Summary	Construction	Operation	Decommissioning/ Post Closure
Project Aspect/ activity	Off-road driving, uncontrolled access to natural areas during all phases of the project.		
Impact Type	Indirect Negative.		
Sensitive Receptors Affected	All natural habitats, threatened, endemic and rare succulent species, naturally occurring wildlife.		

Box 9.18 Summary of Impact: Human influx Impacts on Biodiversity

<u>Nature</u>: Construction and operation of the mine will attract increasing numbers of people to the area, which could have an **Indirect Negative** impact on the diversity and functionality of ecological environments. However improved security by the mine and restricted access may lead to a **Positive** impact within the mine concession area.

<u>Sensitivity/Vulnerability/Importance of Resource/Receptor</u>: **Medium.**
<u>Irreplaceability</u>: The impact could result in limited habitat degradation and loss of individual plants or animals, but is **Not Irreplaceable**.

<u>Impact Magnitude</u>: **Small to Medium.**
<u>Extent:</u> The extent of the impact is **Regional**, as the increase in population will extend to Aggeneys, other towns and intermediate areas.
<u>Duration:</u> The expected impact will be **Long term**.
<u>Scale:</u> The impact will result in **Slight** changes to the affected environments.
<u>Frequency:</u> The frequency that the impact may occur would be **Occasional.**
<u>Likelihood</u>: The likelihood of the impact occurring is **Possible**.

IMPACT SIGNIFICANCE (PRE-MITIGATION): **MINOR.**

<u>Degree of Confidence</u>: **Moderate.**

Mitigation Measures

Measures to avoid or reduce at source:

- Grazing of livestock within the mine property and mine controlled areas will be prohibited.

- Implement controlled access to natural areas of the mine property and mine controlled areas. Fencing must be maintained as discussed in Section 9.3.4 with locked gates and no entry signs prominently displayed.

- All forms of off-road driving will be prohibited within the mine property and mine controlled areas. Development of roads and tracks within the natural areas will be minimised but sufficient to allow access to key areas.

Measures to abate at site:

- Occasional patrolling of the mine property and mine controlled areas will be conducted by the mine security to watch for evidence of illegal livestock grazing, encroachment of settlements and vagrants, presence of unauthorised persons and evidence of hunting or plant collecting.

Additional conservation actions:

- Collaboration should be considered between the mine security and Northern Cape Conservation authorities for sharing of skills for patrolling the natural areas of the mine property and mine controlled areas.

Residual Impact

The pre-mitigation significance of the impacts on biodiversity resulting from a human influx has been assessed as MINOR to MODERATE. Mitigation measures are presented to implement and enforce access control and prohibit off-road driving. These measures will improve the current protection of the biodiversity of the Gamsberg, which together with effective implementation of a BMP will change this negative impact into a positive impact of MINOR significance (*Table 9.28*). As mentioned in Section 0, this will contribute towards demonstrating an "on the ground" net gain of biodiversity values as required by the Vedanta Standard for critical habitats.

Table 9.29 Pre- and Post- Mitigation Significance: Human Influx Impacts on Biodiversity

Phase	Significance (Pre-mitigation)	Residual Significance (Post–mitigation)
Construction	MODERATE (-ve)	MINOR (-ve)
Operation	MINOR (-ve)	MINOR (+ve)
Decommissioning and Post Closure	MINOR (-ve)	MINOR (+ve)

9.4 SUMMARY OF BIODIVERSITY IMPACTS

9.4.1 Cumulative Impacts on Biodiversity

The loss and degradation of habitats resulting from the mine footprint, dust deposition and groundwater drawdown have a cumulative effect on selected habitats as presented in *Table 9.12*. Additional biodiversity-related impacts may occur through surface water impacts (flow, pollution), a groundwater pollution plume and acrid rock drainage effects. Of particular concern is the irreplaceable Headwater Seep and Kloof habitat that are located within the footprint of the mine. Dust emissions and close to the lowest groundwater drawdown areas will affect the remainder of these two habitats as well as other irreplaceable habitats on the site. This cumulative impact is thus expected to result in a severe loss of habitat and ecosystem function within the mine site.

Cumulative impacts on the biodiversity beyond the borders of the Project area could occur from habitat fragmentation. BMM have an existing mine in the adjacent concession where habitat loss and fragmentation effects will similarly interrupt the movement of species. The influx of people to the area will increase as a result of both mining operations and similarly represents a cumulative impact.

Renewable energy projects, current (and possibly increased) livestock grazing in the area and the broad effects of climate change will contribute cumulative impacts on the high biodiversity of the Bushmanland Inselberg Region and the greater biome.

9.4.2 *Residual Negative Impacts and Potential for Offsets*

Ecologically sustainable development is enshrined in South Africa's Constitution and laws. The need to conserve biodiversity is directly or indirectly referred to in a number of Acts, not least the NEMA, which is fundamental to the notion of sustainable development. The Act requires that impacts on biodiversity and ecological integrity are avoided, and if they cannot altogether be avoided, are minimised and remedied.

All currently available guidelines within South Africa (1) (2) (3) as well at the IFC Performance Standard 6 emphasise that biodiversity offsets represent a last resort in the mitigation hierarchy and are an option to be pursued only when significant residual impacts on biodiversity remain after all other options (ie avoidance, minimisation and rehabilitation) have been thoroughly explored.

Biodiversity offsets are applicable where the residual impacts on biodiversity are assessed by a competent specialist to be of moderate to high significance, but are not usually applied to situations with a residual impact of low significance. The biodiversity loss cannot be offset where the residual impact is assessed as very high. (4)

An overview of the residual impacts on biodiversity is presented in *Table 9.29*. Three impacts are identified where a biodiversity offset would be appropriate

(1) Western Cape Guidelines (2011).
(2) Draft KZN Guidelines (2009).
(3) SAMBF (2012).
(4) Western Cape Guidelines (2011).

through a like-for-like based approach. Only two impacts can be adequately mitigated to a level that offsetting is not required.

The combination of impacts leading to habitat loss cannot be adequately mitigated, and remain with high residual impacts; ie impacts from the mine footprint, dust and groundwater drawdown. Uncertainties exist around the significance of the dust impacts. A conservative approach has been followed in the assessment of that impact, and an adaptive management style will need to be adopted.

Table 9.30 Overview of the Pre-mitigation and Residual Significance of Impacts on Biodiversity of the Gamsberg

Impact on Biodiversity	Pre-mitigation Significance	Residual Significance	Offset required
Habitat loss caused by the mine footprint.	**MAJOR(-ve)**	**MODERATE (-ve) to MAJOR (-ve)**	Yes
Habitat degradation from dust deposition (Low confidence).	**MAJOR (-ve) (high uncertainty)**	**MAJOR (-ve) (high uncertainty)**	Yes
Habitat degradation from groundwater drawdown.	**MAJOR (-ve)**	**MAJOR (-ve)**	Yes
Habitat fragmentation.	**MAJOR (-ve)**	**MODERATE (-ve)**	Yes
Loss of species diversity.	**MAJOR (-ve)**	**MODERATE (-ve)**	Yes
Encroachment of alien species.	**MODERATE (-ve)**	**NEGLIGIBLE (-ve)**	No
Human influx impacts on biodiversity.	**MINOR (-ve)**	**MINOR (+ve)**	No

Options for offsetting of these impacts need to be explored, however the impacts involve some loss of irreplaceable habitat. It is not possible to offset impacts on biodiversity that are of 'very high' significance; the loss of 'irreplaceable' biodiversity generally implies that impacts would not be 'offsetable' since no measure could effectively compensate that loss. The only option in this case is to provide an alternative form of compensation or positive contribution to conservation (as opposed to an offset). Opportunities for offsetting are available, are discussed in *Section 13*. The practicalities of acquiring land in South Africa require that predefined farms are purchased and non-target land is thus likely to be included. Opportunities for non-target land to accommodate the uncertain "dust offset" should be explored. The full extent of the dust offset may not be required based on the outcomes of monitoring programmes, but would only be apparent after the mine operational phase is established. Offsetting options will need to be finalised prior to establishment of the mine, however offsetting of the dust impacts should be considered necessary until the uncertainty is removed.

The dust impacts result in degradation of habitats and not necessarily total loss of habitat. The estimated extent of the loss of sensitive habitats is presented in *Table 9.30*.

Table 9.31 Estimation of Areas of Habitat Loss and Degradation

Habitat Sensitivity	**Extent of Habitat Loss / degradation (ha)**
Irreplaceable (critical) habitat.	1 186
Constrained (natural) habitat.	1 044
Flexible (natural) habitat.	4 627
TOTAL AREA (ha)	**6 857**

It is not possible to compensate the loss of some habitats as they're irreplaceable and there is insufficient remaining 'like' habitat to provide compensation that would prevent undermining of conservation targets.

The impact of habitat fragmentation can also only be partially offset as this impact relates to disruption of a regional biodiversity corridor that cannot be precisely quantified or ascribed to the discrete management unit of the Gamsberg Mine. The impact could only be quantified in terms of dimensions of that corridor in current systematic conservation plans, and alleviated through seeking a substitute corridor incorporating remaining inselbergs that could be protected in perpetuity.

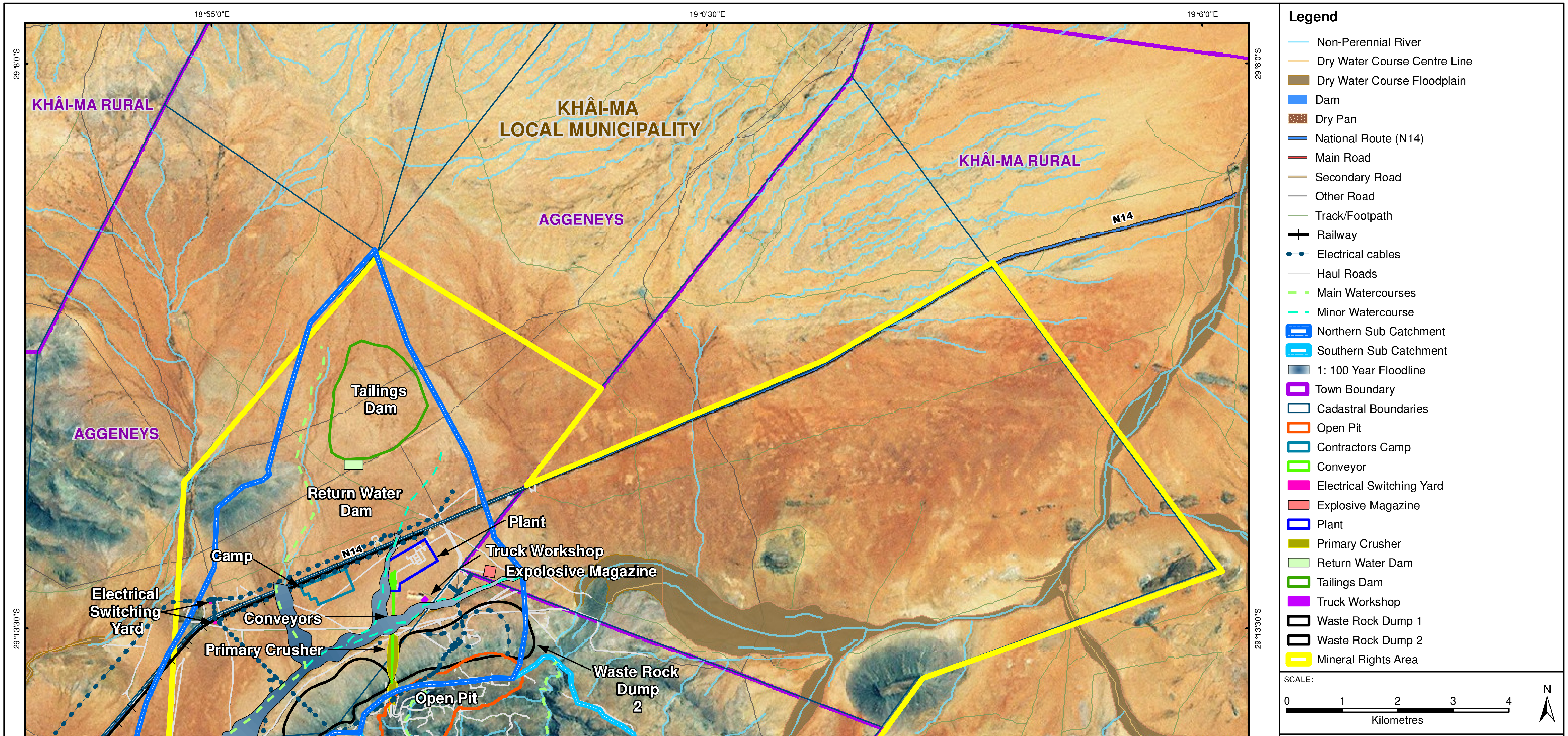
As mentioned above, an offset is accepted as a last resort mitigation measure, and therefore does not alleviate the necessity of applying previously mentioned mitigation measures to avoid, minimise or rehabilitate impacts within the Gamsberg and neighbouring areas.

9.5 IMPACT ON SURFACE HYDROLOGY

This section provides a description of the potential impacts the Project may have on surface water hydrology. The key receptors or resources considered are all affected sub-catchments and watercourses.

9.5.1 *Removal and Alteration of Natural Water Courses*

Figure 9.10 illustrates the Project layout in relation to sub-catchment boundaries, project infrastructure, on-site watercourses and associated floodlines.



TITLE:

Figure 9.10: Proposed Project layout in relation to sub-catchment boundaries, project infrastructure and watercourses and associated floodlines

CLIENT:

vedanta

BLACK MOUNTAIN MINING (PTY) LTD

DATE: Apr 2013	CHECKED: MP	PROJECT: 0164903
DRAWN: AB	APPROVED: SHC	SCALE: 1 : 70 000

DRAWING:	REV:
Hydrology.mxd	0

ERM
Great Westerford Building
240 Main Road
Rondebosch, 7725
Cape Town, SOUTH AFRICA
Tel: +27 21 681 5400
Fax +27 21 686 073
ERM

	SIZE:
Projection: Transverse Mecator, CM19. Datum : WGS84 Source: Chief Directorate National Geo-Spatial Information. Black Mountain Mining (Pty) LTD Inset Map: Esri Data & Maps	A3

T:\Gis Projects\0164903_Gamsberg\Mapping\MXD\Report\April2013\Hydrology.mxd

The section below provides an assessment of the extent to which natural river courses within the Project area will need to be altered or removed as a result of the construction of project infrastructure and facilities.

Table 9.32 Impact Characteristics: Impact of the Removal and Alteration of Natural Water Courses on Catchment Response

Summary	Construction	Operation	Decommissioning/ Post Closure
Project Aspect/ activity	Construction of the following infrastructure and/or facilities: • The open pit; • The explosives magazine; • The process plant; and • The truck workshop.	N/A	N/A
Impact Type	Direct.	N/A	N/A
Stakeholders/ Receptors Affected	Affected ephemeral river courses. Downstream users. Fauna and flora that use the affected water courses. Groundwater.	N/A	N/A

Construction Phase Impacts

As the proposed layout of the open pit covers a significant portion of the southern catchment, it is inevitable that certain existing water courses that collect and convey surface water runoff from the western section of this catchment would be removed or altered. In this regard, certain of the minor water courses in this sub-catchment would be permanently removed by the development of the open pit, while the longest collector, which governs catchment response, would be curtailed (refer to *Figure 9.10*). Despite this, the circular shape of this catchment, its mountainous character and the number of ephemeral watercourses present, means that the construction of the pit is only expected to result in a marginal change over time to its concentration and other catchment characteristics. In this regard, a comparison between baseline and post-development catchment characteristics demonstrates that the post-mitigation hydrological response of the southern catchment is similar to that of the baseline scenario (refer to *Table 9.32*). As such, the anticipated decrease in time of concentration is expected to be negligible.

Table 9.33 A comparison Between Baseline and Projected Post-development Catchment Characteristics

Sub-Catchment	A_e (km²)	L (km)	L_C (km)	S_L (m/m)	S_A (m/m)	T_C (h)	T_L (h)
Baseline catchment characteristics							
North	38.7	11.0	6.5	0.0075	0.0155	4.6	2.1
South	13.1	6.4	3.1	0.0198	0.1172	1.8	1.1
Post-development catchment characteristics							
North	35.4	11.0	6.5	0.0075	0.0155	4.6	2.1
South	9.0	5.3	2.8	0.0236	0.1172	1.7	1.0

Notwithstanding the above, the proposed explosives magazine, which covers a large area on the north-eastern plateau of the inselberg, would also affect several minor watercourses in the southern catchment. With respect to this, the proposed footprint of this facility measures roughly 320 m² and transects three watercourses. However, it is predicted that these watercourses could be maintained in their current location if suitable culverts are installed. In this regard, the culverts would convey surface water beneath the explosives magazine along its natural routes.

Finally, ephemeral watercourses in the northern catchment area would not require removal or alteration; however the proposed location for the processing plant and the truck workshop (the plain to the north of the inselberg) protrudes into the 100 year floodplain. These facilities will need to be reconfigured or relocated such that they fall outside of the floodplain.

Impact Assessment and Description

The construction of the above mentioned facilities and infrastructure will have a **direct negative** impact on affected natural water courses. The impact will be **irreplaceable**, as some of the minor water courses will be removed permanently. The extent of the impact is **on-site**, as only drainage lines within the Project area will be impacted upon. The expected impact will be **permanent** (ie irreversible) and will result in **notable** changes to the receptor (ie affected ephemeral river courses.). In light of this assessment, the significance of this impact is considered to be **Moderate** during the construction phase of the Project. Furthermore, the degree of confidence in this assessment is **High**.

Box 9.19 Summary of Construction Impact: Impact of the Removal and Alteration of Natural Water Courses on Catchment Response

Nature: The construction of the above mentioned facilities and infrastructure will have a **direct negative** impact on affected natural water courses.

Sensitivity/Vulnerability/Importance of Resource/Receptor: **Low.**
Irreplaceability: The impact will be **irreplaceable**, as some of the minor water courses will be removed permanently.

Impact Magnitude: **Medium.**
Extent: The extent of the impact is **on-site**, as only rivers within the Project area will be impacted upon.
Duration: The expected impact will be **permanent** (ie irreversible).
Scale: The impact will result in **notable** changes to the receptor (ie affected ephemeral river courses.)
Frequency: The frequency of the impact will be **once-off.**
Likelihood: The likelihood of the impact occurring is **definite**.

IMPACT SIGNIFICANCE (PRE-MITIGATION): **MODERATE.**

Degree of Confidence: The degree of confidence is **high**.

Construction Phase Mitigation

- The compromise setback line, as discussed in *Section 4.6.4* will be implemented to limit impacts to the western catchment area of the kloof.

- The explosives magazine on the eastern plateau will be repositioned away from the existing natural watercourses, east of the plant on the plains.

- A detailed stormwater management plan will be produced at preliminary design stage to ensure hydraulic performance and environmental functionality.

- Revised flood levels and flood lines should be calculated for all main water courses, both natural and man-made, once the layout of the Project has been finalised. This information would be used to determine floodplain boundaries and define ecological buffer zones.

Operational Phase Impacts

No new infrastructure will be constructed during the operation phase of the Project. As such, the removal and alteration of natural water courses is not expected. No further assessment is thus required.

Operational Phase Mitigation

The water quality of drainage lines and the proposed canals should be monitored on a monthly basis as described in the operational management plan.

Decommissioning and Post Closure Phase Impacts

No new infrastructure will be constructed after the operation phase of the proposed Project. As such, the removal and alteration of natural water courses is not expected. No further assessment is thus required.

Decommissioning and Post Closure Phase Mitigation

The water quality of drainage lines and the proposed canals should be monitored on a regular basis.

Residual Impact

With the implementation of the above mitigation, impact intensity and magnitude will be reduced in the southern catchment during the construction phase. The impact significance would accordingly reduce to **MINOR**. The degree of confidence in this assessment is **HIGH**.

Table 9.34 Pre- and Post- Mitigation Significance: Removal and Alteration of Natural Water Courses

Phase	**Significance (Pre-mitigation)**	**Residual Significance (Post–mitigation)**
Construction	**MODERATE (-ve)**	**MINOR (-ve)**
Operation	**N/A**	**N/A**
Decommissioning and Post Closure	**N/A**	**N/A**

9.5.2 Impact of Reduced Peak Runoff and Discharge Volumes on Water Courses

This section assesses the extent to which post-development peak runoff flows and discharge volumes will be altered as a result of the Project.

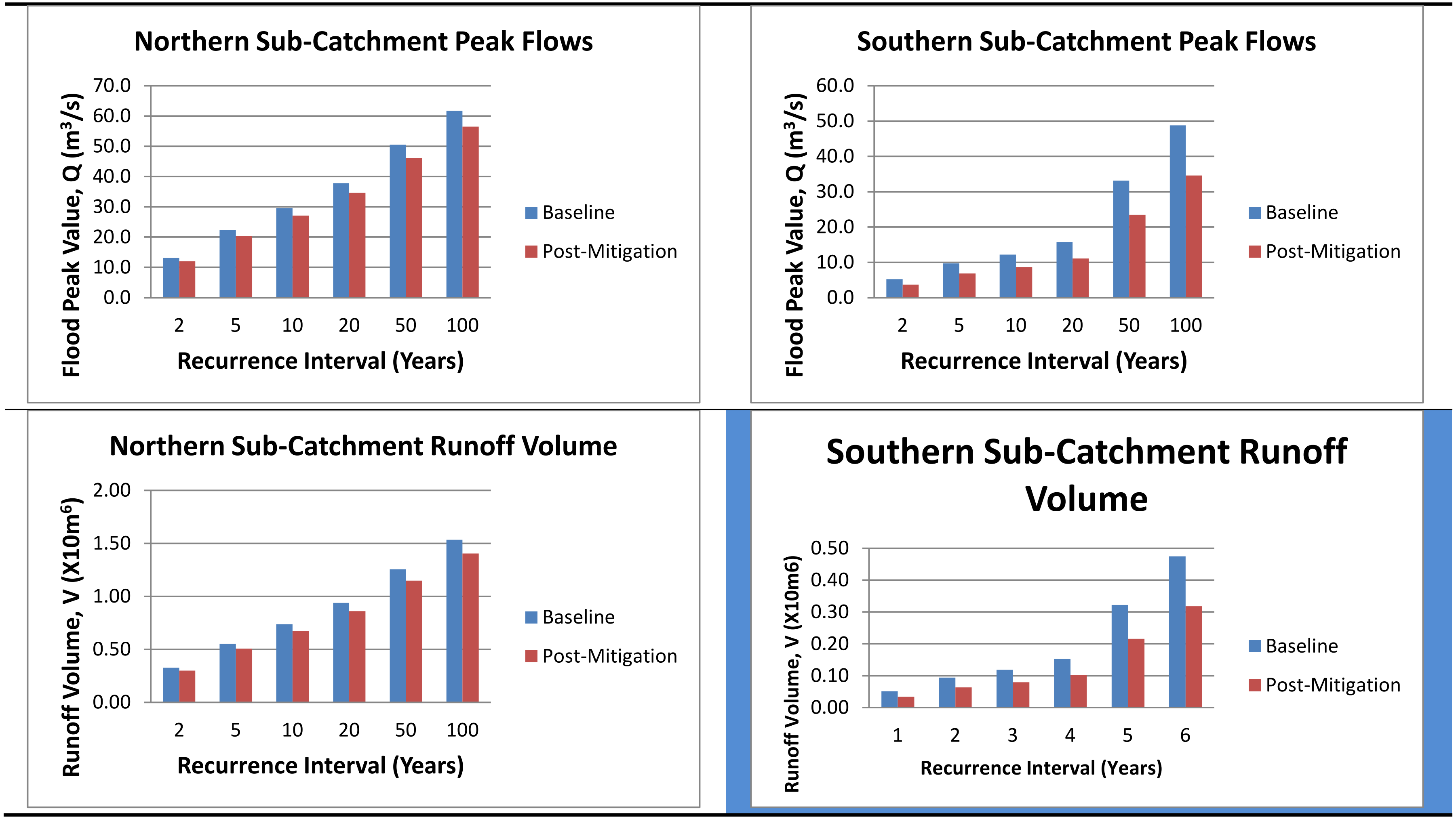
Table 9.35 Impact Characteristics: Impact of Reduced Peak Runoff and Discharge Volumes on Water Courses

Summary	**Construction**	**Operation**	**Decommissioning/ Post Closure**
Project Aspect/ activity	Project facilities and infrastructure that capture rainfall (ie dams).	Project facilities and infrastructure that capture rainfall (ie dams).	Project facilities and infrastructure that capture rainfall (ie dams).
Impact Type	Direct.	Direct.	Direct.
Stakeholders/ Receptors Affected	Adjacent landowners. Fauna and flora in close proximity to the Project site. Groundwater.	Adjacent landowners. Fauna and flora in close proximity to the Project site. Groundwater.	Adjacent landowners. Fauna and flora in close proximity to the Project site. Groundwater.

Construction, Operation and Decommissioning Phase Impacts

The Project will require the excavation of a large open pit and the construction of a tailings dam, pollution control dams, process plant and other ancillary infrastructure. Being classified as 'dirty' areas, rain falling onto this infrastructure will be captured and contained. Consequently, the quantum of surface water runoff would reduce. Post-development storm peak flows and volumes have been calculated and compared to baseline values, as can be seen in *Table 9.35* below. Here it is evident that post-development storm peak flows and volumes have reduced in relation to existing baseline values. Furthermore, it is clear that the northern sub-catchment is not as severely impacted than the southern sub-catchment, and a comparison between the baseline and post-mitigation values reveal an average net decrease of roughly 8.5% in both peak flow and volume. The expected decrease in peak flow and volume is approximately 30% for the southern sub-catchment.

Table 9.36 Comparison Between Baseline and Post Development Storm Peak Flows and Volumes



Impact Assessment and Description

In summary, the calculated reduction in peak runoff and discharge volumes is viewed as a **direct positive** impact as the risk of damage to downstream communities, property, operations or infrastructure would be reduced. However, it is important to note that the concomitant reduction in mean annual runoff (MAR), is considered a **direct negative** impact and is presented in *Section 9.5.3* below.

The impact will be **irreplaceable**, as some of the minor water courses will be removed permanently. The extent of the impact is **local**, as the impact may extend just beyond the site boundaries. The expected impact will be **permanent** (ie irreversible) and will result in **notable** changes to the receptor (ie adjacent landowners). In light of this assessment, the significance of this impact therefore considered to be **Moderate** during all phases of the Project. The degree of confidence in this assessment is **Medium**.

Box 9.20 Summary of Operation Impact: Impact of Reduced peak Runoff and Discharge Volumes

Nature: The calculated reduction in peak runoff and discharge volumes is viewed as a **direct positive** impact as the risk of damage to downstream communities, property, operations or infrastructure would be reduced.

Sensitivity/Vulnerability/Importance of Resource/Receptor: **Low.**
Irreplaceability: The impact would result in an **irreplaceable** loss of surface water resources.

Impact Magnitude: **Medium.**
Extent: The extent of the impact is **local**.
Duration: The expected impact will be **permanent** (ie irreversible).
Scale: The impact will result in **notable** changes to the receptor (ie adjacent landowners).
Frequency: The frequency of the impact will be **once-off.**
Likelihood: It is **likely** that the impact will occur.

IMPACT SIGNIFICANCE (PRE-MITIGATION): **MODERATE.**

Degree of Confidence: The degree of confidence is **medium**.

Construction, Operation and Decommissioning Phase Mitigation

No mitigating measures proposed.

Residual Impact

It is unlikely that the ineffective areas giving rise to the reduction in flood peaks would be removed in the closure phase. Consequently, the residual impact is **MODERATE**. The degree of confidence in this assessment is **MEDIUM**.

Table 9.37 Pre- and Post- Mitigation Significance: Impact of Reduced Peak Runoff and Discharge Volumes on Water Courses

Phase	Significance (Pre-mitigation)	Residual Significance (Post–mitigation)
Construction	MODERATE (+ve)	MODERATE (+ve)
Operation	MODERATE (+ve)	MODERATE (+ve)
Decommissioning and Post Closure	MODERATE (+ve)	MODERATE (+ve)

9.5.3 Impact of Reduction in Mean Annual Runoff

This section assesses the extent to which the Project is expected to result in the reduction of mean annual runoff (MAR).

Table 9.38 Impact Characteristics: Impact of Reduction In mean Annual Runoff (MAR)

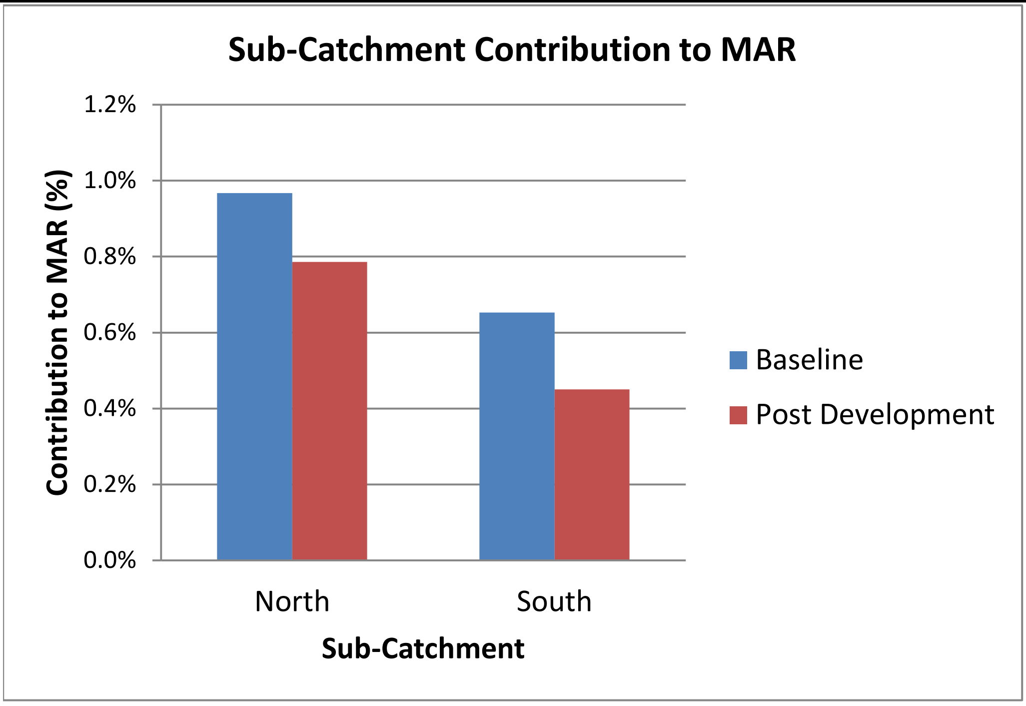
Summary	Construction	Operation	Decommissioning/ Post Closure
Project Aspect/ activity	Project facilities and infrastructure that capture rainfall (ie dams).	Project facilities and infrastructure that capture rainfall (ie dams).	Project facilities and infrastructure that capture rainfall (ie dams).
Impact Type	Direct.	Direct.	Direct.
Stakeholders/ Receptors Affected	Ephemeral ecosystems within the affected quaternary catchment.	Ephemeral ecosystems within the affected quaternary catchment.	Ephemeral ecosystems within the affected quaternary catchment.

Construction, Operation and Decommissioning Phase Impacts

As discussed in the previous section, the Project will require the excavation of a large open pit and the construction of a tailings dam, pollution control dams, process plant and other ancillary infrastructure. Being classified as 'dirty' areas, rain falling onto this infrastructure will be captured and contained. Consequently, the quantum of surface water runoff will be reduced. Whereas the resultant reduction in peak runoff and discharge volumes, which corresponds to large storm events, is seen as a positive impact (refer to section above), the resultant reduction in marginal annual runoff (MAR) is instead considered as a negative impact. The reason for this apparent contradiction is that smaller storm events generally have a natural, restorative function in ephemeral ecosystems. While large storm events, can often be more destructive in nature.

The total reduction in MAR can either be viewed in terms of the greater quaternary catchment or assessed at the local sub-catchment level. In this regard the resultant MAR reduction in the quaternary catchment is predicted at approximately 0.2% (refer to *Box 9.22*), which is considered to be negligible. However, at the sub-catchment level future MAR is expected to reduce by 8% in the case of the northern sub-catchment, and 31% for the southern sub-catchment (refer to *Table 9.38*). The latter represents the sensitive Inselberg kloof.

Box 9.21 Comparison between Baseline and Post-Development Contribution to MAR



Post-development MAR would be 4,050 m³ per annum if surface runoff from the north-western ridge is allowed to enter the pit. This quantity of surface water would exit via the kloof. This implies that an estimated 1,820 m³ of surface water would enter the pit annually. Should surface runoff from the north-western ridge be diverted away from the pit towards the kloof, the post-development MAR leaving the Inselberg catchment via the kloof would be approximately 4,520 m³ per annum. This would represent a 23% reduction in sub-catchment MAR, but only a 0.2% reduction in quaternary catchment MAR. Surface water entering the pit annually would amount to roughly 1,350 m³.

Technically it would be very difficult to divert surface water runoff from the north-western ridge towards the kloof without causing extensive ecological damage to that part of the sub-catchment. This risk of damage would negate any benefits this intervention may hope to achieve. Accordingly, it would be preferable for this small area to be allowed to enter the pit. The above findings verify that there certainly would be no noticeable impact on the larger quaternary catchment. Similarly, the local impact on the kloof would be only marginally worse (ie 31% reduction in MAR as opposed to 23%).

Table 9.39 Anticipated Post-Development Reduction in MAR

Sub-Catchment	Post-Development Sub-Catchment MAR (X10³ m³)	Reduction in Sub-Catchment MAR (%)	Sub-Catchment Contribution to MAR (%)
North	7.09	8%	0.2%
South	4.05	31%	0.2%

The 31% calculated reduction of MAR in the southern sub-catchment will cause irreversible change to the Inselberg kloof, as aquatic biota and reliant flora will receive less than three quarters of their current allotment of surface water flow.

Impact Assessment and Description

The calculated reduction in MAR is viewed as having a **direct negative** impact particularly on affected ephemeral ecosystems. The impact will be **irreplaceable**, as it is unlikely that the ineffective areas giving rise to the reduction in MAR would be removed in the closure phase. The extent of the impact is **local**, as the impact may extend just beyond the site boundaries. The expected impact will be **permanent** (ie irreversible) and will result in **notable** changes to the receptor. In light of this assessment, the significance of this impact therefore considered to be **MODERATE** during all phases of the Project. The degree of confidence in this assessment is **High**.

Box 9.22 Summary of Operation Impact: Impact of reduction in mean annual runoff (MAR)

Nature: The calculated reduction in MAR is viewed as having a **direct negative** impact on affected ephemeral ecosystems within the inselberg kloof area.

Sensitivity/Vulnerability/Importance of Resource/Receptor: **Medium.**
Irreplaceability: The impact would result in an **irreplaceable** loss of surfacewater resources.

Impact Magnitude: **Medium.**
Extent: The extent of the impact is **local**.
Duration: The expected impact will be **permanent** (ie irreversible).
Scale: The impact will result in **notable** changes to the receptor (ie ephemeral ecosystems within the inselberg kloof area).
Frequency: The frequency of the impact will be **periodic.**
Likelihood: The likelihood of the impact occurring is **definite**.

IMPACT SIGNIFICANCE (PRE-MITIGATION): **MODERATE.**

Degree of Confidence: The degree of confidence is **High**.

Construction, Operation and Decommissioning Phase Mitigation

It is not viable to relocated the pit although the incorporation of a setback line reducing the extent of the pit has been accepted as a project adaptation, which may reduce this impact.
An alternative suggestion could be to supply piped fresh water of similar quantity and quality to the kloof watercourse. This water would replace the lost MAR and provide artificial replenishment. However, groundwater investigations indicate that these features depend on baseflow seepage from groundwater and artificial replenishment would not replace the groundwater resource.

Residual Impact

The implementation of the setback line would reduce the impact on MAR. Accordingly, the impact significance on local downstream water resources could be classified as **MINOR** during the all phases of the Project. The degree of confidence in this assessment is **HIGH**.

Table 9.40 Pre- and Post- Mitigation Significance: Impact of Reduction in Mean Annual Runoff

Phase	Significance (Pre-mitigation)	Residual Significance (Post–mitigation)
Construction	MODERATE (-ve)	MINOR (-ve)
Operation	MODERATE (-ve)	MINOR (-ve)
Decommissioning and Post Closure	MODERATE (-ve)	MINOR (-ve)

9.5.4 Impact of Increased Sediment Yield on Surface Water Quality

This section assesses the extent to which Project activities are expected to result in increased sediment yield and the impact that this may have on affected receptors (ie ephemeral rivers within the Project site).

Table 9.41 Impact Characteristics: Impact of Increased Sediment Yield on Surface Water Quality

Summary	Construction	Operation	Decommissioning/ Post Closure
Project Aspect/ activity	Removal of vegetation and the stripping of topsoil.	The use of haul roads, and general operation activities such as blasting, loading and hauling.	Removal of vegetation and the stripping of topsoil.
Impact Type	Direct.	Direct.	Direct.
Stakeholders/ Receptors Affected	Local soils. Local fauna and flora habitats. Ephemeral ecosystems within the affected quaternary catchment.	Local soils. Local fauna and flora habitats. Ephemeral ecosystems within the affected quaternary catchment.	Local soils. Local fauna and flora habitats. Ephemeral ecosystems within the affected quaternary catchment.

Construction, Operation and Decommissioning Phase Impacts

Given the erosion potential of the local soils, it is likely that the construction and operational phases of the proposed development would cause an increase in erosion. Thus an increase in sediment deposition could be expected along slow moving water courses. In order to limit the environmental impact on faunal and floral communities, it is essential that sediment yield be reduced as far as is possible.

Notwithstanding the arid, sparsely planted terrain, the proposed mine infrastructure would require removal of vegetation and the stripping of topsoil. This would increase the erosion potential of the sub-catchments and subsequently result in increased sediment deposition in water courses. Furthermore, the construction of haul roads, and general mining activities such as blasting, loading and hauling would increase the quantity of airborne dust. This dust would settle on the ground surface where it would present an additional source of sediment during rain events.

Impact Assessment and Description

The calculated increase in sediment yield is expected to have a **direct negative** impact on the water quality of nearby surface water bodies. The extent of the impact is **local**, as it is expected to extend just beyond the boundaries of the Project site. The expected impact will be **long-term** as it will last for the entire Project lifespan (ie Life of Mine is expected to be approximately 20 years). The impact will result in **notable changes** to the receptor (ie ephemeral ecosystems). The frequency of the impact will be **periodic**. In light of this assessment, the significance of this impact therefore considered to be **MODERATE** during all phases of the Project. The degree of confidence in this assessment is **High**.

Box 9.23 Summary of Operation Impact: Impact of Increased Sediment Yield on Surface Water Quality

Nature: The calculated increase in sediment yield is expected to have a **direct negative** impact on the water quality of nearby surface water bodies.

Sensitivity/Vulnerability/Importance of Resource/Receptor: **Medium.**
Irreplaceability: The impact will not result in loss of an **irreplaceable** resource.

Impact Magnitude: **Medium.**
Extent: The extent of the impact is **local,** as it is expected to extend just beyond the boundaries of the Project site.
Duration: The expected impact will be **long-term** as it will last for the entire Project (ie Life of Mine is expected to be approximately 20 years).
Scale: The impact will result in **notable** changes to the receptor.
Frequency: The frequency of the impact will be **periodic.**
Likelihood: The likelihood of the impact occurring is **definite**.

IMPACT SIGNIFICANCE (PRE-MITIGATION): **MODERATE.**

Degree of Confidence: The degree of confidence is **High**.

Construction, Operation and Decommissioning Phase Mitigation

- Pollution control dams should be constructed to contain surface water runoff from all dirty areas, such as waste rock stockpiles. Dirty runoff should be directed towards these dams though a well-designed system of berms and channels. The dams should be designed to accommodate and retain transported sediment. It is therefore important that dams are designed to have adequate dead storage volume.

- The runoff from bare areas, such as haul roads, would need to be collected and conveyed by adequate side drains. This water, which would be high in TSS content, should be attenuated and retained sufficiently to allow sediment to settle prior to the discharge of the sufficiently clean supernatant.

- Dust mitigation should be implemented in accordance with the air quality impact assessment forming part of this ESIA.

- The quality of runoff in watercourses should be monitored on a regular basis depending on flow and corrective actions taken as appropriate.

- During the decommissioning phase, all unnecessary bare surfaces and developed zones should be removed and, as far as is possible, restored to their natural state.

Residual Impact

Should the above mitigation measure be accepted, the anticipated decrease in water quality attributable to increased sediment load could be greatly reduced. Accordingly, the impact significance on local downstream water resources could be classified as **MINOR** during the all phases of the project. The degree of confidence in this assessment is **HIGH**.

Table 9.42 Pre- and Post- Mitigation Significance: Impact of Reduction in Mean Annual Runoff

Phase	Significance (Pre-mitigation)	Residual Significance (Post–mitigation)
Construction	**MODERATE (-ve)**	**MINOR (-ve)**
Operation	**MODERATE (-ve)**	**MINOR (-ve)**
Decommissioning and Post Closure	**MODERATE (-ve)**	**MINOR (-ve)**

9.5.5 Impact of Increased Pollutant Load on Surface Water Quality

This section assesses the impact associated with the expected increase in pollutant load on surface water resources as a direct result of activities undertaken during all phases of the Project.

Table 9.43 Impact Characteristics: Impact of Increased Pollutant Load on Surface Water Quality

Summary	Construction	Operation	Decommissioning/ Post Closure

Summary	Construction	Operation	Decommissioning/ Post Closure
Project Aspect/ activity	The construction of a Waste Water Treatment Works (WWTW). Construction of mining infrastructure and facilities. Accidental spillages.	Operation of the Waste Water Treatment Works (WWTW). Operation of mining infrastructure and facilities. Accidental spillages.	Mining infrastructure. Accidental spillages.
Impact Type	Direct.	Direct.	Direct
Stakeholders/ Receptors Affected	Local fauna and flora habitats. Ephemeral ecosystems within the affected quaternary catchment.	Local fauna and flora habitats. Ephemeral ecosystems within the affected quaternary catchment.	Local fauna and flora habitats. Ephemeral ecosystems within the affected quaternary catchment.

Construction, Operation and Decommissioning Phase Impacts

The proposed construction of a Waste Water Treatment Works (WWTW) would inevitably increase the risk of surface water resources being contaminated by untreated sewerage. This contamination could be caused by insufficient maintenance of the WWTW, or as a consequence of blocked sewer mains or manholes. Furthermore, raw sewerage spillages could occur in the event of power outages affecting foul sewer pump stations or the WWTW.

By their very nature, metallurgical processes are dirty and a major source of pollutants. Whilst the proposed mining infrastructure has been classified as either "clean" or "dirty," it is imperative that surface water runoff from the dirty areas we captured and adequately treated. Wherever possible, treated water should be reused in the mining process.

Hydrocarbons, such as oils and petroleum fuels, represent a threat to surface water quality. As such, the potential impact of accidental spillages should be assessed and mitigated.

Impact Assessment and Description

The calculated increase in pollutant load is expected to have a **direct negative** impact on the water quality of nearby surface water bodies. The extent of the impact is **local,** as it is expected to extend just beyond the boundaries of the Project site. The expected impact will be **long-term** as it will last for the entire Project (ie Life of Mine is expected to be approximately 20 years). The impact will result in **notable** changes to the receptor. The frequency of the impact will be **periodic**. In light of this assessment, the significance of this impact therefore considered to be **MODERATE** during all phases of the Project. The degree of confidence in this assessment is **High**.

Box 9.24 *Summary of Operation Impact: Impact of Increased Pollutant Load on Surface Water Quality*

Nature: The calculated increase in pollutant load is expected to have a **direct negative** impact on the water quality of nearby surface water bodies.

Sensitivity/Vulnerability/Importance of Resource/Receptor: **Medium.**
Irreplaceability: The impact will not result in loss of an **irreplaceable** resource.

Impact Magnitude: **Medium.**
Extent: The extent of the impact is **local,** as it is expected to extend just beyond the boundaries of the Project site.
Duration: The expected impact will be **long-term** as it will last for the entire Project (ie Life of Mine is expected to be approximately 20 years).
Scale: The impact will result in **notable** changes to the receptor (ie ephemeral ecosystems within the inselberg kloof area).
Frequency: The frequency of the impact will be **periodic.**
Likelihood: The likelihood of the impact occurring is **definite**.

IMPACT SIGNIFICANCE (PRE-MITIGATION): **MODERATE.**

Degree of Confidence: The degree of confidence is **High**.

Construction, Operation and Decommissioning Phase Mitigation

- A thorough, regular inspection and maintenance regime should be implemented by the operator of the proposed Waste Water Treatment Works (WWTW).

- Pump stations should be inspected, serviced and cleaned on a monthly basis, and manholes and underground pipes inspected and cleaned every six months.

- The WWTW and all sewer pump stations should be equipped with emergency generators, or adequate emergency storage. Typically, four hours' storage should suffice.

- An emergency response unit should be established to undertake urgent maintenance and repair work after hours.

- It is imperative that surface water runoff from the dirty areas (*eg* process plant, waste rock stockpiles, tailings dam) be captured and wherever possible, reused in the mining process. Pollution control dams should be deployed as indicated on Figure 3. Dirty runoff should be directed towards these dams though a well-designed system of berms and channels.

- Dirty water not used in the mining process should be adequately treated prior to release. Treatment should be undertaken in the prescribed manner, as detailed in the Operational Management Plan.

- All areas where hydrocarbons, such as oils and petroleum fuels are handled (*ie* workshops should be bunded and strictly controlled to minimise the risk of accidental spillages.

- The quality of runoff into watercourses should be monitored on a monthly basis when water is present and corrective actions taken as appropriate. Baseline water quality is described in Section 3.8 of this report.

Residual Impact

Should the above mitigation measure be accepted, the anticipated decrease in water quality attributable to increased pollutant load could be greatly reduced. Accordingly, the impact significance on local downstream water resources could be classified as **MINOR** during the all phases of the project. The degree of confidence in this assessment is **HIGH**.

Table 9.44 Pre- and Post- Mitigation Significance: Impact of Increased Pollutant Load on Surface Water Quality

Phase	Significance (Pre-mitigation)	Residual Significance (Post–mitigation)
Construction	**MODERATE (-ve)**	**MINOR (-ve)**
Operation	**MODERATE (-ve)**	**MINOR (-ve)**
Decommissioning and Post Closure	**MODERATE (-ve)**	**MINOR (-ve)**

9.6 NOISE AND VIBRATION IMPACTS

This section describes the predicted noise and vibration impacts associated with the Project determined through noise modelling. The main impacts associated with the Project include noise and vibration levels around the processing plant site, the mining pit (including blasting), the relevant overburden dumping as well as generation of additional road traffic due to the workers and processed zinc transportation to Loop 10.

Impact Assessment

The noise and vibration modelling indicated that noise levels above the daytime rural guideline level (45 dB(A)) and the night-time level (35 dB(A)) are well inside the site boundaries. This is attributed primarily to the fact that the plant and the mining pit are located at least 3 km from the site boundary, as well as the ground formation around the pit. The expected noise level increase anticipated above the rural district guideline of 45 dB(A) for daytime and 35 dB(A) for night-time can be seen in *Figure 9.11* and *Figure 9.12* respectively.

Figure 9.11 Noise Level Differences of the Project Minus Existing Day-time

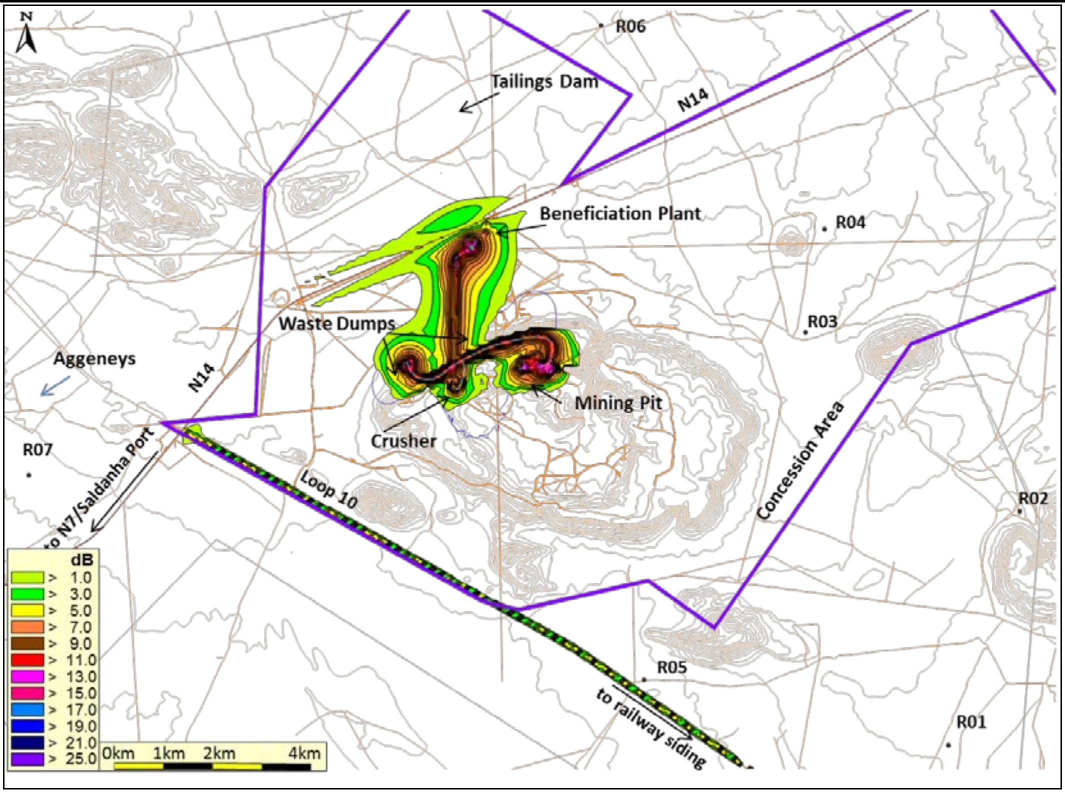
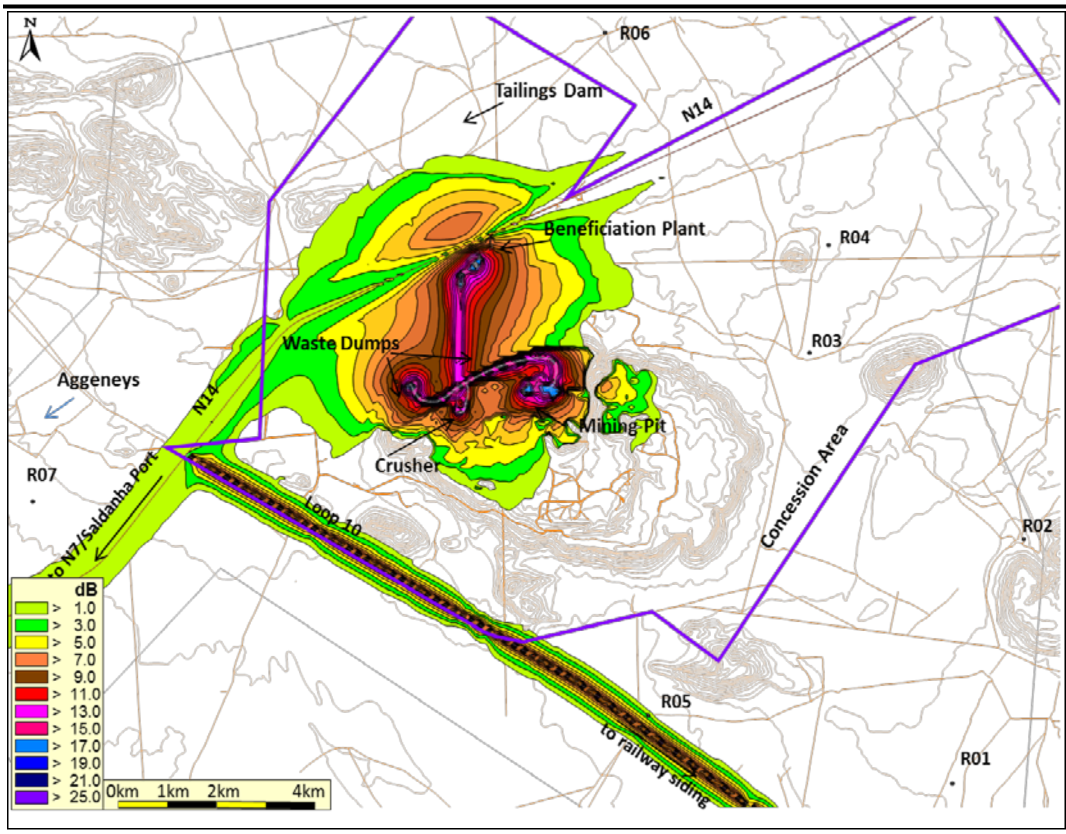


Figure 9.12 Noise Level Differences of the Project Minus Existing Night-time



During daytime the expected 3 dB(A) increase above the 45 dB(A) level will not reach any of the mine licence area boundaries, and is well away the farm houses around the mine and the town of Aggeneys. The noise increase due to Project operation beyond a 1km zone will be below 1 dB for the daytime. During night-time a 3 dB noise increase is expected to reach 2.5 km around the plant. There are no sensitive receptors within these zones.

The Project will introduce additional vehicles on the N14 and Loop 10 roads. The noise impact of this additional traffic will be minor, since the daytime noise level increase from the existing situation and the 45 dB(A) guideline will be below 1 dB(A) along the N14 road (see *Figure 9.13*). The night-time increase above the 35 dB(A) guideline is expected to be approximately 1 dB(A) within a 500 m zone (see *Figure 9.14*).

Figure 9.13 Future Day-time Noise Contours around the Project

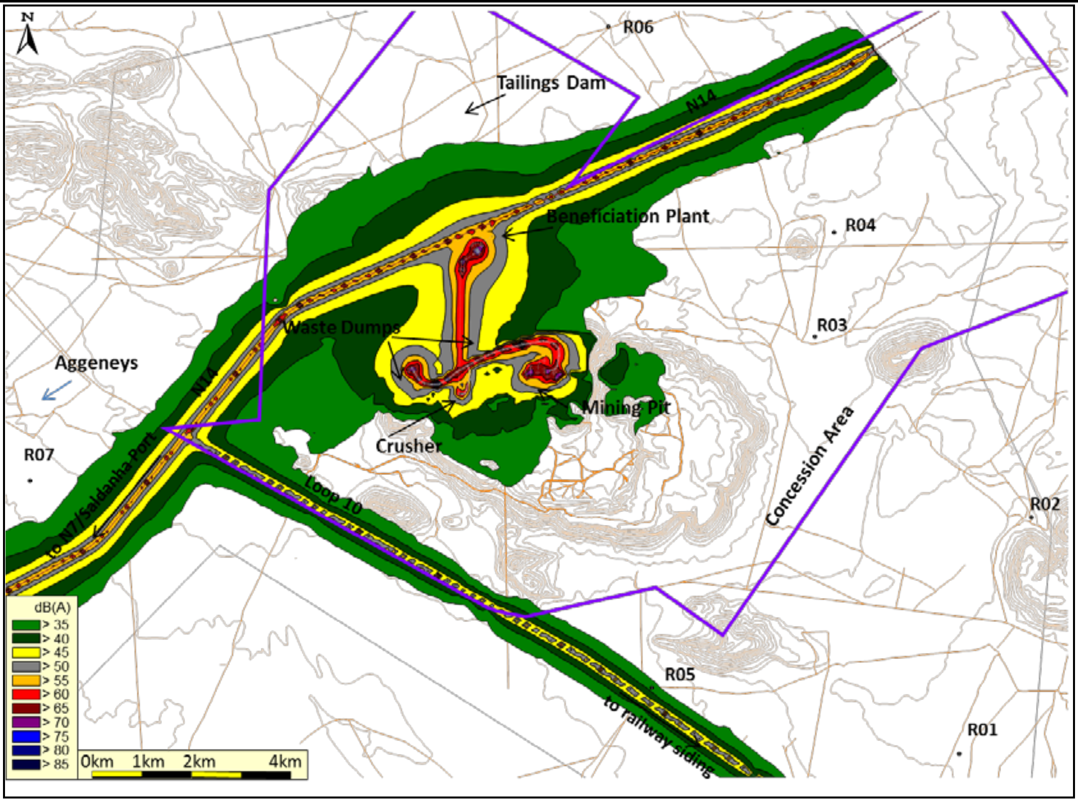
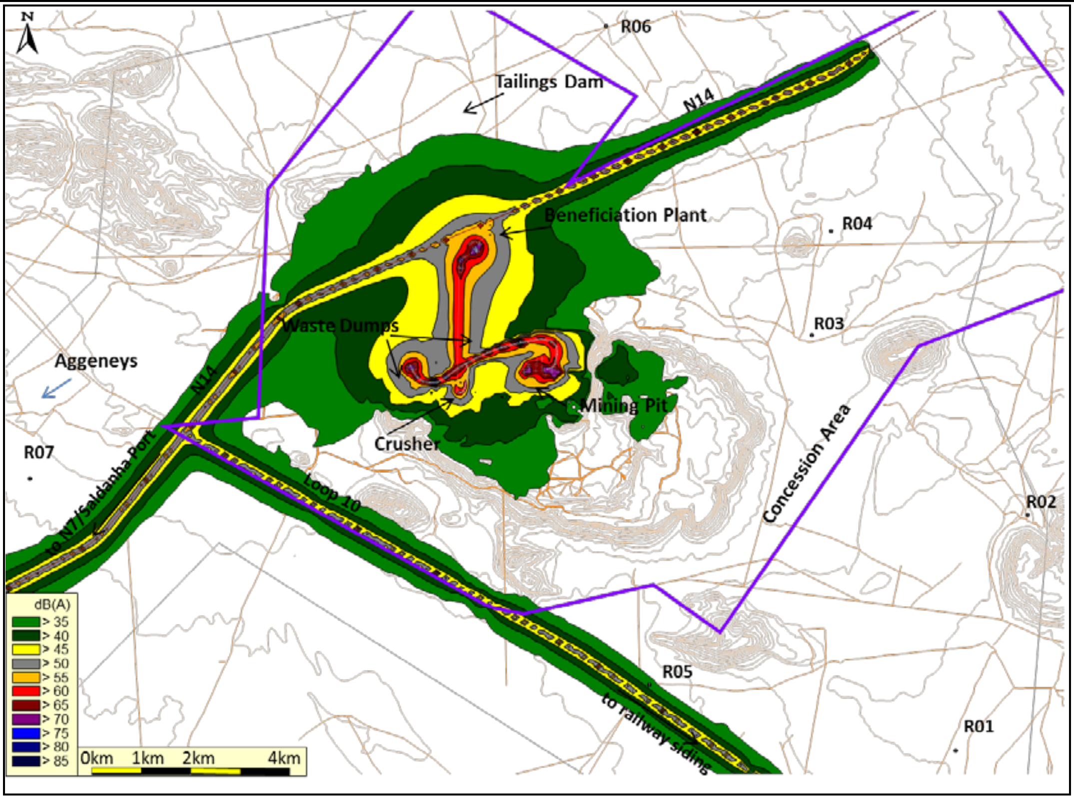


Figure 9.14 Future Night-time Noise Contours around the Project



Around Loop 10 the daytime increase above 45 dB(A) will be below one beyond a 100 m zone around the road. The night-time noise level increase above the rural guideline of 35 dB(A) will reach 3 dB within 300 m from the road. Around Loop 10 there are very few scattered farm houses, with most of them situated at more than 600 m from the road.

9.6.2 *Noise and Vibration Impact*

The noise and vibration impacts associated with the Project are discussed below.

Table 9.45 Impact Characteristics: Noise and Vibration Impact

Summary	**Construction**	**Operation**	**Decommissioning/ Post Closure**
Project Aspect/ activity	Noise and vibration generation through site clearance, road upgrade and establishment of the camp, laydown and assembly areas.	Mining operations, including drilling, blasting, hauling, crushing and ore processing.	The removal of operational infrastructure, equipment and waste management of hazardous substances.
Impact Type	Direct.	Direct.	Direct.
Stakeholders/ Receptors Affected	Noise levels and sensitive receptors.	Noise levels and sensitive receptors.	Noise levels and sensitive receptors.

Construction

The construction activities at receptors outside a 1,000 m zone from the main working area will be noticeable but will not constitute a disturbing noise. For receptors located at greater distances than a 1.5 km radius, the construction noise will be barely audible. Since the closest receptor is more than 5 km away this impact is expected to be Negligible.

The vibration during the site construction is not considered to have a significant impact on the surrounding receptors, as the closest one has a more than 5 km separation distance from the site.

The impact rating for the construction phase are summarised in Box 9.25, below.

Box 9.265 Construction Impact: Noise and Vibration Impact

Nature: Construction activities would result in a **negative direct** impact on existing noise levels in the mining area

Sensitivity/Vulnerability/Importance of Resource/Receptor: **Low.**

Impact Magnitude: **Small.**
Extent: The extent of the impact is **local**.
Duration: The expected impact will be **short-term**.
Scale: The impact will not result in notable changes to the receptor.
Frequency: The frequency of the impact will be **periodic.**
Likelihood: The impact is **likely**.

IMPACT SIGNIFICANCE (PRE-MITIGATION): **NEGLIGIBLE.**

Degree of Confidence: The degree of confidence is **high**.

Mitigation

No specific mitigation measures are required during construction.

Operational Phase

The 45 dB(A) daytime and 35 dB(A) night-time noise levels will be primarily contained within the mine licence area and these levels will not be exceeded in any of the scattered farm houses around the mine nor in Aggeneys. The exception is the unoccupied farm house R05, which is situated within 300 m from the Loop 10 road.

Along the Loop 10 road, most of the scattered farm houses are located more than 500 m from the alignment, and as such the expected level contribution due to the trucks will be below 34 dB(A), which is considered to be of low significance (see *Box 9.276*).

Box 9.286 Operational Impact: Noise and Vibration Impact

<u>Nature</u>: Operational activities would result in a **negative direct** impact on noise levels in the mining area and surrounding areas, including along the Loop 10 road.

<u>Sensitivity/Vulnerability/Importance of Resource/Receptor</u>: **Low.**

<u>Impact Magnitude</u>: **Small.**
<u>Extent:</u> The extent of the impact is **local**.
<u>Duration:</u> The expected impact will be **long-term**.
<u>Scale:</u> The impact will result in **notable** changes to the receptor.
<u>Frequency:</u> The frequency of the impact will be **periodic.**
<u>Likelihood</u>: The impact is **likely**.

IMPACT SIGNIFICANCE (PRE-MITIGATION): **NEGLIGIBLE.**

<u>Degree of Confidence</u>: The degree of confidence is **high**.

Mitigation Measures

No specific mitigation measures are required.

Monitoring

Noise and vibration monitoring will be performed on an annual basis along the site boundaries and at four selected locations within the farm houses closest to the mine and the Loop 10 road.

Decommissioning

The noise impacts associated with decommissioning are anticipated to similar to construction impacts associated with activities on site and movement of vehicles.

Residual Impact

Pre-mitigation impacts were rated negligible for construction, operation and decommissioning. The pre- and post-mitigation impacts are compared in *Table 9.3* below.

Table 9.46 Pre- and Post- Mitigation Significance: Impact on Noise and Vibration

Phase	Significance (Pre-mitigation)	Residual Significance (Post-mitigation)
Construction	**NEGLIGIBLE (-ve)**	**NEGLIGIBLE (-ve)**
Operation	**NEGLIGIBLE (-ve)**	**NEGLIGIBLE (-ve)**
Decommissioning	**NEGLIGIBLE (-ve)**	**NEGLIGIBLE (-ve)**

9.7 CLIMATE CHANGE IMPACTS

ERM was commissioned to undertake a Climate Change Specialist study as part of this ESIA process to inform/identify climate change impacts associated with the Project. The study comprised of two distinct parts, including:

- a Climate Risk Assessment (CRA); and
- a Greenhouse Gas (GHG) Assessment.

While the GHG assessment aims to identify and mitigate the impacts of the Project (ie GHG emissions) on the environment, the CRA looks at the impacts of the environment (and projected climate change) on the Project. There are a number of key drivers for conducting a CRA and GHG assessment alongside an ESIA process for a new development. These include the following:

- Climate change impacts (as identified through the CRA) may have implications on the environmental performance of a Project.

- Integrating CRA input into the design and conceptual phases of the process can help improve the climate resilience of projects and can help to avoid the maladaptation of projects to climate change. Projects failing to consider climate change risks at the planning stages could face severe financial, safety and operational impacts in the future if climate change impacts bring about the damage or disruption of operations, assets, infrastructure, and energy supply.

- Conducting a CRA and GHG assessment to inform the ESIA process offers a valuable opportunity for information on climate change risks, opportunities and implications to feed into project design considerations. The earlier climate change (including the need to minimise carbon emissions) considerations can be considered, the easier and less costly it is likely to be to adapt projects to the impacts of climate change, and the lower the climate change-induced liability will be on the project.

- Projects conducting a CRA and GHG assessments are likely to be identified by stakeholders as being forward looking and responsible, bringing about reputational benefits.

The following sections provide the key findings and recommendations derived from the CRA and GHG assessment studies conducted. There is some uncertainty in the GHG estimates that have been made given the early stage of Project design. As such, it should be noted that the GHG emission sources and estimated volumes assessed herein are considered to reflect a worst-case scenario.

9.7.1 Climate Change-induced Risks on the Project

Overview

This section presents the findings of the climate risk assessment (CRA) and review of adaptation (impact mitigation) options for the Project. In this regard, the objectives of the CRA were to:

- identify the principal climate-related risks associated with the proposed Project across the timescale of the Project;
- prioritise the principal climate-related risks; and
- identify potential mitigation measures (ie climate change adaption measures [1]) that could reduce risk or take advantage of opportunities.

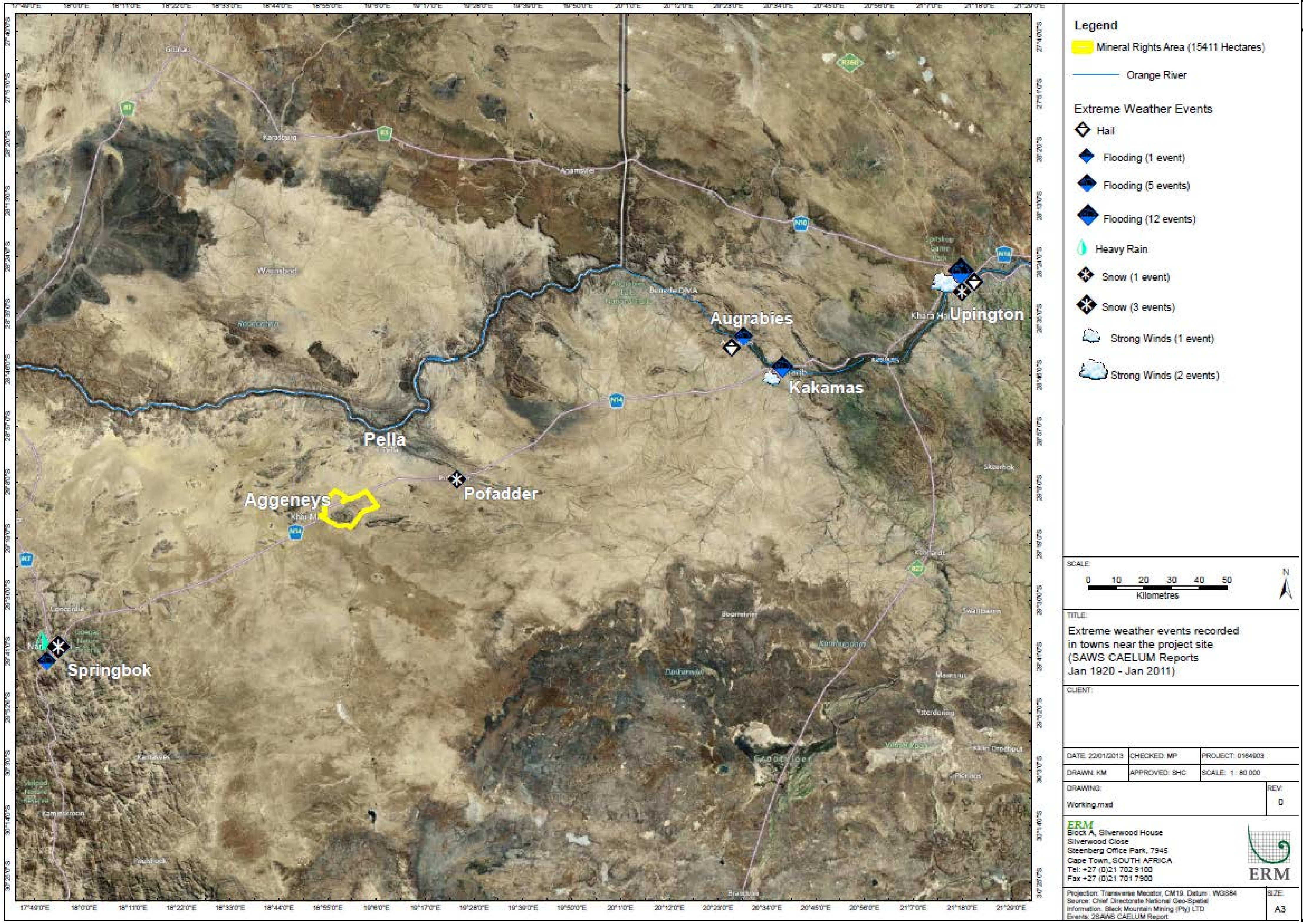
Please note that this CRA impact assessment section does not follow the standard format used in the rest of the Impact Assessment Chapter. This is owing to uncertainties that exist with regard to the accuracy of simulated climate change predictions, specifically due to the early stage of project design and that (in many cases) available information was insufficient to determine significant change to the baseline risk profile. As such, a conservative approach has been adopted and estimated values are considered to reflect worst-case scenarios.

Projected Climate Change

As mentioned in the Biophysical Receiving Environment Chapter (refer to *Chapter 5*), the climate in the Project area is typically hot and dry with limited precipitation throughout the year. There is also a low incidence of flooding and other extreme weather events in the area, particularly in close proximity to the Project area. With respect to this, most of the significant events recorded have occurred at settlements located along the banks of the Orange River (*Figure 9.15*). A full summary of the climate baseline for the Project area is provided in Section 5.

(1) Climate change adaptation in the context of capital project development can be thought of as activities to avoid, minimise or mitigate the business risks arising from extreme weather events and/or gradual changes in climate. Adaptation measures include altering physical design of the Mine site or infrastructure, implementing business procedures, and altering operating patterns.

Figure 9.15 Recorded Weather Events around the Project Site (SAWS, 2011)



Year	Month	Event	Place
1920	Feb	FLOODS	Upington
1925	Mar	FLOODS	Upington
1934	Jan	FLOODS	Upington
1941	Jan	FLOODS	Kakamas
1941	Jan	FLOODS	Upington
1948	Apr	FLOODS	Upington
1953	Jul	SNOW	Springbok
1955	Feb	FLOODS	Kakamas
1957	Sep	FLOODS	Kakamas
1964	Feb	STRONG WIND	Upington
1965	Mar	STRONG WIND	Upington
1966	Jan	FLOODS	Upington
1967	Feb	FLOODS	Kakamas
1967	Feb	FLOODS	Upington
1974	Mar	FLOODS	Kakamas
1974	Mar	FLOODS	Upington
1976	Mar	FLOODS	Upington
1981	Aug	SNOW	Pofadder
1981	Aug	SNOW	Upington
1985	Dec	STRONG WIND	Kakamas
1988	Feb	FLOODS	Augrabies
1988	Feb	FLOODS	Upington
1988	Apr	FLOODS	Upington
1988	Jul	SNOW	Springbok
1991	Oct	HAIL	Augrabies
1994	Feb	FLOODS	Springbok
1994	Feb	FLOODS	Springbok
1994	Feb	FLOODS	Upington
1994	Jun	SNOW	Springbok
1996	Apr	FLOODS	Kakamas
2002	Dec	HAIL	Upington
2006	May	HEAVY RAIN	Springbok
2011	Jan	FLOODS	Upington

In terms of expected Climate Change projections, the CRA study proposes that the Project area is likely to get hotter and drier, with increasingly variable precipitation, as a result of climate change. Furthermore, flooding along the Orange River is projected to become more common given expected increases in precipitation over the River's source and catchment area.

Table 9.46 below summarises the key predicted scenarios for the Project area.

Table 9.47 Climate Baseline and Climate Change Scenarios

Climate Risk Source	Climate Change Scenario
Precipitation Intensity	Precipitation intensity unlikely to change significantly.
Average Precipitation (mm/month)	Precipitation projections for the project area are inconsistent. Average precipitation is likely to remain low. Increasing temperatures may result in increased evaporation levels, thereby reducing surface water availability.
Average Precipitation (mm/month)	Precipitation projections for the project area are inconsistent. While some sources report that at the amount of precipitation received within the project area is unlikely to change. Others, suggest that on average precipitation will increase over the summer months by 3 mm per month and will decrease over the winter months by 3.7 mm per month (The World Bank Group, 2013).
Average Air Temperature (°C)	Average air temperatures are projected to increase across all seasons, possibly leading to an increase in evaporation levels. By 2020 – 2039, average temperatures in January are projected to reach 27°C compared with a baseline of 26°C (1990 – 2009). Overall, air temperatures are expected to increase by 2.5°C over the summer months by 2070 – 2100 compared with a baseline from 1975 – 2005.
Wind Speeds (m/s)	Very minor changes in wind speed are expected, but the direction of such change is unknown (there is some model disagreement). Average annual eastward winds are projected to change by - 0.13 m/s to + 0.04 m/s by 2011 to 2030 against the baseline from 1961 to 1990 according to three different GCMs (IPCC, 2012). There is model disagreement on the direction of change for each month.
Relative Humidity (percent)	The change in relative humidity is unknown. However, an increase in temperature and reduction in precipitation could lead to a reduction in humidity.
Dry Spells	Dry spells within the proposed Project area are likely to increase in duration and occur on a more frequent basis. The median duration of dry spells for the mid-21st Century over the western and northern regions of South Africa is expected to increase between spring and autumn, compared with the period from 1961 to 1990. It is also projected that dry spells of relatively long duration may be expected to occur more frequently (SARVA, 2012).
Flooding	Flooding of the Orange River is expected to occur more frequently; however limited information is available to assess the frequency or intensity of such flooding, as well as the nature of such flash flooding episodes and how they are expected to change. Precipitation within the catchment area of the Orange River is expected to increase across all seasons and by 10 - 50 mm during spring and summer by 2046 – 2065. As a result, flooding of the lower reaches of the Orange River can be expected to occur more frequently.

Assessment of Impacts under Future Projected Climate Change Conditions

As a result of the prevailing arid climate associated with the Project area, the likelihood of identified impacts occurring and having negative consequences on the Project are generally low. This specifically relates to the degree of climate change that is expected within the timescale of the Project (ie Life of Mine of 20 years). As such, none of the future projected climate change conditions were assessed to pose major risks to the Projects viability. Despite this, there are a number of climatic changes projected that could result in disruptions to mining operations, without proper management/forward planning. Specific climatic changes that could pose some risk include the following:

- predictions of higher mean annual temperatures;
- lower mean annual rainfall;
- increases in high magnitude precipitation events (eg flooding);
- increased dry spells;
- increased evaporation; and
- stronger winds.

These are expected to impact the Project in the following manner:

<u>Higher Mean Annual Temperatures</u>

- affecting staff health (ie changes in distribution of vector-borne diseases, (such as malaria) and could lead to dehydration or heatstroke);
- reducing worker productivity; and
- reducing the efficiency of equipment.

<u>Increased Dry Spells</u>

- may threaten water security/availability and lead to water restrictions, which could lead to reduced production.

<u>Increased High Magnitude Precipitation Events</u>

- may damage the pumps on the river or result in them having to be pulled out of the river to avoid being damaged. This would lead to reduced production as a result of water abstraction capabilities being compromised.

- leading to erosion and flooding in pit and surrounding area causing disruption to operations and posing health and safety risks to workers and contractors;

- rehabilitation efforts may be hampered by an increase in the frequency and/or magnitude of heavy rainfall/flooding events (and also through slope failure).

Adaption Measures

'Climate Adaptation' in the context of capital project development can be thought of as activities to avoid, minimise or mitigate the business risks arising from extreme weather events and/or gradual changes in climate. Adaptation measures include altering the physical design of the mine site or infrastructure, implementing business procedures, and altering operating patterns.

Successful adaptation will encompass a variety of physical, operational, management or strategic measures and will include a strong on-going review element, which needs to be undertaken in order to re-visit and confirm the climate science projections and assumptions that underlie the original risk assessment. A number of applicable adaptation measures (listed under relevant climate change projections) which could be implemented as part of the Project to mitigate risks associated with predicted climate change are listed below. These include:

<u>Increased Dry Spells:</u>

- Reduce, reuse and recycle water on-site.
- Install rainwater harvesting measures.
- Introduce innovative water recycling measures.
- Roll-out community-based adaptation programmes, which address issues such as improving community food security under climate change conditions (including the introduction of drought adapted farming techniques and materials), in order to improve the resilience of the community.
- Investigate alternative dust management/suppression options that do not involve the use of water.

<u>Increased Number of High Magnitude Precipitation Events/Flooding:</u>

- Erect flood protection measures around the Pella Water Board (PWB) abstraction pump station, if necessary.
- Design the PWB abstraction pumps to withstand more frequent flooding of the Orange River.
- Install early warning systems so that the PWB abstraction pumps can be protected effectively.
- Develop and implement appropriate flooding control measures.

- Vegetate slopes along Orange River to prevent slope failure during flooding events. Otherwise, implement structural measures to secure such slopes (netting etc).

- Install flood protection measures in and around the mine.

- Seek alternative access routes to utilise when normal routes are flooded.

- Undertake regular drain maintenance to reduce the flooding risks.

- Design dams in such a manner as to prevent over-flow during periods of high precipitation.

- Install flood protection measures around areas harbouring waste materials.

Increased Mean Annual Temperatures:

- Prevent working under very hot conditions.
- Ensure availability of cool drinking water for staff on-site.
- Change working hours to prevent working at the heat of the day.
- Review and adjust, if possible, the operating temperature for equipment.
- Increase maintenance schedule to prevent slow/shut downs.

9.7.2 *Impact of Project GHG Emissions on South Africa's National Emissions*

This section provides an assessment of the potential impacts associated with the Project's contribution to climate change through 'greenhouse gas' (GHG) emissions. To determine this, the operational phase carbon footprint [1] of the Project has been estimated in a Climate Change Specialist Study.

Please note that, although the construction and decommissioning phases of the Project are sources of GHG emission, at the scale at which this study was commissioned they were excluded for this Study for following reasons:

- Inherent uncertainty in emission factors around land use change;

- Inherent uncertainty and reliability on emissions from the limited Scope 1[2] and Scope 2[3] sources within these phases of the Project. The major sources of emissions during this phase would also be attributed to Scope 3[4] emission sources. These have been excluded from the Study due to the fact that there is considerable uncertainty with respect to estimating

(1) A carbon footprint is a measure of the estimated greenhouse gas emissions caused directly and indirectly by an individual, organisation, event or product.
(2) Scope 1 emissions relate to direct emissions from sources owned or under the operational control of the company.
(3) Scope 2 emissions relate to indirect emissions from the consumption of purchased electricity.
(4) Scope 3 emissions relate to indirect emissions of an optional reporting category, which allows for other indirect emissions associated but not controlled by the company to be included, such as contractor activities.

contractor activity and employee business travel. Furthermore, this data was not available at the stage of writing the report; and

- The materiality of the contribution of GHG emissions compared to the operational activities emissions over the life of the mine.

As such, this GHG emissions assessment only presents forecast estimates for Scope 1 and Scope 2 emissions for the Operational phase of the Project.

This process is also complicated further by the fact that the impact of greenhouse gas emissions on the environment cannot be quantified within a defined space and time. As such, it is not possible to link emissions from a single source (ie the Project facilities and infrastructure) to particular impacts that may occur within the broader study area. Subsequently, the GHG emissions assessment does not consider the physical impacts of climate change resulting from increased project GHG emissions, but rather the impact of the Project on South Africa's National GHG Inventory and the implications associated with this.

For a detailed overview of the methodology and approach used in calculating the Projects carbon footprint please refer to the Climate Change Specialist report in *Annex G9*.

Table 9.48 Impact Characteristics: Greenhouse Gas Emissions

Summary	**Construction**	**Operation**	**Decommissioning/ Post Closure**
Project Aspect/ activity	N/A	Emissions sources (see *Table 9.48* below).	N/A
Impact Type	Direct and indirect.	Direct and indirect.	Direct and indirect.
Stakeholders/ Receptors Affected	The impact of greenhouse gas emissions on the environment cannot be quantified within a defined space and time.	The impact of greenhouse gas emissions on the environment cannot be quantified within a defined space and time.	The impact of greenhouse gas emissions on the environment cannot be quantified within a defined space and time.

Operational Phase Impacts

<u>Project Emission Sources</u>

Table 9.48 below summarises the key emission sources that will be present on site during the operational phase of the Project. These emission sources are all included in calculations to determine the operational carbon footprint associated with the Project.

Table 9.49 Summary of Key Emission Sources

Emission category	**Emission Source**
Mobile combustion	• Fuel used in vehicles including cars, buses etc. • Fuel used in mobile equipment.

Emission category	Emission Source
Stationary combustion	• Diesel used for power generation such as generators. • Diesel used for stationary equipment.
Non-combustion	• Use of lubricant oils and greases in machinery.
Refrigerants	• Leakage/use of refrigerant gases in air conditioning units in vehicles and offices/accommodation in air conditioning units.
Explosives	• Explosives used in the blasting of rock in the core activity of the open cast mining activity of this operation.
Waste Emissions	• Methane emissions from waste. • Methane emissions from waste water (sewage) treatment.
Electricity	• Emissions associated with the total electricity consume.

Operational Carbon Footprint for the Project

The operational carbon footprint for the Project is predicted to be approximately 552 449 tCO_2e per annum from 2015 onwards. *Table 9.49* below breaks down emissions for each source during a year of 'normal' operations, once construction has ended. It should be noted that emissions associated with Scope 2 activities (ie electricity usage) account for 496 980 tCO2e, which is approximately 90% of the total emissions predicted. Scope 1 emissions will account for 55 469 tCO2e, which makes up the final 10% of the total emissions estimated. It is also important to note that these estimates do not include additional activities, which may come into play in the future.

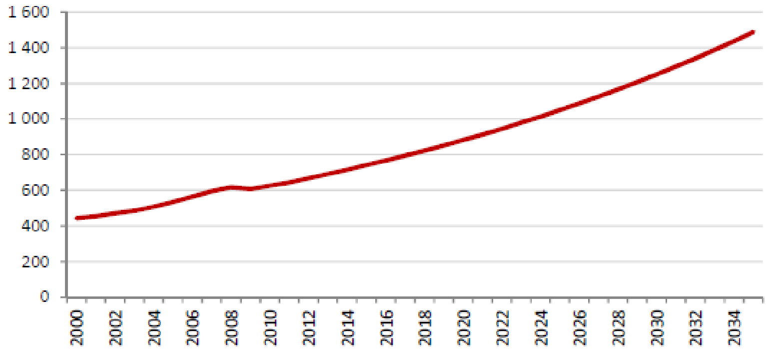
Table 9.50 Gamsberg Estimated Annual Operational Carbon Footprint

Emission Source	Estimated Operational Emissions (tCO2e)	Percentage of total emissions
Mobile Combustion	44 246	8.01%
Stationary Combustion	1 630	0.3%
Non Combustion	178	0.0%
Refrigerant Usage	1 170	0.2%
Explosives	362	0.1%
Waste	7 883	1.4%
Electricity	496 980	90.0%
Total CO_2e Emissions	552 449	100%

Comparison of Projected Project Emissions Against National Emissions

The impact of the Project's estimated operational emissions against South Africa's national GHG inventory has been assessed by comparison with an emissions trajectory from 2011 to 2035, which has been determined based on historic and projected economic growth and development pathways represented in terms of *Figure 9.16.* According to the most recent national GHG inventory, total emissions in South Africa in the year 2015 (the commencement of the operational phase of the Project) are predicted to amount to approximately 740.31 million tCO_2e. This is expected to increase to 1,436.37 million tCO_2e by the year 2034, given the estimated rate of growth of the Country.

Figure 9.16 *South Africa's National Emissions (MtCO2e) Based on GDP Growth*



The estimated emissions of GHG into the atmosphere from the Project, as well as the associated increase in South Africa's national emissions are shown in *Table 9.50*. From this, it is evident that the Project will result in a minor (≤0.07%) increase to annual emissions; however the impact will be over a long period of time (life of mine is predicted to extend for 19 years).

Table 9.51 ***Comparison of Gamsberg with Projected National Emissions (tCO2e)***

Year	SA National Emissions (excl. Gamsberg)	Gamsberg estimated emissions	SA National Emissions (incl. Gamsberg)	% Increase in national emissions
2015	740 313 419.21	552 449	740 865 868	0.07%
2016	766 594 545.59	552 449	767 146 995	0.07%
2017	793 808 651.96	552 449	794 361 101	0.07%
2018	821 988 859.11	552 449	822 541 308	0.07%
2019	851 169 463.61	552 449	851 721 913	0.06%
2020	881 385 979.56	552 449	881 938 429	0.06%
2021	912 675 181.84	552 449	913 227 631	0.06%
2022	945 075 150.79	552 449	945 627 600	0.06%
2023	978 625 318.65	552 449	979 177 768	0.06%
2024	1 013 366 517.46	552 449	1 013 918 966	0.05%
2025	1 049 341 028.83	552 449	1 049 893 478	0.05%
2026	1 086 592 635.35	552 449	1 087 145 084	0.05%
2027	1 125 166 673.91	552 449	1 125 719 123	0.05%
2028	1 165 110 090.83	552 449	1 165 662 540	0.05%
2029	1 206 471 499.06	552 449	1 207 023 948	0.05%
2030	1 249 301 237.27	552 449	1 249 853 686	0.04%
2031	1 293 651 431.20	552 449	1 294 203 880	0.04%
2032	1 339 576 057.00	552 449	1 340 128 506	0.04%
2033	1 387 131 007.03	552 449	1 387 683 456	0.04%
2034	1 436 374 157.78	552 449	1 436 926 607	0.04%
2035	1 487 365 440.38	552 449	1 487 917 889	0.04%

Benchmark Against Other Zinc Mines

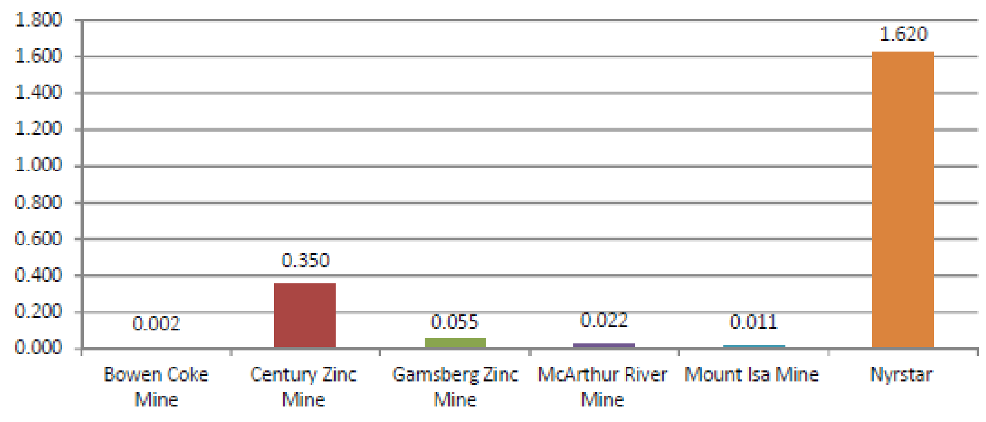
Benchmarking emissions intensity of the Project against other Zinc mines provides a measure of its performance against the industry average. The emissions intensity of zinc mines is influenced by a range of internal (technological) and external (environmental/geographic) factors as indicated in *Table 9.51*.

Table 9.52 Factors Influencing Greenhouse Gas Emissions Intensity

Internal	**External**
Choice of mining technology.	Spatial characteristics influencing vehicle usage.
Assumptions regarding the amount of flaring that may be required.	Electricity from the national supply is – coal has a high carbon content.
Power generation – choice of energy source, technology and configuration.	Economy affecting the price of equipment and vehicles .
Efficiency of equipment and vehicles.	Available alternative energy opportunity.

The production capacity of the Project is 10 million tonnes of zinc ore per annum. With an estimated annual carbon footprint of 552 449 tCO2e for Project activities, this is equivalent to 0.055tCO2e/tonne zinc ore. This is compared with the intensity of other zinc ore mining projects under operation around the world, and is illustrated in *Figure 9.17*.

Figure 9.17 Emissions Intensity of Gamsberg and other International Zinc Ore Mines



Impact Assessment

The potential magnitude of the impact is highly uncertain and involves unique/unknown risks. However, according to current designs, there is high confidence that the significant greenhouse gas emissions from the Gamsberg Facility would have a **moderate** impact on South Africa's national emissions.

Box 9.297 Summary of Operational Impact: Greenhouse Gas Emissions

Nature: Sensitivity/Vulnerability/Importance of Resource/Receptor – **High.** Irreplaceability: The activity will result in the long term changes to climate change, which is **irreversible** and **irreplaceable**. Impact Magnitude – **Medium.** Extent: The extent of the impact is **national** as it is South Africa's greenhouse gas emissions that are directly increased due to the impact of the project. Although the greenhouse effect is **transboundary** and global emissions are directly affected, this project assesses the impact on South Africa's emissions. Duration: The duration of the impact is regarded as **permanent** as science has indicated that the persistence of carbon dioxide in the atmosphere is said to range between 100 and 500 years and therefore continues beyond the life of the project. Scale: The substantial increase in South Africa's national greenhouse gas emissions and the long residence time in the atmosphere would indicate that the impact would have a **medium** scale during operations. Functions and natural process will be **notably altered** in the long term. Frequency: The substantial increase in South Africa's national greenhouse gas emissions will be **constant/periodic** as the Gamsberg project will be operational for 20 years. Likelihood: The probability of the impact of increased levels of greenhouse gas emissions with the proposed project is regarded as **certain**. IMPACT SIGNIFICANCE (PRE-MITIGATION) – **MODERATE.** Degree of Confidence: The degree of confidence is **high**.

Operational Phase Mitigation

Given its global nature, mitigation of the impact of climate change takes the form of reducing the concentration of greenhouse gases in the atmosphere. BMM has an opportunity to influence the overall impact of the Gamsberg Facility and associated activities on GHG emissions by ensuring that the final design includes the most energy efficient and low emissions options available. This section identifies a number of best practice options to be considered for the Project in order to increase the energy efficiency and/or emissions intensity of its activities in South Africa and thereby reduce Scope 1, 2 and 3 emissions.

Given the early stage in the design of the project, it was not possible to accurately estimate the abatement potential of each option. These activities will, however, contribute towards the sustainability of the project, reducing the greenhouse gas emissions, and reducing costs (eg fuel use for electricity generation).

Recommendations regarding the Project include the following:

- Consider effective driving and vehicle use to optimize transport as well as heavy (mining) vehicle use.
- Consider minimising business travel.

- Optimise transport logistics.
- Incorporate 'green building' features in the design of offices and accommodation; particularly the type of refrigerant to be used when choosing cooling technology by considering the global warming potential of the selected refrigerant.
- Implement at outset a high efficiency equipment purchasing policy on maintenance and replacement policy on motors and pumps.
- Consider alternative energy technologies for electricity supply.
- Consider the development of a waste to energy plant for non-hazardous, carbon-based waste.

10 SOCIO-ECONOMIC IMPACT ASSESSMENT

This Chapter identifies and evaluates the actual and potential socio-economic consequences of the Project. Furthermore, the potential for mitigation of negative impacts and enhancement of positive impacts (DEAT, 2003) are described.

The Chapters presents impacts related to the following aspects:

- Macro-Economics;
- Social and health;
- Visual landscapes;
- Traffic volumes; and
- Cultural heritage, archaeology and palaeontology.

10.1 IMPACT ON ECONOMIC ENVIRONMENT

Aside from compatibility with planning and financial viability (and associated zinc market considerations), the following impacts were identified as relevant for assessment based on the guidelines for economic specialist input (van Zyl et al., 2005), information from consultations with I&APs and nature of the Project and receiving environment:

- Impacts on jobs and incomes linked to Project expenditure;
- Impacts on key macro-economic variables focused on foreign exchange earnings and taxes;
- Impacts on tourism;
- Impacts on other surrounding land uses; and
- Impacts on municipal finances.

The sections below provide an assessment of each of the above mentioned impacts. This assessment is provided separately for the construction, operation and decommissioning phases of the Project. A significance rating is also assigned to each impact, using accepted conventions for determining their significance (refer to *Chapter 8*), and mitigation measures to reduce the impacts are outlined below.

Please note that the quantification of economic impacts in order to inform the assessment of the significance of impacts was not possible, nor considered necessary, for all impacts. Where possible, quantification focused on impacts considered to be most important in the overall assessment. Assessments of impact significance made without quantification (and based on a consideration of the likely magnitudes of impacts and/or expert judgements) are, however, considered adequate unless otherwise specified.

10.1.1 *Impacts linked to Project Expenditure*

The construction and operational phases of the Project would result in spending injections that would lead to increased economic activity, best measured in terms of impacts on employment and associated incomes focusing on the local area and region as a whole.

Spending by BMM during both the construction and operation phases would be new spending as it would not displace or substitute for spending by other companies given that that there are no other existing competing production facilities in the country. All expenditures would lead to linked direct, indirect and induced impacts on employment and incomes. Taking employment as an example (refer below for specific impacts associated with employment) the following types of impacts would apply:

- there would be direct impacts whereby people are employed directly on the project in question (eg jobs such as construction workers);
- there would be indirect impacts where the direct expenditure associated with a project leads to jobs and incomes in other sectors (eg purchasing building materials maintains jobs in that sector); and
- there would be induced impacts whereby jobs are created due to the expenditure of employees and other consumers that are gained from the project.

Direct impacts are the most important of these three categories as they are the largest and more likely to be felt in the local area. Their estimation also involves the lowest level of uncertainty. The quantification of indirect and induced impacts is a far less certain exercise due to uncertainty surrounding accurate multipliers particularly at a local and regional level. This uncertainty makes it inadvisable to quantify indirect employment unless an in-depth analysis of this aspect is absolutely essential to decision making. Potential direct employment and income impacts are consequently quantified here and likely indirect impacts are borne in mind qualitatively when providing overall impact ratings.

Table 10.1 Impact Characteristics: Project Expenditure and Withdrawal Thereof

Summary	**Construction**	**Operation**	**Decommissioning/ Post Closure**
Project Aspect/ activity	This phase of the project would result in spending injections that would lead to increased economic activity best measured in terms of impacts on employment and associated incomes.	This phase of the project would result in spending injections that would lead to increased economic activity best measured in terms of impacts on employment and associated incomes.	This phase of the project would result in a withdrawal of spending injections that would lead to decreased economic activity relative to the operational phase.
Impact Type	Direct and indirect.	Direct and indirect.	Direct and indirect.

Summary	Construction	Operation	Decommissioning/ Post Closure
Stakeholders/ Receptors Affected	Direct and indirect beneficiaries of project expenditure.	Direct and indirect beneficiaries of project expenditure.	Direct and indirect beneficiaries of project expenditure.

Construction Phase Impacts

Construction expenditure would constitute a positive injection of new investment. The applicant's preliminary estimates indicate that a total of approximately R 8.235 billion would be spent on all aspects of the construction phase over roughly four years (see *Table 10.2* below) [(1)].

Table 10.2 Construction Phase Expenditure

Construction component	Costs in 2013 rands (excl inflation)				
	Year 1	Year 2	Year 3	Year 4	Total
Mine & Pre-Stripping	R 1 068 750 000	R 1 068 750 000	R 832 500 000	R 840 000 000	R 3 810 000 000
Concentrator plant	R 405 000 000	R 405 000 000	R 360 000 000	R 397 500 000	R 1 567 500 000
Housing	R 206 250 000	R 206 250 000	R 63 750 000	R 63 750 000	R 540 000 000
Infrastructure	R 438 750 000	R 438 750 000	R 228 750 000	R 1 211 250 000	R 2 317 500 000
Total	**R 2 118 750 000**	**R 2 118 750 000**	**R 1 485 000 000**	**R 2 512 500 000**	**R 8 235 000 000**

The Project has the potential to have a significantly positive impact on commercial activity in the local area during the construction phase given its size and resultant expenditure, as illustrated in *Table 10.3* above. During the construction phase the building, civil and other construction and specialist industrial machinery sectors would benefit substantially. The structural metal products, wholesale and retail trade and construction materials sectors would also stand to gain due to indirect linkages. The Project would therefore provide a major injection for contractors and workers in the local area, region and province leading to positive impacts.

Table 10.3 provides a tentative indication from the applicant of what proportions of construction expenditure would go to suppliers from the Khâi-Ma municipal area, the rest of the Namakwa District, rest of the Northern Cape, rest of the country and what would be imported. Imports would primarily come in the form of specialised machinery, equipment and spares and some electrical inputs that are not available in South Africa. It is anticipated that approximately R 40.5 million will be spent on suppliers or contractors from within the Khâi-Ma Municipality, the majority of which would be for housing construction. A further R 1.74 billion is expected to be spent within the Namakwa District and roughly R 1.14 billion in the Northern Cape as a whole. Note that these projections have been kept conservative at a

(1) Note that all data on Vedanta expenditure during construction and operation and its likely geographic spread were sourced from Vedanta and found to be reasonable.

local level and the intention of the applicant is to ensure that local suppliers are given preference wherever possible (refer to construction phase mitigation measures below).

Table 10.3 ***Construction Phase Expenditure per Geographic Area***

Construction component	Anticipated spend on Khai-Ma municipal area suppliers	Anticipated spend on suppliers from the rest of the Namakwa District	Anticipated spend on suppliers in the rest of the Northern Cape	Anticipated spend on suppliers in the rest of SA	Anticipated spend on imports
Mine & Pre-Stripping	R 0	R 762 000 000	R 381 000 000	R 2 667 000 000	R 0
Concentrator plant	R 0	R 313 500 000	R 156 750 000	R 1 097 250 000	R 0
Housing	R 40 500 000	R 202 500 000	R 135 000 000	R 162 000 000	R 0
Infrastructure	R 0	R 463 500 000	R 463 500 000	R 1 158 750 000	R 231 750 000
Total	**R 40 500 000**	**R 1 741 500 000**	**R 1 136 250 000**	**R 5 085 000 000**	**R 231 750 000**

Employment during Construction

In order to estimate direct temporary employment during construction, standard construction industry estimates for labour required per spend were sourced from the Applicant. *Table 10.4* outlines the total Project. It is anticipated that approximately 3,200 contract jobs with an average duration of 19 months each would be associated with all construction expenditure. The majority of these employment opportunities would be medium and low skilled positions in keeping with the nature of the construction required.

Please note that the estimates given below are not to be regarded as being highly accurate and are merely estimates that are meant to provide the reader with an indication of potential employment impacts.

Table 10.4 ***Estimated Direct Temporary Employment During Construction***

Construction component	Total number of workers needed				Ave duration of each employment contract within overall 36 to 42 month construction period
	Highly skilled	Medium skilled	Low skilled	Total	
Mine & Pre-Stripping	150	375	675	1200	19 months
Concentrator plant	120	300	550	970	
Housing	50	125	225	400	
Infrastructure	80	200	350	630	
Total	**400**	**1000**	**1800**	**3200**	

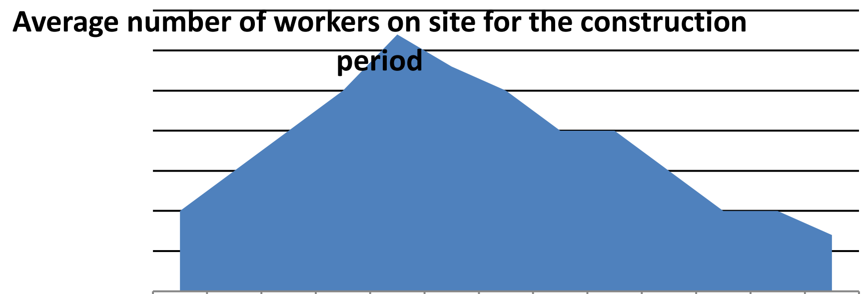
Based on the likely availability of labour and the experience of the applicant in the area and at other sites, approximately 357 workers would probably come from within Khâi-Ma Municipality. A further 1,335 workers would probably come from the rest of the Namakwa District and 960 workers from the rest of the Northern Cape (see *Table 10.5*). Note that these estimates are based largely on a fairly broad assessment of the availability of labour in these areas and it is the proponent's intention to use a greater proportion of labour from Khâi-Ma Municipality and the Namakwa District, if people are available and/or willing to be trained.

Table 10.5 ***Likely Spread of Construction Jobs Per Area***

Worker origin	Highly skilled		Medium skilled		Low skilled		All skill levels
	Likely % of workers	*Nr of workers*	*Likely % of workers*	*Nr of workers*	*Likely % of workers*	*Nr of workers*	*Nr of workers*
Khai-Ma municipal area	3.0%	12	7.5%	75	15%	270	357
Rest of the Namakwa District	15.0%	60	37.5%	375	50%	900	1 335
Rest of the Northern Cape	30.0%	120	30%	300	30%	540	960
Rest of South Africa	42.0%	168	25%	250	5%	90	508
Overseas	10.0%	40	0%	-	0%	-	40
Total	**100.0%**	**400**	**100.0%**	**1 000**	**100.0%**	**1 800**	**3 200**

In terms of the spread of construction activity over time, *Table 10.6* shows that worker numbers on site would build gradually reaching their maximum of roughly 3,200 during months 13 to 15 of the construction phase and staying above 2,000 workers until months 25 to 27 and thereafter gradually reducing until construction is completed.

Table 10.6 ***Average Number of Construction Workers on Site over the Construction Period***



	Month 1 - 3	Month 4 - 6	Month 7 - 9	Month 10 - 12	Month 13 - 15	Month 16 - 18	Month 19 - 21	Month 22 - 24	Month 25 - 27	Month 28 - 30	Month 31 - 32	Month 33 - 35	Month 36 - 38
Nr of construction workers	1000	1500	2000	2500	3200	2800	2500	2000	2000	1500	1000	1000	700

Incomes From Wages During Construction

Direct household income impacts would flow from all wages paid during construction. These were estimated by multiplying the projected number of direct jobs associated with the Project (estimated above) by assumed average monthly salaries for each skill category (ie R7,000 for low skilled, R22,500 for medium skilled and R52,000 for highly skilled employees). Again, these estimates are to be treated as indicative. The results of this exercise show that total income of R 1.01 billion would be associated with the construction phase (refer to *Table 10.7*). Approximately R80 million of this total, would probably accrue to workers currently residing in Khâi-Ma Municipality. A further R339 million would be expected to accrue to workers in the rest of the Namakwa District and R319 million to workers from the rest of the Northern Cape (see *Table 10.8*).

Table 10.7 Direct Household Income Impacts During Construction (2013 Rands)

Construction component	Total salaries per skill level over construciton period			
	Highly skilled	Medium skilled	Low skilled	Total
Mine	R 148 200 000	R 160 312 500	R 89 775 000	R 398 287 500
Concentrator plant	R 118 560 000	R 128 250 000	R 73 150 000	R 319 960 000
Housing	R 49 400 000	R 53 437 500	R 29 925 000	R 132 762 500
Infrastructure	R 79 040 000	R 85 500 000	R 46 550 000	R 211 090 000
Total	**R 395 200 000**	**R 427 500 000**	**R 239 400 000**	**R 1 062 100 000**

Table 10.8 Direct Household Income Impacts During Construction Per Area (2013 Rands)

Worker origin	Total salaries over construciton phase			
	Highly skilled	Medium skilled	Low skilled	All skill levels
Khai-Ma municipal area	11 856 000	32 062 500	35 910 000	79 828 500
Rest of the Namakwa District	59 280 000	160 312 500	119 700 000	339 292 500
Rest of the Northern Cape	118 560 000	128 250 000	71 820 000	318 630 000
Rest of South Africa	165 984 000	106 875 000	11 970 000	284 829 000
Overseas	39 520 000	-	-	39 520 000
Total	**395 200 000**	**427 500 000**	**239 400 000**	**1 062 100 000**

Indirect Opportunities During Construction

In addition to the above direct employment and associated income opportunities, a significant number of temporary indirect opportunities would be associated with the Project. These would stem primarily from expenditure by Vedanta in the local area and region, as well as expenditure by workers hired for the construction phase.

Impact Assessment and Description

Expenditure on construction would result in a **positive** impact on the economy, increasing commercial activity, creating jobs and increasing incomes. The impact will not include the loss of any irreplaceable resources. The extent of the impact is **national** (though impacts would be proportionately greater at a regional and local scale). The expected impact will be **short-term** (ie reversible). The impact will result in **notable** changes to the receptor (ie the economy). The frequency of the impact will be **once-off** but for the duration of construction. Impacts from expenditure are a **certainty** in the economy.

An assessment of the significance of the combined impacts of project-related expenditure based on the findings above is presented in the *Box 10.1* below.

Box 10.1 ***Summary of Construction Impact: Construction Phase Expenditure***

Nature: Expenditure on construction would result in a **positive** impact on the economy, increasing commercial activity, creating jobs and increasing incomes.

Sensitivity/Vulnerability/Importance of Resource/Receptor: **Low.**
Irreplaceability: The impact will not include the loss of irreplaceable resources

Impact Magnitude: **High**
Extent: The extent of the impact is **national** (though impacts would be proportionately greater at a regional and local scale)
Duration: The expected impact will be **short-term** (ie reversible)
Scale: The impact will result in **notable** changes to the receptor (ie the economy)
Frequency: The frequency of the impact will be **once-off** but for the duration of construction
Likelihood: Impacts from expenditure are a **certainty** in the economy

IMPACT SIGNIFICANCE (PRE-MITIGATION): **MODERATE (+)**

Degree of Confidence: The degree of confidence is **high**.

Construction Phase Mitigation

The objective of mitigation is to maximise economic benefit from jobs and expenditure particularly at a local and regional scale.

Vedanta's social and labour plan (SLP) should act as a departure point and take the lead when considering and enforcing benefit enhancement measures. This plan will have to deal with and provide specific guidance on actions such as giving preference to local and historically disadvantaged individuals and companies. It will need to be drawn up with care and in full consultation with all relevant stakeholders and as per the requirements of the DMR. It will also need to recognise and deal with perceptions in the area that mines operating in it could do more for local economic development. For example, The Khâi-Ma Municipality LED Strategy mentions that "The mines are seen as important stakeholders and partners in LED. The SLP's of the mining corporations should be more vigorously enforced." (KMLM, 2011, p 64).

Some of the broad types of measures that should be considered and detailed in the SLP are listed below:

- Formal targets should preferably be set (in tender documents, for example) for how much local labour should be used based on the needs of the proponent and the availability of existing skills and people that are willing to undergo training.

- Opportunities for the training of unskilled and skilled workers from local communities during construction and operation should be maximized.

- Local sub-contractors should be used wherever possible and contractors from outside the local area that tender for work should also be required to meet targets for how many locals are given employment.

- Decisions will be required from the applicant in consultation with local communities, the authorities and building contractors as to the percentage of jobs that are to be earmarked for the local community, and the percentage of jobs that are to be granted to residents of the wider region. Employment forums have proven effective in this regard.

- The recently formed Khâi-Ma LED Forum should also play a role here and in the process of unlocking opportunities for local businesses.

- Vedanta's existing database of potential local suppliers should be updated prior to any procurement. All companies on the list should be invited to tender for work.

- Tender forms need to be kept as simple as possible so as not to act as a barrier to entry and BMM must be willing to provide assistance with tendering where required.

Operational Phase Impacts

Project Expenditure/Investment During Operations

The key operational phase impacts associated with the Project would flow from expenditure on operations at the mine and plant. Operational costs would increase in line with production from approximately R 528 million in during the first year of production to R 1.76 billion in the fifth year of production at which point it is anticipate that full production levels would achieved (see *Table 10.9 below*).

Table 10.9 Estimated Operational Expenditure

Cost categories	Operational costs in 2013 rands (excluding inflation)	
	1st year of production	*5th year - full production*
Staff	R 132 187 500	R 440 625 000
Fuels	R 105 750 000	R 352 500 000
Electricity	R 42 300 000	R 176 250 000
Water	R 15 862 500	R 52 875 000
Transport	R 15 862 500	R 52 875 000
Chemicals	R 15 862 500	R 52 875 000
Maintenance	R 79 312 500	R 264 375 000
Overheads	R 37 012 500	R 123 375 000
Outsourced activities	R 84 600 000	R 246 750 000
Total	**R 528 750 000**	**R 1 762 500 000**

Table 10.10 shows the likely spread of the above operational costs per geographical area focusing on the situation three years after the start of each phase. It is predicted that once full production is reached, roughly R 436 million per annum will be spent in the Khâi-Ma Municipality area, R 180 million in the rest of the Namakwa District and R 121 million in the rest of the Northern Cape.

Table 10.10 Operational Expenditure at Full Production per Geographical Area

Cost component	Anticipated spend in the Khai-Ma municipal area	Anticipated spend in the rest of the Namakwa District	Anticipated spend in the rest of the Northern Cape	Anticipated spend in the rest of SA	Anticipated spend on imports
Staff	R 352 500 000	R 44 062 500	R 22 031 250	R 22 031 250	R 0
Fuels	R 0	R 0	R 0	R 352 500 000	R 0
Electricity	R 0	R 0	R 0	R 176 250 000	R 0
Water	R 52 875 000	R 0	R 0	R 0	R 0
Transport	R 5 287 500	R 21 150 000	R 5 287 500	R 21 150 000	R 0
Chemicals	R 0	R 0	R 10 575 000	R 42 300 000	R 0
Maintenance	R 13 218 750	R 52 875 000	R 52 875 000	R 145 406 250	R 0
Overheads	R 0	R 12 337 500	R 6 168 750	R 98 700 000	R 6 168 750
Outsourced activities	R 12 337 500	R 49 350 000	R 24 675 000	R 148 050 000	R 12 337 500
Total	**R 436 218 750**	**R 179 775 000**	**R 121 612 500**	**R 1 006 387 500**	**R 18 506 250**

Employment during Operations

Table 10.11 outlines the operational phase employment opportunities that would be associated with the Project. During the first year of production (planned for 2015) approximately 630 jobs would be created (of which, roughly 195 would be outsourced to contractors) increasing to 1,230 jobs (of which 380 would be outsourced to contractors) once full production is reached by the 5th year of production.

Table 10.11 Operational Employment

Component of project and job type	Number of operational employees					
	1st year of production			5th year - full production		
	In house	Contractors/ outsourced	Total	In house	Contractors/ outsourced	Total
Mine						
Managers & supervisors	41	19	**60**	62	28	**90**
Operators	97	43	**140**	173	77	**250**
Admin	7	3	**10**	28	12	**40**
Cleaners	7	3	**10**	21	9	**30**
Security	7	3	**10**	21	9	**30**
Other operational worke	55	25	**80**	173	77	**250**
Total	214	96	**310**	477	213	**690**
Concentrator plant						
Managers & supervisors	28	12	**40**	55	25	**80**
Plant operators	97	43	**140**	138	62	**200**
Admin	7	3	**10**	21	9	**30**
Cleaners	7	3	**10**	10	5	**15**
Security	7	3	**10**	10	5	**15**
Other operational worke	55	25	**80**	104	46	**150**
Total	200	89.6	**290**	339	151	**490**
Transport to port						
Loaders	7	3	**10**	7	3	**10**
Drivers	14	6	**20**	28	12	**40**
Total	21	9	**30**	35	15	**50**
TOTAL	**435**	**195**	**630**	**850**	**380**	**1230**

Table 10.12 shows the likely allocation of jobs to people from different areas within the Northern Cape for both Phases once they are in full operation. Note that these estimates are based largely on a fairly broad assessment of the availability of labour in these areas and it is the proponent's intention to use a greater proportion of labour from Khâi-Ma Municipality and the Namakwa District if people are available and/or willing to be trained. It is anticipated that:

- Khâi-Ma Municipality residents would benefit from 127 jobs in the first year of production and 258 jobs once full production is reached.
- Residents in the rest of the Namakwa District would benefit from 276 jobs in the first year of production and 540 jobs once full production is reached.
- Residents in the rest of the Northern Cape would benefit from 112 jobs in the first year of production and 220 jobs once full production is reached.

Table 10.12 Operational Employment per Geographical Area

Component of project	Workers from Khai-Ma		Workers from the rest of the Namakwa District		Workers from the rest of the Northern Cape	
	1st year of production	*5th year - full production*	*1st year of production*	*5th year - full production*	*1st year of production*	*5th year - full production*
Mine	60	146	134	304	54	123
Concentrator plant	60	100	129	213	52	87
Transport to port	8	13	14	23	6	10
Total	**127**	**258**	**276**	**540**	**112**	**220**

Incomes from Salaries during Operations

Direct household income impacts would flow from all salaries paid during operations. These were estimated by multiplying the projected number of direct jobs associated with the Project above by assumed average yearly salaries for each skill category. Again, these estimates are to be treated as indicative. The results of this exercise, shown in *Table 10.13* below, indicate that at the start of production approximately R 138 million in salaries and sub-contractor payments would be made yearly increasing to R 256 million once full production is reached by the 5th year of production.

Table 10.13 Income from Operational Employment

Component of project and job type	Total salaries paid including contractors		Average annual salary range for job category		
	1st year of production	*5th year - full production*			
Mine					
Managers & supervisors	R 36 000 000	R 54 000 000	500 000	to	700 000
Operators	R 23 100 000	R 41 250 000	150 000	to	180 000
Admin	R 1 650 000	R 6 600 000	150 000	to	180 000
Cleaners	R 700 000	R 2 100 000	60 000	to	80 000
Security	R 1 000 000	R 3 000 000	80 000	to	120 000
Other operational workers	R 10 800 000	R 33 750 000	120 000	to	150 000
Total	R 73 250 000	R 140 700 000			
Concentrator plant					
Managers & supervisors	R 24 000 000	R 48 000 000	500 000	to	700 000
Plant operators	R 23 100 000	R 33 000 000	150 000	to	180 000
Admin	R 1 650 000	R 4 950 000	150 000	to	180 000
Cleaners	R 700 000	R 1 050 000	60 000	to	80 000
Security	R 1 000 000	R 1 500 000	80 000	to	120 000
Other operational workers	R 10 800 000	R 20 250 000	120 000	to	150 000
Total	R 61 250 000	R 108 750 000			
Transport to port					
Loaders	R 1 350 000	R 1 350 000	120 000	to	150 000
Drivers	R 2 700 000	R 5 400 000	120 000	to	150 000
Total	R 4 050 000	R 6 750 000			
TOTAL	**R 138 550 000**	**R 256 200 000**			

Approximately R 23 million of salaries and payments to contractors should accrue to workers from Khâi-Ma Municipality during the first year of production increasing to R 44 million once full production is reached. A further R 50 million of salaries and payments to contractors should accrue to workers from the rest of the Namakwa District during the first year of production increasing to R 94 million at full production (see *Table 10.14*).

Table 10.14 Incomes from Operational Employment per Geographical Area

Component of project	Total annual salaries to workers from Khai-Ma		Total annual salaries to workers from the rest of the Namakwa District		Total annual salaries to workers from the rest of the Northern Cape	
	1st year of production	*5th year - full production*	*1st year of production*	*5th year - full production*	*1st year of production*	*5th year - full production*
Mine	R 11 200 000	R 24 555 000	R 25 745 000	R 52 545 000	R 10 880 000	R 22 230 000
Concentrator plant	R 10 682 500	R 17 842 500	R 22 662 500	R 39 187 500	R 9 680 000	R 16 695 000
Transport to port	R 1 215 000	R 2 025 000	R 1 620 000	R 2 700 000	R 810 000	R 1 350 000
Total	**R 23 097 500**	**R 44 422 500**	**R 50 027 500**	**R 94 432 500**	**R 21 370 000**	**R 40 275 000**

Indirect Opportunities During Operations

In addition to the above direct employment and associated income opportunities, indirect opportunities would be associated with the operational phase of the project. These would stem primarily from increased expenditure by BMM and its employees in the local area and region.

Impact Assessment and Description

Expenditure on operations would result in a **positive** impact on the economy, increasing commercial activity, creating jobs and increasing incomes. The impact will not include the loss of **irreplaceable** resources. The extent of the impact is **national** (though impacts would be proportionately greater at a regional and local scale). The expected impact will be **long-term** for the life of mine (ie reversible). The impact will result in **notable** changes to the receptor (ie the economy). The frequency of the impact will be **periodic** with a very high frequency making it virtually constant for the period of operations as expenditure will flow on an on-going basis. Impacts from expenditure are a **certainty** in the economy.

An assessment of the significance of the combined impacts of project-related expenditure based on the findings above is presented in *Box 10.2* below.

Box 10.2 *Summary of Operational Impact: Operational Phase Expenditure*

<u>Nature</u>: Expenditure on operations would result in a **positive** impact on the economy, increasing commercial activity, creating jobs and increasing incomes.

<u>Sensitivity/Vulnerability/Importance of Resource/Receptor</u>: **Low.**
<u>Irreplaceability:</u> The impact will not include the loss of **irreplaceable** resources.

<u>Impact Magnitude:</u> **High.**
<u>Extent</u>: The extent of the impact is **national** (though impacts would be proportionately greater at a regional and local scale).
<u>Duration</u>: The expected impact will be **long-term** for the life of mine (ie reversible).
<u>Scale:</u> The impact will result in **notable** changes to the receptor (ie the economy).
<u>Frequency</u>: The frequency of the impact will be **periodic** with a very high frequency making it virtually constant for the period of operations as expenditure will flow on an on-going basis.
<u>Likelihood</u>: Impacts from expenditure are a **certainty** in the economy.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – **MODERATE (+).**

<u>Degree of Confidence</u>: The degree of confidence is **high**.

Operational Phase Mitigation

The objective of mitigation is to maximise economic benefit from jobs and expenditure particularly at a local and regional scale.

Mitigation measures would be the same as for the construction phase focused on local employment and procurement as outlined in more detail in construction phase mitigation section. Such measures include the following:

- Formal targets should preferably be set (in tender documents, for example) for how much local labour should be used based on the needs of the proponent and the availability of existing skills and people that are willing to undergo training.

- Opportunities for the training of unskilled and skilled workers from local communities during construction and operation should be maximized.

- Local sub-contractors should be used wherever possible and contractors from outside the local area that tender for work should also be required to meet targets for how many locals are given employment.

- Decisions will be required from the applicant in consultation with local communities, the authorities and building contractors as to the percentage of jobs that are to be earmarked for the local community, and the percentage of jobs that are to be granted to residents of the wider region. Employment forums have proven effective in this regard.

- The recently formed Khâi-Ma LED Forum should also play a role here and in the process of unlocking opportunities for local businesses.

- Vedanta's existing database of potential local suppliers should be updated prior to any procurement. All companies on the list should be invited to tender for work.

- Tender forms need to be kept as simple as possible so as not to act as a barrier to entry and Vedanta must be willing to provide assistance with tendering where required.

Decommissioning and Post Closure Phase Impacts

Decommissioning and closure would essentially result in no more operational expenditure or jobs associated with the Project, which would result in negative impacts as the Project is withdrawn from the economy. The impacts of this withdrawal could be mitigated somewhat with careful planning and a focus on supporting the creation of sustainable businesses while the mine is operational. A highly significant decrease in economic activity in the area would, however, not be avoidable given the large size of the Project.

Impact Assessment and Description

Decommissioning and closure would essentially result in no more operational expenditure or jobs associated with the Project which would result in **negative** impacts as the Project is withdrawn from the economy. The impact would include the loss of mine expenditure in the area which would be **irreplaceable** to a degree. The extent of the impact is **national** (though impacts would be proportionately greater at a regional and local scale). The expected impact will be **permanent** (ie irreversible). The impact will result in **notable** changes to the receptor (ie the economy). The frequency of the impact will be **once-off**. Impacts from expenditure are a **certainty** in the economy. The degree of confidence is **medium**.

An assessment of the significance of the impacts of project-related expenditure during the decommissioning phase is presented in *Box 10.3* below.

Box 10.3 *Summary of Decommissioning Impact: Impacts Linked to Withdrawal of Expenditure*

Nature: Decommissioning and closure would essentially result in no more operational expenditure or jobs associated with the project which would result in **negative** impacts as the project is withdrawn from the economy.

Sensitivity/Vulnerability/Importance of Resource/Receptor – **Medium.**
Irreplaceability: The impact include the loss of mine expenditure in the area which would be **irreplaceable** to a degree.

Impact Magnitude – **Medium.**
Extent: The extent of the impact is **national** (though impacts would be proportionately greater at a regional and local scale).
Duration: The expected impact will be **permanent** (ie irreversible).
Scale: The impact will result in **notable** changes to the receptor (ie the economy).
Frequency: The frequency of the impact will be **once-off.**
Likelihood: Impacts from expenditure are a **certainty** in the economy.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – **MAJOR (-).**

Degree of Confidence: The degree of confidence is **medium**.

Decommissioning and Post Closure Phase Mitigation

The objective of mitigation is to minimise the negative impacts of the withdrawal of project expenditure form the local area and region.

Mitigation measures will have to be developed and refined with time as part of the Vedanta SLP. These will probably include training and assistance with the establishment of local businesses that can continue to provide opportunities post-mining (ie businesses that do not rely on mining directly or indirectly through their customers being Vedanta employees).

Residual Impact

The implementation of the above mitigation measures would increase the positive construction phase impacts from **Moderate** to **Major** significance and the operation phase impacts from **Moderate** to **Major**. The implementation of the decommissioning phase mitigation measures would probably reduce the significance of negative impacts from **Major** to **Moderate** if they are particularly well resourced and executed. The pre- and post-mitigation impacts are compared in *Table 10.15* below.

Table 10.15 *Pre- and Post- Mitigation Significance: Impacts Associated with Project Expenditure*

Phase	Significance (Pre-mitigation)	Residual Significance (Post-mitigation)
Construction	MODERATE (+ve)	MAJOR (+ve)
Operation	MODERATE (+ve)	MAJOR (+ve)

Phase	Significance (Pre-mitigation)	Residual Significance (Post–mitigation)
Decommissioning and Post Closure	MAJOR (-ve)	MODERATE (-ve)

The no-go would result in no construction and operational phase impacts as outlined above. The opportunities created by the positive impacts associated with expenditure on the Project would thus not materialise.

10.1.2 Impacts on Key macro-Economic Variables

Key economic impacts associated with Project expenditure have been assessed in the preceding section. These are the positive impacts with the greatest potential to affect communities in the local area and wider region. Aside from these impacts, positive impacts are also expected to flow primarily from project income and profits which are best measured using the following macro-economic indicators:

- Increased foreign exchange earnings (current project planning is for all of the zinc concentrate produced at the mine to be exported).
- Increased tax revenues from income taxes and minerals royalty payments associated with the Project.

Table 10.16 Impact Characteristics: Impacts on Key Macro-Economic Variables

Summary	Construction	Operation	Decommissioning/ Post Closure
Project Aspect/ activity	This phase of the project would require imported machinery and other materials resulting in relatively limited foreign exchange outflows (when compared with inflows during operations).	This phase of the project would result in significant net foreign exchange and tax earnings with positive macro-economic implications.	The closure of the project would result in decreased foreign exchange and tax earnings with negative macro-economic implications.
Impact Type	Direct and indirect.	Direct and indirect.	Direct and indirect.
Stakeholders/ Receptors Affected	Those with a stake in the macro-economic health of the country.	Those with a stake in the macro-economic health of the country.	Those with a stake in the macro-economic health of the country.

Construction Phase Impacts

During the construction phase, foreign exchange outflows would occur in order to import key project components. However, these outflows would be minor when compared to inflows during the operational phase (ie outflows would be less than 5% to 10% of the magnitude of total inflows over time). As such, foreign exchange outflows during the construction phase are assessed to have a negligible influence on related macro-economic conditions. Therefore, no further assessment is considered necessary.

Operational Phase Impacts

Table 10.17 shows the highly significant annual flows of foreign exchange revenues and associated taxes anticipated for the Project. These flows are then converted into present value (PV) terms, in *Table 10.18*, using a range of discount rates.

Table 10.17 Likely Foreign Revenue and Tax Flows Associated with the Project

	2015	2017	2019	2021	2025	2030	2031	2032
Mine production volumes - tpa	3 000 000	6 000 000	10 000 000	10 000 000	10 000 000	10 000 000	10 000 000	2 100 000
Concentrate sales volumes - tpa	367 751	735 503	1 225 838	1 225 838	1 225 838	1 225 838	1 225 838	257 426
Revenue / turnover in USD millions	388.1	754.5	1 257.5	1 257.5	1 257.5	1 257.5	1 257.5	264.1
Revenue / turnover in ZAR millions	2 910.9	5 658.9	9 431.5	9 431.5	9 431.5	9 431.5	9 431.5	1 980.6
Income tax in USD millions	-	-	93.8	140.8	140.8	151.3	152.8	32.1
Royalties in USD millions	19.0	37.0	61.6	61.6	61.6	61.6	61.6	12.9
Total taxes in USD millions	19.0	37.0	155.5	202.4	202.4	212.9	214.4	45.0
Total taxes in ZAR millions	142.6	277.3	1 166.0	1 517.8	1 517.8	1 596.6	1 607.9	337.6

Foreign exchange revenues are expected to start at roughly USD 385 million/yr (for 360,000 tonnes of concentrate production) in the first year of production, increasing to USD 750 million/yr (for 735,000 tonnes of concentrate production) in the third year and stabilising at roughly USD 1.257 billion/yr (for 1,225,000 tonnes of concentrate production) from the fifth year onwards. The present value of the sum of these flows over the project's life should be roughly USD 10.2 billion (or R 76.7 billion) using a base case discount rate of 6%.

Table 10.18 Present Values of Likely Foreign Revenue and Tax Flows Associated with the Project

Discount rate	Present Value of all revenues		Present Value of all taxes	
	USD millions	ZAR millions	USD millions	ZAR millions
2%	15 212	114 088	2 222	16 666
4%	12 402	93 015	1 778	13 333
6%	**10 226**	**76 696**	**1 437**	**10 778**
8%	8 523	63 919	1 173	8 798
10%	7 174	53 808	967	7 249

Tax payments consisting of income taxes and royalties are expected to start at roughly R 142 million/yr (for 360,000 tonnes of concentrate production) in the first year of production, increasing to R 277 million/yr in the third year, R 277 million/yr in the fifth year and stabilising at roughly R 1.52 billion/yr from the seventh year onwards. The present value of the sum of these flows should be roughly R 10.8 billion using a base case discount rate of 6%.

Impact Description and Assessment

Foreign exchange flows and tax revenues would result in a **positive** impact on the macro-economy improving the balance of payment and taxes collected. The impact will **not** include the loss of **irreplaceable** resources. The extent of the impact is **national.** The expected impact will be **long-term for the life of mine (ie reversible).** The impact will result in **notable changes** to the receptor (ie the economy). The frequency of the impact will be **periodic** with a very high frequency making it virtually constant for the period of operations as Foreign exchange and taxes will flow on an on-going basis. Impacts from expenditure are a **certainty** in the economy.

Box 10.4 Summary of Construction and Operational Impact: Impacts on Key Marco-Economic Variables

Nature: Foreign exchange flows and tax revenues would result in a **positive** impact on the macro-economy improving the balance of payment and taxes collected.

Sensitivity/Vulnerability/Importance of Resource/Receptor – **Low.**
Irreplaceability: The impact will **not** include the loss of **irreplaceable** resources.

Impact Magnitude – **High.**
Extent: The extent of the impact is **national.**
Duration: The expected impact will be **long-term for the life of mine (ie reversible).**
Scale: The impact will result in **notable changes** to the receptor (ie the economy).
Frequency: The frequency of the impact will be **periodic** with a very high frequency making it virtually constant for the period of operations as Foreign exchange and taxes will flow on an on-going basis.
Likelihood: Impacts from expenditure are a **certainty** in the economy.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – **MAJOR (+).**

Degree of Confidence: The degree of confidence is **high**.

Construction and Operational Phase Mitigation

There is no scope for enhancement measures within the ESIA process.

Decommissioning and Post Closure Phase Impacts

Decommissioning and closure would essentially result in no more foreign exchange earnings and tax revenues associated with the Project, which would result in negative impacts (or a cessation of positive impacts) as the Project is withdrawn from the economy.

An assessment of the significance of the impacts of the Project on key macroeconomic variables based on the findings above is presented in *Box 10.5* below.

Impact Description and Assessment

Decommissioning and closure would result in no more foreign exchange earnings or tax revenues associated with the Project which would result in **negative** impacts as the Project is withdrawn from the economy. The activity will result in the loss of mine related benefits which would be **irreplaceable** to a degree. The extent of the impact is **national.** The expected impact will be **permanent** (ie irreversible). The impact will result in **notable changes** to the receptor (ie the economy). The frequency of the impact will be **once-off.** Impacts from expenditure are a **certainty** in the economy.

Box 10.5 Summary of Decommissioning Impact: Impacts on Key Marco-Economic Variables

Nature: Decommissioning and closure would result in no more foreign exchange earnings or tax revenues associated with the project which would result in **negative** impacts as the project is withdrawn from the economy.

Sensitivity/Vulnerability/Importance of Resource/Receptor – **Medium.**
Irreplaceability: The activity will result in the loss of mine related benefits which would be **irreplaceable** to a degree.

Impact Magnitude: Medium.
Extent: The extent of the impact is **national.**
Duration: The expected impact will be **permanent** (ie irreversible).
Scale: The impact will result in **notable changes** to the receptor (ie the economy).
Frequency: The frequency of the impact will be **once-off.**
Likelihood: Impacts from expenditure are a **certainty** in the economy.

IMPACT SIGNIFICANCE (PRE-MITIGATION): **MAJOR (-).**

Degree of Confidence: The degree of confidence is **medium to high**.

Decommissioning and Post Closure Phase Mitigation

There is no scope for mitigation within the ESIA process.

Residual Impact

No mitigation is recommended so impact significance ratings will stay the same (refer to *Table 10.19*).

Table 10.19 Pre- and Post- Mitigation Significance: Impacts on Key Marco-Economic Variables

Phase	**Significance (Pre-mitigation)**	**Residual Significance (Post-mitigation)**
Construction	**NEGLIGIBLE**	**NEGLIGIBLE**
Operation	**MAJOR (+ve)**	**MAJOR (+ve)**
Decommissioning and Post Closure	**MAJOR (-ve)**	**MAJOR (-ve)**

10.1.3 *Impacts on Tourism*

Table 10.20 Impact Characteristics: Impacts on Tourism

Summary	**Construction**	**Operation**	**Decommissioning/ Post Closure**
Project Aspect/ activity	All project aspects and activities that could impact on characteristics of the area which support tourism (ie visual quality, air quality, biodiversity, noise, etc.).	All project aspects and activities that could impact on characteristics of the area which support tourism (ie visual quality, air quality, biodiversity, noise, etc.).	Closure and rehabilitation of project aspects and activities that could impact on characteristics of the area which support tourism (ie visual quality, air quality, biodiversity, noise, etc.).
Impact Type	Direct and indirect.	Direct and indirect.	Direct and indirect.
Stakeholders/ Receptors Affected	Tourists and those that rely on them for their livelihoods.	Tourists and those that rely on them for their livelihoods.	Tourists and those that rely on them for their livelihoods.

Tourism plays an important role in the economy of the wider area and has the potential to play an increasingly prominent role as a driver of economic development. It is thus important to consider the potential impacts of the Project on this sector.

In order to assess tourism impacts, information on current tourism use and potential future use focusing on the wider area surrounding the site was gathered. In order to verify and augment tourism issues raised during scoping, discussions were also held with tourism authorities and tourism stakeholders in order to get their views on potential impacts. These discussions confirmed that visual, air quality and traffic and habitat impacts were the key concerns for tourism. Sources of positive impacts would stem from increased potential business-related visitors to the Project.

The Tourism Development Context

The provincial, district and local municipality IDPs and SDFs all point out the importance of tourism in the wider area and focus on its future potential. Specifically at a local level the Khâi-Ma Local Municipality SDF (KMLM, 2010: p 114) reports that 'the Khâi-Ma environment is characterised by vast open land, unique topographical features (ie, mountain ranges, Bushmanland, Inselberg, wilderness areas along the Orange River, etc.) and rich heritage of the Khoi San/Nama people as well as the cathedral at Pella provides ample eco-tourism, adventure tourism and cultural tourism opportunities.' With regard to tourism corridors, the SDF advocates the prioritisation of the 'Pofadder-Onseepkans' and 'Pofadder-Witbank' tourism routes for tourism development with Pofadder, Onseepkans and Pella the identified tourism nodes. It also points out that, the tourism of Khâi-Ma should be promoted and marketed through a well-developed tourism strategy. Such a strategy should focus on tourism attractions offered by the towns, mainly Pofadder, Onseepkans and Pella, tourism possibilities along the Orange River and proper roads linking these tourist attractions' (KMLM, 2010: p 140).

Discussions with the local tourism authorities confirmed that the focus of current tourism activity and future potential in the area near the Project site was along the identified corridors and in general along the Orange River and in the mountainous areas around Pella and Klein Pella to the north of the N14 (L van Wyk, Khâi-Ma Municipality, pers com). The Namaqua Eco Trail, for example, starts near Pella and runs roughly along the Orange River to the West ending at the sea near Alexander Bay. There are also 4X4 trails between Pella and Pofadder and hiking trails in the mountains. The N14 itself is also recognised as the most important tourism route in the area. Note that it is likely that ad-hoc specialised tours are taking place in the area to specific sites particularly in the mountains nearer the project site (eg Aggeneys and Namies mountains). However, they are likely to be small in number and have not been brought to the attention of the tourism authorities in the local municipality.

Key tourism establishments in the wider area around the site are listed below along with their basic details (room and bed numbers) and their distances from the nearest project components. The only tourism accommodation facilities identified within 15 km of the site boundaries would be guest houses in Aggeneys (roughly 8km from the site) and the Oase in de Wilderness Lodge between 9km and 11km to the north-east of the site along the road connecting the N14 to Klein Pella.

Table 10.21 Key tourism Establishments Nearby the Site

Area and name of establishment	Nr units/rooms	Nr of beds	Distance to closest element of project in km
Aggeneys			
Guest houses and B&Bs	20 - 30 rooms	40 to 60	8
Pella & Klein Pella area			
Pella River Resort	20+ rooms and camping	40+	25
Klein Pella Guest Farm	7 rooms, 4 rondavels, 20 camp sites	30	17 to 19
Oase in de Wilderness	6 -10 rooms	12 to 20	9 to 11
AmAm Lodge	2 units	8	25
Pofadder			
Pofadder Hotel	34 rooms	70	33
Guest houses and B&Bs	30 - 40 rooms	60 - 80	33
Total		**284**	

Visual Impacts

A review of the visual specialist study alongside the tourism context revealed that the following points made in the visual specialist study are particularly important when considering tourism impacts (NLA, 2013):

<u>Visual Resource Value/Scenic Quality and Sense of Place:</u>

- The overall study area can be regarded as having a high visual resource value with its relatively unspoilt, vast, arid pains and rugged, rocky koppies contrasting dramatically with the blue skies.

- Although the study are evokes a distinct sense of place, it is not unique to the district or region. Nevertheless, the landscape quality or visual resource of the study area is considered to be high.

<u>Sensitive Receptors:</u>

- The vast majority of the views to the Project will be experienced from the N14 as motorists travel past the site in an easterly or westerly direction. This makes views from the N14 road important and perhaps the most sensitive to the proposed intervention.

- Other primary views of the Project would be from the mining town of Aggeneys, to the west of the Project, and from farmsteads nearby.

- Sensitive viewer locations would be views from tourists travelling long the N14 and views from the farmstead of the farm Achab.

<u>Landscape Impact:</u>

- The landscape impact (ie the change to the fabric and character of the landscape caused by the physical presence of a development) of the Project will be high as the physical impact of the construction, operation, decommissioning and closure of the mining activities will disturb a great percentage of the Project site.

<u>Visibility and Visual Exposure Levels:</u>

- The project's 'zone of potential influence' was established at 15km by the visual specialist noting that beyond 15km the impact of the proposed activities would have diminished

<u>Overall Significance of Impacts:</u>

- The overall significance of the visual impact is rated as being high.
- Even after mitigation measures are implemented, the significance of the visual impact will remain high as that waste rock dumps and tailings dam would remain.

Drawing on the above findings in particular in the visual impact assessment combined with tourism usage patterns and potential in the area, the following observations are made with regard to impacts for areas of tourism sensitivity:

Pella, Klein Pella including the gravel road to Klein Pella:
None of these areas would be within the 15km visual impact 'zone of potential influence' as outlined in the visual specialist study. Impact are therefore likely

to be minimal and restricted to temporary impacts on those visitor that drive past the project site on the N14 in order to access these areas.

Aggeneys and surrounds:
Aggeneys would fall within the low exposure area of the projects visual 'zone of potential influence'. This along with the mining town nature of Aggeneys should limit impacts. Tourists exploring the Aggeneys Mountains would, for the most part, be shielded from views of the Project.

The N14:
Visual risks along this key route would be particularly prominent. Impacts would be mitigated by the temporary nature of visual exposure, ie they would be limited to a relatively short period of time when motorists are passing the project area. Visual exposure would be moderate or higher for a 10-11km stretch of the road (ie for 5-7 minutes of driving time) and low beyond this distance implying lower impacts.

Overall:
The combined scale of the project elements and their visual impacts indicate that overall changes to the visual sense of place which supports tourism will be highly significant. Impacts on specific tourism facilities and key tourism areas would be limited, however, given the project's location relative to these. Visual exposure from the N14 would be high although temporary in nature for passing motorist who would largely still be able to enjoy the key attractions and tourist facilities in the wider area which are relatively far removed and screened from the project.

Loss of Conservation Worthy Land and Conservation Off-sets

Any significant loss of highly conservation worthy land such as that found on the Project site has potential implications for tourism. This is because conservation worthy lands has appeal to tourists and is becoming increasingly scarce. As outlined in the vegetation specialist study, the mine and plant site's high species diversity and number of rare species are of high conservation value and are reflected in its importance in local and regional conservation planning (see Desmet, 2013).[1] Should the Project proceed on the site, a significant portion of highly conservation worthy land would be sacrificed. This is a highly significant loss as recognised in the vegetation specialist study and will trigger the need for a biodiversity/conservation offset which conserves and safeguards appropriate conservation worthy land elsewhere. With pro-active planning there may be possibilities to allow controlled eco-tourism activities on an offset site. An investigation of appropriate options in this regard should ideally form part of offset selection and planning.

[1] Note that the fauna and flora specialist report concentrated on assessing the impacts of supporting infrastructure (such as extension to the waste water treatment works, housing, switching yard, power lines, offtake water pipeline) and found that impacts would be low with mitigation as the areas affected have relatively low conservation status (see Todd, 2013).

Without the Project and its conservation offset one can only speculate regarding future use of the site and its potential implications for tourism. For example, it the status quo is maintained, the most likely scenario is that the land would probably remain a private underground with no access for tourists, but with views of the site in an undisturbed state. This scenario would limit tourism risks from aesthetic degradation of the area but is not likely to secure tourism opportunities through access to the site. In the longer term this potential for future mining seems set to remain given the size and quality of the deposit and as zinc reserves continue to be depleted elsewhere thereby increasing pressure for the mining of the site.

Air Quality and Noise Considerations

Negative impacts on air quality have the potential to impact on the experience of tourists particularly if significant direct nuisance is caused (primarily from dust) and if decreased air quality feeds into deteriorated visual quality in the area. With regards to overall air quality impacts, the key findings of the air quality specialist study is that with mitigation, air quality impacts would be negligible during construction and minor during operations implying minimal risks for tourism (see DDA, 2013).

It should be recognised that some level of nuisance from dust outside the boundaries of the Project site would be unavoidable. Considering the above findings, however, it seems reasonable to conclude that risks specific to tourism from air quality impacts would be of a low significance with mitigation.

Noise impacts also have the potential to impact on tourism if they are shown to be particularly severe and to affect tourism receptors. The key findings of the noise specialist study indicate that, with mitigation, noise impacts are expected to be of a very low significance and generally highly localised within the project site with no impacts on sensitive tourism receptors identified (DDA, 2013a).

Potential for Increased Business Tourism

Experience indicates that a number of technical, management and sales staff generally associated with the numerous companies involved in the construction of a project of the large and complex nature proposed by BMM is required to periodically visit the Project site to conduct business. These staff generally fall into middle to higher income brackets and will require accommodation for their stays thereby creating opportunities for accommodation and other tourist facilities and services such as restaurants, transport, retail, etc. These opportunities would primarily be available to businesses in the Khâi-Ma Municipality area and in larger towns such as Springbok.

Although the short term magnitude of impacts are likely to be greater during construction given the level of activity at the site, increased business tourism flows are also likely during operations particularly given the presence of new technology requiring suppliers, servicing, etc. This positive impact should be taken into account although it is difficult to accurately estimate the number of business visitors that would need to go to site and the durations of their stays. At a minimum the positive impacts associated with business tourism will act as a partial counter to negative impacts on tourism. Bear in mind also that trips for business purposes can also lead to return visits for leisure as business people are exposed to the attractions of the area.

Overall Impacts and Significance

An assessment of the significance of the un-mitigated impacts of the construction and operation of the Project on tourism based on the findings above is presented in the Boxes below.

The no-go alternative would not result in impacts on tourism as it would maintain the status quo.

Box 10.6 Summary of Construction Phase Impacts: Impacts on Tourism

Nature: Biophysical impacts would impact on the tourism appeal of the area resulting in overall **negative impacts** notwithstanding the potential for increased business tourism.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Medium.
Irreplaceability: The activity will result in the loss of tourism resources with medium level of **irreplaceability.**

Impact Magnitude – Medium.
- Extent: The extent of the impact is **local.**
- Duration: The expected impact will be **short-term (ie reversible).**
- Scale: The impact will result in **notable changes** to the receptor.
- Frequency: The frequency of the impact will be **once-off.**
- Likelihood: Impacts are a **certainty** in the economy.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MODERATE (-).

Degree of Confidence: The degree of confidence is **medium**.

Box 10.7 Summary of Operational Phase Impact: Impacts on Tourism

Nature: Biophysical impacts would impact on the tourism appeal of the area resulting in overall **negative impacts** notwithstanding the potential for increased business tourism.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Medium.
Irreplaceability: The activity will result in the loss of tourism resources with medium level of **irreplaceability.**

Impact Magnitude – High.

- Extent: The extent of the impact is **local.**
- Duration: The expected impact will be **long-term for the life of mine (ie reversible).**
- Scale: The impact will result in **notable changes** to the receptor.
- Frequency: The frequency of the impact will be **periodic.**
- Likelihood: Impacts are a **certainty** in the economy.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MODERATE TO MAJOR (-).

Degree of Confidence: The degree of confidence is **medium**.

Construction and Operational Phase Mitigation:
Impacts on tourism are primarily dependent on how BMM's operations are designed, constructed and operated to minimise negative biophysical and social impacts and enhance positive ones. The measures recommended in other specialist studies to minimise negative impacts (primarily visual, air quality, noise, traffic and ecological habitat measures) and enhance positive impacts would thus also reduce impacts on tourism and should be implemented. These measures are not repeated here.

With pro-active planning there may be possibilities to allow controlled eco-tourism activities on the biodiversity offset area. An investigation of appropriate options in this regard should ideally form part of offset selection and planning.

Decommissioning and Post Closure Phase Impacts

Decommissioning would essentially result in the reduction or removal of tourism risks as project elements are closed. The eventual significance of impacts will be highly dependent on rigorous rehabilitation of the Project site. Closure would also result in a reduction in business tourism to the area that would be linked to the presence of the Project. An assessment of the significance of the impacts based on the findings above is presented in the Box below.

Box 10.8 Summary of Decommissioning Phase Impacts: Impacts on Tourism

Nature: Biophysical impacted that affected the tourism appeal of the area would cease and/or reduce resulting in overall **positive impacts** notwithstanding the potential for decreased business tourism.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Medium.
Irreplaceability: The activity will result in the loss of tourism resources with medium level of **irreplaceability.**

Impact Magnitude – Low.
- Extent: The extent of the impact is **local.**
- Duration: The expected impact will be **permanent (ie not reversible).**
- Scale: The impact will result in **notable changes** to the receptor.
- Frequency: The frequency of the impact will be **periodic.**
- Likelihood: Impacts are a **certainty** in the economy.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MINOR (+).

Degree of Confidence: The degree of confidence is **medium**.

Decommissioning Phase Mitigation:

If one takes a sample of mines throughout South Africa it is clear that rehabilitation effort and the success associated with it can be highly variable even if all mines are required to abide by the same regulations (see van Zyl et al., 2012). This variability can be seen when comparing both operating and closed mines. It therefore stands to reason that, with regards to minimising impacts, much will depend on how BMM EMPr is conceived and implemented in partnership with the DMR, DENC and other local stakeholders. If rehabilitation is rigorously applied and well-funded both concurrently and at closure to avoid visual scarring along with air pollution control measures, impacts are likely to be significantly less.

Residual Impact

The implementation of the above mitigation measures would decrease the negative construction phase impacts from **Moderate** to **Minor** significance and the operation phase impacts from **Moderate/Major** to **Moderate**. The implementation of the decommissioning phase mitigation measures would probably introduce positive impacts of a **Moderate** significance if they are particularly well resourced and executed. The pre- and post-mitigation impacts are presented below.

Table 10.22 Pre- and Post- Mitigation Significance: Impacts on Tourism

Phase	Significance (Pre-mitigation)	Residual Significance (Post–mitigation)
Construction	MODERATE (-ve)	MINOR (-ve)
Operation	MODERATE TO MAJOR (-ve)	MODERATE (-ve)
Decommissioning and Post Closure	MINOR (+ve)	MODERATE (+ve)

10.1.4 *Impacts on Surrounding Land Uses*

Table 10.23 ***Impact Characteristics: Impacts on Surrounding Land Uses***

Summary	Construction	Operation	Decommissioning/ Post Closure
Project Aspect/ activity	All project aspects and activities that could impact on the current and future use and economic potential of surrounding lands.	All project aspects and activities that could impact on the current and future use and economic potential of surrounding lands.	Closure and rehabilitation of project aspects and activities that could impact on the current and future use and economic potential of surrounding lands.
Impact Type	Direct and indirect.	Direct and indirect.	Direct and indirect.
Stakeholders/ Receptors Affected	Surrounding land owners and those that rely on them for their livelihoods.	Surrounding land owners and those that rely on them for their livelihoods.	Surrounding land owners and those that rely on them for their livelihoods.

Current use of lands immediately surrounding the site (and therefore potential impacted on due to activities on the site) is focused on agriculture primarily in the form of low potential grazing. Although projects are yet to be established, the potential for surrounding lands and those in the wider area to be used for renewable energy projects has also been recognised. Among others, there is an application pending for the use of a portion of Farm RE 1/57 adjacent to the site for a solar energy project. Given these land use options, this section focuses on potential risks to agriculture and solar development potential in particular. It also comments on potential risks to property values.

Hydrological and Hydrogeological Impacts

Impacts on the hydrological environment can have implications for agricultural production and, if severe enough, for access to water for households. The findings of the hydrogeological specialist study indicate that (ERM, 2013a):

- Decreases in groundwater depths of between 5 and 10m are anticipated 100 years after mine closure extending up to 3,000m from the site boundary in all direction excluding to the west. There are currently two existing boreholes in this area that would be potentially affected.

Given the above findings, overall risk to groundwater levels with serious implications for farming on adjacent lands area are considered low and mostly expected to manifest in the long term.

The findings of the hydrological specialist study indicates that, with adequate mitigation, impacts on surface water flows on neighbouring farms are likely to be minor (HHO Africa, 2013). It therefore stands to reason that the risk of negative impacts on current agricultural practice or production would be minor.

Air Quality Impacts

With regard to air quality impacts on neighbouring lands, the air quality specialist study has divided impact into those associated with particulate matter and dust deposition:

- Dust deposition was light (< 250 $mg/m^2/d$) around the N14, and moderate (250-500 $mg/m^2/d$) around the Loop 10 road.

- Heavy dust fall (> 500 $mg/m^2/d$) occurred mainly within the mining area and along the haul roads.

- The SANS residential guideline of 600 $mg/m^2/d$ was not exceeded at any of the sensitive receptors.

Based on these findings it is considered unlikely that air quality impacts (mainly from dust deposition) would translate into material impacts on the grazing potential of land outside the Project boundaries. Impacts on the potential of neighbouring lands to be used for solar projects are also considered minor and confined to the narrow areas along the Loop 10 Road (where dust deposition was found to be moderate) and, to a lesser degree, the N14 (where dust deposition was found to be light). The possibility of impact should not, however, be ignored and the environmental quality monitoring plan should include the monitoring of air quality and any associated impacts.

Noise and Social Impacts

The noise specialist study found that noise impacts would have a very low overall significance and that the Project did not pose significant noise risks to sensitive receptors nearby. Based on these findings, unacceptable noise and related nuisance impacts on surrounding farms are not predicted. There is also no reason to suspect that noise impacts would translate into property value impacts particularly with respect to farm houses.

The social specialist study conducted an assessment of the potential for the influx of people associated with the Project to result in an increase in so-called social pathologies (see ERM, 2013). It found that the significance of this group of impacts would be moderate without mitigation and minor to moderate with mitigation. Among the risks identified, a general increase in crime including stock theft would be of particular concern to neighbouring land owners. Based on experiences elsewhere it stands to reason that some level of stock loss would be inevitable. Mitigation including compensation mechanisms would thus be important in this regard.

Visual Impacts

Visual impacts will not impact on productive potential of surrounding lands. These impacts do, however, have the potential to impact on the amenity value of surrounding land and farmsteads in particular. Based on a matching of the visual exposure map produced by the visual specialist with mapped farmstead locations, two farmsteads belonging to neighbours would be within the visual zone of influence of the Project and close enough to be affected as follows:

- The farmstead on Portion 1/57 would be roughly 2.8km to the south-west of the tailings dam and was found to have a medium significance visual exposure by the visual specialist.

- The farmstead on Portion 2/57 would be roughly 7.5km to the north-east of the tailings dam and was found to have a low significance visual exposure by the visual specialist.

Other farmstead to the east of the site such as those on RE/59, Portion 1/87, Portion 2/87 and RE/87 would be shielded from views of the site.

Property Value Implications of Impacts

The value of surrounding agricultural land is primarily driven by the productive potential of the land and, to a lesser degree, by its other 'lifestyle' or non-productive factors which essentially determine how pleasant it is to live on the land. These can include visual appearance, noise levels, pollution levels, etc.

Based on the synopsis of impacts above, it seems most reasonable to conclude that there would be a minor to moderate risks of decreases in value related to losses in production or productive potential with mitigation. While risks to neighbouring land owners with mitigation seem manageable, uncertainties regarding these risks remain. It is therefore clear that risks would need to be monitored and systems put in place to deal with impacts should they arise. It will be particularly important that these systems are devised with inputs from neighbouring land owners and that they are highly explicit regarding actions required from the applicant should negative impacts arise.

With respect to non-productive factors, the findings of the air quality and noise specialist studies do not indicate significant concern regarding impacts on neighbouring farmsteads. Visual impacts are a relatively greater source of concern as they would result in impacts on the overall sense of place of the area that would change significantly given the introduction of a large mining/industrial project in an areas dominated by agriculture. For the whole surrounding area, risk from this source should be low to medium in magnitude given the extensive size of farms. They would be particularly focused on the farmsteads on Portion 1/57 (roughly 2.8km to the south-west of the tailings dam) and, to a lesser degree, on Portion 2/57 (roughly 7.5km to the north-east of the tailings dam) which would have views over the project site.

The value of farms adjacent to the site may also be impacted on due to negative perceptions. Portion 1/57 would be particularly at risk as it would effectively be 'sandwiched' between the Gamsberg project and the existing mining operations at Black Mountain. Even in the absence of verifiable negative environmental impacts from the Project, this position is likely to result in the risk of significant property values loss primarily as it would be associated with negative perceptions among potential buyers. These would probably include perceptions regarding pollution levels as well as concerns regarding social nuisances such as perceived increased potential for stock theft. On the whole, the actual change in the character of the area that will be associated with the mine combined with negative perceptions should result in very limited interest in nearby properties from buyers that place importance on lifestyle factors.

Overall Impacts and Significance

An assessment of the significance of the un-mitigated impacts of the construction and operation of the Project on surrounding land uses based on the findings above is presented in the Boxes below. The no-go alternative would not result in impacts on surrounding land uses as it would maintain the status quo.

Box 10.9 Summary of Construction Phase Impacts: Impacts on Surrounding Land Uses

Nature: Biophysical and social impacts would impact on current and future potential land uses surrounding the site resulting in overall **negative impacts**.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Low.
Irreplaceability: The activity will result in the loss of surrounding land use potential and resources with a low level of **irreplaceability.**

Impact Magnitude – Medium.
- Extent: The extent of the impact is **local.**
- Duration: The expected impact will be **short-term (ie reversible).**
- Scale: The impact will result in **notable changes** to the receptor.
- Frequency: The frequency of the impact will be **once-off.**
- Likelihood: Impacts are a **certainty** in the economy.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MODERATE (-).

Degree of Confidence: The degree of confidence is **medium**.

Box 10.10 Summary of Operational Phase Impact: Impacts on Surrounding Land Uses

Nature: Biophysical and social impacts would impact on current and future potential land uses surrounding the site resulting in overall **negative impacts**.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Medium.
Irreplaceability: The activity will result in the loss of surrounding land use potential and resources with a low level of **irreplaceability.**

Impact Magnitude – Medium.
- Extent: The extent of the impact is **local.**
- Duration: The expected impact will be **long-term for the life of mine (ie reversible).**
- Scale: The impact will result in **notable changes** to the receptor.
- Frequency: The frequency of the impact will be **periodic.**
- Likelihood: Impacts are a **certainty** in the economy.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MODERATE (-).

Degree of Confidence: The degree of confidence is **medium**.

Construction and Operational Phase Mitigation:

Impacts on surrounding land uses and land owners are primarily dependent on how BMM's operations are designed, constructed and operated to minimise negative biophysical and social impacts and enhance positive ones. The measures recommended in other specialist studies to minimise negative impacts (primarily visual, air quality, ground and surface water, noise, traffic and social measures) and enhance positive impacts would thus also reduce impacts on surrounding land uses and should be implemented. These measures are not repeated here.

Although significant impact on surrounding lands are not predicted at present, it should be recognised that these may arise in time and that principles and systems to deal with such eventualities should ideally be established before mining commences in consultation with those potentially affected. In other mining areas (Sishen, for example), a lack of clarity regarding who is responsible for impacts combined with unclear processes for dealing with compensation for impacts (without landowners having to resort to legal action) has cause high levels of tension between mines and surrounding land owners.

BMM should therefore actively engage with surrounding land owners and establish a clear policy for dealing with complaints. At a minimum this will require a forum that could meet regularly to discuss concerns.

In order to avoid confusion and contention regarding the source of impacts, it will also be critically important to set up monitoring systems for impacts such as those that may affect ground and surface water quantity/quality, air quality, etc. These systems need to be set up in such a way that, where impacts occur due to mining, these can be easily understood and ascribed to mining or not. BMM should also realise that they are introducing an activity with potentially high risks for surrounding land owners into the area and therefore the risks should be transferred to BMM where possible.

A memorandum of understanding and clear protocols for dealing with potential impacts should also be established. This should be between BMM and surrounding land owners, but should also include relevant authorities such as those is agriculture, water affairs who have an interest and can play a role in policing and/or conflict resolution if needed. For example, it should be agreed that if farmer's boreholes lose pressure or need to be drilled deeper then BMM should carry out the necessary work or provide adequate funds.

There should also be a protocol established that makes it clear to all parties under what conditions and how the purchase of surrounding lands will be handled should the need arise. This will ensure clarity and build trust with surrounding land owners.

Decommissioning and Post Closure Phase Impacts

Decommissioning would essentially result in the reduction or removal of risks to surrounding land uses as project elements are closed. The eventual significance of impacts will be highly dependent on rigorous rehabilitation of the project sites. Impacts on the recovery of groundwater in particular will be important to continued agriculture in the area. An assessment of the significance of the impacts based on the findings above is presented in the Box below.

Box 10.11 Summary of Decommissioning Phase Impacts: Impacts on Surrounding Land Uses

Nature: Biophysical impacted that affected surrounding land uses would cease and/or reduce assuming adequate mitigation and closure resulting in overall **positive impacts**.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Medium.
Irreplaceability: The activity will result in the loss of surrounding land use potential and resources with a low level of **irreplaceability.**

Impact Magnitude – Small to medium.
- Extent: The extent of the impact is **local.**
- Duration: The expected impact will be **permanent (ie not reversible).**
- Scale: The impact will result in **notable changes** to the receptor.
- Frequency: The frequency of the impact will be **periodic**.
- Likelihood: Impacts are a **certainty** in the economy.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MINOR TO MODERATE (+).

Degree of Confidence: The degree of confidence is **medium**.

Decommissioning Phase Mitigation:

If one takes a sample of mines throughout South Africa it is clear that rehabilitation effort and the success associated with it can be highly variable.

This variability can be seen when comparing both operating and closed mines. It therefore stands to reason that, with regards to minimising impacts, much will depend on how BMM EMPr is conceived and implemented in partnership with the DMR, DENC and other local stakeholders. If rehabilitation is rigorously applied and well-funded both concurrently and at closure to avoid external environmental costs, impacts are likely to be significantly less than the case of BMM simply doing the minimum to satisfy DMR and DENC requirements.

Residual Impact

The implementation of the above mitigation measures would decrease the negative construction phase impacts from **Moderate** to **Minor** significance and the operation phase impacts from **Moderate** to **Minor**. At an aggregate level, risks could be reduced to a low level with mitigation although there are instances (such as farm Portion 1/57) where risks would be higher for specific reasons. The implementation of the decommissioning phase mitigation measures would probably result in positive impacts which could have a **Moderate** significance if they are particularly well resourced and executed.

Table 10.24 Pre- and Post- Mitigation Significance: Impacts on Surrounding Land Uses

Phase	**Significance (Pre-mitigation)**	**Residual Significance (Post–mitigation)**
Construction	**MODERATE (-ve)**	**MINOR TO MODERATE (-ve)**
Operation	**MODERATE (-ve)**	**MINOR TO MODERATE (-ve)**
Decommissioning and Post Closure	**MINOR (+ve)**	**MINOR TO MODERATE (+ve)**

10.1.5 Impacts on Municipal Services

Table 10.25 Impact Characteristics: Impacts on Municipal Services

Summary	**Construction**	**Operation**	**Decommissioning/ Post Closure**
Project Aspect/ activity	Overall project has the potential to improve whilst also straining the financial position of the local and district municipality.	Overall project has the potential to improve whilst also straining the financial position of the local and district municipality.	Withdrawal of project has the potential to improve whilst also straining the financial position of the local and district municipality.
Impact Type	Direct and indirect.	Direct and indirect.	Direct and indirect.
Stakeholders/ Receptors Affected	The municipality and those who finance it (primarily its residents and national government).	The municipality and those who finance it (primarily its residents and national government).	The municipality and those who finance it (primarily its residents and national government).

New development projects have the potential to improve the financial positions of local municipalities where they are located through net increases in rates and other income. Despite this, large developments of this nature can also place greater strain on municipal services and lead to overall negative impacts on municipal finances. Note that cases where this has occurred are especially likely to be found in rapidly growing communities (see Altshuler et al. 1993, Ladd 1992 and RKG Associates 1989 cited in Fausold & Lilieholm 1996).

In order to assess what may happen to municipal finances it is necessary to understand the basics of the overall municipal financial planning process associated with new development projects. When a developer proposes a new project, a process of negotiation is entered into with the municipality aimed at determining the financial or other contributions needed from the developer in order to cover the increased cost of the provision of services to the site (ie to extend the existing network of services and to account for increased use of existing services). Services may include roads, sewerage, water, electricity, waste collection, and an accurate estimation of this contribution by the municipality is a key to ensuring cost recovery. If it is an underestimation, some of the costs associated with the development will not be recovered from the developer and will have to be covered using other sources (most often municipal ratepayers in general). The ability of the municipality to negotiate favourable contributions and extract these contributions is also a key determinant of whether the overall financial position of the municipality improves, stays the same or deteriorates.

In addition to the estimation of the costs of additional services to the development site, it is necessary for the municipality to get an accurate understanding of the potential implications of a project for population movement in the municipality. How many workers from outside the municipality are expected and where will they live? These are some of the key considerations that allow for municipal planning to proceed. This, in turn, determines how municipal services can be charged for and across what number of households. Thereby it provides the municipality with an understanding of how its rates base will be improved and where.

Based on the description above it is clear that in the case of this Project, or any other large development project, the municipality bears ultimate responsibility for ensuring that the Project contributes to the financial sustainability of the Khâi-Ma Municipality and the wider district and does not burden them with increased costs. These potential cost should be viewed at a broad scale and include costs associated with potential influxes of workers and job seekers, as well as any other impacts that could impose costs on the municipality. Discussions with the Khâi-Ma Municipality revealed that they are well aware of the need to recover costs and would endeavour to ensure that BMM not only covers their own costs, but also make a contribution to the development of the area. The municipality has confirmed that they are currently in the early stages of a process of negotiation with BMM in this regard. They also have confirmed that no decisions have yet been made pending the outcome of the EIA process and the provision of more detailed project information to the municipality as it becomes available (P van der Merwe, Khâi-Ma Municipality, pers. com.). No clear conclusions regarding impacts on municipal finances are therefore possible at this stage. It is, however, safe to predict overall positive impacts on finances provided these negotiations proceed well and in-migration is managed. This kind of outcome would be consistent with other smaller municipalities that have benefited from increased incomes among its residents and an in-flux of new residents with jobs. With sound municipal management, both of these trends tend to increase municipal income from existing residents and provide municipalities with a wider rates resulting in healthier municipal finances.

Construction and Operational Phase Impacts

An assessment of the significance of the un-mitigated impacts during the construction and operational phases of the Project on municipal finances, based on the findings above, is presented in *Box 10.12* below. For both phases, inadequate management, limited co-operation between the municipality and the proponent, along with un-controlled in-migration, could lead to overall moderate negative impacts on municipal finances.

The no-go alternative would maintain the status quo and would not provide the opportunity to raise added funds for the municipality, but would also not introduce the risk of not covering increased service costs.

Impact Description and Assessment

Without mitigation the project has the potential to result in an overall **negative impact** on municipal finances notwithstanding its potential to also improve the financial position of the local and district municipality. The impact will not include the loss of irreplaceable resources. The extent of the impact is **local**. The impact will result in **notable changes** to the receptor. The frequency of the impact will be **once-off** during the construction phase and **periodic** during operation. Impacts are a **certainty** in the economy.

Box 10.12 Summary of Overall Impact Significance (Construction and Operational Phases): Impacts on Municipal Services

Nature: Without mitigation the project has the potential to result in an overall **negative impact** on municipal finances notwithstanding its potential to also improve the financial position of the local and district municipality.

Sensitivity/Vulnerability/Importance of Resource/Receptor **– Low.**
Irreplaceability: The impact will **not** include the loss of **irreplaceable** resources.

Impact Magnitude – **Medium.**
Extent: The extent of the impact is **local.**
Duration: The overall expected impact will be **long-term for the life of mine (ie reversible).**
Scale: The impact will result in **notable changes** to the receptor.
Frequency: The frequency of the impact will be **once-off** during the construction phase and **periodic** during operation.
Likelihood: Impacts are a **certainty** in the economy.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – **MODERATE (-).**

Degree of Confidence: The degree of confidence is **medium**.

Construction and Operation Phase Mitigation

The municipality should continue to take responsibility for ensuring that the Project contributes to municipal financial sustainability and does not burden it with increased costs.

The proponent will need to engage with the municipality in good faith and with the intention to ensure that it does not burden the municipality with additional costs.

The mitigation measures contained in the social specialist study aimed at limiting the influx of job seekers to the area would need to be implemented in order to ensure that their impacts on services provision costs remain as low as possible.

Decommissioning and Post Closure Phase Impacts

Decommissioning would essentially result in the reduction or removal of Project related contributions to municipal finances as well as potential strains on these finances as project elements are closed. The eventual significance of impacts will be highly dependent on rigorous rehabilitation of the project sites as inadequate rehabilitation has the potential to transfer costs onto the local municipality (eg clean-ups). An assessment of the significance of the impacts based on the findings above is presented in the Box below.

Impact Description and Assessment

Without mitigation the withdrawal of the Project has the potential to result in an overall **negative impact** on municipal finances. The impact will **not** include the loss of **irreplaceable** resources. The extent of the impact is **local.** The expected impact will be **permanent** (ie not reversible). The impact will result in **notable changes** to the receptor. The frequency of the impact will be **periodic**. Impacts are a **certainty** in the economy.

Box 10.13 Summary of Decommissioning Impact: Impacts on Municipal Services

Nature: Without mitigation the withdrawal of project has the potential to result in an overall **negative impact** on municipal finances.

Sensitivity/Vulnerability/Importance of Resource/Receptor – **Low.**
Irreplaceability: The impact will **not** include the loss of **irreplaceable** resources.

Impact Magnitude – **Medium.**
Extent: The extent of the impact is **local.**
Duration: The expected impact will be **permanent (ie not reversible).**
Scale: The impact will result in **notable changes** to the receptor.
Frequency: The frequency of the impact will be **periodic**.
Likelihood: Impacts are a **certainty** in the economy.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – **MODERATE (-).**

Degree of Confidence: The degree of confidence is **medium**.

Decommissioning and Post Closure Phase Mitigation

The principles that should govern adequate mine and plant decommissioning and closure as outlined in the section above on tourism impacts would also apply to limiting impacts on municipal finances.

BMM will need to ensure continuous engagement with the municipality and keep it informed of any closure plans well in advance of them occurring.

The municipality, in turn, should be pro-active and plan for changes well in advance of potential mine closure.

Residual Impact

The implementation of the above mitigation measures would decrease the negative construction phase impacts from **Moderate negative** to **Moderate positive** significance and the operation phase impacts from **Moderate negative** to **Moderate positive**. The implementation of the decommissioning phase mitigation measures are relatively uncertain, not primarily under the control of BMM and in the distant future implying that impact would remain **Moderate negative** with mitigation if one takes a conservative view. The pre- and post-mitigation impacts are compared in *Table 10.26* below.

Table 10.26 Pre- and Post- Mitigation Significance: Impacts on Municipal Services

Phase	Significance (Pre-mitigation)	Residual Significance (Post–mitigation)
Construction	MODERATE (-ve)	MODERATE (+ve)
Operation	MODERATE (-ve)	MODERATE (+ve)
Decommissioning and Post Closure	MODERATE (-ve)	MODERATE (-ve)

10.2 IMPACT ON SOCIAL ENVIRONMENT

The potential for social and economic impacts will arise through a range of direct Project activities as well as indirect activities. This section provides an assessment of the key socio-economic issues identified during the study. The identification of key issues was based on:

- the Final Scoping Report;
- a review of project related information, including other specialist studies;
- interviews with key informants as well as focus group meetings with interested and affected parties (I&APs);
- comments received from I&APs through the public participation process;
- experience of the authors with the area and local conditions; and
- experience with other mining projects.

The identified impacts will occur as a result of direct Project activities, including the presence of a large workforce, as well as the in-migration of job-seekers to the broader area. The impacts assessed in this chapter include:

- economic impacts as related to:
  - employment;
  - training and skills development;
  - procurement of goods and services; and
  - economic diversification; and
  - unmet expectations and associated social unrest.

- infrastructure and services impacts as related to direct Project activities:
  - increased pressure on infrastructure and services;
  - groundwater resources; and
  - road infrastructure.

- infrastructure and services impacts as related to influx of job-seekers:
  - increased pressure on infrastructure and services; and
  - road infrastructure.

- health impacts as related to direct Project activities:
  - communicable diseases; and
  - road traffic accidents.

- health impacts as related to influx of job-seekers:
  - communicable diseases; and
  - road traffic accidents.

- Quality of Life and Cultural Heritage Impacts
  - relations between locals and migrants;
  - social pathologies; and
  - cultural and social values.

10.2.1 Key Social Considerations

Impacts Associated with Influx

One of the most significant factors that will cause/exacerbate some of the identified socio-economic impacts will be the in-migration of workers and job-seekers to the area. They are likely to originate from other areas in the NDM, province, as well as the rest of South Africa and internationally.

The majority of the migrants will anticipate opportunities linked to employment, procurement, small business development and other general community benefits. *Section 10.2.2* provides detail on the expected number of job opportunities that will be created for the construction and operation phases as well as the proportion of local workers and those who are likely to originate from other areas. Taking into account the family members or dependants who might relocate with the workers and the job-seekers, the population in the LM is likely to increase significantly.

Given the length of the Project life and the number of migrant workers expected, the presence of in-migrants will have an impact on the local communities in the direct area of influence. Where relevant, the impacts associated with the influx of job-seekers have been assessed as discrete impacts to those associated with the in-migration of Project-related workers. Given the distribution of the settlements (see *Figure 6.2*) in relation to the Project site, impacts resulting from the influx of job-seekers will primarily be experienced in the settlements of Pofadder and Pella; whereas, impacts associated to the in-migration of workers will be experience in Aggeneys. The specific impacts that will be exacerbated by the influx of job-seekers include:

- infrastructure impacts as related to:
  - housing;
  - health and education;
  - water and sanitation;
  - electricity; and
  - refuse removal;
- health impacts as related to:
  - increase in communicable diseases; and
  - increase in the risk of traffic accidents due to increase in traffic volumes;
- unmet expectations and associated social unrest;
- increased tension between locals and in-migrants;

Socio-economic Impacts

During the expected lifespan, the Project is expected to contribute positively to the local, regional and national economy in the following ways:

- creation of direct and indirect employment
- training and development opportunities
- procurement of goods and services; and
- increased economic diversification.

The project has an anticipated operational lifespan of 19 years. During this time the economic impacts of the project will be positive; however, Project decommissioning and closure will impact on the economy negatively as a result of economic divestment, job losses and decreased income in the local economy.

10.2.2 *Employment*

Table 10.27 Impact Characteristics: Employment Opportunities

Summary	Construction	Operation	Decommissioning/ Post Closure
Project Aspect/ activity	Creation of employment opportunities.	Creation of employment opportunities.	Loss of employment opportunities.
Impact Type	Direct and indirect.	Direct and indirect.	Direct and indirect
Stakeholders/ Receptors Affected	Job seekers.	Job seekers.	Job seekers.

Employment opportunities will be generated through direct, indirect and induced employment opportunities during all Project phases.

- direct opportunities are those jobs with BMM, both permanent and temporary;
- indirect opportunities are the jobs with the contractors and suppliers; and
- induced employment arises from increased spending in the local area as a result of increased disposable income and demand for additional goods and services.

The Project is expected to create an estimated 3,200 employment opportunities during the construction phase. The construction phase jobs are expected to last an average of 19 months over a period of 36 to 42 months. Approximately 850 permanent positions will be created by the Project during the operation phase. The Project will require highly skilled, semi-skilled and unskilled workers to undertake the construction; see *Chapter 3* for the Project description.

There are high expectations amongst the local population associated with employment opportunities that will be brought about by the Project. Illiteracy and a lack of skills are, very high in the area with the majority of the population having some secondary schooling and only 18 percent of the LM having completed high school. The lack of other industries and formal employers in the LM means that the pool of experience in the local workforce is limited. In addition, there are currently no accredited professional training opportunities in the LM. An influx of migrant job-seekers into the area will increase competition for employment opportunities. It is likely that migrant job-seekers will come from other areas of NDM such as Steinkopf, Nababeep and Kleinsee, where there have been recent mine closures as well as from other parts of the Province such as Kathu, Postmasburg and Kuruman all of which are mining areas. These migrant job-seekers will have gained skills in mining and construction in large-scale projects, which will be an advantage in seeking work positions within the Project. As such, they are likely to out-compete local job-seekers.

In essence, local workers are expected to be qualified to fill unskilled positions at first, whilst a limited number of people will be sufficiently qualified for the semi-skilled and highly skilled positions. According to the Economic Specialist Study (See *Annex G*) it is estimated that 11 percent of workers will come from the LM across all skills levels for the construction phase. Technically skilled personnel required for the construction and operation of the Project are limited in the LM and estimated to contribute three percent towards the highly skilled labour of the Project. Other parts of the NDM, Province and country make up 87 percent of the labour requirement and ten percent of the highly skilled labour is expected to come from other countries.

In addition to the direct employment opportunities available to local people, there will be a number of indirect and induced employment opportunities generated through the Project for both the construction and operation phases. Indirect employment will be created through the supply chain and procurement of local goods and services. Induced employment will also be created through increased spending in the economy by people employed to work on the Project. However, given the limited goods and services available to the Project in the LM, it means that indirect employment opportunities are likely to be limited. There will however be induced employment due to an increase in services linked to greater demand. Such services include informal (spaza) shops, salons, restaurants, accommodation, petrol attendants etc.

Mine decommissioning and closure will result in the loss of jobs for those employed to work for the Project, as it scales down. The job losses will not only be experienced by the direct employees of the Project, but those employed in the supply chain as the procurement needs of the Project will change. Previously induced employment opportunities, also risk job losses as a result of diminished demand. During the same time, some new temporary employment opportunities will arise for those who specialise in mine decommissioning and closure processes; however, these will be limited and highly specialised jobs.

Impact Assessment

Construction

The impact will be **positive** and **direct** as related to the creation of direct employment opportunities and **indirect** as it relates to indirect and induced jobs. The magnitude of the impact will be **medium** during the construction phase. The magnitude is linked to the duration of the employment opportunities, quality/level of employment, and the degree to which local workers will secure the employment opportunities. The duration will be short term as jobs will last on average 19 months. The impact will be experienced at the local, regional, national and international levels as the employment opportunities will be extended to people from outside the country. The scale of the impact will be **medium** as the Project will provide employment to an area with limited opportunities. However, based on the employment estimates above, approximately 350 employment opportunities will be made available at the local level; thus the number of people locally who will be employed during the construction phase is likely to be low in comparison with the number of job-seekers in the Project area. The frequency of employment opportunities will be occasional as these opportunities will become available on average once every 19 months when contracts come to an end. The sensitivity of people locally will be **medium** for despite the exceptionally high unemployment rate, the skills levels are such that local people will not be able to take up the employment opportunity. The sensitivity will be **medium** for people at the regional level and negligible at other levels. The pre-mitigation significance level is likely to be ***moderate positive*** during the construction phase.

Box 10.14 Summary of Construction Impacts: Employment Opportunities

Nature: Construction activities would result in a **positive direct** impact on employment opportunities

Sensitivity/Vulnerability/Importance of Resource/Receptor – Medium.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Medium.

- Extent: The extent of the impact is **International.**
- Duration: The expected impact will be **short term.**
- Scale: The impact will result in **Medium changes** to the resource/ receptor.
- Frequency: The frequency of the impact will be **occasional.**
- Likelihood: Employment opportunities will **definitely** be generated.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MODERATE (+).

Degree of Confidence: The degree of confidence is **high**.

Operation

The impact of employment creation at the operational phase will be **positive** and **direct** as well as **indirect** as it relates to indirect and induced employment. The magnitude of the impact will be **medium** as is linked to the duration of the employment opportunities, quality/level of employment, and the degree to which local workers will secure the employment opportunities. The duration will be long term for those employed during the operation phase and the extent will be international because employment will extend to people at all levels. The scale of the impact will be medium for the operation phase as the Project will aim to create the majority of employment opportunities at the local and regional levels, areas with limited opportunities. The number of people who will be employed during the operational phase is low in comparison to construction phase; however these jobs will be permanent. The frequency of the impact will be constant. The sensitivity will be **medium** at the local and regional level as a key contributor to employment but **low** at the national and international level. The pre-mitigation significance level is likely to be ***moderate positive*** during the construction phase.

Box 10.15 *Summary of Operation Impacts: Employment Opportunities*

Nature: Construction activities would result in a **positive direct** impact on employment opportunities.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Medium.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Medium.
- Extent: The extent of the impact is **International.**
- Duration: The expected impact will be **long term.**
- Scale: The impact will result in **Medium changes** to the resource/receptor.
- Frequency: The frequency of the impact will be **constant.**
- Likelihood: Employment opportunities will **definitely** be generated.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MODERATE (+).

Degree of Confidence: The degree of confidence is **high**.

Decommissioning and Closure

The impact on employment will be **negative**, **direct** and **indirect** as related to supply chain job losses as well as **induced** because of reduced demand for services in the local communities The magnitude of the impact will be **large** due to the limited opportunities available at the local and regional levels. This is also linked to the extent, duration, scale and frequency. The extent of the impact will be local, regional and to a limited degree national and international. The duration of the impact will be permanent and the scale will be large at the local and regional level but minor at the national and international level. The frequency will be constant. The sensitivity of people at the local and regional level will be **high** in general but **low** for those at the national and international level. The pre-mitigation impact significance is rated as ***major negative.***

Box 10.16 *Summary of Decommissioning Impacts: Employment Opportunities*

Nature: Decommissioning activities would result in a **negative direct** impact on employment opportunities.

Sensitivity/Vulnerability/Importance of Resource/Receptor – High – Low.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Large.
- Extent: The extent of the impact is **International.**
- Duration: The expected impact will be **permanent.**
- Scale: The impact will result in **Large changes** to the resource/receptor.
- Frequency: The frequency of the impact will be **constant.**
- Likelihood: Employment opportunities will **definitely** be generated.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MAJOR (-).

Degree of Confidence: The degree of confidence is **high.**

Mitigation and Enhancement Measures

The mitigation and enhancement measures presented below indicate general mitigation measures that are applicable to all phases followed by specific measures for each phase of the project.

Objective:
The objective of the mitigation and enhancement measures is to optimise opportunities for employment of local people (LM) and of South Africans in general as well as to assist employees and local communities to prepare for closure.

<u>General: Enhancement Measures</u>

- BMM will establish a recruitment and human resources management policy that is aligned with South African labour legislation and ILO requirements. The policy should address but not be limited to the following:

  - specific labour requirement such as the number of people, professions and specific skills required;

  - establishment of a recruitment committee consisting of local community representatives, the LM, BMM and Vedanta with the aim of identifying and employing local people for available employment opportunities;

  - transparency in the recruitment procedures as well as monitoring to ensure those that are employed are eligible for employment;

  - the monitoring function will either by conducted by the recruitment committee or by an independent consultant as is appropriate;

  - promote the employment of women as a means to ensure gender equality is attained in accordance with Broad-based Black Economic Empowerment (BBBEE) policies of South Africa; and

  - prioritisation of residents in the LM over people from other parts of the NDM and country should the necessary skills be available.

- BMM will partner with the NDM and LM to establish a labour centre. The centre will focus on the following services:

  - posting of employment opportunities;

  - compilation of a database of the local and regional labour force (skilled, semi-skilled and skilled); and

    - providing basic training (including labour laws and financial management training). The training course will be targeted mainly to people from the NDM and LM.

- All contractors will be required to recruit and manage personnel in terms of BMM's recruitment and human resources management policy, where practical.

- BMM will provide all its local workers with induction/orientation. As part of the orientation process, brochures will be provided on financial management and the country's labour laws. The brochure must be in the local languages spoken by employees, simple and easy to understand.

- BMM will implement a grievance procedure that is easily accessible to stakeholders, through which complaints related to contractor or employee road use infringements (eg speeding, accidents) can be lodged and responded to. BMM will respond to all such complaints. Key steps of the grievance mechanism include:

    - circulation of contact details of 'grievance officer' or other key contact;

    - awareness raising among local communities (including all directly affected and neighbouring farmers) regarding the grievance procedure and how it works; and

    - establishment of a grievance register to be updated by BMM, including all responses and response times.

<u>Construction: Enhancement Measures</u>

- BMM will advertise job opportunities and criteria for skills and experience needed through local, regional and national media (including radio), at least three months ahead of recruitment. This information should also be provided to all relevant authorities, community representatives and organisations on the stakeholder database.

- No employment will take place at the entrance to the site. Only formal channels for employment will be used, however these channels need to be accessible.

- BMM to ensure that all local workers open banking accounts, into which their wages will be paid.

Operational: Enhancement Measures

- BMM will implement a skills and development training programme;
- BMM will implement a bursary scheme aimed at members from the local community.

Decommissioning and Closure: Mitigation Measure

- BMM will start conversations about the closure process with all employees at the peak of the operations.

Residual Impacts

Assuming that the above mitigation measures are implemented, the anticipated impact on employment creation at the local level is likely to increase over time. The significance rating of the construction and operation phase will be ***major positive***. The decommissioning and closure the significance rating will decrease to ***moderate negative***.

Table 10.28 Pre- and Post- Mitigation Significance: Employment opportunities

Phase	Significance (Pre-mitigation)	Residual Significance (Post–mitigation)
Construction	MODERATE (+ve)	MAJOR (+ve)
Operation	MODERATE (+ve)	MAJOR (+ve)
Decommissioning and Post Closure	MAJOR (-ve)	MODERATE (-ve)

10.2.3 Training and Skills Development

Table 10.29 Impact Characteristics: Training and Skills Development

Summary	Construction	Operation	Decommissioning/ Post Closure
Project Aspect/ activity	Increase training and skills development.	Increase training and skills development.	Increase training and skills development.
Impact Type	Direct and indirect.	Direct and indirect.	Direct and indirect.
Stakeholders/ Receptors Affected	Mine employees.	Mine employees.	Mine employees.

Those people who are employed via the Project (directly and indirectly) will also receive training and that will significantly enhance their skills, thus improving their potential for future employment. This will be achieved by on-the-job training (1) , as well as through training courses on production and on Health, Safety and Environment (HSE) standards required for the Project, as are common to the mining sector. This will also be a positive impact amongst employees of the suppliers and contractors, who will have to meet particular production, operational, and quality standards as required by the Project.

Long lasting and sustained benefits can be expected for businesses and their employees that have the opportunity to form part of the Project's supply chain, in the form of:

(1) The on-the-job training will be limited to health and safety training as well as induction training (pers. com. Ralph Losper, 11 February 2013).

- enhanced work experience;
- delivery capacity; and
- training.

This will result in an increase in the percentage of local people employed in semi-skilled and skilled jobs over the Project's lifespan.

Decommissioning and closure will involve large scale downscaling and retrenchment of the workforce over a number of years. By that time however, a large number of local, regional and national professionals will have worked on the Project, and will be equipped to work on other such projects. Closure will have a considerable impact on the youth, as they will be in the prime of their working lives at the time of decommissioning, with significant earning potential, and demands on their income (ie. young families). Because training and skills development will cease after closure of the Project, there is little value in rating the 'impact' for the decommissioning and closure phase separately. It should be noted that those that have benefitted during the construction and operation phases of the Project will continue to benefit as they would have become more employable. This is assuming that there are other mining or industrial projects that could absorb the workforce at the time of decommissioning. The former Project workers are likely to have a significant advantage when competing for similar types of employment opportunities as a result of their training and skills developed.

Impact Assessment

Construction, Operation, Decommissioning and Closure

The enhancement and upgrade of skills resulting from the Project will be experienced as a **positive** impact through **direct** opportunities (permanent and temporary) at the mine and **indirect** opportunities through the supply chain. The magnitude of this impact is linked primarily with the type, manner and style of training, as well as the opportunity to practice the skills learnt; as such it is rated as **small** during the construction and operation phases of the Project. This impact will be experienced locally as related to the Project, and regionally, nationally and internationally as related to the supply chain. Skills development will be experienced in the short term as related to the construction and decommissioning activities, and during the operation phase this impact will be long term. The scale of the impact will be medium, given the poor skills at the local level, but the frequency will be occasional as the available information suggests that training will be focussed on induction training as well as health and safety training.

People will be able to adapt to the opportunity as long as they are provided with correctly targeted skills training (given the low baseline literacy and skills levels), making them of **medium** sensitivity to this impact. It is likely that sensitivity amongst people from Pofadder and Pella will be higher given their higher levels of vulnerability. The pre-mitigation significance level will be ***minor positive*** for the life of the Project.

Box 10.17 Summary of Construction, Operational and Decommissioning Impacts: Training and Skills Development

Nature: Construction, operation and decommissioning activities would result in a **positive direct** impact on training and skills development.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Medium.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Small.
- Extent: The extent of the impact is **local – international.**
- Duration: The expected impact will be **short to long term.**
- Scale: Medium.
- Frequency: Occasional.
- Likelihood: Likely.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MINOR (+).

Degree of Confidence: The degree of confidence is **medium**.

Mitigation Measures

The mitigation measures presented below indicate general mitigation measures that are applicable to all phases followed by specific measures for each phase of the project.

Objectives:
The objective of the mitigation measures is to ensure the enhancement and upgrade of skills and experience, accrued through working for the Project or in the supply chain. In addition, it is to maximise the number of local and regional employees during the operation phase.

General: Mitigation Measures

- BMM, in partnership with the local municipality, local education and training NGOs and CBOs, will develop a Training Plan that enhances skills in the area. The Plan should:
  - identify the skills gaps (between existing skills and Project needs) and initiate mechanisms to train local people to meet the Project's needs;
  - identify the particular needs of the youth and women, based on feedback from stakeholders; and
  - prioritise the youth and women for training programs.
- All capacity building and skills development initiatives and commitments for core and non-core mining skills (including sustainable alternative

livelihoods) will be defined as commitments in the Mine's Social and Labour Plan (SLP).

- BMM will support the development of literacy enhancement programmes for the local community, in coordination with the local authorities, as part of the community development plans.

- BMM will provide local and national scholarships throughout the life of the project to recognised public and private universities for courses that are related to both core and non-core mining skills.

<u>Construction: Enhancement Measures</u>

- BMM will begin training potential candidates from the LM for the construction phase during the pre-construction phase to maximise local employees during the construction phase.

- BMM will begin training potential candidates from the LM and NDM for operation phase positions during the construction phase. Those candidates who display sufficient capacity to develop their skills and deliver high performance will be given priority.

<u>Operation: Enhancement Measures</u>

- On-the-job performance and training will be monitored through performance reviews. Training needs will be identified and provided on an on-going basis to foster continuous learning during the operation phase.

- BMM will begin training potential candidates from the LM and NDM for operation phase positions during the construction phase. Those candidates who display sufficient capacity to develop their skills and deliver high performance will be given priority.

<u>Decommissioning and Closure: Enhancement Measures</u>

BMM will identify and provide training to support sustainable alternative livelihoods (preferably aligned with priority areas as defined in the Integrated Development Plan) related to other sectors in the LM such agriculture and tourism in order to build skills that are not dependant on mining activities.

Residual Impacts

With the implementation of the above mitigation measures, the anticipated impact on enhancement and upgrade of skills and experience will increase from ***moderate positive*** significance for Project construction and operation. No further enhancements will be experienced during decommissioning and closure of the Project.

Table 10.30 Pre- and Post- Mitigation Significance: Training and Skills Development

Phase	Significance (Pre-mitigation)	Residual Significance (Post–mitigation)
Construction, Operation and Decommissioning and Post Closure	**MINOR (+ve)**	**MODERATE (+ve)**

10.2.4 Procurement of Goods and Services

Table 10.31 Impact Characteristics: Procurement and Services

Summary	Construction	Operation	Decommissioning/ Post Closure
Project Aspect/ activity	Increase in procurement and services.	Increase in procurement and services.	Increase in procurement and services.
Impact Type	Direct.	Direct.	Direct.
Stakeholders/ Receptors Affected	Local and regional communities.	Local and regional communities.	Local and regional communities.

The planning, design, construction and operation of the Project will require the purchase of equipment and other goods and services and will generate large contracts, particularly during construction. The majority of these will be for highly specialised and technical work and will be provided by specialist providers of goods and services. There is potential to feed into this supply chain for local businesses in the LM and NDM.

However, locally owned businesses in the LM will have limited capacity to meet the standards of quality and sophistication required by the Project. Despite this, the Project will provide a major boost to suppliers in the LM during construction phase. The estimated expenditure of the Project across geographic areas for the construction phase is reflected below.

Table 10.32 Construction Phase Expenditure per Geographic Area

Construction component	Anticipated spend on Khai-Ma municipal area suppliers	Anticipated spend on suppliers from the rest of the Namakwa District	Anticipated spend on suppliers in the rest of the Northern Cape	Anticipated spend on suppliers in the rest of SA	Anticipated spend on imports
Mine & Pre-Stripping	R 0	R 762 000 000	R 381 000 000	R 2 667 000 000	R 0
Concentrator plant	R 0	R 313 500 000	R 156 750 000	R 1 097 250 000	R 0
Housing	R 40 500 000	R 202 500 000	R 135 000 000	R 162 000 000	R 0
Infrastructure	R 0	R 463 500 000	R 463 500 000	R 1 158 750 000	R 231 750 000
Total	**R 40 500 000**	**R 1 741 500 000**	**R 1 136 250 000**	**R 5 085 000 000**	**R 231 750 000**

Source: Economic Specialist Study (Independent Economic Researchers, 2013).

The Project expenditure during the construction phase will primarily be for the construction of temporary worker accommodation. It is expected that

R40.5 million of the total procurement spend will be spent in the LM during the construction phase. In comparison to the expenditure in other areas this amounts to approximately 0.5 percent of the total (See *Table 10.32*). The procurement of services and consumables will be managed to ensure that high standards of quality and health and safety are maintained. Consumables (eg. food) will need to be purchased in large quantities while meeting stringent quality, health and safety standards. This requirement will mean that it is unlikely that local suppliers will be able to demonstrate an appropriate level of quality, health and safety management.

There is a general lack of established businesses that have the capabilities to deliver large quantities and meet the strict health and safety criteria in the LM thus the overall benefits to the LM will be limited. It is likely that many of the specialised procurement needs of the operation will be fulfilled by national companies. While the smaller and less experienced local and regional (LM and NDM level) businesses will supply goods and services such as: civils and construction materials, hospitality services (eg. accommodation, catering), transport, vehicle servicing and security services. For those local and regional companies from which goods and services are procured, there will be long lasting and sustained benefits to the businesses and their employees. The benefits will be through increased experience, capacity building and training, particularly in having to meet more stringent international requirements.

The operational cost will increase with the increase in production. According to the Economic Specialist study (see *Annex G*) the operational costs will increase from R528 million during the first year to R1.7 billion in the fifth year when full production levels are anticipated. *Table 10.33* below shows the estimated operational expenditure for each of the geographical areas.

Table 10.33 Estimated Operational Expenditure at Full Production per Geographic Area

Cost component	Anticipated spend in the Khai-Ma municipal area	Anticipated spend in the rest of the Namakwa District	Anticipated spend in the rest of the Northern Cape	Anticipated spend in the rest of SA	Anticipated spend on imports
Staff	R 352 500 000	R 44 062 500	R 22 031 250	R 22 031 250	R 0
Fuels	R 0	R 0	R 0	R 352 500 000	R 0
Electricity	R 0	R 0	R 0	R 176 250 000	R 0
Water	R 52 875 000	R 0	R 0	R 0	R 0
Transport	R 5 287 500	R 21 150 000	R 5 287 500	R 21 150 000	R 0
Chemicals	R 0	R 0	R 10 575 000	R 42 300 000	R 0
Maintenance	R 13 218 750	R 52 875 000	R 52 875 000	R 145 406 250	R 0
Overheads	R 0	R 12 337 500	R 6 168 750	R 98 700 000	R 6 168 750
Outsourced activities	R 12 337 500	R 49 350 000	R 24 675 000	R 148 050 000	R 12 337 500
Total	**R 436 218 750**	**R 179 775 000**	**R 121 612 500**	**R 1 006 387 500**	**R 18 506 250**

Source: Economic Specialist Study (Independent Economic Researchers, 2013).

The operational phase activities associated with the Project will provide opportunities for local business growth and development. It is estimated that at full production approximately R436 million will be spent in the LM per year (approximately 25 percent of total operational expenditure). This compares to 10 percent in the NDM and seven percent in the Province. Procurement locally will assist in creating income and building a more stable and diverse economy. Furthermore, as the Project develops and there is increased demand for goods and services, employees and in-migrants will have the opportunity to establish local businesses (see *Section 10.2.5* as related to economic diversification). The induced employment opportunities (as mentioned in *Section 10.2.2*) will be aligned with this expenditure and growth at the local, regional and national levels.

The procurement needs for decommissioning and closure has not yet been defined and therefore cannot be assessed at this time.

Impact Assessment

Construction

Given the current scarcity of suitably resourced and qualified local business, the **positive** and **direct** impact associated with procurement will primarily be experienced at the regional, national and international level. The magnitude of the procurement impact will be **small** at the local level but **large** at the regional and national levels. Procurement during the construction phase will be short to medium term. The extent of the impact will be international. The scale of the impact will be medium across all levels in the context of current procurement activities at each level. The frequency will be constant. The sensitivity will be high in the LM but medium across other levels. The impact significance is rated as ***moderate positive*** during the Construction

Box 10.18 Summary of Construction Impacts: Procurement and Services

Nature: Construction activities would result in a **positive direct** impact on procurements and services.

Sensitivity/Vulnerability/Importance of Resource/Receptor – High.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources

Impact Magnitude – Small – Large.

- Extent: The extent of the impact is **local – international.**
- Duration: The expected impact will be **short-medium term.**
- Scale: The impact will result in **medium changes** to the resource/receptor.
- Frequency: The frequency of the impact will be **constant.**
- Likelihood: Increase in procurement will **definitely** occur.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MODERATE (+).

Degree of Confidence: The degree of confidence is **high**.

Operation

The impact on procurement of goods and services during operation will be **positive** and **direct**. The magnitude of the impact is **medium** as a function of the duration, extent, scale and frequency. The duration of the operation phase impact will be medium to long term. The extent of the impact will be international and the scale of the impact will be large at the local level given that 25 percent of the total procurement spend will be in the LM. The frequency of the impact will be constant. The sensitivity will be high for businesses in the LM but medium to low with widening extent. The overall significance of the impact is rated as ***moderate positive***.

Box 10.19 ***Summary of Operation Impacts: Procurement and Services***

Nature: Operational activities would result in a **positive direct** impact on procurements and services.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Low – High.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Medium.
- Extent: The extent of the impact is **international.**
- Duration: The expected impact will be **medium - long term.**
- Scale: The impact will result in **large changes** to the resource/receptor.
- Frequency: The frequency of the impact will be **constant.**
- Likelihood: Increase in procurement will **likely** occur.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MODERATE (+).

Degree of Confidence: The degree of confidence is **medium**.

Enhancement Measures

The enhancement measures presented below indicate general enhancement measures that are applicable to all phases followed by specific measures for each phase of the project.

Objective:
The objectives are to optimise opportunities for procurement of goods and services from vendors and suppliers in the LM and NDM, where possible; and to build capacity of the local supply chain in line with BMM's local procurement policy.

General: Enhancement Measures

- BMM will disseminate information regarding procurement opportunities and specific health, safety and quality requirements during pre-construction phase in a manner that is accessible.

- BMM will establish a local business development centre through which assistance is provided to local business to meet the necessary tender requirements.

- BMM will assist with building supplier capability. This will entail the following:

- o audit of suppliers in the LM and NDM;
- o identify skills gaps and development needs;
- o develop a supplier training programme; and
- o target vulnerable groups to benefit from the supplier training initiative.

Construction: Enhancement Measures

- BMM will split certain contracts to allow a number of small businesses that are BBEE compliant to provide goods and services as far as possible, to facilitate partnerships between large and small contractors. Rather than allow the supply to be monopolised by one large contractor.

Operation: Enhancement Measures

- As part of the tendering process, large companies will need to demonstrate how they will partner with local or regional companies to jointly supply a service if it is not possible to split a contract

- Through a tendering process, the Project will invite recognised national and international organisations, institutions or NGOs to prepare and implement a programme for training, promoting and supporting entrepreneurship and small business development.

Residual Impact

Assuming that the above mitigation measures are implemented, the anticipated impact on procurement is likely to increase over time at the local level to ***major positive*** significance during the construction and ***major positive*** for the operation phase.

Table 10.34 Pre- and Post- Mitigation Significance: Procurement and Services

Phase	Significance (Pre-mitigation)	Residual Significance (Post–mitigation)
Construction	**MODERATE (+ve)**	**MAJOR (+ve)**
Operation	**MODERATE (+ve)**	**MAJOR (+ve)**

10.2.5 Economic Diversification

Table 10.35 Impact Characteristics: Economic Diversification

Summary	Construction	Operation	Decommissioning/ Post Closure
Project Aspect/ activity	Increase in demand for goods and services.	Increase in demand for goods and services.	Increase in demand for goods and services.
Impact Type	Direct and indirect.	Direct and indirect.	Direct.
Stakeholders/ Receptors Affected	Local and regional communities.	Local and regional communities.	Local and regional communities.

As the Project develops, the increased demand for goods and services from the Project, employees and in-migrants should create commercial opportunities for local businesses/ entrepreneurs. These commercial opportunities will result in diversification of the economy of the LM and NDM. People will have access to economic opportunities associated with the Project, its supply chain and in the businesses providing goods and services. Although construction activities will provide a lot of opportunity for economic and business development, other constraints such as access to finance, transport, and limited infrastructure and skills, will continue to constrain the level and sophistication of local development. Larger business from outside the local area, including chain stores and foreign-owned companies, could potentially take up the opportunity that the Project provides and are likely to establish a presence in the settlements of Pofadder and Aggeneys.

The influx of migrant job-seekers will bring people with different experiences, knowledge and demands. This will supplement the existing economic and livelihood activities serving to diversify the local economy. It is expected that local economic development policies will be implemented throughout the life of the Project, in line with the proposed social and labour plan (SLP) that is being developed for the Project. The SLP will in part focus on economic diversification in advance of mine closure. BMM anticipate that the SLP will build local resilience to change in anticipation of mine closure.

At the time of decommissioning and closure, it is likely that there will be a high reliance on the Project supply chain and the demand for goods and services created by the Project employees and their families. The Project and its employees will no longer be contributing towards the economy in the same way. This impact will be acutely experienced by the youth who will be at the prime of their wage-earning lives at the time of closure, and are likely to have a particularly high demand for goods and services that they would have become accustomed to.

Construction and Operation
Economic development and diversification will be experienced as a **positive** impact for the majority of stakeholders (ie those who value the change and development, specifically the youth). This impact will be **direct** as related to the Project activities and demands and **indirect** as related to job-seekers. The overall magnitude of this impact will be **medium** for the life of the Project. The impact will be experienced for the long term. Economic diversification is likely to occur at the local and regional level. For those who will take up business opportunities, the scale will be medium**.** The frequency of the impact will be constant for the construction and operation phase. The sensitivity of communities in settlements in the LM and NDM will be **low** because the Project will not result in the development of various industries, instead there will be greater markets to support the existing economic activities. The significance rating will be ***minor positive*** for construction and operation phases of the Project.

Box 10.20 Summary of Construction and Operational Impacts: Economic Diversification

Nature: Construction and operational activities would result in a **positive direct** impact on economic diversification.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Low.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Medium.
- Extent: The extent of the impact is **local – regional.**
- Duration: The expected impact will be **long term.**
- Scale: The impact will result in **medium changes** to the resource/receptor.
- Frequency: The frequency of the impact will be **constant.**
- Likelihood: Economic diversification will **likely** be improved.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MINOR (+).

Degree of Confidence: The degree of confidence is **high**.

Decommissioning and Closure

The decommissioning ad closure phase will result in a decrease in the economic diversification of the LM. The impact on economic diversification will be **direct and negative.** The magnitude will be **medium** as related to the duration, extent, scale and frequency. The impact will be permanent for the LM. The scale of the impact will be medium as the economic diversity will not have changed significantly, although more employment opportunities would have resulted from the Project. The frequency will be constant. The sensitivity at the local level will be **high** given the dependency on the supply chain of the Project as well as the induced economic spin-offs. The impact significance is rated as ***major negative*** for the decommissioning and closure phase of the Project.

Box 10.21 Summary of Decommissioning Impacts: Economic Diversification

Nature: Decommissioning activities would result in a **negative direct** impact on economic diversification.

Sensitivity/Vulnerability/Importance of Resource/Receptor – High.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Medium.
- Extent: The extent of the impact is **local.**
- Duration: The expected impact will be **permanent.**
- Scale: The impact will result in **medium changes** to the resource/receptor.
- Frequency: The frequency of the impact will be **constant.**
- Likelihood: Economic diversification will **likely** be lost.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MAJOR (-).

Degree of Confidence: The degree of confidence is **high.**

Mitigation and Enhancement Measures

The mitigation and enhancement measures presented below indicate general mitigation measures that are applicable to all phases followed by specific measures for each phase of the project.

Objective:
The main objective is to enhance economic diversification in the LM and the NDM.

General: Enhancement Measures

- BMM will assist relevant authorities to update their local economic development plans for the LM and NDM.

- BMM will support the relevant authorities as far as possible in implementing selected components of the local economic development plans.

Construction and Operation: Mitigation Measures

Implement all mitigation measures stipulated to enhance the levels of employment, skills development and procurement in the LM and NDM, giving priority to vulnerable groups such as women, and ensuring that the youth are empowered to maximise these opportunities.

Decommissioning and Closure: Enhancement Measures

- BMM will invest in and promote sustainable projects, training and education to help communities to develop alternative livelihoods and to ensure that economic dependence on the Project is limited.

Residual Impact

With implementation of the above mitigation measures, the anticipated impact will remain as ***minor positive*** significance for the construction and operation phases of the Project and ***moderate negative*** for the decommissioning and closure phases of the Project. Without implementing the mitigation measures the impact significance will decrease adding no benefit or value to the LM.

Table 10.36 Pre- and Post- Mitigation Significance: Economic Diversification

Phase	**Significance (Pre-mitigation)**	**Residual Significance (Post–mitigation)**
Construction	**MINOR(+ve)**	**MINOR (+ve)**
Operation	**MINOR (+ve)**	**MINOR (+ve)**
Decommissioning and Post Closure	**MAJOR (-ve)**	**MODERATE (-ve)**

10.2.6 Unmet Expectations and Potential for Social Unrest

Table 10.37 Impact Characteristics: Unmet Expectations and Associated Social Unrest

Summary	**Construction**	**Operation**	**Decommissioning/ Post Closure**
Project Aspect/ activity	Unmet expectations for employment.	Unmet expectations for employment.	Unmet expectations for employment.
Impact Type	Indirect.	Indirect.	Indirect.
Stakeholders/ Receptors Affected	Local communities.	Local communities.	Local communities.

The communities of the settlements in the LM settlements have high expectations of benefitting from the Project, specifically related to economic opportunities (such as employment and procurement). There is likely to be disappointment, anger and resentment (specifically with the communities in the LM) if these employment and procurement opportunities do not materialise and meet the high expectations. In the context of limited skills and experience in the LM, it is probable that there will be high levels of unmet expectations.

Increasingly, in South Africa unmet expectations, lead to unrest and conflict. It is important for BMM to proactively manage these expectations, as levels of conflict and tension can escalate to conditions of unmanageable disruption which could affect BMM's social license to operate.

Impact Assessment

Construction and Operation
The impact of unmet expectations will be experienced as an **indirect** and **negative** impact. The magnitude of the impact is expected to be **medium**. The impact will be localised to the communities in the settlements of Pofadder and Pella and to some extent Witbank and Onseepkans [(1)]. The duration of the impact will be short to long–term for the construction phase and throughout the operational phase. The scale of the impact will be medium to large as people might feel that the Project has not benefited them or are not satisfied with the degree of benefits derived from the Project. The frequency of the impact is likely to be often at first but reduce to occasional as the communities derive greater benefits from the Project and the relationship with BMM matures. The sensitivity of the receptors is considered to be **high** and the impact is likely to occur because of the disparity between the skills available in the LM and the skills required for the Project. Overall the impact is rated as being of a ***major negative*** significance**.** The impact is however variable depending on the receptors and their sensitivity.

(1) Pers. Com. Aurelia J. Jossop, Khai Ma Mayor, 21 June 2012, Pofadder.

Box 10.22 Summary of Construction and Operational Impacts: Unmet Expectations and Associated Social Unrest

Nature: Construction and operational activities would result in a **negative direct** impact in the form of unmet expectations.

Sensitivity/Vulnerability/Importance of Resource/Receptor – High.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Medium.
- Extent: The extent of the impact is **local.**
- Duration: The expected impact will be **short term.**
- Scale: The impact will result in **medium - large changes** to the resource/receptor.
- Frequency: The frequency of the impact will be **often.**
- Likelihood: Unmet expectations will **likely b**e experienced.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MAJOR (-).

Degree of Confidence: The degree of confidence is **high.**

Decommissioning and Closure

In the absence of other major economic activities planned in the area and uncertainty of the mineral resources base as well as the remoteness of the area it is likely that the decommissioning of the Project will result in a decline in the social fabric of the settlements in the LM. Unmet expectations as related to the plans for decommissioning and closure cannot be assessed at this stage as the decommissioning and closure plans have yet to be drafted.

Mitigation Measures

The mitigation measures presented below indicate general mitigation measures that are applicable to all phases followed by specific measures for each phase of the project.

Objective:

The objective is to proactively manage stakeholder expectations throughout the life of the Project.

General: Mitigation Measures

- BMM will develop a detailed Stakeholder Consultation and Engagement Plan (SCEP) that identifies all stakeholders, defines methods and frequency for engagement and defines responsibility for these activities. This plan should be updated on an annual basis.

- BMM will keep the communities regularly informed of on-going Project activities through the ward councillors and community leaders. Method and frequency to be defined in the above-mentioned SCEP.

Construction and Operation: Mitigation Measures

- All concerns regarding jobs and other expectations will be addressed in accordance to the grievance procedure.

- Maximise local employment and procurement.

- Along with the measures undertaken to address the employment and procurement impacts, the following measures should be implemented to manage the impact of unmet expectations.

- clearly advertise criteria for skills and experience needed for available jobs through local, regional and national media; and clearly advertise experience, quality and volume requirements from the supply chain.

Residual Impact

Proactive and effective management of expectations is important. The above mitigation measure will assist in managing expectations. The residual impact will range from ***minor** to **moderate negative*** significance depending how effectively BMM manages their operation, social projects/initiatives and on-going engagement.

Table 10.38 Pre- and Post- Mitigation Significance: Unmet Expectations and Associated Social Unrest

Phase	Significance (Pre-mitigation)	Residual Significance (Post–mitigation)
Construction	**MAJOR (-ve)**	**MINOR (-ve) to MODERATE (-ve)**
Operation	**MAJOR (-ve)**	**MINOR (-ve) to MODERATE (-ve)**

10.2.7 Increased Pressure on Infrastructure and Services (Direct)

Table 10.39 Impact Characteristics: Increased Pressure on Infrastructure and Services

Summary	Construction	Operation	Decommissioning/ Post Closure
Project Aspect/ activity	Increased pressure on public services by the work force.	Increased pressure on public services by the work force.	Increased pressure on public services by the work force.
Impact Type	Direct and indirect.	Direct and indirect.	Direct and indirect.
Stakeholders/ Receptors Affected	Local municipal area.	Local municipal area.	Local municipal area.

The impact on infrastructure and services as related to Project activities specifically refers to the increase in pressure on infrastructure and services in Aggeneys. In general, the local municipality is characterised by poor public infrastructure and services, with the exception of Aggeneys. The infrastructure systems that specifically require upgrading include the

Aggeneys wastewater treatment works and power infrastructure in order to meet the requirements of the Project. BMM currently supplies all bulk infrastructure and services for Aggeneys.

Despite the quality of infrastructure and services provided by BMM in Aggeneys, most are currently operating at capacity. For example, Aggeneys currently has a housing shortage for BMM workers; however the housing backlog is being addressed through housing and transport subsidies which allow BMM employees to live in other settlements. Workers that cannot be accommodated in Aggeneys live in the local communities or in Springbok.

The pressure on bulk infrastructure and services as related to the direct Project activities will largely be addressed by the client as part of their embedded mitigation measures. Upgrade to all bulk infrastructure and services noted below will be required in order to accommodate the growth in population as related to the Project.

The public infrastructure and services that are expected to be impacted include:

- housing;
- healthcare and education;
- water and sanitation infrastructure and supply;
- electricity; and
- refuse removal.

More detail on each of the infrastructure impacts for the different phase of the project life cycle are provided below.

Box 10.23 Housing

The construction phase housing requirement will be for a workforce of approximately 3,200 workers over a period of 36 to 42 months. These workers will be housed in a contractors camp located on the Project site.

An additional 1,000 permanent housing units are projected for the operation phase of the project; these are to be constructed in Aggeneys. The current housing tenure structure is that the existing housing units belong to BMM; however this is set to change. BMM intends to institute a worker ownership scheme in order to decrease the dependency on BMM. The change to the ownership scheme will likely be beneficial for the workers as they will gain an asset. Details of the proposed scheme were not available at the time of this assessment and therefore cannot be commented on further.

Typically the decommissioning and closure phase of a mine results in out-migration from the area in search of employment opportunities elsewhere. The demand for housing will therefore decrease significantly. The proposed changes to the housing tenure scheme will mean that employees will have an asset at the end of the Project life-cycle. It may, however, be difficult to sell the house given the lack of activity in the area and the value of the property is likely to decrease. It is also possible that employees may still owe money on the house, but would likely be without employment as a result of retrenchment.

It should be noted that it may be possible for the community of Aggeneys to derive a positive benefit from the impact on housing in that they may end up with a valuable asset, however this depends on a number of factors, most importantly whether the town of Aggeneys will be sustainable post-closure and whether there will be other major economic activities in the area; all of which are unknown at this stage and thus cannot be rated.

Box 10.24 Health Care and Education

Health care and education infrastructure and services are limited in the LM. *Chapter 6* provides detail of the health care facilities in each settlement in the LM. The Project will result in an influx of workers. During the construction phase workers will likely move to the area without their families as they will be employed on a temporary basis. In comparison, the long term contract or permanent workers are more likely to move to the areas with their families during the operation phase.

The influx of workers during the construction phase will significantly increase the pressure on health care and education facilities. The pressure on the health care system will be as a result of the increase in the number of people in the area. *Chapter 6* provides further detail on the impact of health, which predicts an increase in the communicable diseases and other health disorders as well as an increase in social ills. These impacts will all lead to further pressure on an already limited health care system. During the operation phase less pressure is expected on the health care system because of a dramatic reduction in the number of workers.

The education system will be impacted primarily during the operation phase by an increase in the learner-teacher ratio, affecting the quality of education of each learner. There is only one high school in Aggeneys, which will be significantly impacted as a result of the expected increase in the population size. Linked to the increase in social ills, female learners are at an increased risk of early pregnancy thus exacerbating the already high drop-out rate (See Chapter 6).

The demands on the health and education systems is expected to decrease during decommissioning and post closure as people are expected to migrate elsewhere in search of economic opportunities. The services offered will likely exceed the demands of the local community. Maintaining education and health infrastructure during the decommissioning and closure phase may demand resources that the LM is unable to provide as a result of reduced income resulting from the decrease in the number of ratepayers. The local community would have grown accustomed to a certain level of service which would have been attainable through the assistance of BMM, but it is likely that without such assistance the quality of education and health infrastructure would depreciate over time.

Box 10.25 Water and Sanitation Infrastructure and Supply

The Project will require approximately 730,000 m^3 per annum for the construction phase and 9.12 million m^3 per annum during the operation phase. The Final Scoping Report notes that Pelladrift Water Board is planning to expand and upgrade the water infrastructure in response to growing demand from the settlements of Pofadder, Pella and Aggeneys as well to meet the water demands of the Project.

Project related activities that will require either water or sanitation services include:

- contractor camp;
- temporary housing;
- permanent housing;
- dust suppression dams;
- engineering workshop;
- open pit;

- concentrator plant; and
- construction staff.

Direct impacts as related to the workers will be minimal as worker needs will be accommodated by BMM.

The project activities during the decommissioning phase are similar to those in the construction phase of the project. The closure of the mine will result in workers leaving the area in search of employment elsewhere. The out-migration will result in less pressure on water and sanitation resources. This also translates into a reduction of the number of ratepayers thereby limiting the LM ability to address any water and sanitation upgrade requirements.

Box 10.26 Electricity

The increase in demand for electricity is set to grow as a result of the influx of job-seekers and Project-related workers to the LM. The settlements of Pofadder and Aggeneys will be more sensitive to increased pressure, due to current electricity backlogs and the addition of 1,000 housing units in Aggeneys. The project activities require 10 MW and 70 MW for construction and operation, respectively. A new substation and power line will be constructed for the purposes of the mine activities; this will not be of benefit to the local communities or the LM. As such, the influx of job-seekers will be the primary cause of the additional pressure.

Closure of the mine usually leads to the out-migration of people in search of employment opportunities elsewhere which may result in the stagnation of the settlements. Initially there will be increased pressure on electricity but as people leave the area, the LM will struggle to maintain the service levels as a consequence of a reduced income. In addition, the municipality will no longer have the assistance provided by the Project that they have become accustomed to.

Box 10.27 Refuse Removal

Refuse removal services are limited, similar to the other infrastructure services provided by the municipality. There are four waste facilities which are located in Aggeneys, Pofadder, Pella and Onseepkans. Of these only the Aggeneys waste management facility is registered. Less than 25 t of waste is produced per day in the LM. More detail on the current volumes and types of waste generated is provided in Waste Specialist Report (see Annex G). In addition it should be noted that there are no hazardous waste management facilities in the Northern Cape Province and the closest facility if Vissershoek in Cape Town, Western Cape Province.

The waste that is likely to be generated by the Project will largely be hazardous and the general waste generated is predicted to exceed the capacity of the registered waste management facility. The Waste Specialist Study suggests that the waste management facilities be upgraded and registered. Generally, with an increase in income levels, waste generation per person increases. According to the Waste Specialist report (see *Annex G*) the construction phase is expected to result in the production of an additional 10 t of general waste per day related to Project-related workers.

During the decommissioning and closure phase, less waste will be generated as people migrate out of the LM. The number of ratepayers will decrease which will limit the LM's ability to maintain the service provided. Poor waste management service can impact the health of the local communities. The LM will also be responsible for providing waste management services to the community of Aggeneys post closure placing additional pressure on the LM.

Impact Assessment

Construction

The impact on public infrastructure during the construction phase will be **negative** and **direct** as it is related to the Project activities. The expected activities for each of the public infrastructure components are noted above, but in general the magnitude of the impact to public infrastructure and services will be **medium.**

The extent of the impacts will be local, confined to the LM; with the greatest impacts being felt in Aggeneys. The duration will be short term for the construction phase but will extend into the future Project phases. It is expected that the scale of the impacts to housing, electricity, refuse removal, water and sanitation associated with the Project will be small as the Project is expected to cater for the needs of the Project and its workers through making the necessary upgrades required. Other public infrastructure and services such as health and education may have a greater direct impact initially as the Project may share these resources with the general public as there is little information available to suggest otherwise. The frequency of the impact on infrastructure and services is likely to be constant.

The sensitivity of receptors will be **low** as most of the activity will be experienced on-site during the construction phase. The impact significance is rated as ***minor negative***, given the current lack of infrastructure and services to accommodate the workers.

Box 10.28 ***Summary of Construction Impacts: Increased Pressure on Infrastructure and Services (Influx)***

Nature: Construction activities would result in a **negative direct and indirect** impact on public infrastructure and services.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Low.
<u>Irreplaceability</u>: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Medium.

- <u>Extent</u>: The extent of the impact is **local.**
- <u>Duration</u>: The expected impact will be **short term.**
- <u>Scale</u>: The impact will result in **small changes** to the resource/receptor.
- <u>Frequency</u>: The frequency of the impact will be **constant.**
- <u>Likelihood</u>: Public infrastructure and services will **likely** experience increased pressure.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MINOR (-).

Degree of Confidence: The degree of confidence is **high.**

Operation

The impacts on public infrastructure during the operation phase will be **negative**, **direct** as it relates to Project activities and workers. It is expected that impacts to housing, electricity, water and sanitation as well as refuse removal will be minimal from the Project as the Project is expected to cater for all these needs, however these measures are not yet in place. The impacts to education and health care will remain strained. At the time of the study there was no information available on any proposed embedded mitigation measures to alleviate the pressure on education and health infrastructure. The impact on these services is expected to be greater during the operations phase because workers will likely migrate with their dependants, dramatically increasing the number of people relying on the infrastructure and services. The magnitude of the impact is expected to be **medium** given the existing lack of infrastructure and services**.** The magnitude of the impact is a function of the extent, duration, scale, likelihood and frequency. The extent of the impact is local, limited to the LM, specifically Aggeneys. The duration of the impact will be long term for the duration of the Project life cycle and the scale of the impact will be medium. The frequency of the impact will be constant and the impact is likely to occur.

The sensitivity of the receptors will be **low** due to the significant increase in the population and thus the impact significance is rated to be ***minor negative***.

Box 10.29 Summary of Operation Impacts: Increased Pressure on Infrastructure and Services

Nature: Operational activities would result in a **negative direct and indirect** impact on public infrastructure and services.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Low.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Medium.

- Extent: The extent of the impact is **local.**
- Duration: The expected impact will be **long term.**
- Scale: The impact will result in **medium changes** to the resource/receptor.
- Frequency: The frequency of the impact will be **constant.**
- Likelihood: Public infrastructure and services will **likely** experience increased pressure.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MINOR (-).

Degree of Confidence: The degree of confidence is high.

Decommissioning and Closure

The impacts on infrastructure and services during the decommissioning and closure phase will be **indirect** and **negative**. With decommissioning, Project activities will cease and it is likely that people will migrate out of the area in search of employment opportunities elsewhere. The magnitude of the impact will be **small**. This is as a function of extent, duration, scale, frequency and likelihood. The extent of the impact will be local, limited to the LM and the impact will be permanent. The scale of the impact is likely to be small as the LM together with BMM would have catered for a larger population size, but with out-migration the number of ratepayers would have decreased thus impacting the LM's ability to maintain the public infrastructure and services. The LM's ability to maintain the public infrastructure and services would also be limited without the support of BMM as it is likely that BMM would have provided considerable support to the LM throughout the Project life. The frequency of the impact would be short to long-term depending how long it takes for the LM to adjust to the change.

The sensitivity of stakeholders, most notably the LM as well as the communities of Aggeneys will be **high**. This is due to the high dependency on BMM by the community of Aggeneys and the LM. In addition the LM will be expected to take over the provision of bulk infrastructure and service to the community of Aggeneys. The impact significance is rated as ***moderate negative*** for decommissioning and closure.

Box 10.30 Summary of Decommissioning Impacts: Increased Pressure on Infrastructure and Services

Nature: Operational activities would result in a **negative indirect** impact on public infrastructure and services.

Sensitivity/Vulnerability/Importance of Resource/Receptor – High.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Small.
- Extent: The extent of the impact is **local.**
- Duration: The expected impact will be **permanent.**
- Scale: The impact will result in **small changes** to the resource/receptor.
- Frequency: The frequency of the impact will be **constant.**
- Likelihood: Public infrastructure and services will **likely** experience increased pressure.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MODERATE (-).

Degree of Confidence: The degree of confidence is **high.**

Mitigation and Enhancement Measures

It is important to emphasise that the Project, while meeting its own infrastructure and service requirements, should not take on the LM's responsibility to develop local infrastructure. BMM will form partnerships with the LM and other relevant stakeholders to support the improvements in infrastructure and services. The mitigation measures and enhancement measures presented below indicate general measures that are applicable to all phases followed by specific measures for each phase of the project.

Objectives:
The key objectives of the mitigation measures are as follows:

- limit the extent of the impact on local infrastructure and services in the LM, specifically for Aggenys,;

- meet all the bulk infrastructure requirements for the Project and workers for all phases of the Project;

- enhance the sustainability of the affected communities beyond closure; and

- encourage and support government in improving the levels of infrastructure and services provided in the Project area.

<u>General: Mitigation and Enhancement Measures</u>

- Assist the LM with engineering and town planning services to improve services provided as the LM currently does not have a town planner and is heavily reliant on consulting services, thus limiting their ability to deliver services.

Health and Education

- Provide assistance to the Provincial Department of Health to improve the quality of services and equipment and infrastructure in state facilities.

- Provide assistance to the Further Education and Training (FET) colleges to expand and offer more accredited courses to communities in the LM.

- Provide support and encourage learners to attend school, for example providing transport, career guidance and access to information.

- Extend the internship programme to learners outside of Aggeneys and provide learners with the necessary support to be able to participate in the internship programme.

- Provide bursaries to learners from Grade 10 onwards to attend FET colleges in study areas that are non-mining related but will support sustainable livelihoods locally.

Water

- BMM will apply water saving technology wherever possible.

- BMM will monitor and report on Project water usage and associated effects on the surrounding communities/ farmers. If communities and farmers are negatively affected as a direct result of the Project, immediate and appropriate action will be taken (in collaboration with the relevant authorities).

- BMM will continue to liaise with the Pelladrift Water Board to ensure that the expansion and upgrade of the water infrastructure takes place.

- Raise awareness of the scarcity of water resources in order to encourage people to save water as far as possible as a measure to manage demand.

Refuse Removal

- Employ an on-site waste management company to ensure compliance of general housekeeping rules as well as to manage the waste streams during all phases of the Project.

- Hazardous waste will be collected and disposed of in a registered hazardous waste facility.

- Appropriate waste management facilities will be provided by the Project to minimise the strain on public facilities.

- BMM will institute a recycling facility to collect waste oil, cans, paper and plastics. Local community members are to be employed resulting in job creation.

- Recycle as far as possible.

<u>Construction: Mitigation and Enhancement Measures</u>

Housing

- Appropriate housing and recreational facilities will be provided to Project related staff to minimise the strain on public facilities.

Health

- BMM will provide health care facilities that have the personnel and equipment to handle all worker related illnesses and injuries. If workers require further specialist attention they will be transported to appropriate hospitals. No additional strain will be placed on the local clinic/ facilities.

Education

- Build new or expand educational facilities in Aggeneys to accommodate the children of Project-related workers to ensure that no additional strain is placed on public infrastructure.

Water

- All water and sanitation needs of the Project and workers will be taken care of by BMM and BMM will not exceed their legal water allocation. In doing so BMM will ensure that no additional strain is put on public infrastructure.

Electricity

- BMM will investigate the feasibility of reducing their power demand through renewable energy off-sets.

- BMM will use alternative energy sources and energy efficient technology for non-essential Project components eg. Solar water heaters for houses, energy efficient lighting, etc.

Operation: Mitigation and Enhancement Measures

Housing

- Finalise and implement the new housing tenure system. The formulation of the system will take into account the possible impacts on the property prices following Project closure.

- Implement change management support systems to assist the community of Aggeneys to adapt to the new housing tenure system.

- Assist the community of Aggeneys to manage and maintain their houses such that it retains its value.

Decommissioning and Closure: Mitigation and Enhancement Measures

- Provide capacity building and training to the LM staff. This capacity building should start early in the operational phase so that there is a clear understanding of the mandate of the LM and their responsibilities post closure.

- Investigate training options from institutions such as the Centre for Sustainability at the University of Stellenbosch and the Development Bank of South Africa, who are currently providing such training.

- Provide additional training with to the LM to ensure that there is a clear understanding of the mandate of the LM and their responsibilities post closure.

Residual Impact

The residual impact will be negative direct as it relates to Project activities and workers. The impact significance will be reduced from ***minor*** to ***negligible negative*** for the construction phase and from ***minor*** to ***negligible negative*** for the operation phase of the Project. The decommissioning and closure phase will be reduced from ***moderate*** to ***minor negative***. This is assuming that all of the mitigation measures outlined above are implemented.

Table 10.40 Pre- and Post- Mitigation Significance: Increased Pressure on Infrastructure and Services

Phase	Significance (Pre-mitigation)	Residual Significance (Post–mitigation)
Construction	**MINOR (-ve)**	**NEGLIGIBLE (-ve)**
Operation	**MINOR (-ve)**	**NEGLIGIBLE(-ve)**

Phase	Significance (Pre-mitigation)	Residual Significance (Post–mitigation)
Decommissioning and Post Closure	**MODERATE (-ve)**	**MINOR (-ve)**

10.2.8 Road Infrastructure and Transport (Direct)

Table 10.41 Impact characteristics: Road infrastructure and transport network

Summary	Construction	Operation	Decommissioning/ Post Closure
Project Aspect/ activity	Increased traffic volumes and impact to road quality.	Increased traffic volumes and impact to road quality.	Increased traffic volumes and impact to road quality.
Impact Type	Direct and indirect.	Direct and indirect.	Direct and indirect.
Stakeholders/ Receptors Affected	Existing road users.	Existing road users.	Existing road users.

The primary access route to the Project site is the N14 national road that connects the Project site to major economic centres of Springbok to the West and Upington to the East. The N14 links to the N7 which is the access route to the Port of Saldanha Bay. The N7 is the main road along the west coast of South Africa into Namibia. Due to the limited rail infrastructure the majority of goods are transported by road, thus the N7 has high volumes of road freight traffic. The N14 is considered to be a high order road carrying long distance and local traffic. According to the Traffic Specialist Study (see *Annex G*) the N14 has considerable reserve capacity due to the low traffic volumes. The current traffic volumes are in the order of 600 vehicles per day in each direction, with the highest volumes reaching 100 vehicles per hour.

The Project will be ramped up in several phases and the associated traffic volumes are shown below.

Table 10.42 Traffic Volumes Associated with the Project Ramp Up during Operation

Phase	Road Volume	Rail Volume	Tonnage (mpta)
1 (Year one and two)	27 trucks per day	-	0.335
2 (Year three and four)	27 trucks per day	20 wagons per day	0.670
3 (Year five to 17)	35 trucks per day	52 wagons per day	1.000

Source: Traffic Specialist Report (Phillips, 2013).

Impact Assessment

Construction

Heavy haul traffic and abnormal loads will be prominent on the N14 and the N7 for the duration of the construction phase. Based on the Traffic Specialist Study the increase in traffic has been modelled to be 155 vehicles per day for Project activities alone, taking into account vehicle trips to transport workers to and from the site. This will have a significant impact on the quality of the roads and will result in rapid deterioration of the roads if it is not maintained.

The impact on the roads during the construction phase will be **negative** and **direct** as it pertains to the Project's transport activities. The magnitude of the impact on the road infrastructure will be **medium**. The extent of the impact extends to the international level because of the use of the N7. The scale of the impact on road infrastructure will be medium due to the existing volumes of the heavy haul traffic and construction vehicles. The frequency of the impact will be constant over the short term for the duration of the construction phase.

The sensitivity of receptors is **medium** as the N14 and N7 are relatively well maintained, and due to the relatively low traffic volumes there is likely to be sufficient reserve to accommodate the increase in the traffic volumes. The impact significance is rated as a ***moderate negative*** impact.

Box 10.31 Summary of Construction Impacts: Road Infrastructure and Transport Network

Nature: Construction activities would result in a **negative direct** impact on existing traffic volumes and road quality.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Medium.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Medium.

- Extent: The extent of the impact is **International.**
- Duration: The expected impact will be **short term.**
- Scale: The impact will result in **medium changes** to the resource/receptor.
- Frequency: The frequency of the impact will be **constant.**
- Likelihood: Increased traffic volumes and deterioration to the road network will **likely** occur.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MODERATE (-).

Degree of Confidence: The degree of confidence is **high.**

Operation

The proposed transport option for the Project is to truck the zinc concentrate to the Port of Saldanha Bay via the N14 and N7 and to transport the zinc concentrate via a gravel road to loop 10 siding of the Sishen- Saldanha railway line and rail the product to the Port of Saldanha. The gravel road to loop 10 is owned and maintained by BMM. Initially only road transport will be used but both transport options will need to be used as the Project ramps up to its full production capacity of 10 million tons per annum (mpta) which translates into one mpta of zinc concentrate.

The impact on the roads will be **negative and direct** as it pertains to the Project's transport activities. The magnitude of the impact on the road infrastructure will be **medium.** The extent of the impact extends to the international level as the zinc concentrate will be hauled via 32 ton trucks (axel load) to the Port of Saldanha Bay thus impacting other international and national road users. The scale of the impact on road infrastructure will be medium during the operational phase if the rail transport option is used and as road users become accustomed to the heavy haul traffic. The frequency of the impact will be constant over the long term for the duration of the operational phase.

The sensitivity of receptors is **low** as the N14 and N7 are relatively well maintained, and given the reserve capacity for the N14 and N7. The overall impact significance is rated as a ***minor negative*** impact.

Box 10.32 Summary of Operation Impacts: Road Infrastructure and Transport Network

Nature: Operational activities would result in a **negative direct** impact on existing traffic volumes and road quality.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Low.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Medium.

- Extent: The extent of the impact is **International.**
- Duration: The expected impact will be **long term.**
- Scale: The impact will result in **medium changes** to the resource/receptor.
- Frequency: The frequency of the impact will be **constant.**
- Likelihood: Increased traffic volumes and deterioration to the road network will **likely** occur.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MINOR (-).

Degree of Confidence: The degree of confidence is **high.**

Decommissioning and Closure

Project activities associated with the decommissioning and closure phase are similar to those during the construction phase of the Project.

The impact on roads will be **direct and negative**. The magnitude of the impact will be **small** over a short term for the duration of the decommissioning phase. The impact on roads may extend nationally depending on the location of future waste management facilities and the scale of the impact will be small by virtue of the activities. The frequency will change from constant to occasional for the decommissioning phase. The sensitivity of receptors will be **low** because they would have adapted to the busy road traffic resulting from the mining activities. The overall impact is rated ***negligible negative.***

Box 10.33 Summary of Decommissioning Impacts: Road Infrastructure and Transport Network

Nature: Decommissioning activities would result in a **negative direct** impact on existing traffic volumes and road quality.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Low.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Small.
- Extent: The extent of the impact is **nationally.**
- Duration: The expected impact will be **short term.**
- Scale: The impact will result in **medium changes** to the resource/receptor.
- Frequency: The frequency of the impact will be **constant.**
- Likelihood: Increased traffic volumes and deterioration to the road network will **likely** occur.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – NEGLIGIBLE (-).

Degree of Confidence: The degree of confidence is **high.**

Mitigation

The mitigation measures presented below indicate general mitigation measures that are applicable to all phases followed by specific measures for each phase of the project.

Objective:
The objectives of the mitigation measures are to limit the impact on the road quality as well as to decrease the impact on road users.

General: Mitigation Measures

- All vehicles will be regularly checked and maintained, including tyre wear.

- Contact details will be displayed on project vehicles to allow other road users to report bad driving at any time.

- All project drivers will be sensitised about potential accident risks to local users and will be periodically checked for alcohol consumption.

- BMM will ensure that vehicles are correctly and safely loaded to avoid accidents, and all loads are secured and covered where they pose a risk of windblown dust or material spillage.

- BMM will work in conjunction with SANRAL to erect appropriate road traffic signage and road markings at the intersections of loop 10 and the Aggeneys access road with the N14.

- BMM and the appointed contractors will develop an induction programme, including a Code of Conduct, for all workers directly related to the Project. A copy of the Code of Conduct shall be presented to all workers and signed by each person. The Code of Conduct must address the following with regards to road traffic management:
    - respect for local residents;
    - compliance with the Traffic Management Plan and all road regulations; and
    - description of disciplinary measures for infringement of the Code and company rules.
    - Workers found to be in contravention of the Code of Conduct, which they signed at the commencement of their contract, will face disciplinary procedures that could result in dismissal.

- BMM will implement a grievance procedure.

- Movement of heavy vehicles through or close to residential areas in Aggeneys will be avoided or minimised to reduce potential impact on local residents, specifically children.

<u>Construction: Mitigation Measures</u>

- BMM will develop a traffic management plan to limit the disruption of the roads when high volumes of abnormal freight are expected on the N14 and N7. The traffic management plan should, at a minimum, address the following:
    - observation of traffic rules (eg speed limits, over-taking, extra precautions through populated areas);
    - night-time driving;
    - vehicles maintenance and regular checks;
    - loading; and
    - non-compliance with the traffic management plan.

- During the construction phase, heavy loads should be planned to avoid weekends and start and end of school holidays, when the potential to impact on other road users is likely to be higher.

<u>Operation: Mitigation Measures</u>

- BMM will work closely with the South African National Road Agency Limited (SANRAL) to monitor the impact on the road quality and upgrade roads periodically for roads within the Project area.

- BMM will work with SANRAL to install traffic calming measures on roads through settlements along the N7 and N14 where appropriate.

<u>Decommissioning and Closure: Mitigation Measures</u>

- BMM will develop a traffic management plan to limit the disruption of the roads when high volumes of abnormal freight are expected on the N14 and N7. The traffic management plan should, at a minimum, address the following:
    - observation of traffic rules (eg speed limits, over-taking, extra precautions through populated areas);
    - night-time driving;
    - vehicles maintenance and regular checks;
    - loading; and
    - non-compliance with the traffic management plan.

Residual Impact Assessment

The impact on road infrastructure will continue to be **direct** and **negative** as it relates to the Project activities. Assuming that the mitigation measures are implemented the impact significance will reduce to ***minor negative*** for the construction. The impact for the operation phase as well as the decommissioning and closure phase of the Project will change to ***negligible negative*** significance. It should be noted that if the mitigation measures for the decommissioning and closure phase are not implemented there is a risk that the impact significance rating may increase.

Table 10.43 Pre- and Post- Mitigation Significance: Road Infrastructure and Transport Network

Phase	**Significance (Pre-mitigation)**	**Residual Significance (Post–mitigation)**
Construction	**MODERATE (-ve)**	**MINOR (-ve)**
Operation	**MINOR (-ve)**	**NEGLIGIBLE (-ve)**
Decommissioning and Post Closure	**NEGLIGIBLE (-ve)**	**NEGLIGIBLE (-ve)**

10.2.9 Health Impact: Communicable Diseases (Direct)

Table 10.44 Impact Characteristics: Communicable Diseases

Summary	**Construction**	**Operation**	**Decommissioning/ Post Closure**
Project Aspect/ activity	Mine workers and in-migrants would result in an increase on the spread of communicable diseases.	Mine workers and in-migrants would result in an increase on the spread of communicable diseases.	Mine workers and in-migrants would result in an increase on the spread of communicable diseases.
Impact Type	Direct and indirect.	Direct and indirect.	Direct and indirect.
Stakeholders/ Receptors Affected	Mine workers, in-migrants and surrounding towns.	Mine workers, in-migrants and surrounding towns.	Mine workers, in-migrants and surrounding towns.

Communicable diseases are also known as infectious or contagious diseases, due to their potential for transmission from one person to another or from one species to another. Transmission of communicable diseases may occur through various pathways including:

- physical contact with infected individuals;
- liquids;
- foods;
- bodily fluids;
- contaminated objects; and
- air-borne inhalation.

The increase in the spread of communicable diseases in the context of the Project is closely linked to population size, living conditions as well as social ills, all of which makes people pre-disposed to the spread of communicable diseases. The rapid increase in the population will be a key driver in the spread of communicable diseases as it impacts on both living conditions as well as the likely increase in social ills. Communicable diseases such as HIV/AIDS and TB are prevalent in the LM. The rate of infection in the local communities is uncertain and inferred from the known rates of the NDM (See Chapter 6).

Impact Assessment

Construction
The most significant increase in the spread of communicable diseases is expected during the construction phase of the project, when a rapid increase in the population size is expected. A key contributor to the spread of communicable diseases in particular relate to housing and living conditions. During the construction phase, a worker camp will be constructed on the Project site. The worker camp will consist of 500 units over an area of 32 ha that will be accessed from the N14. The presence of approximately 3200 construction workers who are predominantly male will likely result in the proliferation of communicable diseases.

The impact of increased spread of communicable diseases is **negative** and **direct** as it relates to Project-related workers. The magnitude will be **large** as a function of the extent, duration, scale, frequency and likelihood. The extent of the impact is local and regional as it relates to the impact on communities of Aggeneys, Pofadder and Pella as well as workers who come from the NDM. The duration of the impact is short term for the duration of the construction phase. The scale of the impact will be large because the local communities of Pofadder and Pella are vulnerable due to the existing prevalence of communicable diseases in the local community, poor education levels, access to healthcare and poor living conditions. The frequency of the impact will be constant.

The sensitivity of Project-related workers will be **medium** compared to the local communities which will be **high**. The significance of the impact is rated as ***major negative*** for both Project-related workers and the local communities.

Box 10.34 Summary of Construction Impacts: Communicable Diseases

Nature: Construction activities would result in a **negative direct** and **indirect** impact with regard to an increase in communicable diseases.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Medium – High.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Large.

- Extent: The extent of the impact is **local – regional.**
- Duration: The expected impact will be **short term.**
- Scale: The impact will result in **large changes** to the resource/receptor.
- Frequency: The frequency of the impact will be **constant.**
- Likelihood: The spread of communicable diseases will **likely** increase.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MAJOR (-).

Degree of Confidence: The degree of confidence is **high.**

Operation

During the operations phase the impact will decrease as a result of a decrease in the number of Project-related workers. These workers will then be housed in Aggeneys. The Aggeneys community will become more sensitive to the increase in the spread of the diseases as the population size is expected to increase substantially with 1,000 housing units planned, approximately double the number of houses there currently.

The impact of increased spread of communicable diseases is **negative** and **direct** as it relates to Project-related workers. The magnitude will be **medium** as a function of the extent, duration, scale, frequency and likelihood. The extent of the impact is local as it relates to the impact on community of Aggeneys. The duration of the impact is long term as the spread of disease is likely to be on-going for the duration of the operations phase. The scale of the impact will be medium because the standard of living and the levels of education of the local community would likely have improved to some extent, although certain sectors of the community will continue to disproportionately vulnerable such as women and the youth. The frequency of the impact will be constant.

The sensitivity of Project-related workers will be **low** compared to the local community which will be **medium**. The significance of the impact is rated as ***minor to moderate negative*** for both Project-related workers and the local community of Aggeneys.

Box 10.35 Summary of Operation Impacts: Communicable Diseases

Nature: Operational activities would result in a **negative direct** and **indirect** impact with regard to an increase in communicable diseases.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Low – Medium.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Medium.
- Extent: The extent of the impact is **local.**
- Duration: The expected impact will be **long term.**
- Scale: The impact will result in **medium changes** to the resource/ receptor.
- Frequency: The frequency of the impact will be **constant.**
- Likelihood: The spread of communicable diseases will **likely** increase.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MINOR - MODERATE (-).

Degree of Confidence: The degree of confidence is **high.**

Decommissioning and Closure

The spread of communicable diseases is expected to diminish substantially during the decommissioning and closure phases due to the likely out-migration as people look for economic opportunities elsewhere. It is possible that during the construction phase several initiatives would have been implemented to improve the standards of living, the quality of infrastructure and services as well as awareness raising campaigns associated to certain diseases and health risks.

The impact during the decommissioning and closure phase will be **negative direct** as it relates to Project-related workers. The magnitude will be **small** as it relates to the extent, duration, scale, frequency and likelihood. The extent of the impact will be local and regional as Project-related workers migrate back to their places of origin. The Project workers at the stage of decommissioning and closure are expected to be primarily from the NDM in keeping with BMM's policies of local procurement and skills development. The duration is expected to be temporary related to a short increase in Project activity related to decommissioning. The scale of the impact will be small in comparison to that of the construction and operation phase and people would have been the recipients of increased living conditions, improved education and training as well as improved access to healthcare and technologies. The frequency of the impact will be occasional. The sensitivity of receptors will be **low** at this late stage in the Project. The impact significance is rated as ***negligible negative*** impact.

Box 10.36 Summary of Decommissioning Impacts: Communicable Diseases

Nature: Construction activities would result in a **negative direct** and **indirect** impact with regard to an increase in communicable diseases.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Low.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Small.

- Extent: The extent of the impact is **local – regional.**
- Duration: The expected impact will be **temporary.**
- Scale: The impact will result in **small changes** to the resource/receptor.
- Frequency: The frequency of the impact will be **occasional.**
- Likelihood: The spread of communicable diseases will **likely** increase.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – NEGLIGIBLE (-).

Degree of Confidence: The degree of confidence is **high.**

Mitigation Measures

The mitigation measures presented below indicate general mitigation measures that are applicable to all phases followed by specific measures for each phase of the project.

Objective:
The objective is to minimise the transmission of diseases, through effective control measures and to reduce the impact of the diseases on the health of Project-related workers and affected local communities to the lowest possible degree.

General: Mitigation Measures

- Support the Provincial Department of Health in their awareness raising campaigns related to communicable diseases.

- All contractors and BMM employees should adhere to the Code of Conduct, and in term of health and safety, which will include a zero tolerance of illegal activities by construction personnel including: prostitution; illegal sale or purchase of alcohol; sale, purchase or consumption of drugs; illegal gambling and/fighting. Any employee or contractor found in violation of the Code shall face disciplinary hearing which may result in a dismissal.

Construction: Mitigation Measures

- BMM will develop an HIV/AIDS Prevention Programme that covers the following key areas:

  Prevention

- raise awareness (address the facts and fiction of HIV transmission);

- get the message out (make use of local languages or non-written forms of communication);

- go beyond the workplace;

- de-stigmatise the disease;

- peer education (train and support peer educators);

- review occupational health and safety procedures;

- distribute male and female condoms;

- promote circumcision;

- establish voluntary HIV testing and counselling centres;

- institute a post exposure prophylaxis programme for all employees with potential exposure to blood or body fluids;

- establish a prevention programme to prevent Mother-to-Child Transmission;

- train managers and supervisors - to improve programme success; and

- work with and support the Provincial Department of Health to establish similar programmes in the local communities.

Treatment/Management and Care

- dispense Anti-Retroviral Treatment (ARV) to workers;
- establish an ARV programme for family members;
- monitor and promote adherence to treatment regime;
- ensure dispensing of medication is controlled;
- provide nutritional programme in addition to treatment regime; and
- provide terminal and home-based care.

<u>Operation: Mitigation Measures</u>

- BMM will establish a TB treatment programme similar to that of the HIV/AIDS programme. Specific measures include:

  - dispense TB Treatment to workers;
  - establish a TB programme for family members;
  - monitor and promote adherence to treatment regime;
  - ensure dispensing of medication is controlled;

- provide nutritional programme in addition to treatment regime; and
- provide terminal and home-based care.

Further to the HIV/AIDS and TB prevention and treatment programme, the following measures will be undertaken:

- All initiatives shall address the symptoms as well as behaviour change issues around the transmission and infection of HIV/AIDS as well as other sexually transmitted infections. The programs will need to be developed and carried out in partnership with health services (at various levels) and will not be the sole responsibility of BMM, but of the local government and NGOs operating in the area.

Residual Impact

The residual impact is based on the assumption that the mitigation measures will be implemented and all role players will bring their part to ensure the successful implementation of the proposed mitigation measures. The residual impact for the construction phases will be ***moderate negative*** and ***minor*** to ***negligible negative*** for the operation and ***negligible negative*** decommissioning and closure phases of the Project.

Table 10.45 Pre- and Post- Mitigation Significance: Communicable Diseases

Phase	**Significance (Pre-mitigation)**	**Residual Significance (Post–mitigation)**
Construction	**MAJOR (-ve)**	**MODERATE (-ve)**
Operation	**MINOR (-ve) to MODERATE (-ve)**	**MINOR (-ve) to NEGLIGIBLE (-ve)**
Decommissioning and Post Closure	**NEGLIGIBLE (-ve)**	**NEGLIGIBLE (-ve)**

10.2.10 Health Impact: Road Traffic Accidents (Direct)

Table 10.46 Impact Characteristics: Road Traffic Accidents

Summary	**Construction**	**Operation**	**Decommissioning/ Post Closure**
Project Aspect/ activity	Increase in road accidents.	Increase in road accidents.	Increase in road accidents.
Impact Type	Direct.	Direct.	Direct and indirect.
Stakeholders/ Receptors Affected	Road users.	Road users.	Road users.

The Project activities will necessitate a significant increase in transport in the LM. Based on the Traffic Specialist Report, it is predicted that the construction phase will generate 155 vehicle trips per day. The vehicle trips predicted for the construction phase is predicted to increase from 40 vehicle trips per day during the first year to 75 vehicle trips per day in year five once they have ramped up to full capacity. The transport activities will result in an increase in the number of heavy haul vehicles, abnormal loads and general traffic in the area. There are two transport options proposed to get the zinc concentrate to the Port of Saldanha. The first is road transport via the N14 and N7. The second transport option is to transport the product via a gravel road to loop 10 and then rail it to the Port of Saldanha on the Sishen Saldanha railway line. This option may only become available later in the operation phase, thus there will be a strong reliance on road transport in the construction phase and the early operation phase. Currently there are low levels of traffic volumes (600 vehicles per day), but heavy haul vehicles are common place due to existing mining activities and the N14 is an important economic corridor connecting Johannesburg, Upington and Springbok. The communities of Aggeneys and Pofadder are accustomed to heavy haul traffic to some extent by virtue of being a mining town and the N14 bisecting the town, respectively. The community of Pella does not experience heavy haul traffic as it is located approximately 10 km away from the N14.

The N14 is currently used by the automotive industry to test cars at high speed but this is only for certain periods of the year for approximately one month at a time [(1)] . The gravel road to loop ten is used by a few farmers as an access road. This road is currently used to transport zinc concentrate to loop ten from mining activities in the LM.

The construction and operation phases will occur concurrently after the first two years of construction as the Project ramps up in a phased approach. However for the first two years there will only be construction related traffic which involves a number of abnormal loads for the delivery of construction materials. Thus it is expected that there will be a sharp increase in traffic in the first two years. The Project site is relatively removed from the local communities in the LM, thus the traffic related to the construction of the Project will be experienced primarily between Springbok and the Project site as well as between Aggeneys and the Project site. The impacts to the rest of the local communities will be experienced as a result of the increase in general traffic as result of influx into the LM.

Impact Assessment

Construction and Operation

The increase in traffic will increase the risk of traffic accidents in the area. Due to low volumes, the cars that use the N14 tend to drive at high speed, often exceeding the speed limit of 120 km per hour. The change in the traffic volumes and the speed at which the construction vehicles generally travel, changes the dynamic of traffic on the N14 considerably. It is this change that increases the risk of accidents. Road accidents could result in serious injury or fatalities given the speeds at which road users generally travel on the N14. There are instances where emergent farmers use the road reserve of the N14 as grazing land for livestock. Road users of the N7 will also experience an

(1) Pers. Com. Hugo van Zyl, 11 February 2013.

increase in the risk of accidents as related to the increase in traffic volumes, however the risk is less because the change between the current traffic volumes and those predicted is not as great compared to that of the N14. Farmers who use the gravel road as an access route will also be affected by an increase risk as volumes increase, however they are relatively accustomed to heavy haul traffic.

The increase in the risk of traffic accidents will have a **negative direct** impact on the local communities. The magnitude of the impact will be **medium** given the extent, duration, scale, frequency and likelihood on the increased risk. The extent of the impact will be local and regional, concentrated at the local level, especially the community of Pofadder as most of the residents are pedestrians. The duration will be long term for the life of the project. The scale of the impact will be large initially but will diminish over time as people become accustomed to traffic volumes and change behaviours to mitigate for the risk of accidents. The frequency will be constant and it is likely that traffic impacts associated with the Project will increase the risk of accidents. The sensitivity of receptors will be **medium** at the local level but **low** at the regional level. The overall impact significance is rated as ***moderate negative***.

Box 10.37 Summary of Construction and Operational Impacts: Road Traffic Accidents

Nature: Construction and operational activities would result in a **negative direct** impact on the number of road traffic accidents.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Medium.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Medium.

- Extent: The extent of the impact is **local – regional.**
- Duration: The expected impact will be **Long term.**
- Scale: The impact will result in **large changes** to the resource/receptor.
- Frequency: The frequency of the impact will be **constant.**
- Likelihood: An increase in road traffic accidents will **likely** occur.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MODERATE (-).

Degree of Confidence: The degree of confidence is **high.**

Decommissioning and Closure

The decommissioning phase will result in a short spate of increased traffic which will decrease as decommissioning activities slow down. The local communities of Pofadder, Pella, and Aggeneys would be used to the impact of traffic in the LM and would have developed behavioural changes to minimise the risk of accidents. Traffic is then expected to decrease substantially post closure, thus having a limited impact on the local communities, thus further minimising the risk of accidents.

The impact will be a **negative direct** as it relates to decommissioning activities and indirect as related to the out-migration of people post closure. The magnitude of the impact will be **negligible** in relation to the extent, duration, scale, frequency and likelihood. The extent of the impact will be local as well as regional because the closest hazardous waste facilities is in Cape Town, however this may change as other hazardous waste facilities may be established during the life of the mine. The duration will short term for the length of the decommissioning phase and at a small scale in comparison to risks associated during the operation phase. The frequency will be often and there will be a likely risk of accidents. The sensitivity of receptors will be **low**. The overall impact significance is rated as ***negligible negative***.

Box 10.38 ***Summary of Decommissioning Impacts: Road Traffic Accidents***

Nature: Decommissioning activities would result in a **negative direct** and **indirect** impact on the number of road traffic accidents.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Low.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Negligible.

- Extent: The extent of the impact is **local – regional.**
- Duration: The expected impact will be **short term.**
- Scale: The impact will result in **small changes** to the resource/receptor.
- Frequency: The frequency of the impact will be **often.**
- Likelihood: An increase in road traffic accidents will **likely** occur.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – NEGLIGIBLE (-).

Degree of Confidence: The degree of confidence is **high.**

Mitigation Measures

The mitigation measures presented below indicate general mitigation measures that are applicable to all phases followed by specific measures for each phase of the project.

Objective:
The objective is to limit the risks of damage to property, injury and death faced by communities and livestock that may arise from an increase to road traffic, speeding and to maintain roads surfaces.

General: Mitigation Measures

- BMM will develop a road Traffic Management Plan and the following provisions will be implemented by BMM or its contractors:
    - Liaise with SANRAL and reach agreement on collaborating to maintain and upgrade roads should they further deteriorate as a result of BMM vehicles.

- Define and visibly display speed limits along all routes within the direct area of influence and enforce these amongst all project-related vehicles.

- All Project drivers will be sensitised about potential accident risks to local users and will be periodically checked for alcohol consumption.

- All vehicles will be regularly checked and maintained, including tyre wear.

- Traffic calming measures will be constructed on the road sections through Pofadder and Aggeneys in order to reduce speeding. In addition speed calming measures will be constructed, as appropriate, as vehicles approach to the mine entrance (loop 10 road) and the turn-off to Aggeneys from the N14.

- Vehicles will be correctly and safely loaded to avoid accidents, and all loads are secured and covered where they pose a risk of windblown dust or material spillage.

- BMM will work with the LM and Provincial Traffic Department to implement an education and awareness programme around health and safety including a focus on traffic risks and road safety for pedestrians.

All concerns regarding traffic management or accidents will be addressed in accordance to the grievance procedures.

Construction: Mitigation Measures

- Workers are to adhere to a Code of Conduct. If found to be in contravention of the Code of Conduct, they will face disciplinary procedures that could result in dismissal.

Operation: Mitigation Measures

- BMM will develop a policy and procedure for assessing all damages and losses (eg damage to property, injury or death of people or livestock resulting from negligent Project vehicle) and to determine appropriate measures to compensate for these losses. This will be implemented in consultation with the affected parties and other relevant stakeholders, including the local authorities.

Residual Impact

The increase in traffic increases the risk of traffic accidents to the local communities and road users of the N14, and N7 in particular. With the implementation of the above measures the impact significance can be reduced to a ***minor to moderate negative*** during the construction and operation phases and remain ***negligible negative*** impact during the decommissioning and closure phase of the Project.

Table 10.47 Pre- and Post- Mitigation Significance: Road Traffic Accidents

Phase	Significance (Pre-mitigation)	Residual Significance (Post–mitigation)
Construction	**MODERATE (-ve)**	**MINOR (-ve) to MODERATE (-ve)**
Operation	**MODERATE (-ve)**	**MINOR (-ve) to MODERATE (-ve)**
Decommissioning and Post Closure	**NEGLIGIBLE (-ve)**	**NEGLIGIBLE (-ve)**

10.2.11 Impact in Relations between Locals and In-migrants

The in-migration of Project workers and job-seekers will likely lead to tension with the local population as they compete for employment opportunities and other Project-related benefits. In addition, tension may arise where in-migrants may be blamed for the increase in the social pathologies experienced by the local communities. It is important to note the relative homogeneity of communities in the local settlements, they are predominantly Coloured and Afrikaans-speaking. This could contrast with Project-related workers and job-seekers who are likely to be African from various parts of the Province and the country or possibly from India. The in-migrants will differ culturally from the locals compounding tensions.

Impact Assessment

Construction and Operation:
During the construction phase the majority of the workforce is expected to be from outside the LM due to the limited skills available locally. This will lead to the perception that in-migrants are taking local jobs, this is likely to result in resentment towards migrant workers. The workforce required during the operational phase will be significantly smaller with higher skill levels. As such, the number of local people that are eligible for employment is significantly less, further exacerbating the perception that in-migrants are taking local jobs and escalating tensions.

In addition to the migrant workforce, the influx of job-seekers is likely to have a compounding effect as they compete directly with the community for limited resources and increase the pressure on public infrastructure and resources.

The social tension between in-migrants and the local community will be **negative** and **direct** as related to Project workers and **indirect** as it related to job-seekers. The magnitude is expected to be **medium**. The extent of the impact will be local and the duration of the impact is expected to be long term lasting throughout the operation phase. It is expected that there will be constant tension between locals and in-migrants as they will be perceived to reap greater benefits from the project, however the scale of the tension will vary throughout the project life-cycle depending on the issues causing the tension. The sensitivity of the local community is **medium** as they are still able to adapt to the changes brought on by the Project, although some may feel disillusioned by the perceived limited benefits, such as employment. Given the length of the operation phase, it is likely that tensions will dissipate over time. The overall significance of the impact of increased tension between locals and in-migrants is rated as a ***moderate negative***.

Box 10.39 ***Summary of Construction and Operational Impacts: Relations between the Locals and In-migrants***

Nature: Construction and operational activities would result in a **negative direct and indirect** impact to social integration of locals and in-migrants.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Medium.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Medium.

- Extent: The extent of the impact is **local.**
- Duration: The expected impact will be **long term.**
- Scale: The impact will result in **Medium changes** to the resource/receptor.
- Frequency: The frequency of the impact will be **constant.**
- Likelihood: The impact will **likely** occur.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MODERATE (-).

Degree of Confidence: The degree of confidence is **medium.**

Decommissioning and Closure:

It is likely that tensions between the local communities and in-migrants will abate as migrants would have assimilated into the community or would be migrating out of the area.

The impact will be **negative**, and both **direct** and **indirect** as it relates to migrant workers and job-seekers, respectively**.** The magnitude is expected to be **negligible** during the decommissioning and closure phase of the Project. The extent of the impact is local and the duration is temporary as the tension abates with people migrating out of the area. The scale of the impact is small in comparison with tensions in the construction and operation phases. The sensitivity is **low** as the community would have grown accustomed to the migrants who are likely to have assimilated into the community. The significance rating for tensions between the local community and in-migrants is ***negligible negative***.

Box 10.40 Summary of Decommissioning Impacts: Relations between the Locals and In-migrants

Nature: Decommissioning activities would result in a **negative direct and indirect** impact to social integration of locals and in-migrants.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Low.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Negligible.
- Extent: The extent of the impact is **local.**
- Duration: The expected impact will be **temporary.**
- Scale: The impact will result in **small changes** to the resource/receptor.
- Frequency: The frequency of the impact will be **occasional.**
- Likelihood: The impact will **likely** occur.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – NEGLIGIBLE (-).

Degree of Confidence: The degree of confidence is **medium.**

Mitigation

The mitigation measures presented below indicate general mitigation measures that are applicable to all phases followed by specific measures for each phase of the project.

Objective:
The objective of the mitigation measures are to:

- monitor the effects of in-migration to the Project area; and
- monitor relations between the local community and the migrants in order to put measures in place as is required to address specific tensions that may arise.

General: Mitigation Measures

- BMM will assist government in developing the following documentation in order to better manage migration into the area:
    - A Migration Situation Analysis Report: this report will show the migration trend of the Local and District municipalities as well as the Province over the past five years. This report is to be updated every five years.
    - A Regional Migration Plan: this plan will outline strategies, programmes and measures to be implemented in order to better manage the levels of migration into the LM and NDM.
    - A Migration Monitoring Programme: this program will outline steps needed to effectively monitor the migration trends.

- BMM will implement the grievance mechanism and address grievances in a timely manner (see Section 10.2.2 for further detail).

Construction and Operation: Mitigation Measures

- BMM will manage expectations of the local communities in terms of the employment and procurement opportunities available to them.

- BMM will communicate with the local communities on all aspects where the community stand to benefit from the project.

- When tensions over a specific issue reach a point where social unrest between the local community and the migrants is imminent, BMM will work with relevant stakeholders and proactively intervene to avoid social unrest.

- Where possible, BMM should make it a requirement for contractors to implement a 'locals first' policy for construction jobs, specifically semi and low-skilled job categories. This will reduce the potential impact that this category of worker could have on local family and social networks;

Residual Impact Assessment

With the implementation of the above-mentioned mitigation measures, it is possible for BMM to reduce the significance of the impact to ***minor negative*** for the construction and operation phases and retain ***negligible negative*** significance during the decommissioning phase of the Project. It is important to implement mitigation measures to avoid an increase in the impact significance at the decommissioning and closure phase.

Table 10.48 Pre- and Post- Mitigation Significance: Relations between the Locals and In-migrants

Phase	**Significance (Pre-mitigation)**	**Residual Significance (Post–mitigation)**
Construction	**MODERATE (-ve)**	**MINOR (-ve)**
Operation	**MODERATE (-ve)**	**MINOR (-ve)**
Decommissioning and Post Closure	**NEGLIGIBLE (-ve)**	**NEGLIGIBLE (-ve)**

10.2.12 Impact on Social Pathologies

Table 10.49 Impact Characteristics: Social Pathologies

Summary	**Construction**	**Operation**	**Decommissioning/ Post Closure**
Project Aspect/ activity	Increase in social pathologies.	Increase in social pathologies.	Increase in social pathologies.
Impact Type	Indirect.	Indirect.	Indirect.

Summary	Construction	Operation	Decommissioning/ Post Closure
Stakeholders/ Receptors Affected	Surrounding communities.	Surrounding communities.	Surrounding communities.

The presence of construction workers poses a potential risk to family structures and social networks in the area, specifically local communities in local towns of Pofadder, Pella and Aggeneys. While the presence of construction workers does not in itself constitute a social impact, the manner in which construction workers conduct themselves can affect the local communities. In this regard the most significant negative impact is associated with the disruption of existing family structures and social networks. This risk is linked to the potential behaviour of male construction workers, including:

- an increase in alcohol and drug use;
- an increase in crime levels;
- an increase in teenage and unwanted pregnancies;
- an increase in prostitution; and
- an increase in sexually transmitted diseases (STDs).

Social pathologies such as drug and alcohol abuse, neglect of children, teenage pregnancies, domestic violence, and crime are pervasive in the local communities. Crimes at the local level include rape, statutory rape, stock theft and domestic violence; it is believed that alcohol abuse is the primary contributing factor in all socially deviant behaviour. It is reported that drugs are brought into the community by outsiders that have come into the area for seasonal or temporary work. In addition, influx of people into an area typically brings about social change.

These changes have been known to cause an increase in vulnerability and increase peoples' susceptibility to social pathologies such as those that are already in existence in the local community. Key concerns raised by stakeholders through the public consultation process linked to social pathologies include the possible increase in drugs, stock theft, as well as the increase threat to personal security for the farming community.

Impact Assessment

Construction, Operation, Decommissioning and Closure:
Given that many of the possible social pathologies already exist, it is likely that these will be exacerbated further by Project activities. It is likely that substance abuse and domestic violence in particular are set to rise significantly because of the increased availability of alcohol and drugs as well as the increase in disposable income. Stock theft and robbery are also likely to increase given the significant increase in population and increased population movement in the local area. Although prostitution has not been identified to be an issue in the local communities, it may well become one, given the

propensity of girls and boys to engage in sexual activity at an early age in exchange for material things.

The increase in social pathologies is an **indirect** and **negative** impact. The magnitude of the impact is **medium** as related to the duration, extent, scale and frequency. The extent of the impact is local and regional as many of the migrant employees would periodically go home and the increase in disposable income may well contribute to social pathologies in the labour-sending areas. The duration of the impact will be permanent as these pathologies are set to continue after closure of the mine. The scale of the impact is medium because these social pathologies already exist and the frequency is constant. The sensitivity of people in the local area is moderate because of existing vulnerabilities linked to poverty, low education and substance abuse issues in the local community. The impact significance is rated to be a ***moderate negative*** impact.

Box 10.41 Summary of Construction, Operational and Decommissioning Impacts: Social Pathologies

Nature: Construction, operational and decommissioning activities would result in a **negative direct** impact in terms of increased social pathologies.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Medium.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Medium.
- Extent: The extent of the impact is **local and regional.**
- Duration: The expected impact will be **permanent(ie irreversible).**
- Scale: The impact will result in **Medium changes** to the resource/receptor.
- Frequency: The frequency of the impact will be **constant.**
- Likelihood: The increase in social pathologies will likely occur.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MODERATE (-).

Degree of Confidence: The degree of confidence is **high.**

Mitigation

The mitigation measures presented below indicate general mitigation measures that are applicable to all phases followed by specific measures for each phase of the project.

Objectives:
The objectives of the mitigation measures are to:

- curb the exacerbation of current social pathologies;
- educate workers and the community on the impacts related to substance abuse; and

- support the South African Police Service (SAPS) to fight against social pathologies prevalent in the local community.

General: Mitigation Measures

- BMM to support SAPS through working with Provincial structures to ensure that the appropriate number of police are deployed to the area in line with the expected increase in the population size.

- BMM will ensure that their security personnel work in close collaboration with the police to monitor any illegal activity.

- The BMM should consider the establishment of a Monitoring Forum (MF) for the construction phase. The MF should be established before the construction phase commences and should include key stakeholders, including representatives from the local community, local councillors, farmers, and BMM. The role of the MF would be to monitor the construction phase and the implementation of the recommended mitigation measures. The MF should also be briefed on the potential risks to the local community associated with construction workers.

Construction and Operation: Mitigation Measures

- BMM and its appointed contractors are to develop an induction programme and a Code of Conduct for all workers directly or indirectly employed by the Project. The Code of Conduct is to form part of induction of all employees related to the Project and it is to be signed by each employee. The Code of Conduct should be available in all relevant languages and at a minimum, English, Afrikaans and Setswana. The Code of Conduct should address the following aspects:

    - respect for local residents;

    - respect for farm infrastructure and agricultural activities;

    - no unauthorised taking of natural resources;

    - respect for the natural environment and no littering or illegal dumping;

    - zero tolerance of illegal activities by Project related employees including: soliciting prostitutes; illegal sale and purchase of alcohol; sale, purchase or consume drugs; illegal gambling or fighting; and engaging in sexual acts with minors;

    - compliance with the traffic regulations on site and all road traffic regulations; and

- o description of disciplinary measures for infringement of the Code of Conduct and company rules.

- If workers are found to be in contravention of the Code of Conduct, which they have signed, they will face disciplinary procedures. If the breach of the code of conduct warrants a dismissal, the dismissal must comply with the South African labour legislation.

- The movement of construction workers on and off the site should be closely managed and monitored by BMM/contractors. In this regard the contractors should be responsible for making the necessary arrangements for transporting workers to and from site on a daily basis.

- BMM/contractor should make necessary arrangements to enable workers from outside the area to return home over weekends and or on a regular basis during the 18 month construction phase. This would reduce the risk posed by non-local construction workers to local family structures and social networks.

- The contractor should make the necessary arrangements for ensuring that all non-local construction workers are transported back to their place of residence once the construction phase is completed. This would reduce the risk posed by non-local construction workers to local family structures and social networks

Residual Impacts

Social pathologies already exist in the local communities of the LM and are expected to be exacerbated as a result of the influx of in-migrants linked to this Project. However, assuming the mitigation measures are successfully implemented, these pathologies can be curbed. The post-mitigation impact significance is rated as ***minor*** to ***moderate negative*** for all phases of the Project.

Table 10.50 Pre- and Post- Mitigation Significance: Social Pathologies

Phase	Significance (Pre-mitigation)	Residual Significance (Post–mitigation)
Construction	**MODERATE (-ve)**	**MINOR (-ve) to MODERATE (-ve)**
Operation	**MODERATE (-ve)**	**MINOR (-ve) to MODERATE (-ve)**
Decommissioning and Post Closure	**MODERATE (-ve)**	**MINOR (-ve) to MODERATE (-ve)**

10.2.13 *Impact on Sense of Place*

Table 10.51 Impact characteristics: Sense of Place

Summary	Construction	Operation	Decommissioning/ Post Closure
Project Aspect/ activity	Change to sense of place.	Change to sense of place.	Change to sense of place.
Impact Type	Indirect.	Indirect.	Indirect.
Stakeholders/ Receptors Affected	Surrounding communities.	Surrounding communities.	Surrounding communities.

Landscapes are considered to be human artefacts; through the influence of human contact there is a continuous change to the landscapes and hence on sense of place. As such, a change in sense of place is therefore inevitable as a result of any human contact and it is experienced in different ways by different people.

Impact Assessment

Construction and Operation, Decommissioning and Closure:

The Project will result in a change in the sense of place because it will significantly increase the footprint of human influence on the landscape. The change will also be brought about as a result of the in-migration of Project workers and job-seekers into the area; they will have their own cultural and social values that will affect the existing values and sense of identity. There has already been significant in-migration into parts of the Project area as a result of existing mining activities and to some extent as a result of seasonal work on commercial farms. The local communities in the settlements of Pofadder and Pella are relatively sheltered as in-migrants tend to live in Aggeneys or on the farm which they work on. The majority of BMM employees live in Aggeneys which is relatively cosmopolitan in comparison.

While the likely changes resulting from in-migration are discussed in *Section 10.2.14,* the visual impact of the Project (as described in *Section 10.3*) also contributes to the change in the sense of place together with noise, vibration and air quality impacts. Receptors that will be sensitive to change in the sense of place include the communities of the settlements of Pofadder, Pella, and the surrounding farming community and to some extent the community of Aggeneys. These receptors are sensitive because they are at greater risk of being impacted due to their proximity to the Project. Despite existing mining activities in the area, the sensitivity of the receptors is increased, because their ability to adapt will be compromised due to the scale of the Project which will be approximately three to four times larger than existing Deeps mine. The change in the sense of place is considered to be both a positive and a negative impact depending on the receptors. Receptors that would be negatively affected by the change to the sense of place include the surrounding farming community and the older generation.

Some people are well equipped to maximise the benefits of the Project (eg. through employment or small business development), and will see the Project as an opportunity to escape their rural identity and become more urbanised. In particular, it is expected that the youth will value the opportunities that the Project provides, to expand their livelihood options and lifestyle for the future, through opportunities that were not previously available to them. These changes in cultural and social values are likely to be embraced as a positive impact.

Change to the Sense of Place as a Negative Impact

The change to the sense of place will be experienced as a **negative** and **indirect** impact. The magnitude of the impact will be **medium** given the extent, duration, scale and frequency of the impact. The extent of the impact will be local and duration will be permanent as the change in sense of place is not reversible. The scale of the impact will be medium for the construction phase but will decrease to a small scale for the other phases of the Project life-cycle. The frequency of the impact is expected to be constant. The sensitivity of receptors who would view the change in sense place as a negative impact is **medium**. The significance of the impact is rated as ***moderate negative***.

Box 10.42 Summary of Construction, Operation and Decommissioning Impacts: Negative Impact to Sense of Place

Nature: Construction activities would result in a **negative indirect** impact to sense of place.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Medium.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Medium.
- Extent: The extent of the impact is **local.**
- Duration: The expected impact will be **permanent(ie irreversible).**
- Scale: The impact will result in **small to medium changes** to the resource/receptor.
- Frequency: The frequency of the impact will be **constant.**
- Likelihood: The impact will **likely** be experienced.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MODERATE (-).

Degree of Confidence: The degree of confidence is **high.**

Change to the Sense of Place as a Positive Impact

To the youth in particular, the change in the sense of place will be experienced as a **positive** and **indirect** impact. The magnitude of the impact will be **medium** given the extent, duration, scale and frequency of the impact. The extent of the impact will be local and duration will be permanent. The scale of the impact will be large for the construction phase but will decrease to a small scale for the other phases of the Project life-cycle. The frequency of the impact is expected to be constant. The sensitivity of receptors who would view the change in sense place as a positive impact is **low** as they currently do not have the means to maximise the potential benefits. The significance of the impact is rated as ***minor positive***.

Box 10.43 ***Summary of Construction, Operation and Decommissioning Impacts: Positive Impact to Sense of Place***

Nature: Construction activities would result in a **positive indirect** impact to sense of place.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Low.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Medium.

- Extent: The extent of the impact is **local.**
- Duration: The expected impact will be **permanent(ie irreversible).**
- Scale: The impact will result in **small changes** to the resource/receptor.
- Frequency: The frequency of the impact will be **constant.**
- Likelihood: The impact will **likely** be experienced.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MINOR (+).

Degree of Confidence: The degree of confidence is **high.**

Mitigation and Enhancement Measures

The mitigation and enhancement measures presented below indicate general mitigation measures that are applicable to all phases followed by specific measures for each phase of the project.

Objective:
The objective of the mitigation and enhancement measures are to assist those affected negatively by the change in the sense of place and to enhance the sense of benefits brought on by the Project.

General: Mitigation Measures

- Other mitigation measures linked to impacts on air quality, noise and vibration as well as visual impacts should be implemented to limit the change to the sense of place.

- As per the mitigation measures linked to increased social tensions, BMM will monitor the impacts associated with the influx of people and to minimise the impacts associated to the change in the sense of place (See *Section 10.2.11*).

- BMM will address concerns raised through a grievance.

Construction and Operation: Enhancement Measures

- BMM will ensure that locals are given priority in terms of employment opportunities (where possible) and are offered training which will make them more employable.

- BMM will invest in and promote sustainable projects, training and education to help communities to develop alternative livelihoods and to ensure that economic dependence on the Project is limited.

- BMM to facilitate cultural or sporting events to encourage interaction between migrants and locals.

Residual Impact

The residual impact will be ***minor negative*** for the farming community and the older generation who view the change in the sense of place as a negative impact. To the youth of the local communities and others that view the change in the sense of place as a positive impact, the residual impact significance will be rated as ***minor positive***. These ratings are based on the assumptions that the mitigation and enhancement measures are implemented. The mitigation measures are implemented to ensure that the significance of the positive impact will not decrease.

Table 10.52 Pre- and Post- Mitigation Significance: Sense of Place

Phase	**Significance (Pre-mitigation)**	**Residual Significance (Post–mitigation)**
Construction, Operation and Decommissioning and Post Closure (Negative Impact).	**MODERATE (-ve)**	**MINOR (-ve)**
Construction, Operation and Decommissioning and Post Closure (Positive Impact).	**MINOR (+ve)**	**MINOR (+ve)**

10.2.14 Local Cultural and Social Values

Table 10.53 Impact Characteristics: Local Cultural and Social Values

Summary	**Construction**	**Operation**	**Decommissioning/ Post Closure**
Project Aspect/ activity	Loss of local cultural and social values.	Loss of local cultural and social values.	Loss of local cultural and social values.
Impact Type	Indirect.	Indirect.	Indirect.
Stakeholders/ Receptors Affected	Surrounding communities.	Surrounding communities.	Surrounding communities.

Most people in the local communities of Pofadder and Pella are of Nama decent, but instead would describe themselves as Coloured. There have been efforts made to revitalise the Nama culture but with limited success. The

Nama culture in the local communities of Pofadder and Pella exists as a relic (it is very diluted) of the Nama culture elsewhere in the NDM.

The local community is relatively urbanised despite the rural context. There is a general sense that the social fabric is eroding because of the social pathologies prevalent in the local communities. Although cultural values and identities are dynamic and are constantly subject to change; it is likely that the Project will indirectly present challenges to cultural and social values. It is expected that the extent and pace of change will be high.

Impact Assessment

Construction, Operation, Decommissioning and Closure
The cultural and social values of newcomers to the area may clash with those held within the local communities. This could cause tension and conflict, particularly among those who perceive their sense of identity and sense of belonging to be under threat. People that are likely to be most vulnerable include the elderly, women, and unskilled or unemployed people who are unable to adapt to the changes. Throughout the project area there is a high level of sensitivity in this regard. Over the project lifetime, culture, social values and traditional structures will continue to change as the population grows (through in-migration of Project employees and job-seekers), becomes more educated and there is increased exposure to different cultures and world views.

The pace at which cultural and social values are likely to change is expected to be significantly less dramatic subsequent to the construction phase. People will have adapted, to some degree, and assimilated new values. However, this does not imply that the changes will immediately stop or reverse, but rather that coping mechanisms amongst the less vulnerable groups will be developed and engaged. To date, the local population have already adapted to such changes as related to other mining operations in the area.

Depending on the level of vulnerability of the stakeholders involved, these changes in social and cultural values could have a **negative** impact as people struggle to assimilate the rapid pace of change in the area. For others, such as the economically active, who are able to embrace this change and actively seek to escape their rural identity, the impact will be perceived as **positive.** The impact will commence prior to construction with the initial change from a rural and urban setting, and continuing beyond the life of the Project (**permanent**). This change will be constant and experienced as an **induced** impact by the majority of people (ie. traditional authorities, older people and people who value the current way of life). This will be experienced at the **local** level throughout the LM but in particular in the Project's direct area of influence. It is of **likely** probability that this impact will occur for most receptors in the community. The overall magnitude will be **medium** given the permanent duration and large number of receptors that will be negatively affected. The sensitivity of stakeholders will be **low** because the cultural heritage is dynamic and is already in flux. The impact significance is rated as ***minor negative.***

Box 10.44 ***Summary of Construction, Operational and Decommissioning Impacts: Local Cultural and Social Values***

Nature: Construction, operational and decommissioning activities would result in a **negative direct** impact on local cultural and social values.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Low.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Medium.

- Extent: The extent of the impact is **local.**
- Duration: The expected impact will be **permanent(ie irreversible).**
- Scale: The impact will result in **small changes** to the resource/receptor.
- Frequency: The frequency of the impact will be **constant.**
- Likelihood: This impact will **likely** occur.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MINOR (-).

Degree of Confidence: The degree of confidence is **high.**

Mitigation Measures

The mitigation measures presented below indicate general mitigation measures that are applicable to all phases followed by specific measures for each phase of the project.

Objective:
The objective of the mitigation measures is to assist affected stakeholders in developing coping mechanisms to help them cope with changing culture and social norms.

General: Mitigation Measures

- Implement the mitigation measures outlined in *Section 10.2.13* (change in sense of place) which related to:
  - monitor and mitigate the impacts associated with influx; and
  - develop and implement a grievance procedure such that the affected stakeholder concerns are addressed and resolved in a timely manner.

Construction and Operation: Mitigation Measures

- Management of workforce and accommodation by:
  - Developing and implementing a Code of Conduct to minimise the risk of conflict;

- Provide induction training to Project-related workers, particularly during the construction phase; and
- Appropriate catering and recreational facilities be provided to Project related staff to minimise the strain on public facilities.

- BMM will establish a heritage resource centre that will showcase Nama cultural heritage was well as heritage important other communities within the LM such the missionary history of the broader area. The objective of a heritage resource centre would be to preserve and educate people about the importance of cultural heritage.

Residual Impacts

The residual impact of change in culture will remain to be of ***minor negative*** significance. Over time, this change will cease to be an impact, as a new social and cultural values and sense of identity will become the 'norm'.

Table 10.54 Pre- and Post- Mitigation Significance: Local Cultural and Social Values

Phase	Significance (Pre-mitigation)	Residual Significance (Post–mitigation)
Construction, Operation Decommissioning and Post Closure.	**MINOR (-ve)**	**MINOR (-ve)**

10.2.15 Increased Pressure on Infrastructure and Services (Indirect resulting from Influx)

Table 10.55 Impact characteristics: Increased pressure on infrastructure and services (Indirect from Influx)

Summary	Construction	Operation	Decommissioning/ Post Closure
Project Aspect/ activity	Increased pressure on public services resulting from influx.	Increased pressure on public services resulting from influx.	Increased pressure on public services resulting from influx.
Impact Type	Indirect.	Indirect.	Indirect.
Stakeholders/ Receptors Affected	Local municipal area.	Local municipal area.	Local municipal area.

The influx of people into the local area will increase pressure on public infrastructure and services. The job-seekers migrating to the area are likely to settle as close as possible to the Project area, thus the settlements of Pofadder and Pella, in particular, are likely to experience in-migration as migrants will not be allowed to settle in Aggeneys. Pofadder is more vulnerable to the influx of job-seekers as it is located on the N14, as compared to Pella, which is located approximately 10 km from the N14. There is a risk that job-seekers may try to establish an informal settlement close to Aggeneys, in order to be closer to the Project site to improve their chances of deriving benefits from the Project.

Public service backlogs pertain to access to water, sanitation, waste management services and housing. The number of informal houses increased threefold between 2001 and 2011 in the LM. Upgrades to public infrastructure and services are hampered by a number of challenges including a lack of funds and capacity by the LM.

Based on the current public infrastructure and service backlogs the additional pressure will further exacerbate the challenges faced by the LM. It is unlikely that the LM will be able to cope with the increased pressure and demand resulting from the indirect influx of people; they are already unable to meet their current obligations. More detail on each of the infrastructure impacts related to influx for the different phase of the project life cycle are provided below.

Box 10.45 Housing

The current housing backlog challenges faced by the LM will be exacerbated by the influx of job-seekers. The increase in demand for accommodation is likely to drive up rental prices which could lead to insecurity in housing tenure of local people who may not be able to afford the cost of accommodation. It is likely that any informal areas that are established during the construction phase will continue to grow.

Box 10.46 Health Care and Education

The influx of job-seekers will significantly increase the pressure on the already strained health care and education facilities. Chapter 6 provides further detail on the impact of health, which predicts an increase in the communicable diseases and other health disorders as well as an increase in social ills. These impacts will all lead to further pressure on an already limited health care system.

The education system will be impacted primarily during the operation phase by an increase in the learner-teacher ratio, affecting the quality of education of each learner. Linked to the increase in social ills, female learners are at an increased risk of early pregnancy thus exacerbating the already high drop-out rate.

The demands on the health and education systems is expected to decrease during decommissioning and post closure as people are expected to migrate elsewhere in search of economic opportunities. The services offered will likely to exceed the demands of the local community. Maintaining education and health infrastructure during the decommissioning and closure phase may demand resources that the LM is unable to provide as a result of reduced income resulting from the decrease in the number of ratepayers. The local community would have grown accustomed to a certain level of service which would have been attainable through the assistance of BMM, but it is likely that without such assistance the quality of education and health infrastructure would depreciate over time.

Box 10.47 Water and Sanitation Infrastructure and Supply

The Final Scoping Report notes that Pelladrift Water Board is planning to expand and upgrade the water infrastructure in response to growing demand from the settlements of Pofadder, Pella and Aggeneys as well to meet the water demands of the Project. Water and sanitation systems will come under increased pressure as a result of influx of job-seekers.

Box 10.48 Electricity

The increase in demand for electricity is set to grow as a result of the influx of job-seekers. The influx of job-seekers in the settlements of Pofadder and Pella, will likely increase the number of illegal electricity connections as the informal settlements in these areas grow. The proposed new substation and power line that will be constructed for the purposes of the mine activities will not be of benefit to the local communities or the LM. Urgent upgrade to the electricity system of the LM is required as the demand for electricity continues to grow.

Box 10.49 Refuse Removal

The influx of people expected during the construction phase will generate significantly more waste placing additional pressure on the landfill sites and waste management facilities. The expected increase in the volume of general waste, related to the influx of job-seekers, cannot be quantified; however significant influx is expected. Due to the high poverty levels, it is likely that people will scavenge on the waste disposal sites which pose a health risk to those individuals. The LM will struggle to cope with waste management as the increase in waste volumes will require more sophisticated waste management techniques as well as specialised equipment that the LM do not have [1].

Impact Assessment

Construction

The impact on public infrastructure during the construction phase will be **negative** and **indirect** as related to the influx of job-seekers. The magnitude of the impact to public infrastructure and services will be **large.**

The extent of the impacts will be local, confined to the LM, specifically in Pofadder and Pella where job-seekers are expected to settle. The duration will be short term for the construction phase. The scale of the impact will be large as the LM will likely struggle to cope with the increased demand for infrastructure and services. The scale of the impact would be highest on infrastructure such as housing, electricity, water and sanitation due to existing backlogs as well as health care. The scale of the impacts is therefore large and these impacts are likely to occur on a constant basis.

(1) Pers. Com., Dr David Baldwin, 5 February 2013.

The sensitivity of receptors will be **high** during the construction phase when the greatest influx is expected. The impact significance is rated as ***major negative***, specifically for Pofadder and Pella.

Box 10.50 *Summary of Construction Impacts: Increased Pressure on Infrastructure and Services resulting from Influx*

Nature: Construction activities would result in a **negative indirect** impact on infrastructure and services.

Sensitivity/Vulnerability/Importance of Resource/Receptor – High.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – High.

- Extent: The extent of the impact is **local.**
- Duration: The expected impact will be **short term.**
- Scale: The impact will result in **large changes** to the resource/receptor.
- Frequency: The frequency of the impact will be **constant.**
- Likelihood: Impact to services and infrastructure will **likely** be impacted.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MAJOR (-).

Degree of Confidence: The degree of confidence is **low.**

Operation

The impacts on public infrastructure during the operation phase will be **negative** and **indirect** as it relates to the influx of job-seekers. The rate of influx of job-seekers will decrease during the operation phase and some may migrate elsewhere if they have been unsuccessful in securing employment, especially given the absence of other large scale industries. There is still a likelihood that some job-seekers may remain as they are hopeful of securing permanent employment or other benefits. It is expected that impacts to infrastructure and services will remain strained, although it is expected to be less compared to the construction phase. The magnitude of the impact is expected to be **medium.** The extent of the impact is local, limited to the LM, specifically in Pofadder and Pella. The duration of the impact will be long term for the duration of the Project life and the scale of the impact will be small. The rate of influx is likely to slow down during the operational phase. The frequency of the impact will be constant and the impact is likely to occur.

The sensitivity of the receptors will be medium because the LM will continue to struggle to meet growing demands for infrastructure and services without assistance. Thus the impact significance is rated to be ***moderate negative***.

Box 10.51 Summary of Operational Impacts: Increased Pressure on Infrastructure and Services resulting from Influx

Nature: Operational activities would result in a **negative indirect** impact on infrastructure and services.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Medium.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Medium.

- Extent: The extent of the impact is **local.**
- Duration: The expected impact will be **long term.**
- Scale: The impact will result in **small changes** to the resource/receptor.
- Frequency: The frequency of the impact will be **constant.**
- Likelihood: Impact to services and infrastructure will **likely** be impacted.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MODERATE (-).

Degree of Confidence: The degree of confidence is **high.**

Decommissioning and Closure

The impacts on infrastructure and services during the decommissioning and closure phase will be **indirect** and **negative**. With decommissioning, it is likely that people will migrate out of the area in search of employment opportunities elsewhere. The magnitude of the impact will be **small**. The extent of the impact will be local, limited to the LM and the impact will be permanent. The scale of the impact is likely to be small as the LM would have catered for a larger population size, but with out-migration the number of ratepayers would have decreased thus impacting the LM's ability to maintain the infrastructure and services. The LM's ability to maintain the infrastructure and services would also be limited without the support of BMM as it is likely that BMM would have provided considerable support to the LM throughout the Project life. The frequency of the impact would be short to long-term depending how long it takes for the LM to adjust to the change.

The sensitivity of stakeholders, most notably the communities of Pofadder and Pella will be **medium**. This as the communities of Pofadder and Pella would have grown accustomed to a good level of service provision from the LM as a result of the support of BMM. The impact significance is rated as ***minor negative*** for the decommissioning and closure.

Box 10.52 Summary of Decommissioning Impacts: Increased Pressure on Infrastructure and Services resulting from Influx

Nature: Decommissioning activities would result in a **negative indirect** impact on infrastructure and services.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Medium.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Small.

- Extent: The extent of the impact is **local.**
- Duration: The expected impact will be **permanent.**
- Scale: The impact will result in **small changes** to the resource/receptor.
- Frequency: The frequency of the impact will be **constant.**
- Likelihood: Impact to services and infrastructure will **likely** be impacted.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MINOR (-).

Degree of Confidence: The degree of confidence is **low.**

Mitigation Measures

The mitigation measures and enhancement measures presented below indicate general measures that are applicable to all phases followed by specific measures for each phase of the project.

Objectives:
The key objectives of the mitigation measures are as follows:

- limit the extent of the impact on local infrastructure and services in the LM, specifically Pofadder and Pella;
- encourage and support government in improving the levels of infrastructure and services provided in the Project area.

General: Mitigation and Enhancement Measures

- Assist the LM with engineering and town planning services to improve services provided as the LM currently does not have a town planner and is heavily reliant on consulting services, thus limiting their ability to deliver services.

- Develop public-private partnerships to support the LM to address the indirect impacts on infrastructure and services.

- Assist the LM to monitor and manage the growth of informal settlements and associated pressure on other infrastructure and services. The aim should be to prevent the establishment of new informal settlements.

- BMM will assist government in developing the following documentation in order to better manage migration into the area:

- A Migration Situation Analysis Report: this report will show the migration trend of the Local and District municipalities as well as the Province over the past five years. This report is to be updated every five years.

- A Regional Migration Plan: this plan will outline strategies, programmes and measures to be implemented in order to better manage the levels of migration into the LM and NDM.

- A Migration Monitoring Programme: this program will outline steps needed to effectively monitor the migration trends.

Health and Education

- Provide assistance to the Provincial Department of Health to improve the quality of services and equipment and infrastructure in state facilities.

- Provide assistance to the Further Education and Training (FET) colleges to expand and offer more accredited courses to communities in the LM.

- Provide support and encourage learners to attend school, for example providing transport, career guidance and access to information.

- Extend the internship programme to learners outside of Aggeneys and provide learners with the necessary support to be able to participate in the internship programme.

- Provide bursaries to learners from Grade 10 onwards to attend FET colleges in study areas that are non-mining related but will support sustainable livelihoods locally.

Water

- BMM will monitor and report on Project water usage and associated effects on the surrounding communities/ farmers. If communities and farmers are negatively affected as a direct result of the Project, immediate and appropriate action will be taken (in collaboration with the relevant authorities).

- Raise awareness of the scarcity of water resources in order to encourage people to save water as far as possible as a measure to manage demand.

Refuse Removal

- Hazardous waste will be collected and disposed of in a registered hazardous waste facility.

- Appropriate waste management facilities will be provided by the Project to minimise the strain on public facilities.

<u>Construction: Mitigation and Enhancement Measures</u>

Health

- BMM will ensure that no additional strain will be placed on the local clinic/ facilities by the Project workers.

- BMM to make medical personnel available to assist medical practitioners in the LM in the case of emergencies

Water

- All water and sanitation needs of the Project and workers will be taken care of by BMM and BMM will not exceed their legal water allocation. In doing so BMM will ensure that no additional strain is put on public infrastructure.

Electricity

- BMM will investigate the feasibility of reducing their power demand through renewable energy off-sets.

<u>Operation: Mitigation Measures</u>

Education

- Build new or expand educational facilities in Aggeneys and Pofadder to accommodate the children of Project-related workers to ensure that no additional strain is placed on public infrastructure.

<u>Decommissioning and Closure: Mitigation and Enhancement Measures</u>

- Provide capacity building and training to the LM staff. This capacity building should start early in the operations phase so that there is a clear understanding of the mandate of the LM and their responsibilities post closure.

- Investigate training options from institutions such as the Centre for Sustainability at the University of Stellenbosch and the Development Bank of South Africa, who are currently providing such training.

- Provide additional training with to the LM to ensure that there is a clear understanding of the mandate of the LM and their responsibilities post closure.

Residual Impact

The residual impacts related to influx of job-seekers on the communities of Pofadder and Pella will be reduced from ***Major*** to ***moderate negative*** for the construction phase, from ***moderate*** to ***minor negative*** for the operation, and from ***minor*** to ***negligible negative*** for the decommissioning and closure phases. This is on the assumption that the mitigation measures are implemented effectively.

Table 10.56 Pre- and Post- Mitigation Significance: Increase Pressure on Infrastructure and Services

Phase	Significance (Pre-mitigation)	Residual Significance (Post-mitigation)
Construction	MAJOR (-ve)	MODERATE (-ve)
Operation	MODERATE (-ve)	MINOR (-ve)
Decommissioning and Post Closure	MINOR (-ve)	NEGLIGIBLE (-ve)

10.2.16 Communicable Diseases (Indirect resulting from Influx)

Table 10.57 Impact Characteristics: Communicable Diseases

Summary	Construction	Operation	Decommissioning/ Post Closure
Project Aspect/ activity	In-migrants would result in an increase in health impacts	In-migrants would result in an increase in health impacts	In-migrants would result in an increase in health impacts
Impact Type	Indirect	Indirect	Indirect
Stakeholders/ Receptors Affected	Mine workers, in-migrants and surrounding towns.	Mine workers, in-migrants and surrounding towns.	Mine workers, in-migrants and surrounding towns.

The increase in the spread of communicable diseases in the context of the Project is closely linked to population size, living conditions as well as social ills, all of which make people pre-disposed to the spread of communicable diseases. The influx of people is the key driver to the spread of communicable diseases as it impacts on both living conditions as well as the likely increase in social ills. Communicable diseases such as HIV/AIDS and TB are prevalent in the LM. The rate of infection in the local communities is uncertain and inferred from the known rates of the NDM. What is certain is that the influx of people will increase the rate of infection and prevalence of HIV/AIDS, other sexually transmitted diseases and TB in the local communities of Pofadder and Pella. Other diseases that are likely to increase include diarrhoea, dysentery and flu as related to poor living conditions and increased pressure on public infrastructure such as housing, water, sanitation and waste management.

Impact Assessment

Construction

The most significant increase in the spread of communicable diseases is expected during the construction phase of the project, when a rapid increase in the population size is expected. In addition, given the current lack of capacity of local government, it is likely that the LM will be ill-equipped to cope with the increased pressure on public infrastructure and services. A key contributor to the spread of communicable diseases in particular relate to housing and living conditions. During the construction phase job-seekers who migrate to the area are likely to settle in Pofadder and Pella adding significant pressure to housing. The communities of Pofadder and Pella are thus at a greater risk to the increase in the spread of communicable diseases.

The impact of increased spread of communicable diseases is **negative** and **indirect** as it relates to the influx of job-seekers. The magnitude will be **large**. The extent of the impact is local as it relates to the impact on communities of Pofadder and Pella. The duration of the impact is short-term for the duration of the construction phase. The scale of the impact will be large because the local community is vulnerable due to the existing prevalence of communicable diseases, poor education levels, access to healthcare and poor living conditions. The frequency of the impact will be constant.

The sensitivity of the local communities will be **high**. The significance of the impact is rated as ***major negative*** for the local communities.

Box 10.53 Summary of construction impacts: Communicable diseases

Nature: Construction activities would result in a **negative direct** and **indirect** impact with regard to an increase in communicable diseases.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Medium.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Large.
- Extent: The extent of the impact is **local – regional.**
- Duration: The expected impact will be **short term.**
- Scale: The impact will result in **large changes** to the resource/receptor.
- Frequency: The frequency of the impact will be **constant.**
- Likelihood: The spread of communicable diseases will **likely** increase.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MAJOR (-).

Degree of Confidence: The degree of confidence is **low.**

Operation

During the operation phase some of the job-seekers are likely to migrate out of the area in search of opportunities elsewhere if they have not been successful in finding employment, however some will stay regardless.

The impact of increased spread of communicable diseases is **negative** and **indirect** as it relates to the influx of job-seekers. The magnitude will be **medium**. The extent of the impact is local as it relates to the impact on communities of Pofadder and Pella. The duration of the impact is long term as the spread of diseases are likely to be on-going for the duration of the operations. The scale of the impact will be medium because the standard of living and the levels of education of the local community would likely have improved to some extent, although certain sectors of the community will continue to disproportionately vulnerable such as women and the youth. The frequency of the impact will be constant.

The sensitivity of the local communities will be **medium** because women and youth make up a large proportion of the communities. The significance of the impact is rated as ***moderate negative***.

Box 10.54 ***Summary of Operation Impacts: Communicable Diseases***

Nature: Construction activities would result in a **negative direct** and **indirect** impact with regard to an increase in communicable diseases.

Sensitivity/Vulnerability/Importance of Resource/Receptor –Medium.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Large.

- Extent: The extent of the impact is **local.**
- Duration: The expected impact will be **long term.**
- Scale: The impact will result in **medium changes** to the resource/receptor.
- Frequency: The frequency of the impact will be **constant.**
- Likelihood: The spread of communicable diseases will **likely** increase.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MINOR - MODERATE (-).

Degree of Confidence: The degree of confidence is **low.**

Decommissioning and Closure

The spread of communicable diseases is expected to diminish substantially during the decommissioning and closure phases due to the likely out-migration as people look for economic opportunities elsewhere. It is possible that during the construction phase several initiatives would have been implemented to improve the standards of living, the quality of infrastructure and services as well as awareness raising campaigns associated to certain diseases and health risks.

The impact during the decommissioning and closure phase will be **negative** and **indirect** as it relates to local communities affected. The magnitude will be **small**. The extent of the impact will be local. The duration is expected to be temporary related to a small influx expected as a result of decommissioning activities. The scale of the impact will be small in comparison to that of the construction and operation phase. The frequency of the impact will be occasional. The sensitivity of receptors will be **low** at this late stage in the Project. The impact significance is rated as ***negligible negative*** impact.

Box 10.55 Summary of Decommissioning Impacts: Communicable Diseases

Nature: Construction activities would result in a **negative direct** and **indirect** impact with regard to an increase in communicable diseases.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Low.
Irreplaceability: The activity will **not** result in the loss of **irreplaceable** resources.

Impact Magnitude – Small.
- Extent: The extent of the impact is **local.**
- Duration: The expected impact will be **temporary.**
- Scale: The impact will result in **small changes** to the resource/receptor.
- Frequency: The frequency of the impact will be **occasional.**
- Likelihood: The spread of communicable diseases will **likely** increase.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – NEGLIGIBLE (-).

Degree of Confidence: The degree of confidence is **low.**

Mitigation Measures

The mitigation measures presented below indicate general mitigation measures that are applicable to all phases followed by specific measures for each phase of the project.

Objectives
The objective is to minimise the transmission of diseases, through effective control measures and to reduce the impact of the diseases on the health of Project-related workers and affected local communities to the lowest possible degree.

General: Mitigation Measures

- Support the Provincial Department of Health in their awareness raising campaigns related to communicable diseases.

Construction: Mitigation Measures

- BMM will develop an HIV/AIDS Prevention Programme that covers the following key areas:

  Prevention
  - raise awareness (address the facts and fiction of HIV transmission);
  - get the message out (make use of local languages or non-written forms of communication);
  - go beyond the workplace;
  - de-stigmatise the disease;
  - peer education (train and support peer educators);
  - review occupational health and safety procedures;
  - distribute male and female condoms;
  - promote circumcision;

- establish voluntary HIV testing and counselling centres;
- institute a post exposure prophylaxis programme for all employees with potential exposure to blood or body fluids;
- establish a prevention programme to prevent Mother-to-Child Transmission;
- train managers and supervisors - to improve programme success; and
- work with and support the Provincial Department of Health to establish similar programmes in the local communities.

Treatment/ Management and Care

- dispense Anti-Retroviral Treatment (ARV) to workers;
- establish an ARV programme for family members;
- monitor and promote adherence to treatment regime;
- ensure dispensing of medication is controlled;
- provide nutritional programme in addition to treatment regime; and
- provide terminal and home-based care.

- BMM will establish a TB treatment programme similar to that of the HIV/AIDS programme. Specific measures include:

    - dispense TB Treatment to workers;
    - establish a TB programme for family members;
    - monitor and promote adherence to treatment regime;
    - ensure dispensing of medication is controlled;
    - provide nutritional programme in addition to treatment regime; and
    - provide terminal and home-based care.

<u>Operation: Mitigation Measures</u>

- BMM will continue to roll out the HIV/AIDS and TB programmes initiated in the construction phase.

Further to the HIV/AIDS and TB prevention and treatment programme, the following measures will be undertaken:

- All initiatives shall address the symptoms as well as behaviour change issues around the transmission and infection of HIV/AIDS as well as other sexually transmitted infections. The programs will need to be developed and carried out in partnership with health services (at various levels) and will not be the sole responsibility of BMM, but of the local government and NGOs operating in the area.

Residual Impact

The residual impact will be reduced from ***major*** to ***moderate*** negative for the construction phase, ***moderate*** to ***minor*** for the operation phase and to ***negligible*** for the decommissioning and closure phases of the Project, based on the assumption that the mitigation measures will be implemented.

10.3 VISUAL IMPACT

10.3.1 *Impact on the Aesthetic Value of the Landscape*

Newtown Landscape Architects (NLA) was commissioned by ERM to carry out a Visual Impact Assessment (VIA) to assess the severity of the visual impacts associated with the Project. As part of this process a baseline for the VIA was established (refer to Chapter 6), whereby the visual resource and 'sense of place' for the area was defined, as well as sensitive receptors being identified.

Assessing the likely effects of this Project on a landscape and on visual amenity is determined through a combination of quantitative and qualitative evaluations (Landscape Institute & the Institute of Environmental Management and Assessment, 2002). The landscape, its examination and the assessment of impacts on the landscape all contributed to the baseline for the VIA study. With respect to this, while the assessment of the potential impact on the landscape is carried out as an impact on an environmental resource (ie the physical landscape), visual impacts, on the other hand, are assessed as one of the interrelated effects on people (ie the viewers and the impact of an introduced object into a particular view or scene).

As such, visual impacts are a subset of landscape impacts, which relate to the changes that arise in the composition of available views as a result of changes to the landscape, people's responses to the changes and to the overall effect with respect to visual amenity. The overall visual impact is therefore measured as the change to the existing visual environment (ie views) caused by the intervention and the extent to which that change compromises (negative impact) or enhances (positive impact) or maintains (status quo) the visual quality of the scene as perceived by people visiting, working or living in the area.

This section describes the potential visual impacts that the Project may have on the surrounding landscape, its characteristic features and on the people who view it.

Table 10.58 Impact Characteristics: Impact on the Aesthetic Value (1) of the Landscape

Summary	Construction	Operation	Decommissioning/ Post Closure
Project Aspect/ activity	Loss of sense of place and aesthetic value of the landscape. Light and dust pollution. Light glow at night.	Loss of sense of place and aesthetic value of the landscape. Light and dust pollution. Light glow at night.	Loss of sense of place and aesthetic value of the landscape.

(1) Aesthetic value is the emotional response derived from the experience of the environment with its particular natural and cultural attributes (NLA, 2013).

Summary	Construction	Operation	Decommissioning/ Post Closure
Impact Type	Direct.	Direct.	Direct.
Stakeholders/ Receptors Affected	Tourists, neighbouring residents and commuters using the N12 highway and local roads. Residents from the study area (ie from the Achab and Kykgate farmsteads and from the town of Aggeneys). Users of the Aggeneys recreational facility /golf course.	Tourists, neighbouring residents and commuters using the N12 highway and local roads. Residents from the study area (ie from the Achab and Kykgate farmsteads and from the town of Aggeneys). Users of the Aggeneys recreational facility /golf course.	Tourists, neighbouring residents and commuters using the N12 highway and local roads. Residents from the study area (ie from the Achab and Kykgate farmsteads and from the town of Aggeneys). Users of the Aggeneys recreational facility /golf course.

Construction Phase Impacts

During construction, direct and indirect visual impacts will arise as a result of the physical presence and visibility of construction activities associated with the Project. These include:

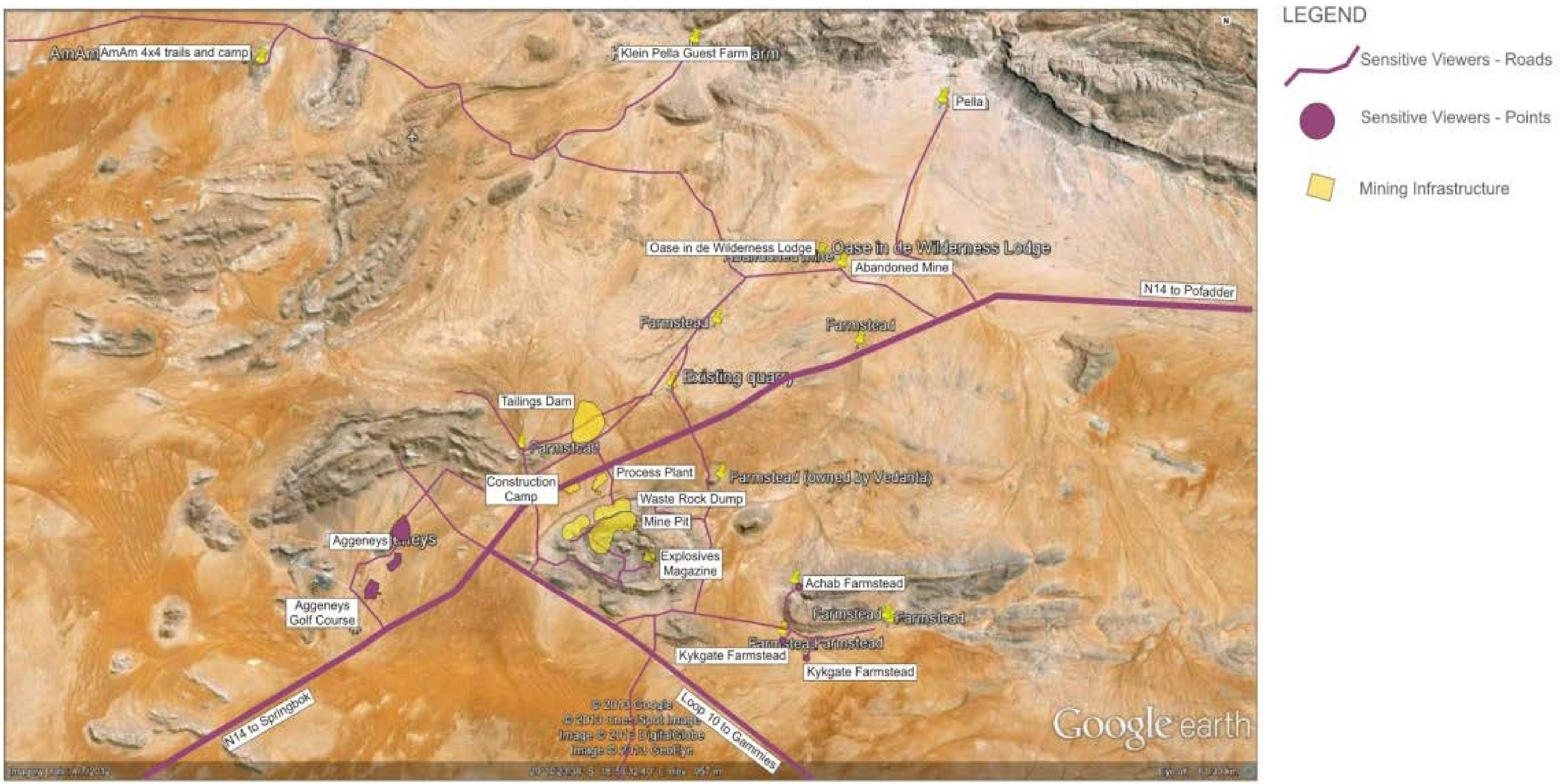
- Site clearance/vegetation removal (which could result in the scarring of the landscape) and topsoil/waste rock stockpiling. The loss of vegetation over this area will be perceived as a change to local landscape character and will be experienced by viewers located near to the project boundary.
- Construction of mining infrastructure.
- Presence and visibility of site boundary fencing and access roads.
- Earth-moving activities (eg digging of trenches, excavations etc.).
- Presence and visibility of construction vehicles and vehicles used for earth-moving activities.
- Lighting that will be used to spread light on the construction sites during the night time, will illuminate the dark rural night sky and the glow is expected to be seen from far beyond the 'zone of potential influence' (note that the 'zone of potential influence' is defined in the *Operational Phase Impacts* Section below).
- Dust generated from construction activities is likely to result in a negative visual impact during the daytime and reduce visibility.

The above construction activities will result in direct visual impacts on the sensitive viewers in the vicinity of the Project area.

The scale and size of the operation, and the fact that much of it is situated in a vast open landscape, will result in a dramatic contrast with the existing landscape patterns of the area. The consequence being that the Project would dominate most views in the immediate area (refer to *Figure 10.1*). In this regard, the Project will be highly visible from the N14, the area from where most people would view the development. This artery is also a relatively popular tourist route and thus determined to be a sensitive viewing area in relation to the Project. Other sensitive receptors include landowners and personnel living/working at the Achab farmstead (east of the Project site), recreational users (ie hikers, cyclists and bird-watchers) and residents/commuters from nearby communities (ie Pella, Pofadder and Springbok). Views from the town of Aggeneys would not be regarded as being sensitive since it is a mining town and most residents are employed by a mining company.

Temporary aesthetic visual impacts associated with construction activities include the presence of excavators, other construction vehicles, earth moving activities (ie site clearance and site preparation activities), as well as associated disturbances including dust and noise. More permanent changes to the landscape will be associated with the development of the necessary mining stockpiles and infrastructure, including the open-pit, the concentrator plant, temporary staff accommodation facilities, the wastewater treatment plant, the tailings dam and the waste rock dump (WRD).

Figure 10.1 Aerial Photograph Showing Proposed Mining Infrastructure in Relation to Sensitive Viewers/Receptors



Impact Description and Assessment

Construction activities would result in a **direct negative** impact on the aesthetic value of the landscape, as it would degrade the character of the existing natural and rural landscape. Although, construction activities will cease after completion of the infrastructure (less than 5 years), the expected impact will be **long-term** as the established infrastructure and support structures will remain in place throughout the operational phase. The scale and size of the operation and the fact that it is situated in a vast open landscape will result in a dramatic contrast with the existing landscape patterns, **severely** altering views in the area. Despite this, the impact would be experienced only at a **local** level as it would extend beyond the boundaries of the site but within the 'zone of potential influence' (approximately 15 km from the site). It is **certain** that the impacts would occur during normal operating conditions. The resulting magnitude is **large** and the resulting Sensitivity / Vulnerability / Irreplaceability of Resource / Receptor would be **high**. In light of this assessment the significance of this impact would be **major**.

Box 10.56 Summary of Construction Impact: Impact on the Aesthetic Value of the Landscape

Nature: The above impacts would result in a **direct negative** impact on the aesthetic value of the landscape, as the existing character of the landscape would undergo dramatic changes during the construction phase.

Sensitivity/Vulnerability/Importance of Resource/Receptor – **High.**
Irreplaceability: The activity will result in the loss of **irreplaceable** resources.

Impact Magnitude – **Large.**
Extent: Impacts would be experienced on a **regional level** beyond the boundaries of adjacent land.
Duration: Although construction activities will cease after completion of the infrastructure (less than 5 years), the expected impact will be **long-term** as the established infrastructure and support structures will remain after this phase.
Scale: Views would be **severely** be altered.
Frequency: The frequency of the impact will be **continuous**.
Likelihood: It is **certain** that the impacts would occur during normal operating conditions.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – **MAJOR (-).**

Degree of Confidence: The degree of confidence is **high**.

Construction Phase Mitigation

Construction of Plant and Associated Infrastructure

- It is proposed that as little vegetation as possible be removed from building and infrastructure areas.

- Ensure, wherever possible, all existing natural vegetation is retained and incorporated into the mine site rehabilitation.

- Paint buildings and structures with colours that reflect and compliment the natural colours of the surrounding landscape. To further reduce the potential of glare, the external surfaces of buildings and structures should be articulated or textured to create an interplay of light and shade.

- The absolute minimum amount of vegetation and topsoil should be removed from the Project area.

- Ensure that conveyor belts are designed to follow the natural contours of the land to avoid extensive cut or fill areas.

<u>Lighting</u>

The negative effect of night lighting, glare and spotlight effects can be mitigated using the following methods:

- Install light fixtures that provide precisely directed illumination to reduce light 'spillage' beyond the immediate surrounds of the project structures and activities.

- Avoid high pole top flood and security lighting around the support infrastructure and areas of activity eg roads.

- To reduce the amount of glare, external surfaces of buildings and other structures should be articulated or textured to increase the interplay of light and shade.

<u>Waste Rock Dumps</u>

- Harsh steep engineered slopes should be avoided as these could impose an additional impact on the landscape by contrasting with the form of the existing topography.

- Final shaping and dumping should be implemented in such a way that the final horizon of the dumps simulates the existing profile of the inselberg and that the sides of the dumps are articulated in a fashion which resembles the existing topography.

- With aging the colour contrast of the exposed waste rock would begin to resemble the colours natural landscape. However, an environmentally safe product that simulates natural weathering can be applied to speed up the 'process of aging'. These applied coatings will have the added benefit of supplying plants with nutrition in the form of vital micronutrients and water-soluble nitrogen.

<u>Landscaping</u>

- Natural vegetation should be retained as far as possible, keeping clearing of vegetation as close as possible to the footprint of structures and activities.

- An ecological approach to landscaping is recommended. Should plants be introduced into the project site, plant selection should be guided by ecological rather than horticultural principles (ie ecological communities of plants provide more bio-diversity and habitat opportunities and would blend with the natural vegetation).

Access and Haul Roads

- Access and haul roads will require an effective dust suppression management programme, such as the application of non-polluting dust suppressing agents.

- Where paved surfaces are required, paving materials with a colour that would complement the natural colours and textures of the area shall be used.

Operational Phase Impacts

The introduction of the Project comprising of large scale buildings, structures and stockpiles (waste rock and zinc ore/concentrate) will add man-made elements, some of which are of considerable scale, to the receiving landscape establishing a new landmark feature and a point of reference for views associated with the proposed Project area.

The direct effects in terms of landscape losses or changes in the Project area are outlined as follows:

- Loss of areas of the landscape that are considered to hold high visual resource value, with its relatively unspoilt, vast, arid pains and rugged, rocky koppies that contrast dramatically with the characteristic blue skies.

- Alteration to the character of existing landscape patterns in the area. The consequence being that the proposed Project would dominate most views in the immediate area.

- Dust and light pollution from operational activities would add to the visual disturbance on the receiving environment.

The same sensitive viewers are expected as per the construction phase. These include motorists and tourists using the N14 highway and the local ancillary road network. In addition to recreational users (eg hikers, cyclists and bird watchers), residents of nearby communities (ie Pella, Pofadder, Aggeneys and Springbok), and adjacent farm landowners, whom are likely to have views that will be compromised as a direct result of the proposed intervention (refer to *Figure 10.1* above).

Long-term impacts will be associated with the operation of the following key Project infrastructure and stockpiles/dumps:

- the open pit zinc mine;
- the crusher;
- the concentrator plant;
- the tailings dam;
- the waste rock dumps;
- contractor camp;
- waste and sewage infrastructure;
- the salvage yard; and
- other support and ancillary infrastructures

These are all expected to result in noticeable visible changes to the landscape.

The waste rock dumps will appear as 'engineered' extensions attached to the side of the inselberg, facing the N14 highway (refer to *Figure 10.2*). The plant and associated infrastructure would also be visible when driving along the N14. The size and scale of the plant and waste rock dumps is expected to draw viewers' attention as they move closer to these features, especially in the earlier years of the mine, when the dumps would still be relatively small. Viewers' attention would also be drawn towards the horizon of the inselberg, which would be animated (during certain intervals) by large trucks dumping waste rock over the edge of the inselberg.

Figure 10.2 ***Simulation Showing Predicted Effect of the Proposed Waste Rock Dump and Plant***

The tailings dam, being located on the other side of the road, would spread the negative effect on the visual environment beyond the perceived 'boundary' created by the N14 road. As such, the negative visual elements would not only be limited to the one side of the road, leaving the other side 'untouched', but also visually 'contaminate' the area north of the N14 (refer to *Figure 10.3*).

Figure 10.3 Simulation Showing Potential Mining Infrastructure on Either Side of the N14

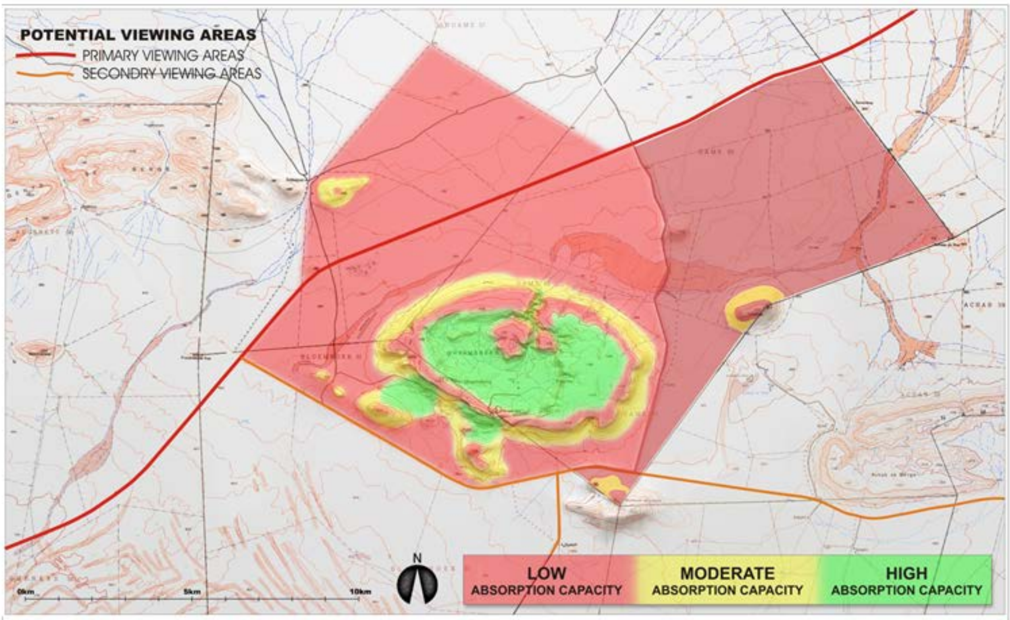
The above simulations clearly illustrate the visually intrusive nature of the Project. It is also clear from the simulations that the tailings dam and the waste rock dumps would have the most dramatic negative effect in the long term as they would remain after closure. Despite this, the plant, associated infrastructure and activities would have the most contrast with the existing natural landscape. The plant and associated infrastructure would also dominate the night time scene, as they would be illuminated for safety and security reasons.

In addition to the simulations shown above, the visual absorption capacity (VAC) of the Project site was mapped as part of the VIA study (*Figure 10.4*). VAC is the measure of the landscape's ability to visually accept the development into it (Cave Klapwijk and Associates, 1994). Areas which have a high VAC are more easily able to 'accept' objects into it so their impact is less noticeable. On the other hand areas with low VAC will suffer a higher visual impact from objects or structures imposed on them. *Figure 10.4* illustrates the three zones of VAC, including:

- low (ie flat plain areas and the crests of koppies and the inselberg);
- moderate (ie side slopes of koppies and the inselberg); and
- high (ie valleys and 'bowl' of the inselberg).

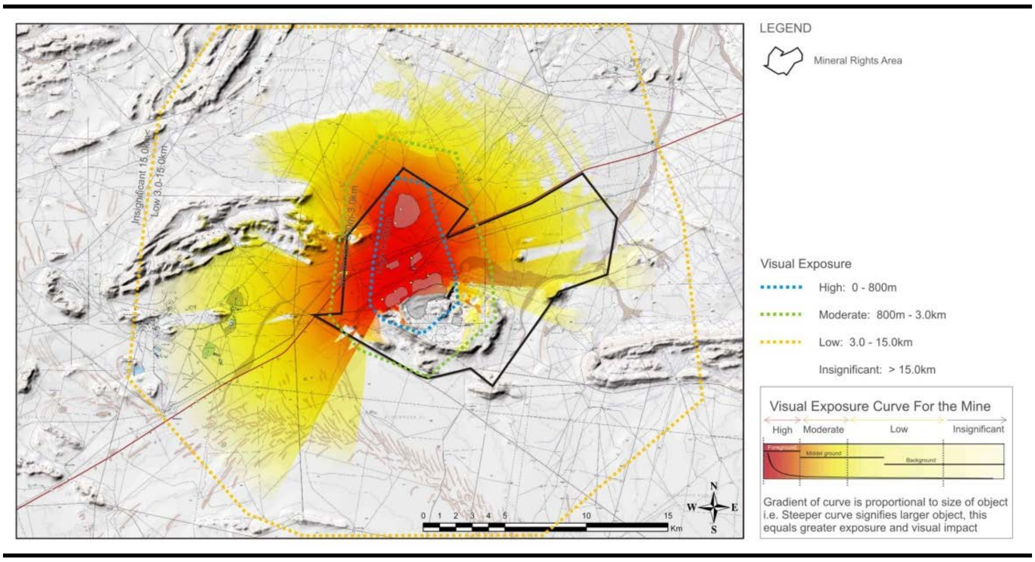
This illustration indicates that the majority of the proposed mining structures and buildings will be located in a zone rated with a low VAC. The waste rock dumps would be partially located in a moderate zone as it would be dumped over the rim of the inselberg, thus covering the whole gradient of the slope.

Figure 10.4 Illustration Showing the Visual Absorption Capacity of the Project Site



In addition to this, the VIA study determined the 'zone of potential influence' associated with the Project. This is the area from which the proposed site is supposedly visible. In terms of the Project, the or the 'zone of potential influence' was established and is regarded to be approximately 15 km (refer to *Figure 10.5*). This means that at a distance of 15 km from the site the visual impact of the proposed activities is expected to be diminished due to the diminishing effect of distance (the project recedes into the background) and atmospheric conditions (haze) on visibility. Also, at this distance the features would appear in the background of a view and thus begin to be 'absorbed' into the landscape setting.

Figure 10.5 Diagram Showing the Proposed 'Zone of Potential Influence' for the Project



Impact Description and Assessment

Operational activities would result in a **direct negative** impact on the aesthetic value of the landscape, as it would degrade the character of the existing natural and rural landscape. The impact would be of a **permanent** nature since waste rock dumps and the tailings dam would remain after decommissioning phase. The plant and other support structures would however be decommissioned during decommissioning phase. Impacts would be experienced on a **local** level beyond the boundaries of the Project site, even after decommissioning phase. Views would be **severely** be altered. It is **certain** that the impacts would occur during normal operating conditions. The resulting Magnitude is **large** and the resulting Sensitivity / Vulnerability / Irreplaceability of Resource / Receptor would be **high**. In the light of these findings the resulting Significance would be rated as being **major**.

Box 10.57 Summary of Operational Impact: Visual

<u>Nature</u>: Operational activities would result in a **direct negative** impact on the aesthetic value of the landscape, as it would degrade the character of the existing natural and rural landscape.

Sensitivity/Vulnerability/Importance of Resource/Receptor – **High.**
<u>Irreplaceability</u>: The activity will result in the loss of **irreplaceable** resources.

Impact Magnitude – **Large.**
<u>Extent</u>: The impact would be experienced only at a **local** level as it would extend beyond the boundaries of the site but within the 'zone of potential influence' (approximately 15 km from the site).
<u>Duration</u>: The impact would be of a **permanent** nature since waste rock dumps and the tailings dam would remain after decommissioning phase.
<u>Scale</u>: The impact will result in **severe changes** to the resource/receptor.
<u>Frequency</u>: The frequency of the impact will be **continuous.**
<u>Likelihood</u>: It is **certain** that the impacts would occur during normal operating conditions.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – **MAJOR (-).**

Degree of Confidence: The degree of confidence is **high**.

Operational Phase Mitigation

<u>Lighting</u>

The negative effect of night lighting, glare and spotlight effects can be mitigated using the following methods:

- Install light fixtures that provide precisely directed illumination to reduce light 'spillage' beyond the immediate surrounds of the project structures and activities.

- Avoid high pole top flood and security lighting around the support infrastructure and areas of activity eg roads.

<u>Waste Rock Dumps</u>

- Harsh steep engineered slopes should be avoided as these could impose an additional impact on the landscape by contrasting with the form of the existing topography.

- Final shaping and dumping should be implemented in such a way that the final horizon of the dumps simulates the existing profile of the Gamsberg and that the sides of the dumps are articulated in a fashion which resembles the existing topography. Would final shaping refer to the decommissioning/ closure phase?

- With aging the colour contrast of the exposed waste rock would begin to resemble the colours natural landscape. However, an environmentally safe product that simulates natural weathering can be applied to speed up the 'process of aging'. These applied coatings will have the added benefit of supplying plants with nutrition in the form of vital micronutrients and water-soluble nitrogen."

Tailings Dam

- Treatment would be similar to that prescribed for the waste rock dumps both in terms of shaping and 'colouration'.

Landscaping

- Natural vegetation should be retained as far as possible, keeping clearing of vegetation as close as possible to the footprint of structures and activities.

- An ecological approach to landscaping is recommended. Should plants be introduced into the project site, plant selection should be guided by ecological rather than horticultural principles. (ie ecological communities of plants provide more bio-diversity and habitat opportunities and would blend with the natural vegetation).

Access and Haul Roads

- Access roads and haul roads will require an effective dust suppression management programme, such as the application of non-polluting dust suppressing agents.

- Where paved surfaces are required, use paving materials with a colour that would complement the natural colours and textures of the area.

Decommissioning and Post Closure Phase Impacts

The decommissioning phase of the Project would result in the removal of all operational facilities such as the plant, crusher, concentrator etc. The process of removal will result in continued levels of visual disturbance. After decommissioning the waste rock dumps and tailings dam will remain. These as well as the scarring of the landscape brought on by the removal of the ancillary infrastructure can be slightly reduced as the veld will be shaped and seeded with indigenous plants.

If the tailings dam and waste rock dumps remain on site and are not rehabilitated successfully the visibility will remain high especially for people travelling along the N14 local road. The visibility can however be reduced if successfully rehabilitated as per the mitigation measures given below.

Impact Description and Assessment

Decommissioning activities would result in a **direct negative** impact on the aesthetic value of the landscape, as the character of the existing natural and rural landscape will continue to be degraded. Although, most of the decommissioning activities will cease after the removal of the operational facilities, the expected impact will be **permanent** as the established tailings dam and waste rock dumps will remain in place after the decommissioning phase and into closure. The scale and size of the tailings dam and the waste rock dumps and the fact that they are situated in a vast open landscape will result in a dramatic contrast with the existing landscape patterns, severely altering views in the area. Despite this, the impact would be experienced only at a **local** level as it would extend beyond the boundaries of the site but within the 'zone of potential influence' (approximately 15 km from the site). It is **certain** that the impacts would occur during normal operating conditions. The resulting magnitude is large and the resulting Sensitivity / Vulnerability / Irreplaceability of Resource / Receptor would be **high**. In light of this assessment the significance of this impact would be **major**.

Box 10.58 Summary of Decommissioning Impact: Visual

Nature: Decommissioning activities would result in a **direct negative** impact on the aesthetic value of the landscape, as the character of the existing natural and rural landscape will continue to be degraded.

Sensitivity/Vulnerability/Importance of Resource/Receptor – **High.**
Irreplaceability: The activity will result in the loss of **irreplaceable** resources.

Impact Magnitude – **Large.**
Extent: The impact would be experienced only at a **local** level as it would extend beyond the boundaries of the site but within the 'zone of potential influence' (approximately 15 km from the site).
Duration: The expected impact will be **permanent (ie irreversible).**
Scale: The impact will result in **notable changes** to the resource/receptor.
Frequency: The frequency of the impact will be **continuous.**
Likelihood: It is **certain** that the impacts would occur during normal operating conditions.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – **MAJOR.**

Degree of Confidence: The degree of confidence is **high**.

Decommissioning and Post Closure Phase Mitigation

- Incorporate all existing natural vegetation into the mine site rehabilitation process.

Lighting

The negative effect of night lighting, glare and spotlight effects, can be mitigated using the following methods:

- Install light fixtures that provide precisely directed illumination to reduce light 'spillage' beyond the immediate surrounds of the project structures and activities.

- Avoid high pole top flood and security lighting around the support infrastructure and areas of activity eg roads.

Landscaping

- An ecological approach to landscaping is recommended. Should plants be introduced into the project site, plant selection should be guided by ecological rather than horticultural principles. (ie ecological communities of plants provide more bio-diversity and habitat opportunities and would blend with the natural vegetation).

Residual Impact

Due to the immense scale of the Project and its resultant residual features (waste rock dumps and tailings dam), it is not possible to reduce the long term negative impact significantly to result in a lower rating. Impact ratings would thus remain similar for before and after implementation of mitigation measures.

Table 10.59 Pre- and Post- Mitigation Significance: Visual

Phase	Significance (Pre-mitigation)	Residual Significance (Post–mitigation)
Construction	**MAJOR (-ve)**	**MAJOR (-ve)**
Operation	**MAJOR (-ve)**	**MAJOR (-ve)**
Decommissioning and Post Closure	**MAJOR (-ve)**	**MAJOR (-ve)**

10.4 IMPACT ON TRAFFIC AND TRANSPORT NETWORKS

10.4.1 Impact on Traffic and Transport Networks

Traffic modelling was undertaken in order to calculate the amount of traffic that will be generated as a result of the Project. A qualitative measure called 'Level of Service' (LOS) was used to assess changes to existing traffic conditions. In determining the LOS for a specific transport network, several different operating conditions are assessed, including speed, travel time, traffic interruptions, freedom to manoeuvre, safety, driving comfort and convenience. Six LOS were defined for capacity analysis. These were given letter designations from LOS A to LOS F, with LOS A representing the best range of operating conditions and LOS F the worst.

In addition to this, expected delays that may occur as a direct result of the Project were assessed. These were measured in seconds.

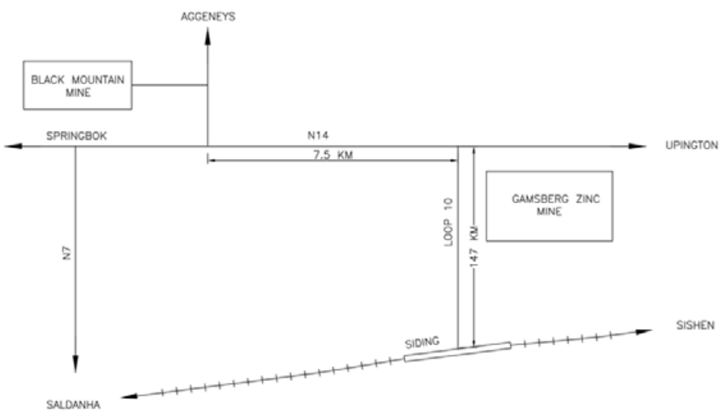
Finally, the projected LOS and expected delays were measured at key intersections that will be affected (see paragraph below) using Highway

Capacity Manual (HCM) software. HCM is an internationally recognised programme for analysing traffic impacts.

Figure 10.6 illustrates the key traffic and transport routes that were assessed as part of this Study. These included:

- the N14 highway (owned by SANRAL);
- Loop 10 (a gravel road that leads from the mine to the Loop 10 rail-siding on the TRANSNET Sishen-Saldanha Ore Line); and
- the N7 highway (owned by SANRAL).

Figure 10.6 ***Schematic of the Key Traffic and Transport Routes***



The following section provides the key findings and recommendations derived from the traffic and transport assessment study conducted.

Table 10.60 ***Impact Characteristics: Traffic and Transport Network***

Summary	**Construction**	**Operation**	**Decommissioning/ Post Closure**
Project Aspect/activity	Increase in traffic (associated with construction vehicles) on-site and at the site access road/N14 intersection.	Transfer of Zinc Concentrate to the Port of Saldanha via the N14 & N7 and via Loop 10 and the Sishen-Saldanha Railway Line.	Increase in traffic associated with the decommissioning of the mine.
Impact Type	Direct.	Direct.	Direct.

Summary	**Construction**	**Operation**	**Decommissioning/ Post Closure**
Stakeholders/Receptors Affected	SANRAL (N14). Local commuters. Local residents. Tourists.	SANRAL (N14 & N7). Provincial and Local Road Authorities (R399 and Loop 10). Transnet (Sishen-Saldanha Railway Line. N14 and N7 road users. Local residents Tourists.	SANRAL (N14). Local commuters. Local residents. Tourists.

Construction Phase Impacts

The Project will generate traffic and transportation impacts throughout the construction phase. Potential traffic impacts associated with the establishment of the Project will be associated with the delivery of construction materials, mining plant and processing components, bulk services infrastructure (eg pipework and transmission lines) and other equipment/infrastructure (eg bulk storage tanks) during the construction phase.

The construction of Project access roadways is also likely to impact upon the local transport network during the construction phase. With respect to this, all surface materials for the roads will be sourced from suitable overburden material and/or existing burrow pits at Lemoenplaas (located north of the existing BMM Township). Material to be brought in from outside will include cement, plant and equipment.

It is also estimated that the construction phase of the Project will require a labour force in the order of 3,200 people, which will include highly skilled engineers and technicians, semi-skilled labourers and unskilled labourers. These employment opportunities will be taken up and result in an increase in traffic between the town of Aggeneys and the Project site, which is 10 km east of the town. *Table 10.63* below shows the predicted person trip generation for the construction phase (60 month period) of the Project. It is estimated that construction activities will result in approximately 507 person trips per day. This relates to the use of approximately 155 vehicles per day, including 3 buses, 25 minibus taxis and 127 cars. It should be noted that there will be two shifts per day during the construction phase. As such, if it is assumed that trips are to be distributed evenly throughout the day, this means that there will be approximately 155 vehicle trips per shift change.

Table 10.61 Forecast of the Person Trip Traffic Generation during the Construction Phase

Assumptions	**Value**			
Total Number of Contractors	3,200			
Contract Period (months)	60			
Average Duration on Site (months)	19			
Contractors on Site Simultaneously	1,013			
Temporary Housing at Gamsberg Mine	500			
Persons / unit	2			
Person trips / day	0.5			
No Shifts	2			
Trip Generation	**Modes**			
Modal Split	Bus	Taxi	Car	NMT
Percentage split	10%	40%	50%	1%
Person trips	51	203	253	12
Persons / mode	20	8	2	
Motorized trips	3	25	127	
Total No. Vehicle Trips / Day	**155 vehicles / day**			

Traffic volumes of 155 trips per hour are considered not to be significant in the context of the background traffic on the N14, which is fairly low. There may, however, be some localised short-lived congestion at the intersection of the N14 and the Aggeneys access road and at the intersection of the N14 and Loop 10, with minor delays of more than 60 seconds per vehicle for a brief period, during the shift changes.

Impact Assessment

Construction activities will result in a **direct negative** impact on the traffic and transport network, particularly to those people using the N14 highway. The activity will **not result in the loss of irreplaceable** resources as the N14 will be able to accommodate the additional traffic associated with the construction phase, especially with the contractors accommodated on site in temporary housing. The extent of the impact is likely to be **localised** and within the sphere of influence of key intersections along the N14 highway. Construction phase impacts will be of a **temporary** nature and will abate on completion of this phase. The impact will result in **notably altered traffic conditions** along the N14 and in the vicinity of the site entrance. Although there is a **definite** likelihood of increased traffic, it is likely that disruption to traffic on the N14 would be **periodic.** In light of this assessment the significance of this impact would be **minor**.

Box 10.59 Summary of Construction Impact: Traffic and Transport Network

Nature: Construction activities will result in a **direct negative** impact on the traffic and transport network, particularly to those people using the N14 highway. Sensitivity/Vulnerability/Importance of Resource/Receptor – **Medium.** Irreplaceability: The activity will **not result in the loss of irreplaceable** resources as the N14 will be able to accommodate the additional traffic associated with the construction phase, especially with the contractors accommodated on site in temporary housing. Impact Magnitude – **Low.** Extent: The extent of the impact is likely to be **localised** and within the sphere of influence of key intersections along the N14 highway. Duration: Construction phase impacts will be of a **temporary** nature and will abate on completion of this phase. Scale: The impact will result in **notably altered traffic conditions** along the N14 and in the vicinity of the site entrance. Frequency: It is likely that disruption to traffic on the N14 would be **periodic.** Likelihood: There is a **definite** likelihood of increased traffic. IMPACT SIGNIFICANCE (PRE-MITIGATION) – **MINOR (-).** Degree of Confidence: The degree of confidence is **high.**

Construction Phase Mitigation

- Establish appropriate construction warning signs and road markings at the site entrance.
- Prepare the carriageway crossing at the Loop 10/N14 intersection with a concrete edge beam or construct an asphalt bell-mouth.
- Restrict all construction activities to designated working areas with all work areas and access areas clearly marked and signposted.
- Ensure lorry/trucks carrying abnormal loads have necessary permits in terms of the National Roads Act.
- Ensure that a traffic and transportation management plan is in place for the construction phase of the Project.

Operational Phase Impacts

One of the major operational activities that will impact on the associated traffic and transport network will be the bulk transportation of zinc concentrate from the Project site to the Port of Saldanha. In this regard, it is proposed that the Project will be implemented in three phases with a ramp up during the operation phase (over a 17 year period) to meet the maximum production target of 1,0 Mtpa. During the first phase of operation (Year 1 and 2) it is anticipated that 0,335 Mtpa of zinc concentrate will be transported by road (N14, N7 and R399) to Saldanha Bay for export. During the second phase transportation of the zinc concentrate will be split between road and rail, with 0,335 Mtpa being transported via road (N14, N7 & R399) and another 0,335 Mtpa being transported via rail on the Sishen – Saldanha railway line. This second phase will involve the road transportation of concentrate from the Project site to the Loop 10 rail-siding (located approximately 147 km to the south-east of the Project site) via the existing Loop 10 gravel road. Similarly, the third phase will involve a split between road and rail with 0,500 Mtpa being transported via road (N14, N7 & R399) and another 0,500 Mtpa being transported via rail on the Sishen – Saldanha railway line. Again the proportion of concentrate being transported via rail will need to be transported via road to the Loop 10 rail siding. In light of the expected ramp-up in operations, the estimated additional trip generation, for road tankers and rail wagons, for each of the three phases mentioned above is indicated in *Table 10.64* below.

Table 10.62 Road Traffic Generation Based on the Proposed Ramp-up

	Transport Requirements	Phase 1 (Year 1 and 2)	Phase 2 (Year 3 and 4)	Phase 3 (Year 5 – 17)
Road based transport to Saldahna via N14, N7 and R399.	**Volume of concentrate transported**	335,000 tons per annum	335,000 tons per annum.	500,000 tons per annum.
	Trucks required.	27 trucks per day (35t trucks operating 350 days per year)	27 trucks per day (35t trucks operating 350 days per year).	41 trucks per day (35t trucks operating 350 days per year).
	Wagons required.	N/A	N/A	N/A
Road and rail based transport to Saldanha via Loop 10 gravel road and Sishen – Saldanha railway line.	**Volume of concentrate transported.**	N/A	335,000 tons per annum.	500,000 tons per annum.
	Trucks required.	N/A	27 trucks per day (35t trucks operating 350 days per year).	41 trucks per day (35t trucks operating 350 days per year).
	Wagons required.	N/A	143 wagons per week (52t wagons operating 45 weeks of the year).	214 wagons per week (52t wagons operating 45 weeks of the year).

As shown above, the three phases of operation are likely to generate significant volumes of heavy vehicular traffic on the road network as zinc concentrate is transferred from the Project site to the Port of Saldanha. Despite this, the additional traffic loading on the N14 and N7 was analysed with HICAP software and the results are found to be satisfactory in relation to the background traffic associated with these transport routes. In this regard, the prevailing 'Level of Service' was found to be LOS A (refer to *Table 10.65* below), with average delays of less than 10 seconds per vehicle.

Table 10.63 HiCap 2000 Analysis: N14 (Springbok to Pofadder) and the N7 (Garies to Springbok)

Measures of Effectiveness	Phase 1	Phase 2	Phase 3
N14 (Springbok to Pofadder)			
Two way hourly volume (vph)	228	228	242
Levels of Service (LOS)	A	A	A
Average Travel Speed (km/h)	105.5	105.5	105.3
V/C Ratio	0.079	0.079	0.084
N7 (Garies to Springbok)			
Two way hourly volume (vph)	245	245	259
Levels of Service (LOS)	A	A	A
Average Travel Speed (km/h)	99.5	99.5	99.3
V/C Ratio	0.095	0.095	0.100

It is anticipated that during the first year of production that approximately 630 jobs will be created. This relates to an estimated 630 person trips per day (refer to *Table 10.66* below), resulting in an additional trip generation of 40 vehicles per day (11 buses, 8 minbus-taxis and 21 cars). It should be noted that during operations of the Project, there will be three shifts per day. If it is assumed that the trips will be distributed evenly throughout the day, it is expected that there will be approximately 27 trips per shift change.

Table 10.64 Forecast of Person Trip Generation during Operation (Year 1)

Assumptions	**Value**			
Number of jobs	630			
Number of contractors	128			
Permanent at Aggeneys	502			
Persons / unit	1			
Person trips	630			
No Shifts	3			
Trip Generation	**Modes**			
Modal Split	Bus	Taxi	Car	NMT
Percentage split	70%	20%	10%	1%
Person trips	441	126	63	6.3
Persons / mode	40	15	3	
Motorized trips	11	8	21	
Total No. Vehicle Trips / Day	**40 Vehicles per day**			

When full production is reached in the 5th year of operation it is expected that approximately 1,230 jobs will be created. This relates to approximately 1,230 person trips per day, resulting in an additional trip generation of approximately 79 vehicles per day (22 buses, 16 minbus-taxis and 41 cars). If it is assumed again that there are three shifts per day and that trips are distributed evenly throughout the day, this relates to approximately 53 trips per shift change.

Table 10.65 Forecast of Person trip Generation during Operation (Year 5)

Assumptions	**Value**			
Number of jobs	1230			
Number of contractors	380			
Permanent at Aggeneys	850			
Persons / unit	1			
Person trips	1230			
No Shifts	3			
Trip Generation	**Modes**			
Modal Split	Bus	Taxi	Car	NMT
Percentage split	70%	20%	10%	1%
Person trips	861	246	123	12.3
Persons / mode	40	15	3	
Motorized trips	22	16	41	
Total No. Vehicle Trips / Day	**79 Vehicles / Day**			

Traffic volumes of 53 trips per hour are not considered significant in the context of the background traffic on the N14, which is fairly low. There may however, be some localised short-lived congestion at the intersection of the N14 and the Aggeneys access road and at the intersection of the N14 and the Project site entrance, with minor delays of more than 20 seconds per vehicle for a brief period, particularly during shift changes.

The N14 has no indication of any public transportation services in close proximity to the Project site. In addition to this, there are not existing sidewalks to the site to serve the needs of cyclists and pedestrians alike.

Impact Assessment

Operational activities that increase traffic would result in a **negative direct** impact on people who use the roads along the final transport route. The activity will **not result in the loss of irreplaceable resources**. The extent of the impact is **regional** as the potential impact will extend along the selected key transport routes (ie N7, N14 & R399). The duration will be **long-term** as the impact is associated with the operational phase which is proposed to last for a minimum of 17 years. There is a definite likelihood of the impact occurring, which will result in **notable** changes to the resource/receptor. In light of this assessment the significance of this impact would be **moderate**.

Box 10.60 *Summary of Operational Impact: Traffic and Transport Network*

Nature: Operational activities that increase traffic would result in a **negative direct** impact on people who use the roads along the final transport route.

Sensitivity/Vulnerability/Importance of Resource/Receptor – **Medium.**
Irreplaceability: The activity will **not result in the loss of irreplaceable resources**.

Impact Magnitude – **Medium.**
Extent: The extent of the impact is **Regional** as the potential impact will extend along the selected transport route.
Duration: The duration will be **long-term** as the impact is associated with the operational phase which is proposed to last for a minimum of 17 years.
Scale: The impact will result in **notable** changes to the resource/receptor.
Frequency: The frequency of the impact will be **constant.**
Likelihood: There is a **definite** likelihood of increased traffic.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – **MODERATE (-).**

Degree of Confidence: The degree of confidence is **high.**

Operational Phase Mitigation

- Balance the transport of Zinc concentrate between the two transportation modes (ie road and rail).
- Ensure that a traffic and transportation management plan is in place for the operational phase of the Project.
- As the specialist report indicates that the N14 and the N7 will be operating at an acceptable LOS for existing and future traffic volume scenarios, no geometric improvements will need to be made to these roads to accommodate anticipate the increased traffic volumes.
- The transport of fuels on public roads is governed by the National Road Traffic Act and as such vehicles and drivers must meet stringent safety controls.
- Bulk road tankers must undergo regular maintenance/servicing inspections to ensure that they remain in good working condition.
- Adequate road signage and warning lights indicating working and turning areas should be provided at and near the site.
- Bus stops and mini-bus taxi stops should be established on the N14, to promote public transport use, particularly for the transport of semi-skilled and unskilled labourers during the operation phase.
- Sidewalks to the site should be provided and made wide enough to safely accommodate cyclists and pedestrians. Furthermore, the use of non-

motorised modes of transport (ie bicycles and walking) should be promoted. In this regard, employees living in close proximity to the site should be encouraged to use non-motorised transport instead of using private vehicles.

Decommissioning and Post Closure Phase Impacts

The decommissioning phase of the activity would result in the removal of all operational equipment. This will result in further impacts to the surrounding road network as the mining equipment is removed from site. The actual details of the decommissioning phase are not available and cannot be assessed comprehensively. Despite this, the receiving environment of the N14 is considered to be sufficiently robust to accommodate the decommissioning phase of the Project, which is expected to have very similar impacts to that of the construction phase.

Impact Assessment

Decommissioning activities will result in a **direct negative** impact on the traffic and transport network, particularly to those people using the N14 highway. The activity will **not result in the loss of irreplaceable** resources as the N14 will be able to accommodate the additional traffic associated with the decommissioning phase, especially with the contractors accommodated on site in temporary housing. The extent of the impact is likely to be **localised** and within the sphere of influence of key intersections along the N14 highway. Decommissioning phase impacts will be of a **temporary** nature and will abate on completion of this phase. The impact will result in **notably altered traffic conditions** along the N14 and in the vicinity of the site entrance. In light of this assessment the significance of this impact would be **minor**.

Box 10.61 Summary of Decommissioning Impact: Traffic and Transport Network

<u>Nature:</u> Decommissioning activities will result in a **direct negative** impact on the traffic and transport network, particularly to those people using the N14 highway.

Sensitivity/Vulnerability/Importance of Resource/Receptor – **Medium.**
<u>Irreplaceability</u>: The activity will **not result in the loss of irreplaceable** resources as the N14 will be able to accommodate the additional traffic associated with the decommissioning phase, especially with the contractors accommodated on site in temporary housing.

Impact Magnitude – **Low.**
<u>Extent</u>: The extent of the impact is likely to be **localised** and within the sphere of influence of key intersections along the N14 highway.
<u>Duration</u>: Decommissioning phase impacts will be of a **temporary** nature and will abate on completion of this phase.
<u>Scale</u>: The impact will result in **notably altered traffic conditions** along the N14 and in the vicinity of the site entrance.
<u>Frequency</u>: It is likely that disruption to traffic on the N14 would be **periodic.**
<u>Likelihood</u>: There is a **definite** likelihood of increased traffic.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – **MINOR (-).**

Degree of Confidence: The degree of confidence is **high.**

Decommissioning and Post Closure Phase Mitigation

- Ensure that a traffic and transportation management plan is in place for the decommissioning phase of the Project.
- Establish appropriate decommissioning warning signs and road markings at the site entrance.
- Restrict all decommissioning activities to designated working areas with all work areas and access areas clearly marked and signposted.
- Ensure lorry/trucks carrying abnormal loads have necessary permits in terms of the National Roads Act.

Residual Impact

The implementation of the above mitigation measures would reduce the construction impacts from Minor to Negligible significance, while the operation impacts will remain Minor. The implementation of the decommissioning phase mitigation measures would reduce the associated significance rating from Minor to Negligible. The pre- and post-mitigation impacts are compared in *Table 10.68* below.

Table 10.66 Pre- and Post- Mitigation Significance: Traffic and Transport Network

Phase	Significance (Pre-mitigation)	Residual Significance (Post–mitigation)
Construction	**MINOR (-ve)**	**NEGLIGIBLE (-ve)**
Operation	**MINOR (-ve)**	**MINOR (-ve)**
Decommissioning and Post Closure	**MINOR (-ve)**	**NEGLIGIBLE (-ve)**

10.5 IMPACT ON ARCHAEOLOGY, HERITAGE AND PALAEONTOLOGY

10.5.1 Impact on Archaeology

Table 10.67 Impact Characteristics: Archaeological Resources

Summary	Construction	Operation	Decommissioning/ Post Closure
Project Aspect/ activity	Loss of archaeological resources through landscape/site disturbance.	Loss of archaeological resources through landscape/site disturbance. Management of archaeological resources relative to operation of the mine and associated infrastructure.	No archaeological impacts are anticipated during decommissioning phase.
Impact Type	Direct.	Direct.	
Stakeholders/ Receptors Affected	Archaeological resources.	Archaeological resources.	

Construction and Operational Phase Impacts

Construction phase activities will include land clearance and excavation of different parts of the site in preparation of infrastructural development. The primary construction activities will include the following:

- Pre-stripping of the open pit;
- Excavation of the waste rock dump and tailings dam area;
- Construction of a contractor's camp and concentrator plant (including some of associated infrastructure); and
- Construction of bulk service requirements (ie water, sewage and power infrastructure).

The following activities will be characteristic of the operational phase of the Project:

- Further expansion of open pit;
- Increase in the waste rock dump and tailings dam footprint;
- Construction of full internal road network; and
- Expansion of the concentrator plant and associated infrastructure.

Archaeological artefacts are considered, in each instance, a unique and non-renewable resource. The Project will result in losses to archaeological artefacts during both the construction and operational phases. The construction and operational phase impacts can be seen as permanent and irreversible, and would likely be experienced at both phases of the Project. It is likely that the construction and operation of infrastructure would contribute to the loss of archaeological artefacts. In light of this, the construction and operational phase impacts associated with the Project are assessed in an integrated manner, as they are closely linked. Note however that mitigation measures are specific to the different phases and are presented accordingly.

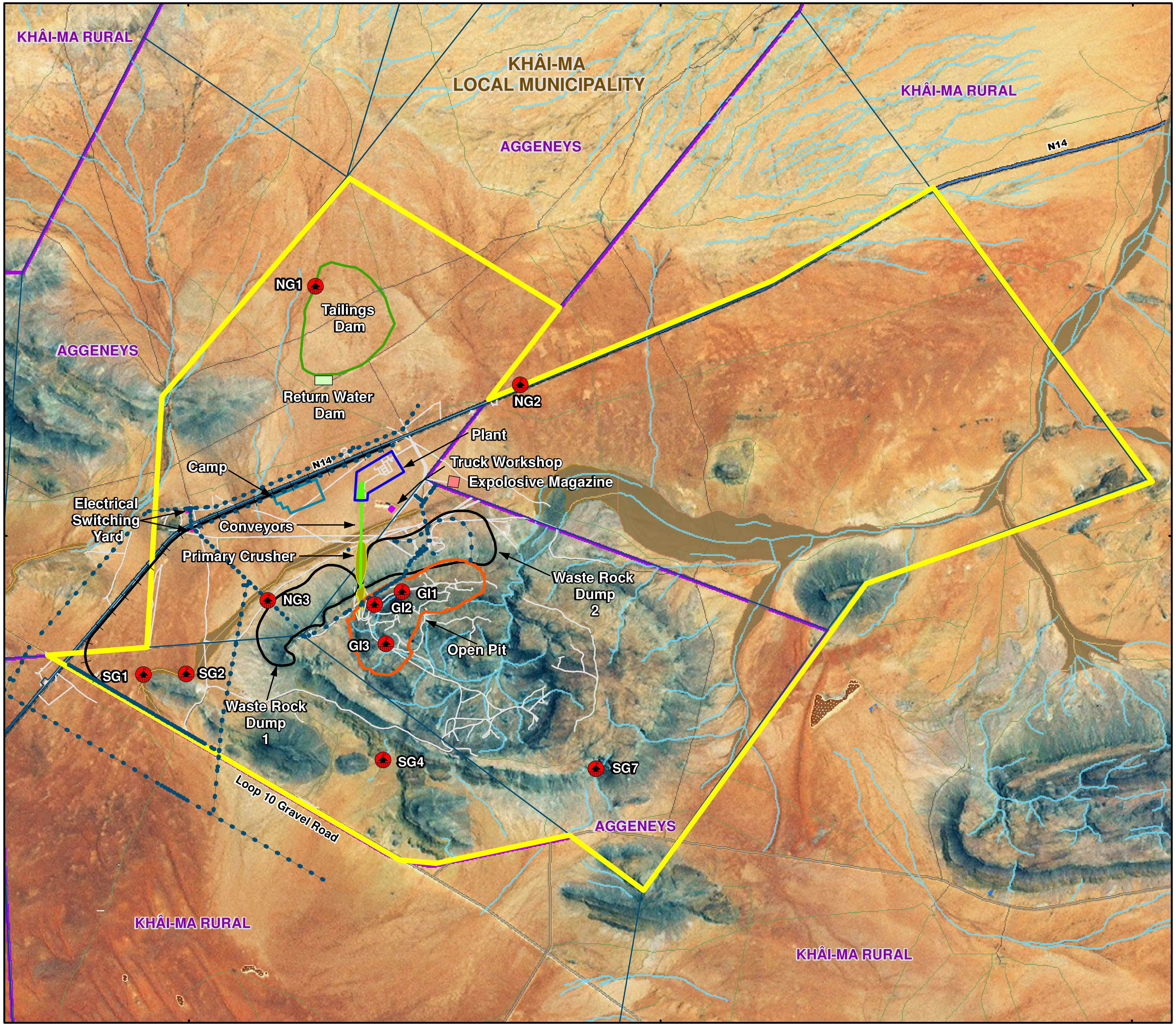
Based on the findings of the site visit undertaken, areas of archaeological importance have been ranked according to the northern slope, southern slope and the inselberg basin (a detailed description of artefacts identified in these three regions are contained in above). *Figure 10.7* illustrates areas of archaeological importance in relation to the proposed layout of the Project.

Northern Slope

Artefact occurrence NG1 (mid-twentieth century drilling site) is likely to be impacted during the construction and subsequent expansion of the tailings dam, located on the northern border of the N14. However, this site has been allocated a low archaeological significance.

Artefact occurrence NG 2 is located along the northern border of the N14, in close proximity to the road. This artefact has been allocated a high archaeological significance, consisting of a series of dome-shaped bedrock outcrops around which are clustered an abundance of Ceramic Later Stone Age artefacts (stone artefacts, pottery, ostrich eggshell). Due to its location well clear of the proposed tailings dam (and other infrastructure), the site is unlikely to be impacted during the construction and operational phase.

Artefact occurrence NG3 will likely be impacted by the construction of powerlines and potentially activities related to the construction and operation of the contractor camp. This artefact has been allocated a low archaeological significance, as this is an individual instance of an isolated Earlier Stone Age cleaver that lacks context and hence is of limited archaeological importance.



Legend

- Archaeological Observation Points
- Non-Perennial River
- Dry Water Course Centre Line
- Dry Water Course Extent
- Dam
- Dry Pan
- National Route (N14)
- Main Road
- Secondary Road
- Other Road
- Track/Footpath
- Railway
- Electrical cables
- Haul Roads
- Town Boundary
- Cadastral_Boundaries
- Waste Rock Dump 1
- Waste Rock Dump 2
- Open Pit
- Contractors Camp
- Conveyor
- Electrical Switching Yard
- Explosive Magazine
- Plant
- Primary Crusher
- Return Water Dam
- Tailings Dam
- Truck Workshop
- Mineral Rights Area

SCALE:

0 1 2 3 4

Kilometres

N

TITLE:

Figure 10.7:
Areas of Archaeological Importance

CLIENT:

vedanta

BLACK MOUNTAIN MINING (PTY) LTD

DATE: Apr 2013	CHECKED: MP	PROJECT: 0164903
DRAWN: AB	APPROVED: SHC	SCALE: 1 : 70 000

DRAWING:

Areas of Archaeological Importance.mxd

REV: 0

ERM
Great Westerford Building
240 Main Road
Rondebosch, 7725
Cape Town, SOUTH AFRICA
Tel: +27 21 681 5400
Fax +27 21 686 073

ERM

Projection: Transverse Mecator, CM19. Datum : WGS84
Source: Chief Directorate National Geo-Spatial Information. Black Mountain Mining (Pty) LTD. McGregor Museum
Inset Map: Esri Data & Maps

SIZE: A3

T:\Gis Projects\0164903_Gamsberg\Mapping\MXD\Report\April2013\Areas of Archaeological Importance.mxd

Southern Slope

The southern slopes of the inselberg contain a greater variety and richness of archaeological artefacts. A total of 8 artefact occurrences considered to be a high archaeological importance were identified.

Artefact occurrence SG 1, which is suspected as being a grave site, is located to the south west of the inselberg. Furthermore, artefact occurrence SG2, which is a surface scatter of Ceramic Later Stone Age material, is also located to the south west of the inselberg. Both artefacts occurrences have been allocated a high importance. Based on the power infrastructure proposed, these two sites (SG 1 and SG 2) may likely be impacted during the construction phases.

The site SG 7 has been identified as the Kloof in which the suspected history of San genocide occurred. The Namies inselberg is also considered to be a potential area, but the exact location of the genocide events could not be confirmed. In light of this, these locations have been identified to be a high heritage importance. Although upon inspection no particular evidence was found at the site itself of this historical event, written and oral history lends support to this speculation, and on this basis the site must be considered important. The existing access road to the inselberg will be widened by 15 m and utilised for the construction phase only. A new access road will be constructed along the northern slopes of the inselberg, at an operational level. The processes of widening the existing access road along the southern slopes of the inselberg will unlikely impact the site SG7.

It is unlikely that the remaining artefact occurrences identified on the southern slope will be impacted by project activities.

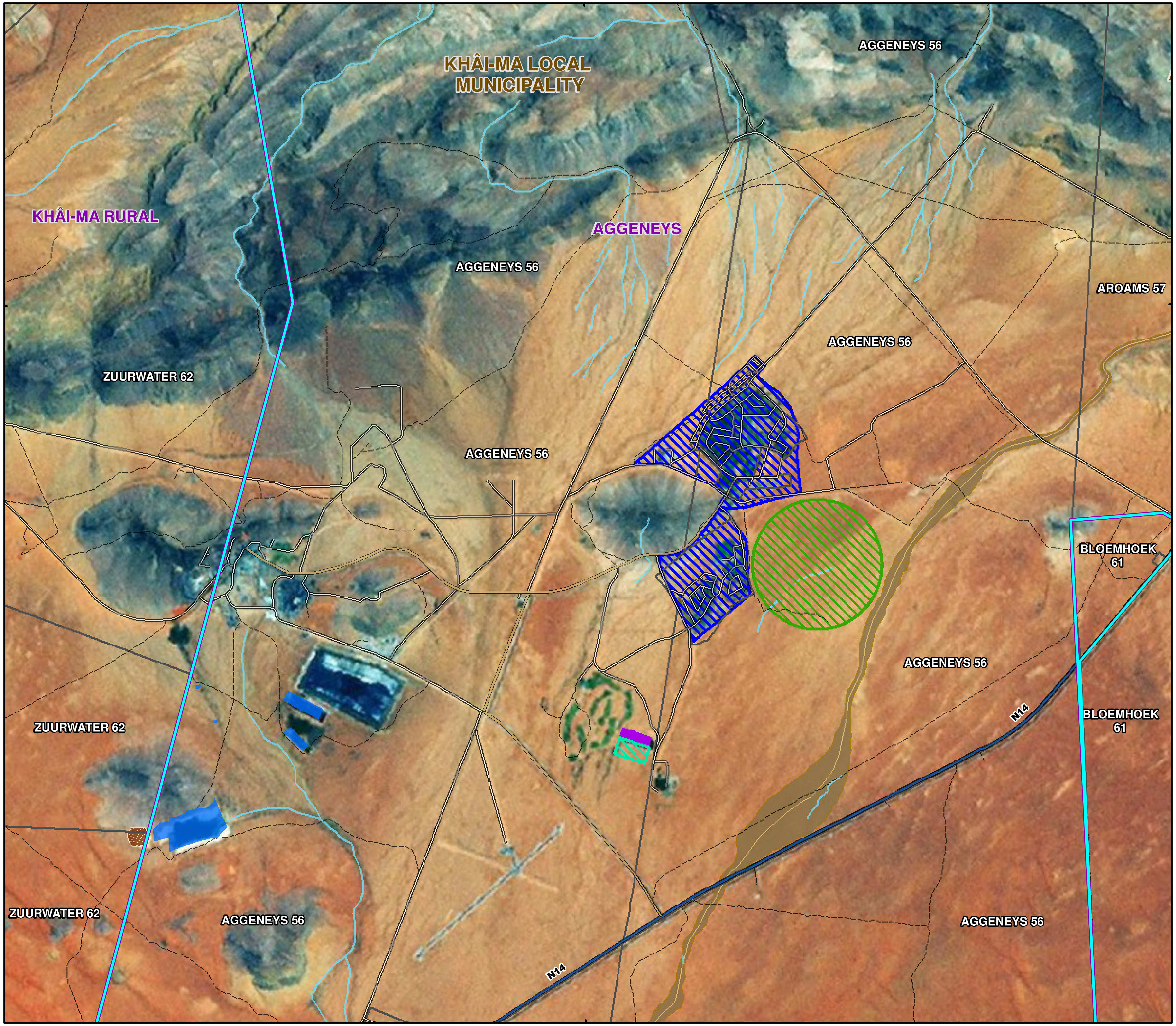
Basin of Inselberg

A total of seven artefact occurrences of archaeological value were identified within the basin (including the rim) of the inselberg. Of the seven artefacts identified, only three sites are expected to be impacted during the construction and operational phases.

Artefact occurrence GI 2, which contains indications of is ephemeral Later Stone Age occupation, was considered to be of low archaeological importance, partly on account of previous disturbance. Artefact occurrence GI3, which is a Middle Stone Age artefact site, has also been allocated an importance rating of low. Both sites have been subject to disturbances form previous mining activities and erosion from high energy surface run-off (ie heavy rains over millennia). Both these sites are likely to be impacted during the construction and operation of the primary crusher and conveyor system. Furthermore, artefact site GI3 will likely be impacted by the operational phase of the open pit.

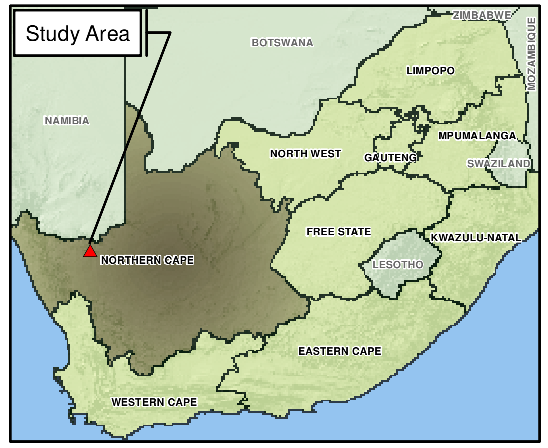
The most significant artefact occurrence identified was found along the rim of the inselberg (artefact GI1). This site is characterised as a Middle Stone Age workshop and is considered of regional importance. The site was originally quarried for material to construct a new landing strip. However, despite the past impacts, the site is still considered to be of a high heritage importance. Based on its location, it is likely that the operational phase (and to a lesser extent construction) of the waste rock dump will have a direct impact on this site.

Survey of the flat plains at the south western side of Aggeneys where the housing development is due to be situated, and alongside (south of) the existing Wastewater Treatment Works, as shown below, yielded no archaeological or cultural heritage resources. It is also considered unlikely that any significant artefact occurrences would be found below the surface in either instance. No mitigation is required.



Legend

- Dry Water Course Center Line
- Non-Perennial Center Line
- Dam
- Dry Pan
- Dry Water Course Extent
- National Route
- Secondary Road
- Other Access
- Track/Footpath
- Town Boundary
- Farm Boundary
- Town Expansion Area
- Existing town
- Waste Water Treatment Works Expansion Area
- Existing Waste Water Treatment Works



SCALE:

0 1 2

Kilometres

N

TITLE:

Figure 10.8:
Expansion of Town and Waste Water Treatment Works

CLIENT:

vedanta

BLACK MOUNTAIN MINING (PTY) LTD

DATE: Oct 2012	CHECKED: MP	PROJECT: 0164903
DRAWN: AB	APPROVED: SHC	SCALE: 1 : 40 000

DRAWING:	REV:
Expansion of town & WWTW.mxd	0

ERM
Great Westerford Building
240 Main Road
Rondebosch, 7725
Cape Town, SOUTH AFRICA
Tel: +27 21 681 5400
Fax +27 21 686 073

	SIZE:
Projection: Transverse Mecator, CM19. Datum : WGS84 Source: Chief Directorate National Geo-Spatial Information. Black Mountain Mining (Pty) LTD Inset Map: Esri Data & Maps	A3

T:\Gis Projects\0164903_Gamsberg\Mapping\MXD\Report\April2013\Expansion of housing & WWTW.mxd

Box 10.62 Summary of Construction and Operational Impact: Archaeological Resources

Nature: Construction and operational activities would result in a **direct negative** impact on archaeological resources.

Sensitivity/Vulnerability/Importance of Resource/Receptor – High.
Irreplaceability: The activity **will** result in the loss of **irreplaceable** resources.

Impact Magnitude – High.
- Extent: The extent of the impact is **local.**
- Duration: The expected impact will be **permanent(ie irreversible).**
- Scale: The impact will result in **severely altered changes** to the resource/receptor.
- Frequency: The frequency of the impact will be **once off.**
- Likelihood: Archaeological resources would **likely** be lost.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MAJOR (-).

Degree of Confidence: The degree of confidence is **high**.

Construction and Operational Phase Mitigation

- Minimise the development footprint to only what is actually needed.
- Restrict all construction activities to designated working areas with all work areas and access areas clearly marked and signposted.
- Immediately report any heritage trace that may come to light during the construction phase.
- In the case of sites NG1 and NG3 it is suggested that a sufficient record exists and/or the sites are of low significance so that no further mitigation is recommended.
- In the case of sites SG 1 and SG 2 it is noted that the sites lie close to proposed power infrastructure, but pending more specific detail on the nature and precise location of the power infrastructure, it appears that mitigation here may not be required.
- In the case of sites GI 1 to 5, it was previously recommended that mitigation by way of salvage be carried out. (SAHRA issued permits in Nov 2000 for this work but these have since lapsed). However, in terms of revised layout, only GI 1, 2 and 3 would be impacted and hence only these three sites would now require Phase 2 archaeological mitigation (salvage).
- Physical salvage of sites would need to take place before commencement of the construction and operational phases. Detailed recommendations and proposals for mitigation need to be made.

- Further investigation of the possible massacre site SG7 and possibly associated archaeological sites SG3 and SG4 (not expected to be impacted) on the south side of Gamsberg is recommended in order to ensure adequate protection of this sensitive zone within the Study Area. If further investigations reveal SG7 to be important, then the suggestion of its declaration as a provincial heritage site may be explored.

- Restrict operational activities to designated working areas with all work areas and access areas clearly marked and signposted.

- Immediately report any heritage trace that may come to light during the operation phase.

- Consider creation of a resource centre/museum for Gamsberg as a means of enhancing tourism in the area while also addressing community needs in terms of local heritage (both for general awareness as well as formal educational uses).

Residual Impact

The implementation of the above mitigation measures would reduce the decommissioning phase impacts from **Major** to **Moderate** significance. The pre- and post-mitigation impacts are compared in *Table 10.70* below.

Table 10.68 Pre- and Post- Mitigation Significance: Impact on Archaeology

Phase	Significance (Pre-mitigation)	Residual Significance (Post–mitigation)
Construction and Operational	**MAJOR (-ve)**	**MODERATE (-ve)**

Consideration was given to potential impacts experienced during the decommissioning phase. However, at decommissioning, activities will include the removal of existing infrastructure and will be limited to the existing disturbed footprint. In doing so, no decommissioning impact is anticipated on archaeological sites.

10.5.2 Impact on Cultural Heritage

Table 10.69 Impact Characteristics: Cultural Heritage

Summary	Construction	Operation	Decommissioning/ Post Closure
Project Aspect/ activity	Loss of cultural heritage resources through landscape/site disturbance.	Loss of cultural heritage resources through landscape/site disturbance.	The removal of operational infrastructure relative to cultural heritage resources.
Impact Type	Direct	Direct	Direct

Summary	Construction	Operation	Decommissioning/ Post Closure
Stakeholders/ Receptors Affected	Cultural Heritage resources	Cultural Heritage resources	Cultural Heritage resources

Construction and Operational Phase Impacts

Similarly to the impact on archaeology, the construction and operational phase impacts to cultural heritage and sense of place will overlap between the two phases. Since these impacts are closely linked, the construction and operational phase impacts will be jointly assessed.

The sense of place for the area derives from the combination of all landscape types and their impact on the senses. Most people who live near or pass through the Study Area approach it along the N14 national road. They travel through an open dry landscape that is frequently 'punctuated' by curious inselbergs. It is this vast, desolate landscape coloured directly by its geological substrate against a wide open blue sky that gives the area its distinctive character. Although the study area evokes a distinct sense of place, it is not unique to the district or region. Nevertheless, the sense of place (including landscape quality) of the Study Area is considered to be high. The Project will disturb the surrounding landscape through the construction of physical infrastructure (ie waste rock dump and tailings dam) and increased traffic volumes of heavy duty vehicles during the operation of the Project. Furthermore, increased ambient dust and noise levels associated with the Project may also contribute to further changes to the overall sense of place.

During the site inspection, tangible artefacts of cultural heritage value were not identified within the mining license area. However, as described above, the southern section of the inselberg may pertain to the local San people who may have been subject to local genocide in the later nineteenth century (the south western and south eastern corner of the inselberg might relate to a historically attested massacre). This makes a rather sensitive landscape that may in future become increasingly a focus of genocide consciousness. Should the massacre site be confirmed within the mining license area (implicating, primarily, site SG 7 and perhaps also SG 4 - refer to *Figure 10.7* above), cultural heritage importance of the site will certainly increase. Furthermore, if the suspected gravesite is confirmed, the cultural value of the area will become of further importance.

Box 10.63 Summary of Construction and Operational Impact: Cultural Heritage Resources

Nature: Construction and Operational activities would result in a **direct negative** impact on cultural heritage.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Medium.
Irreplaceability: The activity **will** result in the loss of **irreplaceable** resources.

Impact Magnitude – Medium.
- Extent: The extent of the impact is **local.**
- Duration: The expected impact will be **permanent (ie irreversible).**
- Scale: The impact will result in **notable changes** to the resource/receptor.
- Frequency: The frequency of the impact will be **once off.**
- Likelihood: Sense of place and cultural heritage resources would un**likely** be lost.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MODERATE (-).

Degree of Confidence: The degree of confidence is **low**.

Construction and Operational Phase Mitigation

- Minimise the development footprint to only what is actually needed.
- Restrict all construction activities to designated working areas with all work areas and access areas clearly marked and signposted.
- Immediately report any cultural heritage trace that may come to light during the construction phase.
- Physical salvage of sites would need to take place before commencement of the construction and operational phases.
- Further investigation of the possible massacre site SG7 and possibly associated archaeological sites SG3 and SG4 (not expected to be impacted) on the south side of Gamsberg is recommended in order to ensure adequate protection of this sensitive zone within the Study Area. If further investigations reveal SG7 to be important, then the suggestion of its declaration as a provincial heritage site may be explored.
- Restrict operational activities to designated working areas with all work areas and access areas clearly marked and signposted.
- Immediately report any cultural heritage trace that may come to light during the construction and operation phase.

Decommissioning Phase Impacts

During decommissioning, mining production will begin to decline and finally come to a halt. This would have the indirect result of reduced traffic volumes of heavy duty vehicles as well as reduced dust and noise generation. This is likely to reduce the expected impacts to the sense of place. However, the key project infrastructure such as the tailings dam and waste rock dump will remain a permanent feature within the landscape. These large features would persist with impacts on the surrounding landscape, post mining. Despite the changes to traffic volumes and dust generation, the permanent nature of the mineralised waste facilities (ie waste rock dump and tailings dam) will continue to impact the sense of place permanently.

Box 10.64 Summary of Decommissioning Impact: Cultural Heritage Resources

Nature: Decommissioning activities would result in a **direct negative** impact on cultural heritage resources.

Sensitivity/Vulnerability/Importance of Resource/Receptor – Medium.
Irreplaceability: The activity **will** result in the loss of **irreplaceable** resources.

Impact Magnitude – Medium.

- Extent: The extent of the impact is **local.**
- Duration: The expected impact will be **permanent(ie irreversible).**
- Scale: The impact will result in **notable changes** to the resource/receptor.
- Frequency: The frequency of the impact will be **once off.**
- Likelihood: The sense of place would un**likely** be impacted.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MODERATE (-).

Degree of Confidence: The degree of confidence is **high**.

Decommissioning Phase Mitigation

- Limit all decommissioning activities to the existing disturbed areas.
- Remove as much as possible of the mine infrastructure from the site, during decommissioning.
- Rehabilitate all disturbed areas and attempt to reinstate the impacted areas as closely as possible to their original state.
- If, as recommended, a museum or resource centre is created for enhancing tourism and awareness of local heritage, then seek to ensure its sustainability as a resource during and beyond decommissioning.

Residual Impact

The implementation of the above mitigation measures would reduce the construction, operational and decommissioning phase impacts from **Moderate** to **Minor** significance. The pre- and post-mitigation impacts are compared below.

Table 10.70 Pre- and Post- Mitigation Significance: Impact on Cultural Heritage

Phase	Significance (Pre-mitigation)	Residual Significance (Post–mitigation)
Construction and Operation	MODERATE (-ve)	MINOR (-ve)
Decommissioning	MODERATE (-ve)	MINOR (-ve)

10.5.3 Impact on Palaeontology

A Paleontological Impact Assessment (PIA) was undertaken by John Pether in (refer to *Annex G* for the report) to outline the nature of paleontological heritage resources (fossils) in the subsurface of the Project area, which may potentially be affected by construction and operation activities (eg bulk earth works) during the development of the mine. While important features of paleontological interest were not explicitly identified on site, the paleontological heritage and the potential for disturbing such resources was acknowledged, especially in the potentially more fossiliferous fluvial/stream deposits associated with ephemeral watercourses at the Project site.

The potential impacts of this development on paleontological resources are assessed and mitigation measures to reduce the impacts are outlined below.

Table 10.71 Impact Characteristics: Paleontological and Heritage Resources

Summary	Construction	Operation
Project Aspect/ activity	Disturbance of or damage to palaeontology heritage resources associated with site preparation and construction activities.	Negligible impacts associated with site expansions and services and maintenance activities.
Impact Type	Direct negative.	Direct negative.
Stakeholders/ Receptors Affected	Paleontological heritage resources within site clearance and excavation areas. On-site fossils.	Paleontological heritage resources within site clearance and excavation areas. On-site fossils.

Construction and Operational Phase Impacts

Project activities undertaken predominantly during the preparation and construction and operational phases of the Project will have the potential to interfere with or disturb paleontological heritage resources on site. These activities include:

- Pre-stripping and establishment of open pit;
- site and vegetation clearance;
- levelling, compacting and grading activities;

- trenching and excavations for infrastructure and pipelines; and
- the laying of foundations for buildings and structures.

The mining of the zinc ore in unfossiliferous Bushmanland Group bedrock strata is not expected to have an impact on fossil heritage in the area. However, a direct impact will be associated with bulk earth works that are excavated into the surficial Kalahari Group sediments that surround the Gamsberg amphitheatre, viz the red aeolian sands (Gordonia Fm/Q-s1), the Q-s2 coversands and colluvial deposits and the fluvial deposits in watercourses. The bulk earth works with a potential paleontological impact are those required for the installation of the mine infrastructure.

Although no areas of particular paleontological sensitivity have been identified in the Study, fossils are expected to occur sporadically in the subsurface of the sands. Provided that no further bulk earth works in the surficial deposits take place there should not be an impact during the operational phase. However, it is possible that with time further infrastructure may be required.

The decommissioning phase likewise should not involve additional installations requiring earth works. However, it is possible that earthmoving involved with rehabilitation and landscaping might entail excavation into undisturbed deposits.

Impact Assessment

Construction and operational activities such as earthworks have the potential to have a **direct negative** impact on paleontological heritage resources on site. The extent of the impact is **on site**, as the potential impact on paleontological resources would be limited to the site. The duration would be **permanent**, as paleontological resources are irreplaceable and any loss would be permanent. The intensity is **low** considering the generally unfossiliferous strata found below the site. Notwithstanding, when fossils are found in these formations, they are often very significant additions to the geologic understanding of the area. Due to the sparse, very patchy distribution of fossils in the subsurface, the probability of a significant fossil find is rated **unlikely**. Due to the low fossil content predictability of the surficial deposits, the degree of confidence is rated as **medium**.

Box 10.65 Construction and Operational Impact: Damage to or Destruction of Paleontological Heritage Resources

<u>Nature:</u> Construction activities such as earthworks have the potential to have a **direct negative** impact on paleontological heritage resources on site.

Sensitivity/Vulnerability/Importance of Resource/Receptor **– Low.**
<u>Irreplaceability</u>: The activity is **unlikely to result in the loss of irreplaceable** heritage resources.

Impact Magnitude – **Low.**
<u>Extent</u>: The extent of the impact is **on-site,** as the extent of their disturbance is limited to the site.
<u>Duration</u>: The duration would be **permanent,** as paleontological and heritage resources are irreplaceable and any loss would be permanent.
<u>Scale</u>: Considering the generally unfossiliferous strata found below the site, the Project is not expected to significantly alter any receptors. Notwithstanding, when fossils are found in these formations, they are often very significant additions to the geologic understanding of the area.
<u>Frequency</u>: The frequency of the impact would be **once-off.**
<u>Likelihood</u>: Due to the sparse, very patchy distribution of fossils in the subsurface, the probability of a significant fossil find is rated **unlikely.**

IMPACT SIGNIFICANCE (PRE-MITIGATION) – **NEGLIGIBLE (-).**

Degree of Confidence: The degree of confidence is **medium.**

Construction Phase Mitigation

<u>Mitigation Measure(s)</u>

The ECO responsible for the development must remain aware that all sedimentary deposits have the potential to contain fossils and he/she should thus monitor all substantial excavations into sedimentary bedrock for fossil remains. If any fossils are found during construction, HWC and SAHRA should be notified immediately.

If significant fossils are found, an appropriately qualified palaeontologist will investigate, and if required, a permit will be obtained to recover and preserve the paleontological resources for scientific purposes before work can be commenced again.

Residual

If the above-mentioned mitigation is adhered to, the residual impact significance on any paleontological resources is considered to be *Negligible*.

Table 10.72 Pre- and Post- Mitigation Significance: Paleontological Heritage Resources

Phase	Significance (Pre-mitigation)	Residual Significance (Post-mitigation)
Construction	**NEGLIGIBLE (-ve)**	**NEGLIGIBLE (-ve)**

Phase	Significance (Pre-mitigation)	Residual Significance (Post–mitigation)
Operation	**NEGLIGIBLE (-ve)**	**NEGLIGIBLE (-ve)**

11 CUMULATIVE IMPACTS

Impacts directly associated with the Project are discussed in the preceding sections. In this section the impacts associated with cumulative effects of the Project and other development are described. Evaluation of potential cumulative impacts is an integral element of an impact assessment.

11.1 ADMINISTRATIVE REQUIREMENTS

In reference to the scope for an impact assessment, IFC's Performance Standards specify that:

> *"Risks and impacts will be analyzed in the context of the project's area of influence. This area of influence encompasses…**areas potentially impacted by cumulative impacts** from further planned development of the project, any existing project or condition, and other project-related developments that are realistically defined at the time the Social and Environmental Assessment is undertaken; and (iv) areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location. "*(IFC 2006).

The overarching piece of legislation governing the EIA process within a South African context (ie NEMA) also requests for the consideration of cumulative impacts within the EIA process.

Cumulative impacts in relation to an activity are defined in the EIA Regulations (Government Notice R543) as meaning *"the impact of an activity that in itself may not be significant, but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area"*

11.2 APPROACH

Cumulative impact assessment methodologies are not well defined, and therefore no general practice can be adopted to assess potential cumulative impacts. In order to understand the manner in which this Project will contribute to cumulative impacts, an understanding of the baseline environment was developed. This included the identification of existing and proposed projects within the region. A search was undertaken to try to identify all current Basic Assessment or full Scoping and Impact Assessment Applications made in the local and regional context. Furthermore, the DENC was also contacted to provide confirmation of other major developments planned in the region [1].

(1) Note that ERM was requested to submit an application form in terms of the Promotion of Access to Information Act (2000) (PAIA) to source relevant information. Note that this application has been submitted and are awaiting a response.

In order to contextualise the potential cumulative impacts associated with this Project, an administrative review of local and regional policies were undertaken. The purpose of this review was to confirm the key challenges faced by the Local and District Municipality. These key challenges, together with current or future development proposals in the region, were used to inform the identification and assessment of cumulative impacts.

11.3 *ASSUMPTIONS AND LIMITATIONS TO CUMULATIVE IMPACTS*

Cumulative effects are difficult to predict as they are the result of complex interactions between multiple projects or activities. Further, prediction of effects of future development has an inherent error in that the fine details of a future development are not generally known and whether a future development actually occurs is dependent on a number of factors. This assessment is thus restricted to consideration of other development that is 'reasonable and foreseeable'.

Lastly, mitigation and management of cumulative effects are frequently beyond the ability of a single action or stakeholder and the mitigations developed in this ESIA have focussed on actions that the Project can take to avoid or control direct project impacts. Management of cumulative effects often requires mitigation in cooperation with other stakeholders or at a government level.

It is assumed that the renewable energy facilities identified in the region will be approved in terms of NEMA and be allowed to proceed with construction and operation.

The summary of local and region challenges faced by the local and district municipality is limited to key considerations that relate to this Project and are not limited to what is identified below.

11.4 *BASELINE CONDITIONS*

11.4.1 *Existing and Potential Future Mining Operation*

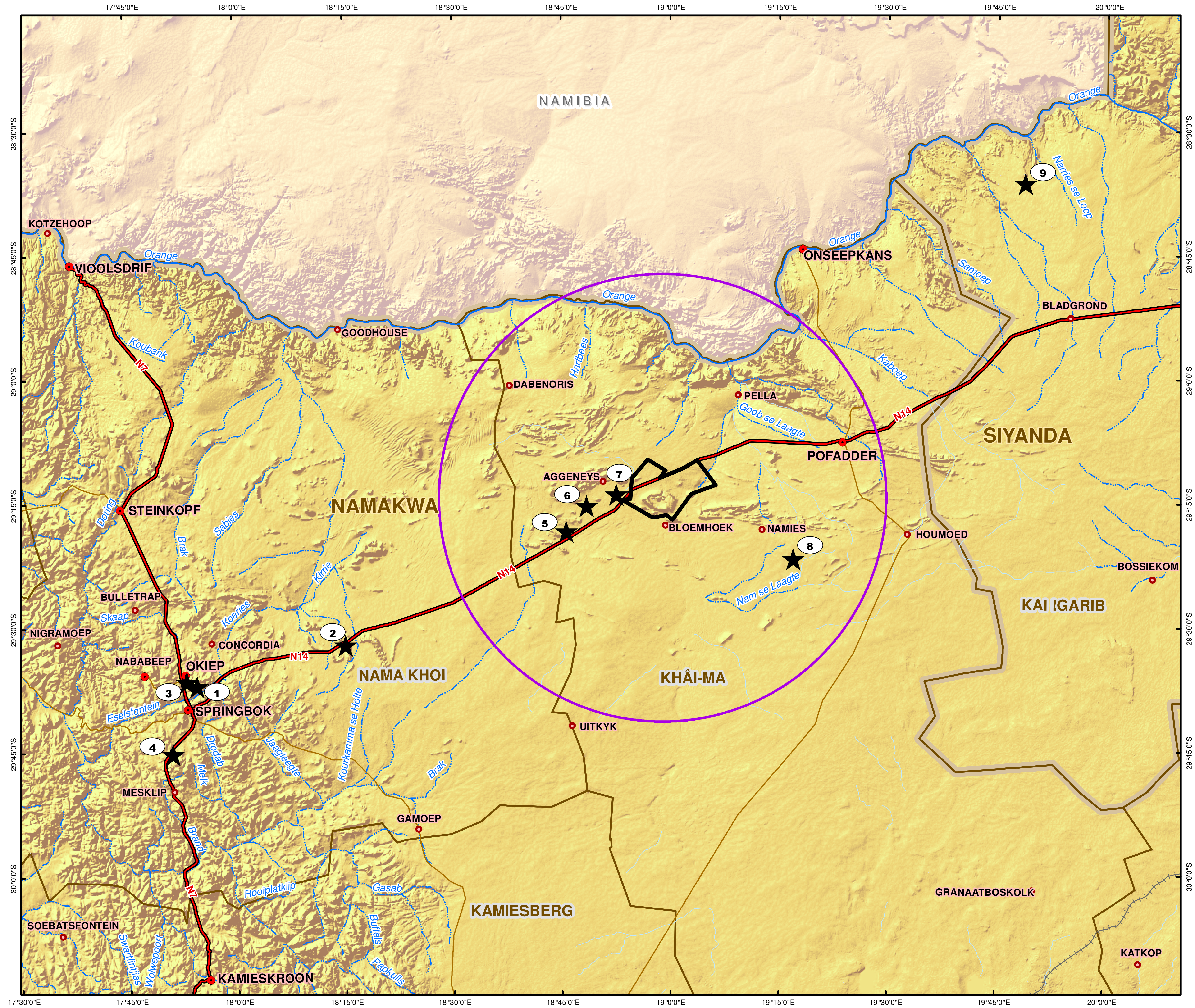
BMM currently operates the Deeps Mine located near the town of Aggeneys, based on an existing mining right. The existing Deeps Mine currently mines zinc, lead, copper and silver.

In addition to this, BMM currently has a new order mining right and approved EMPr for the zinc resources located within the Gamsberg inselberg, 10 km east of Aggeneys. BMM are presently mining 60,000 tons per annum (tpa) (metal production) from underground workings at the Gamsberg inselberg. The ore currently mined at the existing underground operation is transported to the BMM concentrator plant in Aggeneys where it is processed, together with ore from the Black Mountain Deeps Mine.

11.4.2 *Renewable Energy Facilities*

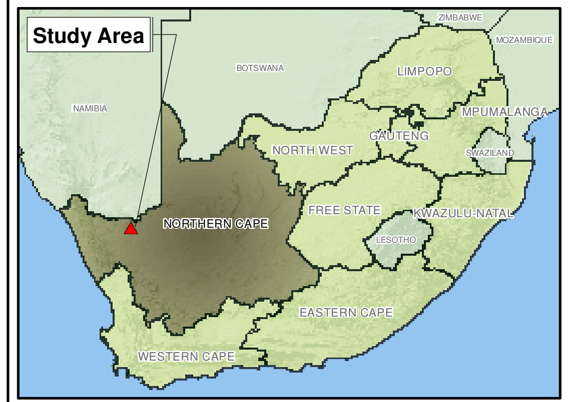
There are four renewable energy projects identified within a 50km radius of the Project site (refer to *Figure 11.1* below). The location of renewable energy facilities is concentrated in close proximity to the Project site, due to the existing Aggeneys substation. From a District perspective, four renewable energy facilities have been identified in and around Springbok. One renewable energy facility was identified east of the town of Onseepkans, close to the Orange River.

In general, the solar energy projects are part of a trend in the wider region and province and are in keeping with the earmarking of a wide strip of land along the N14 as a Solar Corridor in Khai Ma Local and Namakwa District Municipality planning. Although Environmental Authorisations have been issued for many of the proposed renewable projects, there is no certainty on the implementation of the project.



Legend

- MainTown
- Towns
- Perennial River
- Non-Perennial River
- Dry river
- Main Roads
- National Roads
- Railways
- Local Municipalities
- District Municipalities
- Buffer (50km)
- Mineral Rights Area (15411 Hectares)
- Proposed Renewable Energy Facilities



SCALE:

0 5 10 15 20 25 30 35 40

Kilometres

N

TITLE:

Figure 11.1:
Proposed Renewable Energy Facilities

CLIENT:

vedanta

BLACK MOUNTAIN MINING (PTY) LTD

DATE: Apr 2013	CHECKED: KK	PROJECT: 0164903
DRAWN: AB	APPROVED: SHC	SCALE: 1 : 400 000

DRAWING:	REV:
Renewable Energy Facilities.mxd	0

ERM
Great Westerford Building
240 Main Road
Rondebosch, 7725
Cape Town, SOUTH AFRICA
Tel: +27 21 681 5400
Fax +27 21 686 073

ERM

Projection: Transverse Mecator, CM19. Datum : WGS84
Source: Chief Directorate National Geo-Spatial Information, SANBI, EnPAT
Inset: ESRI Data and Maps

SIZE: A3

T:\Gis Projects\0164903_Gamsberg\Mapping\MXD\Report\Apr2013\RRenewable Energy Facilities.mxd

The potential to utilise renewable energy to meet the power requirements for the Gamsberg mine was explored. Due to the volumes and reliability of power supply, renewable energy facilities would not be able to meet the base load power requirements for the Project and was not considered further.

11.4.3 *Proposed Zinc Refinery and Smelter*

During the initial EIA process undertaken, the Gamsberg mine included the construction of a new zinc refinery and smelter. The insecurity and rising cost of power was one of the driving factors to suspend the Project. During the initial phases of the ESIA process, BMM suggested the potential for the construction of a new zinc refinery and smelter, on condition a secure power supply could be assured. Discussions have been initiated with Eskom, however, for purposes of this cumulative impacts section, it is assumed that a new zinc refinery and smelter will be constructed in close proximity to the Gamsberg mine.

11.5 LOCAL AND REGIONAL POLICY FRAMEWORK

The local and regional challenges currently being experienced by the local and district government has been divided, based on key planning documents. A brief summary of the some of the key challenges experienced has been identified, based on a review of the following documentation:

- Northern Cape Provincial Growth and Development Strategy (2011)
- Namakwa District Municipality Local Economic Development Strategy (2007)
- Khai Ma Rural Spatial Development Framework Plan (2010)
- Khai Ma Integrated Development Plan (2006-2011)

In light of the above referenced documents, the following is a consolidated list of key challenges currently being faced by the local and district municipality:

Table 11.1 Summary of Key Challenges Experienced by Local and District Municipality

Summary of Challenges Experienced	Applicability to Project
Conservation of critical biodiversity in the region.	Loss of ecological habitat
Improve basic service delivery for water, sanitation, power and housing	While the mine will provide for additional housing and associated services for its employees, some influx of work seekers may place additional strain to existing basic services in Aggeneys and surrounding towns.

Summary of Challenges Experienced	Applicability to Project
Improving access to health, education and living standards	The expected increase in employees (and associated family members) resulting from the Project together with possible influx of work seekers will place additional strain to existing health and education facilities of Aggenys and the surrounding towns.
Decreasing the prevalence rate of TB, HIV and AIDS	The expected influx of people could impact the spread of communicable diseases.
Reducing criminal activities	The influx of migrants may increase criminal activities in the region, if employment is not secured.
Opportunities for employment	The Project will increase the number of employment opportunities in the region.
Strengthen local economic development	The Project will likely increase the expendable income in the region through wages/ salaries, as well as increase potential for growth of local suppliers/ contractors. Lastly, the increase in expendable income may increase the potential for secondary business opportunities in the local market.
Cultural, science and nature tourism	The loss of biodiversity of conservation value, together with increased dust and noise emissions and the visual impact of the mine infrastructure will likely influence sense of place. This may negatively influence tourism
Encourage industrial activities, especially the mining sector as it's the largest contributor to employment in the region	The Project is the construction of a new mine.

11.6 *CONSIDERATION OF CUMULATIVE ISSUES*

Based on the descriptions/ definitions provided above, it is apparent that a number of factors can be considered, when assessing cumulative impacts. However, the focus of this assessment will remain on key significant issues that have been informed by the findings of the impact assessment in *Chapters 9* and *10* and key local and regional challenges as discussed above. The following factors are incorporated into the cumulative impact assessment, which is presented below:

Table 11.2 Summary of Cumulative Considerations

Project Activities	Element/ Issue to be Impacted	Additional consideration
Construction of infrastructure and day to day activities resulting from mining, renewable and other projects.	Change to the visual aesthetic and overall sense of place may impact tourism potential.	Apart from the physical infrastructure such as waste rock dumps and tailings facilities, solar infrastructure, increase dust generation and traffic volumes will exacerbate the impact.
Ground clearing and preparation for construction for mining, renewable and other projects.	Removal of ecological habitat.	The potential impacts of dust and groundwater drawdown on ecological habitat and the impact of noise on faunal species.
The commencement of mining, renewable and other projects would result in the influx of migrants in search of employment opportunities.	This may impacts bulk municipal services.	The impact of influx will also indirectly impact the spread of communicable diseases and criminal elements.
The development of various mining, renewable and tourism projects Project will result in an increase in expenditure in the region and increased employment.	Increase in capital spending within the region and employment opportunities within the local and district municipal area.	Indirect benefits to local businesses, contractors and service providers.
The development on mining and renewable activities in the area will introduce training and skills developments to employees.	Employees from surrounding communities will be provided with training and skills development.	On the job trainings, prior to construction, would be critical to achieving a high local employment rate.

11.7 EXPECTED CUMULATIVE IMPACTS

In light of key challenges faced by the local and district municipality, together with the baseline conditions (including foreseeable developments), each of the aforementioned issues/ elements will be qualitatively assessed below.

11.7.1 *Impact of Changes to the Visual Aesthetic (including sense of place) on Tourism Potential*

Key Local and District Challenges

The district and local municipality IDPs and SDFs point out the importance of tourism in the wider area and focus on its future potential. With regard to tourism corridors, the SDF supports the prioritisation of the 'Pofadder-Onseepkans' and 'Pofadder-Witbank' tourism routes for tourism development with Pofadder, Onseepkans and Pella the identified tourism nodes. These tourism routes have been identified as having a high tourism potential.

Existing and Foreseeable Developments

The existing Deeps Mine is located within 15 km of the Project site. The Deeps Mine generates increased traffic volumes on the N14 and Loop 10 Gravel Road. The dust generation of the Deeps Mine is limited, as it's an underground mining operation. Furthermore, the existing underground mining operation at Gamsberg also contributes to the ambient dust and noise levels in the region. Due to the small volumes of product at Gamsberg underground mine, the impact on traffic is minimal [(1)]. The other major developments such as the Gamsberg mine and potential zinc refinery and smelter would also result in similar impacts. Impacts of the specific mining activities at Gamsberg on specific tourism facilities and key tourism areas would be limited, given the project's location relative to these. Visual exposure from the N14 would be high although temporary in nature for passing motorists who would largely still be able to enjoy the key attractions and tourist facilities in the wider area which are relatively far removed and screened from the project.

The proposed renewable energy facilities are likely to result in the impact to the existing visual fabric of the region. There are approximately four renewable energy facilities being proposed near or adjacent to the town of Aggeneys (ie located within 50 km of the Gamsberg inselberg). The changes to the visual fabrics are likely to impact the visual aesthetic of the landscape. Furthermore, the construction of the renewable energy facilities will also contribute to an increase in dust generation (through ground clearing) and traffic flows, thus influencing the sense of place of the region.

The combined effect of the Gamsberg mine and existing/ foreseeable developments will have a cumulative impact on the visual aesthetic and potential subsequently impact tourism potential of the area. The scale of this impact is however uncertain. Future developments will need to consider the local and district planning goals and objectives in establishing a tourism corridor. Local and District Municipality will need to address this issue through screening various development applications against the tourism goals and objectives to ensure that cumulative impacts are considered.

11.7.2 Removal of Ecological Habitat

Key Local and District Challenges

In recognition of the global importance of Succulent Karoo habitat and specifically the "Bushmanland Inselberg Region", the local and regional planning documents promote the protection and on-going conservation of critical biodiversity. The challenge is managing and protecting these areas of ecological importance, while stimulating economic development and growth within the region. Responsible development is required to ensure a balance between conservation and growth within the region.

(1) Note that the existing underground mining operation at Gamsberg will be closed, should this Project be approved.

Existing and Foreseeable Developments

Depending of the viability to explore additional resources, the Deeps Mine may contribute to the further but limited impact to sensitive ecological habitat in the region. Any other mining developments in the region may have similar impacts on biodiversity. The consideration of a new refinery and smelter, which would more than likely be developed in close proximity to the Gamsberg mine may also impact sensitive habitat, depending on the location of the infrastructure. Careful site selection and planning would be required, before a suitable location can be identified.

Similarly, the proposed renewable facilities could potentially result in the loss of ecological habitat. However, it's likely that renewable energy facilities will be located on existing farmlands, which have been previously ploughed and/ or used for grazing. As a result, the construction of the proposed renewable energy facilities is unlikely to result in the loss of extensive critically important ecological habitats. However, as no certainty is available on the specific locations, the consideration of critical biodiversity and associated ecological corridors will need to be considered when locating any renewable energy infrastructure, including associated transmission lines.

The Gamsberg mine will result in the need for a biodiversity offset as a result of the impact on irreplaceable and constrained habitat, as well as compensation in lieu of irreplaceable habitat that is not ofsetable within the Gamsberg Inselberg. The Gamsberg Inselberg lies at the heart of what is termed the "Bushmanland Inselberg Region", which includes all the large, quartzite-capped inselbergs located in the northern Bushmanland plains in South Africa. The Bushmanland inselbergs effectively comprise an archipelago of rocky islands within a vast expanse of sand. These rocky islands share common floristic affinities that are fundamentally distinct from the surrounding sandy plains. The flora of these inselbergs forms a distinct centre of plant endemism located within the larger Eastern Gariep Centre of Endemism. There are many species endemic to the Bushmanland Inselbergs and the region is defined as a distinct centre of endemism termed the "Bushmanland Inselberg Centre of Endemism". Any further threats to the habitat or ecological linkages of the Bushmanland Inselbergs are likely result in unacceptable impacts on the biodiversity of the area. Future protection of the Gamsberg off-set area together with the remaining inselbergs will be important to mitigate potential future cumulative impacts. This will need to be driven through Local and District Municipality and regional biodiversity and conservation planning.

11.7.3 *Increased Demand on Municipal Services*

Key Local and District Challenges

A key challenge to the local and district municipality's is that of service delivery. The provision of basic services such as water, sewerage, power and housing has been an on-going problem in the region. Several of the planning documents for the region have identified basic service delivery as key issues.

Existing and Foreseeable Developments

Employees of the existing Deeps Mine are mainly located within the town of Aggeneys, however some are living in the surrounding towns of Springbok, Pella, Pofadder and Onseepkans. It is anticipated that all employees for the Gamsberg mine will also be accommodated in Aggeneys. As BMM and potentially future mining activities will provide all basic services to the employees in Aggeneys, no additional strain to municipal service delivery is anticipated from future mining developments.

The proposed renewable energy facilities are likely to provide employment to surrounding communities, which may result in a minor impact to the basic service delivery of the local and district municipality. The potential for employment may however attract migrant labourers into the region, in anticipation of jobs. Although the influx expected for a renewable energy facility is limited, there is likely to be a growing demand for basic services in the area. Similarly, the establishment of additional mining activities, including a potential zinc refinery and smelter could certainly result in a large influx of job seekers into the area. The influx related impacts would certainly increase the pressure on basic services.

The combined effect of the Gamsberg mine and other foreseeable development could have a significant cumulative impact on the local and district Municipality to meet the bulk service requirements, resulting mainly from influx of job seekers. A strategic influx management plan should be developed, together with the major developers in the region to proactively anticipate and manage the impacts of influx, expected in the District.

11.7.4 *Project Expenditure*

Key Local and District Challenges

A key challenge in the region is to encourage industrial activities (specifically mining [(1)]). Related challenges include increasing employment opportunities and strengthen local economic development. These three challenges are closely linked with each other. The encouragement of industrial activities will increase the employment opportunities in the region. Furthermore, industries increased expenditure in the region, thereby introducing additional wages/

(1) Mining has been identified, as it's currently the largest employment sector in the region.

salaries, opportunities for smaller business and contractors, growth opportunities for local suppliers and potential for secondary industries. The additional capital expenditure would also likely assist the region with improving the quality of living in surrounding communities.

Existing and Foreseeable Developments

The introduction of any new projects into the District will result in increased expenditure in the region, thus having the benefits for smaller business, suppliers and contractors. It would also result in an increase in employment opportunities and potential for secondary businesses. The introduction of increased salaries into the communities would likely result in stronger economic development in the region. Notwithstanding, increased salaries could potentially increase activities related to social ills (drug and alcohol abuse due to increased income), which needs to be acknowledged. The increased benefits are likely to be experienced in a lesser extent for renewable energy projects.

The combined effect of the current and foreseeable projects will have a significant cumulative impact on project expenditure and associated benefits. However, these positive impacts should be enhanced at a local and district level to ensure local communities benefit directly. Stronger measures and commitments are required from the project developers in terms of maximising local employment and downstream economic activities such as supplier, secondary industries etc. Collaborating closely with the local and district municipalities in supporting the objectives of the Integrated Development Plans will be important to maximise these benefits.

11.7.5 Training and Skills Development

Key Local and District Challenges

A key challenge for the region is to develop opportunities to reduce the high levels of unemployment. It is assumed that low skills levels are a contributing factor to the lack of employment opportunities. Furthermore, the region itself lacks the diversity of activities to increase the employment opportunities available to residents. An increase in the levels of skills present in the community will certainly increase the opportunities for employment as well as strengthen local economic development.

Existing and Foreseeable Developments

The existing Deeps Mine and other major developments (including Gamsberg mine and refinery and smelter) contribute to the skills base of its employees [(1)] during the operational and decommissioning phases. Development of these skills can be transferred to other industrial activities, which thereby increases the potential for alternative employment opportunities.

(1) Majority of Deeps Mine employees are based in the surrounding region.

The proposed renewable energy facilities are likely to contribute to the surrounding communities through community trusts and employment. This will not only increase the opportunities for employment in the surrounding area, but also diversifies the potential opportunities for alternative means of employment. As the district is characterised with mining, this will ensure that the skills based can be diversified from the mining sector.

The combined effect of the Gamsberg mine and existing/ foreseeable projects are likely to have a significant positive cumulative impact on skills developments. It is important that the project applicant's work together with the local and district municipality to identify the skills gaps present in the District. Furthermore, the project applicants should try to align their corporate social responsibilities with skills development objectives and plans identified by the local and district municipality.

11.8 CONCLUSION

The expected negative cumulative impacts are likely to place additional strain on the existing challenges experienced by the local and district authorities. These challenges include increased conservation of critical biodiversity, improving basic services and decreasing prevalence rates of TB, HIV/AIDs and criminal elements (expected to be related to impacts of influx). However, current and foreseeable developments are also likely to positively contribute to local economic development, improved employment opportunities and general increase in quality of life. It is evident that the Project would have both positive and negative cumulative effects that are closely inter-related with local and district municipal challenges. The effective on-going management of these cumulative impacts is strongly dependant on the relationship between the individual developers and the local and district municipality. Close cooperation between the various developers and the local authorities in meeting the objectives of the local Economic Development Strategies, Bioregional Plans and Integrated Development Plans is essential to mitigating and managing potential future cumulative impacts.

12 CLOSURE, REHABILITATION AND POST MINING LANDUSE

In terms of the MPRDA, BMM will be required to undertake a detailed closure and rehabilitation process at the end of the life of mine. The purpose of this Section is to outline the proposals contained in the conceptual closure plan, including closure and rehabilitation objectives and financial provisioning. The Section closes with potential suggestions for post mining landuse.

12.1 CLOSURE AND REHABILITATION FRAMEWORK

The planning for closure and rehabilitation is an on-going process, which will be adapted and updated during the operational phase of the Project. For purposes of this ESIA process, closure planning will include the approved Project Description (see *Section 3*), final layout plan, expected life of mine and financial provision linked to projected financial returns. Based on the current level of engineering design available and understanding of DMR requirements, a Draft Conceptual Closure Plan has been developed (*Annex D*) together with a Draft Social and Labour Plan. During the operational phase, the closure criteria will need to be refined further, together with the associated costing to develop a preliminary closure and rehabilitation plan.

As the Project approaches the end of the life of mine, a final closure and rehabilitation plan will need to be compiled, based on further refinements of the above iterations, and submitted to the DMR for final approval. The final closure plan will include an updated financial breakdown and allocation for closure, as well as approved suggestions for post mining landuse (based on further engagement with surrounding landowners and key stakeholders).

12.2 CLOSURE AIM AND OBJECTIVES

The aim of the Conceptual Closure Plan for the Gamsberg Project is to ensure that the area transformed by mining, processing and other operational activities is either returned to as natural a state as possible or facilities remaining at the end of the life of BMM are utilised for other economically viable and sustainable activities. The closure objectives should be achieved in as cost effective a manner as possible, and the closure solution should be sustainable in the long term.

Four Key Objectives are identified:

1. To make sure that the following commitments will be achieved as a minimum:
    - The site will be made safe for both humans and animals,
    - The site will be rehabilitated to be physically, chemically and biologically stable,
    - The residual impacts will be managed to acceptable levels and will not deteriorate over time, and
    - Closure will be achieved with minimal socio-economic upheaval.

2. To ensure that the biodiversity and environment on the site is protected.

3. To secure the effective and sustainable transfer of the municipal services of the town, Aggeneys, and the Pella-drift Water Board to the Khai Ma municipality.

4. To provide sufficient funds at the end of life of mine, to properly implement the closure plan, and also to make provision for possible premature closure, and post closure monitoring requirements.

12.3 PROPOSED DECOMMISSIONING METHODS AND MANAGEMENT STRATEGIES TO AVOID, MINIMISE AND MANAGE RESIDUAL AND LATENT ENVIRONMENTAL AND SOCIAL IMPACTS

A number of proposed rehabilitation methods and management strategies for the decommissioning of the various areas and elements of the Gamsberg Project will be carried out in accordance with the associated legal requirements and international standards.

The Conceptual Mine Closure Plan identified a number of decommissioning strategise for the following mine infrastructure components:

- Shafts
- Tailings Storage Facility
- Waste Rock Dump
- Open Pit
- Evaporation Ponds
- Concentrator Plant
- Workshops / Offices / Stores / Salvage Yard
- Concentrate Pads
- Conveyor Belts
- Explosives Magazines
- Fencing
- Gravel Roads
- Rehabilitation of Open Surfaces
- Residential Areas
- Construction Camp
- Landfill Sites

Post-Closure monitoring and management is also accounted for and it is recommended that this involve:

- Vegetation succession monitoring and management
- Erosion monitoring and management
- Groundwater quality monitoring
- Surface run-off monitoring
- Monitoring and management of pollution control facilities, ie the tailings dam seepage collection pond and associated evaporation ponds, cut-off trenches etc.

The costs associated with the decommissioning strategies and the monitoring and management programme up to a period of five years post-closure have been included in the closure cost estimate presented in *Table 12.1* below.

The Draft Social and Labour Plan also makes provision for various mechanisms to manage post closure social issues. The following mechanisms are recommended:

- Establishment of a Future Forum;
- Mechanisms to Save Jobs and avoid Job Losses and a Decline in Employment;
- Mechanisms to Provide Alternative Solutions and Procedures for Creating Job Security where Job Losses cannot be avoided; and
- Mechanisms to Ameliorate the Social and Economic Impact on Individuals, Regions and Economies where Retrenchment or Closure of the Mine is certain.

At this stage, no financial provision is made for the above mentioned mechanisms and BBM will ensure that sufficient provision is made for the management of these issues within in the SLP and Mine Closure Plans.

12.4 FINANCIAL PROVISION

In terms of Section 41 read with Regulations 51(b)(v) and 54 of the Mineral and Petroleum Resources Development Act (Act 28/2002), BMM must make financial provision for the rehabilitation of the negative environmental impacts. BMM is further required to determine the quantum of the financial provision, which must include cost for pre-mature closure, decommissioning and final closure and post closure management of the residual and latent environmental impacts.

More specifically, Regulation 37(1) promulgated under the MPRDA requires that the quantum of the financial provision must be based on the requirements of the approved EMPr and shall include a detailed itemisation of all actual costs required for:

- the rehabilitation of the surface of the area;
- the prevention and management of pollution to the atmosphere; and
- the prevention and management of pollution of water and the soil;
- decommissioning and final closure of the operation; and
- post-closure management of residual and latent environmental impacts.

In view of the above and for the purpose of this EMPr, BMM has determined the quantum of the financial provision for the entire mining area as shown in *Table 12.1* below. The detailed costing is included in Conceptual Closure Plan included in the EMPR (*Annex D*).

Table 12.1 Gamsberg Draft Closure Quantum – April 2013

Ref	Item	R (2011)	
1	Open Pit	R 1 289 251	
2	Tailings Dam and Environs	R 27 113 315	
3	Waste Rock Dump	R 3 447 472	
4	Broken Hill Decline Portal	R 241 900	
5	Evaporation Ponds	R 8 516 784	
6	Concentrator Plant	R 11 691 098	
7	Workshops,Stores,Lab, Offices,Storeyard	R 5 684 680	
8	Concentrate Pads	R 1 972 349	
9	Conveyor Belts	R 80 997	
10	Explosives Magazines and Area	R 453 880	
11	Fencing	R 379 996	
12	Gravel Roads	R 2 528 600	
13	Open Surface Areas	R 6 826 390	
14	Construction Camp	R 378 075	
15	Landfill Sites	R 742 486	
16	Post Closure Monitoring / Maintenance	R 8 846 214	
	TOTAL	**R 80 193 488**	R (2011)
	QUANTUM TOTAL (2011)	**R 80 193 488**	R (2011)
	QUANTUM TOTAL (2013)	**R 86 893 192**	R (2013)
	DMR Weighting Factor 2 for Remote Location: 1.1	R 95 582 511	R (2013)
	Preliminary and General of 6%	R 5 734 951	R (2013)
	Contingencies of 10%	R 9 558 251	R (2013)
	SUB-TOTAL	**R 110 875 713**	R (2013)
	Vat 14%	R 15 522 600	R (2013)
	GRAND TOTAL	**R 126 398 312**	R (2013)

Note: Items excluded from this assessment, covered within Black Mountain Mine Closure Quantum;
Gamsberg Underground Mine;
Gamsberg Existing Evaporation Pond for pumped minewater;
Railtrack and sidings (Loop 10 and Saldanha); and
Aggeneys township.

12.5 SUGGESTIONS FOR POST MINING LANDUSE

The potential post mining landuses will continue to be discussed with the DMR and DENC, the Namakwa District and Khai-Ma municipalities and other key stakeholders. Future landuses will need to be identified, based on the manner in which the Project impacts civil infrastructure, agreements reached with surrounding landowners and local authorities, closer to the time of decommissioning. In terms of post mining land use it is recommended that the biodiversity sensitivity of the remaining sensitive habitat on the site and the local Spatial Development Plans and Integrated Development Plan be considered.

13 SUMMARY OF PROPOSED BIODIVERSITY OFFSET PROCESS

Based on initial discussion, the provincial competent environmental authority (DENC) informed BMM that due to the ecological importance of the site, (confirmed in the previous EIA), it was likely that a *Biodiversity Offset* commitment would need to be investigated. The purpose of this Section is to provide a brief overview of the current status of the Biodiversity Offsetting investigation that is currently being undertaken. The Biodiversity Offset investigation will be on-going; however, a summary of the offsetting process is presented for review and consideration. The Draft Biodiversity Offset Report is attached as Annex F.

13.1 POLICY FRAMEWORK

According to the Business and Biodiversity Offset Program, a Biodiversity Offset is defined as the following:

> *"the measurable conservation outcomes resulting from actions designed to compensate for significant negative residual impacts on biodiversity arising from project development after appropriate prevention and mitigation measures have been taken" (Business and Biodiversity Offset Programme, 2012).*

In January 2012 the IFC released an updated set of performance standards for large projects. IFC Performance Standard 6 in the series covers *Biodiversity Conservation and Sustainable Management of Living Natural Resources*, and includes reference to the use of Offsets in the mitigation hierarchy. It requires consideration and due process to avoid and mitigate impacts, as far as possible, on critical habitat, threatened species and ecosystem services.

A draft National Biodiversity Offsets Policy Framework is currently under development in South Africa by the Department of Environmental Affairs (DEA), the nine provinces and SANBI and as yet is only available in draft form. Both the Western Cape and KwaZulu-Natal have issued guidelines for Biodiversity Offsets, and other provinces are developing their own.

A detailed explanation of the theoretical framework for biodiversity offsets is contained in the Draft Report (see Annex F). The theoretical discussions revolve around when a biodiversity offset is required, what habitat can be offset, which habitat cannot be offset (ie irreplaceable) and the implications thereof in terms of tradeoffs and ecological compensation.

13.2 APPROACH TO BIODIVERSITY IMPACT ASSESSMENT

The findings of the biodiversity impact assessment are included into *Section 9*. A variety of sensitive habitats are expected to be impacted and/ or lost as a result of this Project. Sensitive habitats were identified, prior to the layout planning process for the mine infrastructure. As explained in *Section 4*, a rigorous process of *avoidance* was undertaken to avoid the physical impact to irreplaceable habitat. As complete avoidance is not possible due to the dimensions of the underground ore body and the associated technical constraints, parts of the open pit will physically impact irreplaceable habitat, (see Project Layout in *Section 3*). Other impacts on irreplaceable and constrained habitat resulting from dust deposition and groundwater drawdown also resulted in a residual impact that needs to be offset.

Based on the habitat classification and expected distribution of impacts identified by Dr Desmet, both the Faunal Specialist and General Ecologist agreed that no additional consideration is required to address habitat losses relevant to their studies.

Concurrent to the biodiversity impact assessment, a regional habitat study was commissioned by BMM to run concurrent to the ESIA process. The purpose of the regional study was to confirm the types of habitats present in the region and its similarity to habitat found on the Gamsberg inselberg. The Regional Study also helped inform the viability of this biodiversity offset process, as it confirmed that most of the habitat found on the Gamsberg inselberg is present in other parts of the region.

13.3 STAKEHOLDER ENGAGEMENT

The biodiversity offset process has included engagement with various key stakeholders. The purpose of the engagement with key stakeholders was to understand the expected residual impacts of the Project, confirmation of the scope of the offset, agreement on the interpretation of applicable local, national and international guidelines/policies applicable to this process and finalisation of the approach and methodology. The following stakeholders have been engaged with, to date:

- DENC
- SANBI (by request of DENC)
- SANParks (by request of DENC)
- WWF-SA
- Conservation South Africa
- BirdLife SA
- Wilderness Foundation
-
- SKEP
- DMR
- DWA

The stakeholders identified were based on recommendations from the DENC and environmental NGO's. Once a detailed offset plan is developed, further stakeholder engagement may be undertaken (outside of the ESIA process).

13.4 DEFINING RESIDUAL IMPACT

Based on the findings of the biodiversity impact assessment contained in *Section 9* above, the residual impacts to habitat were determined. Based on the sensitivity (which includes conservation considerations and ecosystem status) of the impacted vegetation, an offset multiplier ratio (1) was established. The draft Biodiversity Offset Report, containing details of the expected offset is attached as Annex F.

13.5 FINANCIAL IMPLICATIONS AND ARRANGEMENT

Calculating the financial implications of the offset would recognise the following costs:

- Costs of land acquisition;
- Cost of incorporation, establishment and restoration of the offset area;
- On-going maintenance and management costs for the offset area over an agreed time-period; and
- The cost of transaction (such as legal, administrative and consulting costs).

Additional factors will also need to be considered and agreement reached between BMM and the relevant stakeholders/ authorities. A dual approach to financing the offset is being proposed, which is as follows:

- An upfront amount should be held in trust by a suitable authority – sufficient to cover the capital costs of offset establishment for the first phase, and including an endowment covering a significant component of the on-going management costs; and
- Annual contributions to the management endowment, not less than the projected costs, and possibly augmented during later phases.

The financial implications of the offset area will need to be finalised, prior to the commencement of the Project.

13.6 WAY FORWARD

Upon receipt of comment, the draft Biodiversity Offset Report will be updated where relevant. The construction of this Project cannot proceed, until such time as the Biodiversity Offset commitment is secured, in line with Policy and stakeholder requirements.

(1) An offset ratio is the extent of habitat required to be offset, relative to the actual loss of habitat. This is represented as a "multiplier", for each impacted habitat, which varies based on ecosystem/ conservation status.

14 SUMMARY, CONCLUSIONS & RECOMMENDATIONS

14.1 INTRODUCTION

The aim of the ESIA for the proposed Gamsberg mine is to provide information to inform decision-making that will contribute to environmentally and socially sound and sustainable development. This report is submitted to the DENC and DMR to enable them to consider whether or not to grant authorisation to the proposed development in terms of NEMA and MPRDA respectively and if granted, to assist them in defining under what conditions the development should go ahead.

Through the ESIA process which has included various stakeholder and specialist input, ERM has identified and assessed a number of issues relating to BMM proposed open pit mine development at Gamsberg. This Chapter provides an overview of the ESIA findings and makes recommendations regarding key mitigation measures.

14.2 THE PROJECT

BMM, a subsidiary of the Vedanta Resources plc, intends to establish the zinc mine and concentrator plant located in the Northern Cape Province of South Africa, between the existing town of Aggeneys and the town of Pofadder, approximately 120 km east of the Springbok, along the N14. The site is commonly referred to as Gamsberg, and is characterised by an oval shaped inselberg, that extends approximately 220 meters above the surrounding plains.

The main mine and infrastructure will include an open pit at the top of the inselberg, crusher, various stockpiles and conveyor belts, waster rock dumps, a tailing storage facility, concentrator plant, workshops, access and haul roads and other mine infrastructure as shown in *Figure 3.1* above. Off-site linear infrastructure in the form of energy and water supply as well as transport routes are also included. Residential housing and associated infrastructure in support of the project will also be established in Aggeneys. All of the above are the subject of this ESIA application.

The Port of Saldanha is currently used by BMM for exporting its products and it is intended that the Project will also utilise this Port. At this stage, only preliminary design and layout options for the expected expansions or upgrades to accommodate the additional zinc concentrate export have been undertaken. Pending outcomes from further feasibility studies and engagement with the National Ports Authority, the preferred option to accommodate the increase in zinc exports will be confirmed and this will be subject to a separate environmental application process, if required.

14.3 *ALIGNMENT WITH PROVINCIAL, DISTRICT AND MUNICIPAL PLANNING AND DEVELOPMENT STRATEGIES*

A critical aspect of economic desirability of the project is whether the proposed development complements economic planning as reflected in spatial development planning. The Northern Cape Growth and Development Strategy and Spatial Development Framework, the Namakwa District Integrated Development Plans and Spatial Development Framework and the Khâi-Ma Local Municipality Integrated Development Plan and Spatial Development Framework as a whole recognise the importance of mining for the future economic development of the area. They also recognise the need for an integrated and diversified economic development that makes optimal use of each area's comparative advantages including their natural resources, sense of place and human capital.

Given the above, the proposed project is in principle compatible with the local planning and economic development strategies. However, these documents also call for caution regarding the global and national significance of the biodiversity of the mining site in particular and recognise the importance of the biodiversity of the area and its links to potential tourism opportunities. The balance between conserving biodiversity whilst promoting economic development through the development of the mining sector is key to this ESIA.

14.4 *THE AFFECTED ENVIRONMENT*

The Gamsberg lies at the heart of what is termed the "Bushmanland Inselberg Region", which includes all the large, quartzite-capped inselbergs located in the northern Bushmanland plains in South Africa. This region is located on the boundary between winter and summer rainfall systems of southern Africa, and the overlap of two biomes is a unique feature and sets these inselbergs apart from other inselbergs elsewhere in the Nama Karoo.

The Bushmanland Inselbergs effectively comprise an archipelago of rocky islands within a vast expanse of sand. These rocky islands share common floristic affinities that are fundamentally distinct from the surrounding sandy plains. The flora of these inselbergs forms a distinct centre of plant endemism located within the larger Eastern Gariep Centre of Endemism. There are many species endemic to the Bushmanland Inselbergs and the region is defined as a distinct centre of endemism termed the "Bushmanland Inselberg Centre of Endemism". This centre of endemism is sometimes referred to as the "Gamsberg Centre of Endemism" as this inselberg lies at the floristic centre of this region and is the key biodiversity feature underpinning ecological processes/ function in this system. The endemism is associated with the inselbergs and not the sandy Bushmanland plains that comprise 90% of the region.

The biodiversity sensitivity of the Project area has been established over a number of years of research in the area associated with bioregional planning initiative s and previous EIA applications for mining activities in the Gamsberg inselberg. As a result of these processes the potential need for biodiversity offset (1) was identified at the start of the ESIA process, while recognising that an offset must be a 'last resort': every effort must be made rather to avoid and minimize potential impacts. The need to avoid irreplaceable (2) and constrained habitat was thus considered in the early planning phases of the project. A Regional Habitat Study was also commissioned by BMM to run concurrent to the ESIA process. The purpose of the Regional Study was to confirm the types of habitats present in the region and their similarity to habitat found on the Gamsberg inselberg. The Regional Habitat Study also helped inform the feasibility (3) of this biodiversity offset process, as it confirmed that most of the habitat found on the Gamsberg inselberg is present in other parts of the region.

The sensitivity of the biodiversity of the region is contrasted by the high unemployment rates at municipal, district and provincial level at 22.9%, 20.1% and 27.4% respectively. This rate increases if discouraged work-seekers are included in estimates to 31.2%, 27.1% and 34.1% respectively. Mining activities form the cornerstone of the local economy, contributing over 50% to the GDP of the Namakwa District in 2007. The next closest contributor to the local GDP is the trade, catering and accommodation sector at just over 10% with agriculture and fishing at below 5%. Renewable energy is seen as a potential key contributor in the future.

The dominant sector in terms of employment in the Namakwa District is mining which provided 21.3% of all employment opportunities in 2007 followed by agriculture and fishing which provided 18% of all jobs. Whilst these two sectors remain the major sources of employment, their relative contribution has declined between 1995 and 2007 by roughly 5%. The wholesale retail trade, catering and accommodation sector showed the greatest proportional increase in job creation over this period up from 11% of employment in 1995 to 14% in 2007.

14.5 *CONSIDERATION OF ALTERNATIVES AND AVOIDANCE OF IMPACTS*

As a result of the high biodiversity sensitivity of the project area of influence it was important to demonstrate that the mitigation hierarchy of, avoid at source, abate on site, abate at receptor, repair (including rehabilitation) or remedy and finally compensate (including offsets) in kind; was robustly

(1) According to the Business and Biodiversity Offset Program, a biodiversity offset is defined as the following: "the measurable conservation outcomes resulting from actions designed to compensate for significant negative residual impacts on biodiversity.

(2) "Irreplaceable habitat" is equivalent to the IFC PS6 definition of "critical habitat", while "constrained and flexible habitat" are equivalent to the "natural habitat" definition.

(3) Note that this excludes the process of securing the relevant properties and reaching mutual consensus on purchase agreement.

adopted. A key driver in terms of avoiding the impact on biodiversity is the size and location of the mine footprint. Prior to considering the detail of the mine layout, it was recognised that underground mining would result in a smaller footprint than open pit mining. BMM's base case for this project, however, included the open pit mining option. As a result, and to adhere to the mitigation hierarchy of firstly striving to avoid the impacts, BMM was requested to consider the potential of adopting an underground mining technique.

BMM appointed AMEC Engineers to undertake a Technical Feasibility Study to consider the technical and commercial viability of undertaking underground mining. At this early stage, no environmental costs were considered in the Technical Feasibility Study for the underground options. The first priority was to establish if the underground mining options was feasible irrespective of any environmental or social mitigation. It was, however, acknowledged upfront, that an open pit mine may result in greater impacts on biodiversity and that a biodiversity off-set was highly likely to be required. The associated off-set costs would need to be considered as part of the overall feasibility of the open pit option. However, the first step in the process was to establish if underground mining would be feasible based on the existing site conditions. The study concluded that the underground mining option was not viable under the present circumstances; BMM supported this conclusion and maintained the open pit mining option as their base case to be assessed as part of this ESIA. The overall feasibility of the open pit option will be tested once the costs of mitigation included in this ESIA are considered in final feasibility calculations.

To avoid significant biodiversity impacts associated with the open pit mine option, a number of alternative locations for key mine infrastructure were considered. This was done by providing a detailed habitat sensitivity map (*Figure 4.2*) to the engineering team and working with them to assess each alternative against a number of criteria (Table 4.5). The primary criterion for selecting the preferred alternative was based on the avoidance of irreplaceable and where possible constrained habitat. Alternative locations were assessed for the following mine components: waste rock dump, tailings dam, contractors camp, ore crusher, engineering workshop, access road to the inselberg (are where open pit is located), and concentrator plant. Other infrastructure such as the expansion of the Aggeneys town and associated wastewater treatment plant were not considered as these areas were not established within irreplaceable/constrained vegetation.

The process of considering alternative locations for the key mine infrastructure (excluding the pit and the north-western waste rock dump), allowed for the avoidance of significant amounts of irreplaceable habitat with some impact remaining on constrained and flexible habitat. However, due to the shape and dimensions of the mineral reserve, avoidance of irreplaceable and constrained habitat when designing the open pit was not possible. A small section of irreplaceable habitat on the western edge of the north-western waste rock dump was also not possible due to engineering constraints. The footprint impact of the pit and western edge of the north-western waste rock dump represents the only important impact on irreplaceable habitat with the remaining area of the pit and other infrastructure impacting on constrained and flexible habitat. The process of avoidance and consideration of alternative locations resulted in a final mine layout plan (*Figure 3.1*) that has been the subject of this ESIA.

14.6 SUMMARY OF BIOPHYSICAL IMPACTS

A number of biophysical impacts were assessed as part of the ESIA including the following:

- Impact on air quality;
- Impacts on groundwater;
- Impacts on biodiversity;
- Impacts on surface hydrology;
- Noise and vibration impacts; and
- Impact on climate change and GHG emissions.

Each of the above impact types was assessed for the construction, operation and decommissioning phases of the proposed project. Appropriate mitigation was recommended according to the mitigation hierarchy as referred to in Chapter 4. Detailed measures recommended to minimise negative impacts or enhance positive impacts were provided and included in a detailed EMPR in *Annex D*. The residual impact was then assessed and an impact significance rating given. The summary of biophysical impacts of the project is included in *Table 14.1* below:

Table 14.1 Summary of Impact Assessment (pre and post mitigation)

	Construction Phase		Operational Phase		Decommissioning Phase	
Primary/Secondary Impact	Pre-mitigation Significance	Residual Impact Significance	Pre-mitigation Significance	Residual Impact Significance	Pre-mitigation Significance	Residual Impact Significance
Biophysical Impacts						
Impact on Air Quality						
Impact on Air Quality	NEGLIGIBLE (-ve)	NEGLIGIBLE (-ve)	MINOR (-ve)	MINOR (-ve)	N/A	N/A
Impact on Groundwater						
Impact of Drawdown on Groundwater Resource	NEGLIGIBLE (-ve)	NEGLIGIBLE (-ve)	MODERATE (-ve)	MODERATE (-ve)	MODERATE (-ve)	MODERATE (-ve)
Impact of Drawdown on Groundwater Users	NEGLIGIBLE (-ve)	NEGLIGIBLE (-ve)	NEGLIGIBLE (-ve)	NEGLIGIBLE (-ve)	MODERATE (-ve)	NEGLIGIBLE (-ve)
Impact on Groundwater Quality	MINOR (-ve)	NEGLIGIBLE (-ve)	MODERATE (-ve)	MODERATE (-ve) to MINOR (-ve)	MODERATE (-ve)	MODERATE (-ve) to MINOR (-ve)
Impact of Water Quality on Groundwater Users	NEGLIGIBLE (-ve)	NEGLIGIBLE (-ve)	NEGLIGIBLE (-ve)	NEGLIGIBLE (-ve)	NEGLIGIBLE (-ve)	NEGLIGIBLE (-ve)
Impact on Biodiversity						
Habitat Loss Caused by the Mine Footprint and Associated Activities	MAJOR (-ve)	MODERATE (-ve) to MAJOR (-ve)	MAJOR (-ve)	MODERATE (-ve) to MAJOR (-ve)	MAJOR (-ve)	MODERATE (-ve) to MAJOR (-ve)
Impacts Resulting from Habitat Degradation from Dust Deposition	MODERATE (-ve)	MODERATE (-ve)	MAJOR (-ve) (Low confidence)	MAJOR (-ve) (Low confidence)	MODERATE (-ve) (Low confidence)	MODERATE (-ve) (Low confidence)
Impacts on Habitat resulting from Groundwater Drawdown	MAJOR (-ve)	MODERATE (-ve)	MAJOR (-ve)	MAJOR (-ve)	MAJOR (-ve)	MAJOR (-ve)
Impacts Arising from Habitat Fragmentation	MODERATE (-ve)	MODERATE (-ve)	MAJOR (-ve)	MODERATE (-ve)	MAJOR (-ve)	MODERATE (-ve)
Impacts on Species Diversity as a result of Mining-related Activities	MODERATE (-ve)	MINOR (-ve)	MAJOR (-ve)	MODERATE (-ve)	MAJOR (-ve)	MODERATE (-ve)
Impacts from Encroachment of Alien Species	MODERATE (-ve)	MODERATE (-ve)	MODERATE (-ve)	NEGLIGIBLE (-ve)	MINOR (-ve)	NEGLIGIBLE (-ve)
Impacts of Human Influx on Biodiversity	MODERATE (-ve)	MINOR (-ve)	MINOR (-ve)	MINOR (+ve)	MINOR (-ve)	MINOR (+ve)
Impact on Surface hydrology						
Removal and alteration of natural water courses	MODERATE (-ve)	MINOR (-ve)	MODERATE (-ve)	MINOR (-ve)	MODERATE (-ve)	MINOR (-ve)
Impact of reduced peak runoff and discharge volumes on water courses	MODERATE (+ve)	MODERATE (+ve)	MODERATE (+ve)	MODERATE (+ve)	MODERATE (+ve)	MODERATE (+ve)
Impact of Reduction in Mean Annual Runoff on Downstream Surface Water Resources	MODERATE (-ve)	MINOR (-ve)	MODERATE (-ve)	MINOR (-ve)	MODERATE (-ve)	MINOR (-ve)
Impact of Increased Sediment Yield on Surface Water Quality	MODERATE (-ve)	MINOR (-ve)	MODERATE (-ve)	MINOR (-ve)	MODERATE (-ve)	MINOR (-ve)
Impact of Increased Pollutant Load on Surface Water Quality	MODERATE (-ve)	MINOR (-ve)	MODERATE (-ve)	MINOR (-ve)	MODERATE (-ve)	MINOR (-ve)
Noise and Vibration Impacts						
Noise and Vibration Impacts	NEGLIGIBLE (-ve)	NEGLIGIBLE (-ve)	NEGLIGIBLE (-ve)	NEGLIGIBLE (-ve)	N/A	N/A
Impact on Climate Change and GHG emissions						
Impact of Project GHG Emissions on South Africa's National Emissions	N/A	N/A	MODERATE (-ve)	MINOR (-ve)	N/A	N/A
Socio-Economic Impacts						
Impact on Economic Environment						
Impacts linked to Project expenditure	MODERATE (+ve)	MAJOR (+ve)	MODERATE (+ve)	MAJOR (+ve)	MAJOR (-ve)	MODERATE (-ve)
Impacts on key macro-economic variables	NEGLIGIBLE	NEGLIGIBLE	MAJOR (+ve)	MAJOR (+ve)	MAJOR (-ve)	MAJOR (-ve)

Impacts on tourism	MODERATE (-ve)	MINOR (-ve)	MODERATE (-ve) TO MAJOR (-ve)	MODERATE (-ve)	MINOR (+ve)	MODERATE (+ve)
Impacts on surrounding land uses	MODERATE (-ve)	MINOR (-ve) TO MODERATE (-ve)	MODERATE (-ve)	MINOR (-ve) TO MODERATE (-ve)	MINOR (+ve)	MINOR (+ve) TO MODERATE (+ve)
Impacts on municipal services	MODERATE (-ve)	MODERATE (+ve)	MODERATE (-ve)	MODERATE (+ve)	MODERATE (-ve)	MODERATE (-ve)
Impact on Social Environmental						
Employment opportunities	MODERATE (+ve)	MAJOR (+ve)	MODERATE (+ve)	MAJOR (+ve)	MAJOR (-ve)	MODERATE (-ve)
Training and skills development	MINOR (+ve)	MODERATE (+ve)	MINOR (+ve)	MODERATE (+ve)	MINOR (+ve)	MODERATE (+ve)
Procurement and services	MODERATE (+ve)	MAJOR (+ve)	MODERATE (+ve)	MAJOR (+ve)	N/A	N/A
Economic diversification	MINOR (+ve)	MINOR (+ve)	MINOR (+ve)	MINOR (+ve)	MAJOR (-ve)	MODERATE (-ve)
Unmet Expectations and Potential for Social Unrest	MAJOR (-ve)	MINOR (-ve) to MODERATE (-ve)	MAJOR (-ve)	MINOR (-ve) to MODERATE (-ve)	N/A	N/A
Increased Pressure on Infrastructure and Services (Direct)	MINOR (-ve)	NEGLIGIBLE (-ve)	MINOR (-ve)	NEGLIGIBLE (-ve)	MODERATE (-ve)	MINOR (-ve)
Road Infrastructure and Transport (Direct)	MODERATE (-ve)	MINOR (-ve)	MINOR (-ve)	NEGLIGIBLE (-ve)	NEGLIGIBLE (-ve)	NEGLIGIBLE (-ve)
Health Impacts: Communicable diseases	MAJOR (-ve)	MODERATE (-ve)	MINOR (-ve) to MODERATE (-ve)	MINOR (-ve) to NEGLIGIBLE (-ve)	NEGLIGIBLE (-ve)	NEGLIGIBLE (-ve)
Health Impacts: Road traffic accidents	MODERATE (-ve)	MINOR (-ve) to MODERATE (-ve)	MODERATE (-ve)	MINOR (-ve) to MODERATE (-ve)	NEGLIGIBLE (-ve)	NEGLIGIBLE (-ve)
Impact in Relations between Locals and In-migrants	MODERATE (-ve)	MINOR (-ve)	MODERATE (-ve)	MINOR (-ve)	NEGLIGIBLE (-ve)	NEGLIGIBLE (-ve)
Impact on Social Pathologies	MODERATE (-ve)	MINOR (-ve) to MODERATE (-ve)	MODERATE (-ve)	MINOR (-ve) to MODERATE (-ve)	MODERATE (-ve)	MINOR (-ve) to MODERATE (-ve)
Impact on Sense of Place	MODERATE (-ve)	MINOR (-ve)	MODERATE (-ve)	MINOR (-ve)	MODERATE (-ve)	MINOR (-ve)
	MINOR (+ve)	MINOR (+ve)	MINOR (+ve)	MINOR (+ve)	MINOR (+ve)	MINOR (+ve)
Local Cultural and Social Values	MINOR (-ve)	MINOR (-ve)	MINOR (-ve)	MINOR (-ve)	MINOR (-ve)	MINOR (-ve)
Increased Pressure on Infrastructure and Services (Indirect resulting from Influx)	MAJOR (-ve)	MODERATE (-ve)	MODERATE (-ve)	MINOR (-ve)	MINOR (-ve)	NEGLIGIBLE (-ve)
Communicable Diseases (Indirect resulting from Influx)	MAJOR (-ve)	MODERATE (-ve)	MINOR (-ve) to MODERATE (-ve)	MINOR (-ve)	NEGLIGIBLE (-ve)	NEGLIGIBLE (-ve)
Impact on Visual Resources						
Impact on the Aesthetic Value of the Landscape	MAJOR (-ve)	MAJOR (-ve)	MAJOR (-ve)	MAJOR (-ve)	MAJOR (-ve)	MAJOR (-ve)
Impact on Traffic and Transport						
Impact on Traffic and Transport Networks	MINOR (-ve)	NEGLIGIBLE (-ve)	MINOR (-ve)	MINOR (-ve)	MINOR (-ve)	NEGLIGIBLE (-ve)
Impact on heritage, Palaeontology and Archaeology						
Impact on Archaeology	MAJOR (-ve)	MODERATE (-ve)	MAJOR (-ve)	MODERATE (-ve)	N/A	N/A
Impact on Cultural Heritage and Sense of Place	MODERATE (-ve)	MINOR (-ve)	MODERATE (-ve)	MINOR (-ve)	MODERATE (-ve)	MINOR (-ve)
Impact on Palaeontology	NEGLIGIBLE (-ve)	NEGLIGIBLE (-ve)	NEGLIGIBLE (-ve)	NEGLIGIBLE (-ve)	N/A	N/A

It is evident from *Table 14.1* that there are several residual negative impacts of moderate and high significance remaining after mitigation. Each of the impacts is discussed below.

Impact on Groundwater

The first of these impacts relates to the groundwater quality and quantity which are assessed to have a moderate negative residual impact at various stages of the project. In an arid environment where water is scared the management of any groundwater impacts is important.

The groundwater quality impacts are primarily linked to the acid rock drainage potential of the tailings that emanate from the concentrator plant and the waste rock dump. The area of impact (dispersion plume), as modelled in a worst case scenario, at the end of the life of mine is contained within the tailing facility and waste rock dump footprint. Modelling to 100 years post mine closure shows a marginal difference with both plumes remaining within the mine license area. No impact on any groundwater users is expected. The mitigation measures recommended for the impact on groundwater quality relate to the design of the tailings storage facility and waste rock dump and the associated engineering design measures to minimise contamination of the groundwater. On-going water quality monitoring and management of the tailings storage facility will continue through the life of mine and into mine closure phase.

The residual negative impact associated with the drawdown of groundwater as a result of the open pit is considered to be moderate through the operation to the decommissioning phases and cannot be mitigated. It is unlikely that any users of groundwater will be directly affected. On-going monitoring of groundwater level will be required through the life of the project and beyond. However, it should be noted that alternative water sources can be provided to farmers dependant on groundwater in the vicinity of the mine if they are impacted by drawdown and the impact on groundwater drawdown is therefore assessed be negligible. The impact of groundwater drawdown on biodiversity is considered in the next section.

Impact on Biodiversity

The negative impact on biodiversity is primarily a result of the footprint of the mine infrastructure, the drawdown of the groundwater and the impact of dust as a result of the mine activities.

The footprint of the mine infrastructure, and specifically the open pit, result in an irreversible negative impact on constrained and irreplaceable vegetation. There is no mitigation for this impact and the residual impact remains major; the impact can only be addressed through a biodiversity offset. The headwater seep represents a unique habitat that is considered non-offsetable. The residual negative impact significance for loss of this habitat remains major irrespective of any mitigation. The loss of the seep area would require ecological compensation through conserving 'unlike' habitat of conservation priority.

Further impacts on irreplaceable habitat are incurred through the drawdown of groundwater as a result of the open pit. The aquatic habitats within the inselberg will be irreversibly lost resulting in a residual negative impact of major significance. The Kloof is considered to be an irreplaceable habitat and considered non-offsetable. As for the seep habitat, some form of ecological compensation will be required.

The impact of dust on the irreplaceable and constrained habitats around the mine pit and associated infrastructure is also considered to have residual negative impact of major significance. The key driver of this impact is the sensitivity of some of the tiny but threatened succulent plants (particularly within the fine grain quartz gravel plains) which could be highly sensitive to dust deposition. The dust fall out may change the physical structure of the gravel substrate as well as the chemical composition of the soil surface from the acid forming dust. However, it is recognised that there is a high degree of uncertainty in understanding the actual impacts of the physical and chemical properties of the dust on these habitats. The actual dust footprint of the mine, the colour and the chemical composition of the dust is also uncertain. In light of the uncertainty and the extreme sensitivity of the affected ecology, a precautionary approach has been adopted. Certain irreplaceable and constrained habitats that are considered to be impacted by dust are partially offsettable and have been included in the offsets calculations.

The impact arising from habitat fragmentation and species diversity is considered to have a residual negative impact of moderate significance. Inselbergs within the Bushmanland Inselberg Region represent an archipelago of rocky islands within a vast expanse of sand. These inselbergs serve as stepping stones for many species that hop from one inselberg to another and represent an important ecological corridor. The Gamsberg is located at the centre of this floristic centre of endemism and is the key biodiversity feature underpinning the ecological connectivity of the greater system. Mining will reduce the Gamsberg's ecological function as a corridor for species between inselbergs. Impacts on habitat fragmentation can be mitigated by safeguarding the remaining landscape linkages and associated habitat through the design of the offset.

The Gamsberg supports a high diversity of species, but particularly the many endemic, rare, threatened, protected and some undescribed species that are currently not adequately understood. A number of species within the Gamsberg are considered to be at risk due to the proposed mining activities. Mitigation measures recommended in this regard together with the proposed offset that would result in the acceptable reduction of this impact's significance.

Based on the need for offsets, a Regional Habitat Study was undertaken in parallel to the ESIA process together with a detailed Offsets Study. Through these two studies, it was established that a biodiversity offset is feasible and land parcels within the vicinity of the mine exist with suitably intact habitat. However, as mentioned earlier, some non-offsetable habitats will be lost and would require ecological compensation through conserving 'unlike' habitat of conservation priority. The acceptability of this loss will need to be tested through engagement with key stakeholders and authorities.

14.7 *SUMMARY OF SOCIO-ECONOMIC IMPACTS*

A number of socio-economic impacts were assessed as part of the ESIA including the following:

- Impact on economic environment;
- Impact on social environment;
- Visual impacts;
- Impacts on traffic and transport infrastructure; and
- Impact on heritage, palaeontology and archaeology.

Each of the above impact types were assessed for the construction, operation and decommissioning phases of the proposed project. Appropriate mitigation was recommended according to the mitigation hierarchy as referred to in Chapter 4. Detailed measures recommended to minimise negative impacts or enhance positive impacts were provided and included in a detailed EMPR in *Annex D*. The residual impact was then assessed and an impact significance rating given. The summary of socio-economic impacts of the proposed project is included in *Table 14.1* above:

It is evident from *Table 14.1* that there are several residual positive and negative impacts of moderate and high significance remaining after mitigation. Each of the impacts is discussed below.

Impact on Economic Environment

The benefits linked to project spending and impacts on key macro-economic variables during the construction and operational phases of the project are considered to have a residual positive impact of major significance.

The project would have a positive impact on economic activity in the local area and region given the sizes of the new spending injections associated with it. Preliminary estimates indicate that a total of approximately R8.35 billion would be spent on all aspects of the construction phase. It is anticipated that approximately 3,200 contract jobs with an average duration of 19 months each would be associated with all construction expenditure. Based on the likely availability of labour and the experience of the BMM in the area and at other sites, approximately 357 workers would probably come from within Khâi-Ma Municipality, a further 1,335 workers from the rest of the Namakwa District and 960 workers from the rest of the Northern Cape. Direct household income impacts would flow from all wages paid during construction. Total incomes of R1.01 billion would be associated with the construction phase. Approximately R80 million of this total would probably accrue to workers currently resident in Khâi-Ma Municipality, a further R339 million to workers in the rest of the Namakwa District and R319 million to workers from the rest of the Northern Cape.

Operational expenditure would increase in line with production from approximately R528 million per year during the first year of production to R1.76 billion in the fifth year of production at which point it is anticipate that full production levels would achieved. During the first year of production approximately 630 jobs would be created (of which, roughly 195 would be outsourced to contractors) increasing to 1,230 jobs (of which, 380 would be outsourced to contractors) once full production is reached by the 5th year of production. Out of these total jobs, it is anticipated that (1):

- Khâi-Ma Municipality residents would benefit from 127 jobs in the first year of production and 258 jobs once full production is reached.
- Residents in the rest of the Namakwa District would benefit from 276 jobs in the first year of production and 540 jobs once full production is reached.
- Residents in the rest of the Northern Cape would benefit from 112 jobs in the first year of production and 220 jobs once full production is reached.

At the start of production approximately R138 million in total salaries and sub-contractor payments would be made yearly increasing to R256 million once full production is reached by the 5th year of production. Approximately R23 million of these salaries and payments to contractors should accrue to workers from Khâi-Ma Municipality during the first year of production increasing to R44 million once full production is reached. A further R50 million of salaries and payments to contractors should accrue to workers from the rest of the Namakwa District during the first year of production increasing to R94 million at full production.

Positive macroeconomic impacts are also expected to flow from the project and have been quantified focusing on increased foreign exchange earnings and tax revenues. Foreign exchange revenues are expected to start at roughly USD385 million/yr (for 360,000 tonnes of concentrate production) in the first year of production, increasing to USD750 million/yr (for 735,000 tonnes of concentrate production) in the third year and stabilising at roughly USD1.257 billion/yr (for 1,225,000 tonnes of concentrate production) from the fifth year onwards. The present value of the sum of these flows over the project's life should be roughly USD10.2 billion (or R76.7 billion) using a base case discount

(1) Note that these estimates are based largely on a fairly broad assessment of the availability of labour in these areas and it is the proponent's intention to use a greater proportion of labour from Khâi-Ma Municipality and the Namakwa District if people are available and/or willing to be trained.

rate of 6%. Note that during the construction phase, foreign exchange outflows would occur in order to import key project components. However, these outflows would be minor when compared to inflows during operations (ie outflows would be less than 5% - 10% of the magnitude of total inflows over time).

Tax payments consisting of income taxes and royalties are expected to start at roughly R142 million/yr (for 360,000 tonnes of concentrate production) in the first year of production, increasing to R277 million/yr in the third year, R277 million/yr in the fifth year and stabilising at roughly R1.52 billion/yr from the seventh year onwards. The present value of the sum of these flows should be roughly R10.8 billion using a base case discount rate of 6%.

The significant macro-economic and socioeconomic benefits associated with the mine during the construction and operational phases of the project are contrast with the potential significant negative impact once the mine closes. These negative impacts will be managed through a well structure Mine Closure Plan and Social and Labour Plan that BMM has developed as part of the overall project. On-going refinement and planning for mine closure will need to be undertaken throughout the life of mine to mitigate this impact.

Impacts on Tourism as a Result of Impact on Sense of Place and Loss of Biodiversity

Key impacts on tourism would relate to visual impacts and to the loss of conservation worthy areas. With regard to the former, the combined scale of the project elements and their visual impacts indicate that overall changes to the visual sense of place which supports tourism will be significant. However, impacts on specific tourism facilities and key tourism areas would be limited, given the project's location relative to these. Visual exposure from the N14 would be high although temporary in nature for passing motorists who would largely still be able to enjoy the key attractions and tourist facilities in the wider area which are relatively far removed and screened from the project.

Any significant loss of highly conservation worthy land such as that found on the site and particularly on the Gamsberg Inselberg has potential implications for tourism. This is because conservation worthy lands have appeal to tourists and are becoming increasingly scarce. However, the need for a biodiversity offset and the associated conservation benefits may enhance the tourism potential of the area with pro-active planning that may allow controlled eco-tourism activities on the offset site.

With regard to positive tourism impacts, experience indicates that increased business tourism would be associated with the project as a number of technical, management and sales staff would be required to periodically visit the project site to conduct business. These staff generally fall into middle to higher income brackets and will require accommodation for their stays thereby creating opportunities for accommodation and other tourist facilities and services.

Impact on Municipal Services

Ultimately it is the Khâi-Ma Municipality and, to a lesser degree, the Namakwa District Municipality's responsibility to ensure that the proposed project contributes to the financial health of the municipal area and does not burden the municipality with increased costs. These potential cost should be viewed at a broad scale and include costs associated with potential influxes of workers and job seekers as well as any other impacts that could impose costs on the municipality. The Khâi-Ma Municipality revealed that they are well aware of the need to recover costs and would endeavour to ensure that Vedanta not only covers their own costs, but also make a positive contribution to the development of the area. The municipality has confirmed that they are currently in the early stages of a process of negotiation with Vedanta in this regard. No clear conclusions regarding impacts on municipal finances are therefore possible at this stage. It is, however, safe to predict overall positive impacts on finances provided these negotiations proceed well and in-migration is managed. This kind of outcome would be consistent with other smaller municipalities that have benefited from increased incomes among its residents and an in-flux of new residents with jobs. With sound municipal management, both of these trends tend to increase municipal income from existing residents and provide municipalities with a wider rates resulting in healthier municipal finances.

Training and Skills Development and Procurement and Services

Those people who are employed via the Project (directly and indirectly) will receive training and that will significantly enhance their skills, thus improving their potential for future employment. This will be achieved by on-the-job training, as well as through training courses on production and on Health, Safety and Environment (HSE) standards required for the Project, as are common to the mining sector. This will also be a positive impact amongst employees of the suppliers and contractors, who will have to meet particular production, operational, and quality standards as required by the Project.

The planning, design, construction and operation of the Project will require the purchase of equipment and other goods and services and will generate large contracts, particularly during construction. The majority of these will be for highly specialised and technical work and will be provided by specialist providers of goods and services. There is potential to feed into this supply chain for local businesses in the Khâi-Ma Municipality and Namakwa District Municipality. However, locally owned businesses in the Khâi-Ma Municipality will have limited capacity to meet the standards of quality and sophistication required by the Project. Despite this, the Project will provide a major boost to suppliers in the LM during construction phase. The implementation of enhancement measures in terms of both skills development and support of local suppliers will rest in a residual positive impact of moderate significance.

Health Impacts: Communicable Diseases

Communicable diseases are also known as infectious or contagious diseases, due to their potential for transmission from one person to another or from one species to another. The increase in the spread of communicable diseases in the context of the Project is closely linked to population size, living conditions as well as social ills, all of which makes people pre-disposed to the spread of communicable diseases. The rapid increase in the population will be a key driver in the spread of communicable diseases as it impacts on both living conditions as well as the likely increase in social ills. Communicable diseases such as HIV/AIDS and TB are prevalent in the Khâi-Ma Municipality.

The most significant increase in the spread of communicable diseases is expected during the construction phase of the project, when a rapid increase in the population size is expected. During the construction phase, a worker camp will be constructed to accommodate approximately 3200 construction workers who are likely to be predominantly male. Apart from the actual construction workers, job-seekers are likely to migrate to the area and settle in Pofadder and Pella. The communities of Pofadder and Pella will thus also be at risk to the increase in the spread of communicable diseases. The development and implementation of an HIV/AIDS and TB Prevention Programme will partly mitigate these impacts.

Increased Pressure on Infrastructure and Services due to the Possible Influx of Job-seekers

The possible influx of people into the local area will increase pressure on public infrastructure and services. Job-seekers migrating to the area are likely to settle as close as possible to the Project area, thus the settlements of Pofadder and Pella, in particular, are likely to experience in-migration as migrants will not be allowed to settle in Aggeneys. Pofadder is more vulnerable to the influx of job-seekers as it is located on the N14, as compared to Pella, which is located approximately 10 km from the N14. There is a risk that job-seekers may try to establish an informal settlement close to Aggeneys, in order to be closer to the Project site to improve their chances of deriving benefits from the Project.

Public service backlogs pertain to access to water, sanitation, waste management services and housing. The number of informal houses increased threefold between 2001 and 2011 in the Khâi-Ma Municipality. Upgrades to public infrastructure and services are hampered by a number of challenges including a lack of funds and capacity by the Khâi-Ma Municipality.

Based on the current public infrastructure and service backlogs the additional pressure will further exacerbate the challenges faced by the Khâi-Ma

Municipality. It is unlikely that the Khâi-Ma Municipality will be able to cope with the increased pressure and demand resulting from the indirect influx of people and are already unable to meet their current obligations. Regular and on-going support and collaboration with the Khâi-Ma Municipality will mitigate this impact to some extent.

Impact on Archaeology

Archaeological artefacts are considered, in each instance, a unique and non-renewable resource. The Project will result in losses to archaeological artefacts during both the construction and operational phases. The impacts can be seen as permanent and irreversible. Based on the findings of the site visit undertaken, areas of archaeological importance have been ranked according to the northern slope, southern slope and the inselberg basin.

Artefacts that occur in the project area have been mapped and include some of the following:

- A mid-twentieth century drilling site - low archaeological significance;
- series of dome-shaped bedrock outcrops around which are clustered an abundance of Ceramic Later Stone Age artefacts (stone artefacts, pottery, ostrich eggshell) - high archaeological significance (unlikely to be impacted);
- individual instance of an isolated Earlier Stone Age cleaver - low archaeological significance (likely to be impacted by power lines);
- grave site, surface scatter of Ceramic Later Stone Age material - high archaeological significance (may be impacted by power lines);
- Kloof area in which the suspected history of San genocide occurred - high heritage importance (unlikely to be impacted);
- indications of is ephemeral Later Stone Age occupation - low archaeological importance (likely to be impacted during the construction and operation of the primary crusher and conveyor system);
- Middle Stone Age artefact site - low archaeological importance(likely to be impacted during the construction and operation of the primary crusher and conveyor system); and
- Middle Stone Age workshop - high heritage importance (impacted by operational phase – waste rock dump).

Various mitigation measures in terms of the national Heritage Resource Act will mitigate these impacts to some extent.

14.8 CONCLUSION AND RECOMMENDATIONS

The Project will undoubtedly have a positive impact on the macro-economics of South Africa as a country. Local economic benefits will also be felt with a significant contribution to the Namakwa District GDP and significant benefits at the Khâi-Ma Municipality level during the life of mine. As a result, the project will generate significant job opportunities at the provincial, district and local municipal level in an area of high unemployment.

In contrast, the project will also result in significant negative impacts on the biodiversity of the region. Biodiversity offsets are possible to remedy most of the predicted residual impacts, and form a key part of the mitigation measures of this project. The offsets required would result in the protection of irreplaceable and other habitats within the Bushmanland Inselberg Region that have not previously been afforded conservation status and thus formal protection. The implementation of the EMPR is likely to provide additional protection to the remaining sensitive biodiversity on the site and adequately mitigate other impacts associated with the mine development. However, there are habitat components within the Gamsberg Inselberg that are unique and irreplaceable and their loss cannot be offset. While BMM will be required to provide compensation in this regard, these habitats will be permanently lost.

The impacts resulting post closure of the mine will also need to be carefully considered. On-going and detailed mine closure planning, combined with a robust Social and Labour Plan will need to accommodate these impacts.

When considering the quantifiable as well as more qualitative costs and benefits of the project it is considered more likely that it would achieve a net benefit at a provincial, regional and local scale provided the financial projections of the applicants prove reasonably accurate and provided the EMPR and Offsets Plan are robustly implemented. However, the cost resulting from the loss of unique biodiversity in the Gamsberg Inselberg cannot be offset and the trade-off between this and the significant local economy benefits and associated job opportunities needs to be considered. The acceptability of this trade-off needs to be tested though open and transparent stakeholder and authority consultation. This report will be made available for stakeholder and authority comment for a period of 40 days. These comments will be collected and analysed and incorporated into the final conclusion for submission DENC and DMR for final decision making.