black mountain

EIA for the Swartberg Mine Expansion

Final Report

19 June 2019

Project No.: 0472502

The business of sustainability

ERM

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19 June 2019

EIA for the Swartberg Mine Expansion

Final Report

Philip Johnson
Partner

ERM Southern Africa (Pty) Ltd

1st Floor | Great Westerford | 240 Main Road | Rondebosch | 7700 | Cape Town | South Africa

NON-TECHNICAL SUMMARY

Purpose of this Document

This document provides a summary of the Final Environmental Impact Assessment (EIA) Report for the proposed Swartberg Mine Expansion Project, which includes a description of the proposed Project and the associated Scoping and EIA process. It aims to help stakeholders understand the proposed Project and provides guidance on how stakeholders can register and be involved in the EIA process.

Project Background

Black Mountain Mining (Pty) Ltd (herein referred to as BMM), part of the global Vedanta Resources Plc., intends to expand the Swartberg Mine at the existing Black Mountain Mine, which is located 10 km west of the town of Aggeneys, Northern Cape Province. BMM currently produces ore from two underground mines, namely the Deeps Mine and the Swartberg Mine (both located on the Black Mountain Mine). To secure the future of underground mining at BMM, it is proposed to ramp-up ore production from Swartberg Mine to a minimum of 1.7 Mtpa before Deeps mine is mined out. The expansion will advance the Swartberg life of mine within the existing Mining Right Area (MR 517) by at least 19 years.

The expansion of Swartberg mine will consist of the expansion of the current underground mine and three new open pit mines, and a total of 150,000,000 tons of ore will be mined from the Swartberg over the 19 year life of mine. Of this expected tonnage, approximately 18,000,000 tons of lead and copper concentrate will be extracted. Lead and copper concentrate will be transported via existing rail and/or road networks and exported via the Port of Saldahna.

The existing Swartberg mine operates under an Environmental Authorisation from the Department of Mineral Resources (reference: NCS 30/5/1/2/3/2/1/517 EM). The development of a decline and the establishment of an open pit with associated workshops and infrastructure are included in this approval. The proposed expansion of the Swartberg Mine includes the expansion of the decline and the development of three more open pits (the Project). It must be noted that the footprint of the existing Black Mountain Mine will not be expanded.

The Proponent

BMM engages in mining operations in South Africa and produces primarily zinc concentrates, as well as lead, copper, and silver concentrates. BMM operates the Gamsberg, Swartberg and Deeps mines and currently employ 1,667 individuals in total through direct employment and business partners.

The Environmental Assessment Practitioner

The ERM team selected for this Project possess the relevant expertise and experience to undertake this EIA. As such, ERM has signed the legally required declaration of independence to function as an objective Environmental Assessment Practitioner (EAP). The CVs and details of the Independent Environmental Practitioner and declaration of independence are presented in Annex A.

Need and Desirability

BMM employs in excess of 1 600 persons, operating as the largest private employer in the Namakwa region and it is a stable employer for the last 30 years. Approximately 80% of the employees are local, with 62% from Namakwa, Khai-Ma and Nama Khoi municipal areas. Should the proposed expansion not occur, approximately 837 permanent employees could be at risk of losing their jobs, with an additional 830 business partners similarly at risk. A number of these business partners also have active contracts with the BMM Gamsberg Mine, and should the proposed Swartberg Mine expansion not occur, a reduction in revenue might be experienced.

Mining is a major gross domestic product (GDP) contributor and provides 22% of the provincial economy, followed by agriculture at 7%, manufacturing at 3%, and construction at 2% (Stats SA, 2016). In addition, The Northern Cape contributed 6% of the national mining GDP (Stats SA, 2016). Stats SA reported that mining contributed 40 000 real jobs in 2014, which was up from 22 000 in 2003

(StatsSA, 2016). BMM is one of the mining operations that has contributed to stable employment and economic growth in the area.

BMM has contributed substantially to local and regional economic growth. The Aggeneys community alone was largely developed as a result of the BMM operations. Mining operations in the Northern Cape Province contribute the highest percentage towards the GDP, followed by the agriculture and manufacturing sectors. Given the crucial role played by the BMM operations both on a local and regional scale, should the proposed mine expansion not occur, the Northern Cape economy faces major employment and development risks.

Project Description

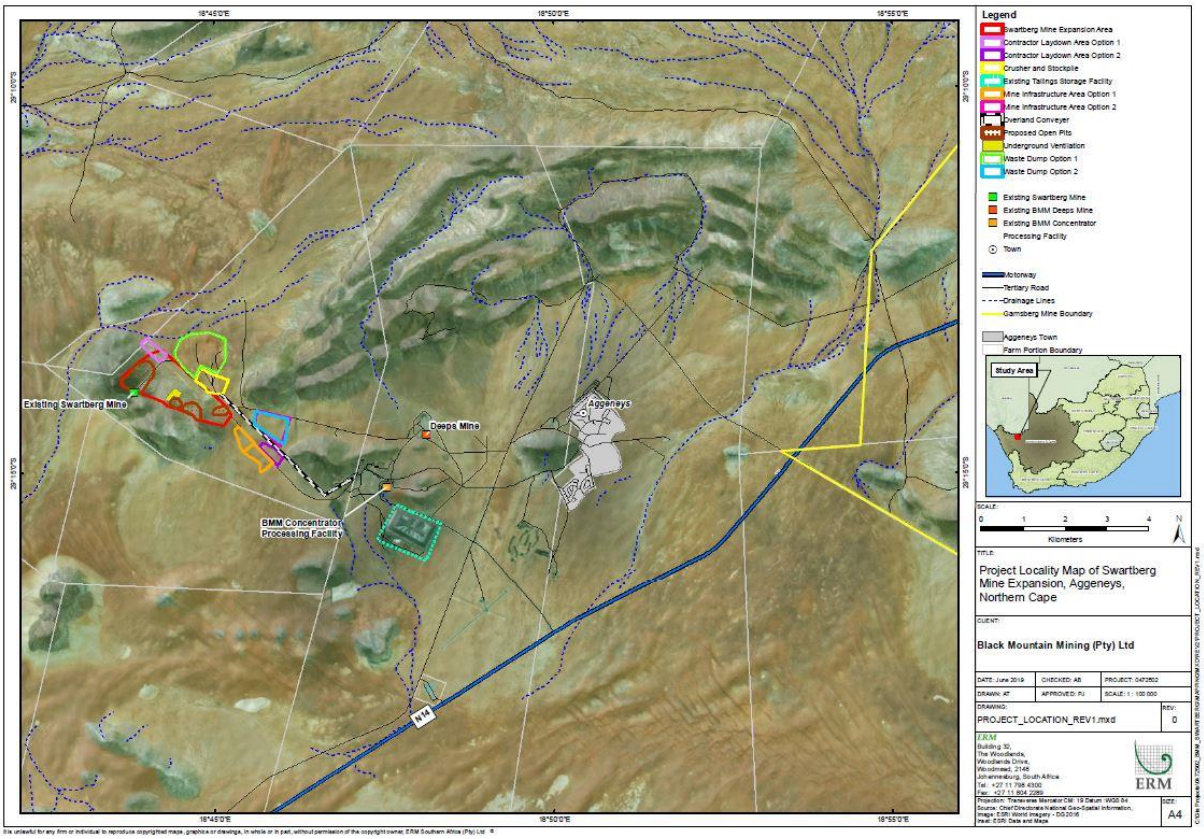
Project Location

The Project site is located in the Northern Cape Province of South Africa, approximately 11 km west of the town of Aggeneys, which lies between the existing towns of Pofadder and Springbok. The Project site falls within the Black Mountain Mine, which is owned by BMM. The Black Mountain Mine is 110 km north-west of Springbok and 60 km east of Pofadder, along the N14. *Table 1* shows the details of the property where the Project will be located and *Figure 1* illustrates the Project Location.

Table 0-1 Property Details

Farm Name	Zuurwater 62
Portion Number	Portion 4
SG21 Code	C05300000000006200004
Local Municipality	Khai-Ma Local Municipality
Magisterial District	Namaqualand [C053]
District Municipality	Namakwa District Municipality

Figure 1 Project Location Map



Project Components

BMM intends to establish the Project with resultant waste rock dumps, mine machinery fleet, workshops and supporting infrastructure to enable mining and handling of the ore towards the concentrator processing plant where the mine ore will be processed. The existing Deeps Mine concentrator processing plant will be upgraded to enable processing of the Swartberg ore, which is of metallurgical difference from the Deeps mine feedstock. The Port of Saldanha will be used for exporting products. As the Swartberg Mine is seen as a replacement for the current Deeps mine, the facilities at Port of Saldanha should not require an upgrade. Product will be transported via trucks to the Port.

The expanded mining operations and associated infrastructure will include the following:

- Three open pits;
- Explosives storage area and ammonium nitrate and emulsion silos;
- Primary crusher;
- Conveyor system network;
- Waste rock dumps;
- Mine bulk fuel and lubricant storage facilities
- Mine store yard;
- Engineering workshops;
- Power lines;
- Water treatment and disposal infrastructure;
- Administrative offices;
- Training centre;
- Surface water lines;
- Laydown areas and vehicle parking;
- Service bays;
- Waste transfer points;
- Concrete batch plant; and
- Paste backfill plant

The processing plant and related infrastructure will include the following:

- Upgrade to the crushing circuit;
- Upgrades to the milling circuit;
- Increase in flotation capacity by increasing the float cell size;
- Upgrade to pumping and services infrastructure;
- Tailings dam expansion or new facility; and
- Return water dam at Tailings Storage facility (TSF).

Site preparation is expected to begin in 2020 and the LOM is expected to be at least 19 years.

Project Activities

The Project activities can be divided into four phases as follows:

- Construction;
- Operation (Mining);
- Export; and
- Decommissioning and Closure.

Administrative Framework

The National Environmental Management Act (No.107 of 1998), as amended (NEMA) is the South African framework legislation governing environmental protection and management. This provides a framework for the integration of environmental issues into the planning, design, decision-making and implementation of plans and development proposals that are likely to have a negative effect on the environment.

Numerous listed activities have been identified for this Project in terms of all the NEMA listing notices. In instances where all the listing notices are triggered (as in this Project), GNR 325 requirements will take precedent and the Project will be subject to a full Scoping & Environmental Impact Assessment (S&EIA) process prior to commencement of any of the associated activities.

Based on the EIA Regulations 2017, it is understood that the competent authority for this Project will be the Department of Mineral Resources (DMR). As such, BMM will be required to obtain a positive Environmental Authorisation from the National DMR prior to commencement of the proposed activities.

EIA Process

The EIA process was initiated through a pre-assessment Public Participation Process (PPP). The pre-assessment process is not a mandatory requirement in terms of the EIA regulations (2017) but a beneficial option for the client and EAP in order to identify key stakeholders and Interested and Affected Parties (I&APs) as well as to identify any fatal flaws at the onset of a project.

This phase was followed by the scoping phase. During the scoping phase the Terms of Reference for the full EIA was formulated, and requirements from the authorities clarified and any potential issues and concerns identified via consultation.

After completion of the scoping phase, detailed specialist studies have been undertaken to address issues identified in the Scoping Report. Specialists have provided baseline information in their particular field of expertise for the Project area, and identified which project actions will result in significant impacts. These consultants have also suggested ways in which these negative impacts could be mitigated, to reduce their severity.

The Draft EIA Report was submitted for public review, during which time ERM will present the key findings of the studies to all Interested and Affected Parties (I&APs). All comments made by I&APs have been captured in a Comments and Response Report, and in this report responses to all issues and concerns raised during the public review period have been provided.

All recommendations cited in the EIA report are detailed in an Environmental Management Programme report (EMPr), which defines the mitigation actions to be implemented as well as the roles and responsibilities for implementation. EMPrs are recognised as important tools for the sound environmental management of projects.

Public Participation

A key component of the EIA process is public participation. In South Africa public participation is required for an EIA process in terms of the EIA Regulations GNR.326 (April 2017). *Table 2* provides a breakdown of the public participation tasks undertaken and still to be undertaken during the remainder of the process.

Table 0-2 Public Participation Tasks

Activity	Description and Purpose
Pre-Application Phase	
Preparation of a preliminary stakeholder database	A preliminary database has been compiled of authorities (local and provincial), Non-Governmental Organisations, neighbouring landowners and other key stakeholders (refer to *Annex B*). This database of registered I&APs will be maintained and updated during the ongoing EIA process.
Preparation and Distribution of a Background Information Document (BID)	BIDs were distributed via email and post to all registered I&APs. See *Annex C*. The BID provides an introduction to the Project and the EIA process.
Pre Application Meeting with the DMR	A pre-application meeting was held with Deidre Karsten (of the DMR) on the 10th of October 2018. The purpose of the meeting was to notify the DMR of the Project and garner feedback on the Project to be included in the EIA process. Meeting minutes were included in *Annex C* of this Report.
Scoping Phase	
Erection of Site Notices	Site notices were placed at the following locations: • Pofadder Community Centre; • Public notice board next to the OK Supermarket in Aggeneys; and • At the entrance to the Project site. Proof of site notices are included in *Annex B.*
Project Website	A website was created for the Project where key contact information as well as the Draft Scoping Report were made available: (https://www.erm.com/bmm-swartberg-mine-expansion-eia)
Release of draft Scoping Report for Public Comment	The draft Scoping Report was released for public comment between 8 November and 14 December 2018. Notifications were sent to all stakeholders on the database and the report was made available online (https://www.erm.com/bmm-swartberg-mine-expansion-eia and in the Pofadder Public Library, Aggeneys Public Library, and the Black Mountain Office in Aggeneys (See *Annex B* for Proof of DSR availability in the Public Libraries). Acknowledgement of submission of the Draft Scoping Report to the DMR are included in *Annex E*.
Public Meetings	I&APs were invited to attend a public meeting at the Aggeneys North Recreation Club on 15 November 2018 in order for ERM to present the proposed Project and solicit input from stakeholders into the scoping process. Stakeholders were notified of this meeting on 1 November 2018. At the request of the Khai Mai Municipal Council, further public meetings were held at the Onseepkans Community Hall, Pofadder Community Hall and the Pella Community Hall on 11 December 2018. Stakeholders were notified of meetings by means of a notification letter (sent on 4 December 2018), public notices placed in Pofadder community centre and through verbal invitations from the Municipal Council. The notification of the additional public meeting included a reminder of the public comment period. Attendance registers for the meeting are included in Annex C of this Report and a summary of discussions held are included in the section below.
Development of a Comments and Response Report	All comments received during the Scoping consultation period were recorded into the Comment and Response Report (*Annex D*) of this Report.
Newspaper Adverts	An advertisement, advertising the commencement of the commenting period was placed in Die Namakwalander (Afrikaans) and in Die Burger (English) on the 7th of November 2018 (*Annex B*).

Activity	Description and Purpose
Key Stakeholder Meetings	Individual meetings with key stakeholders were also undertaken. These included surrounding farm owners Hester Maasdorp and Deon Maasdorp on the 15th of November 2018 at Zuur Water Farm, Jasper Mostert on the 17 of November 2018, and the Khai Mai Municipal Council on the 13th of November 2018. Attendance registers of the key stakeholder meetings were included in *Annex C* of the final Scoping Report.
EIA Phase	
Release of draft EIA and EMPr for Public Comment	The draft EIA and EMPr document was made available for a 30-day comment period to stakeholders and the relevant authorities. The 30-day comment period was from 4 April to 13 May 2019. A notification letter was sent on 8 April to all registered I&APs on the project database. This letter served to invite I&APs to comment on the draft EIA. Newspaper adverts were placed in local newspapers notifying stakeholders of the availability of the Draft EIA report for review and inviting them to public meetings. All comments received have been included in this final EIA Report.
Availability of draft EIR	The Report was made available on the project website: https://www.erm.com/bmm-swartberg-mine-expansion-eia, on request from ERM, and at the following public locations: • Aggeneys Public Library • Poffadder Public Library • Black Mountain Mining Office, Penge Road, Aggeneys • Department of Mineral Resources, Springbok
Stakeholder Meetings	A public meeting was held during the EIA phase to gather comments on the draft EIA as its development progresses. This public meeting was held in Aggeneys on 16 April 2019. No stakeholders attended this meeting. I stakeholder meeting was also held with neighbouring farmers in the area on 15 April 2019 to discuss the Project. Meeting minutes are attached as Appendix C,
Authority Meeting	An authority meeting was held during the EIA phase with the Department fo Environmental Affairs Northern Cape on 14 May 2019. Meeting minutes have been attached as Appendix C.
Focus Group Discussions	A biodiversity focus group meeting was held on Thursday, 2 May 2019, in order to facilitate discussion and feedback on important potential impacts. Meeting minutes are attached as Appendix C.
Submission of Final EIR	The Final Report has been submitted to the Competent Authority on the 20th of June 2019 for decision making.
Notification of Decision	I&APs will be notified of the decision with regards to the EA and the statutory appeal period. An advertisement will be placed to advertise the EA.

Summary of Impacts

Following ERM's assessment, the following impacts are considered likely to arise from construction, operation and maintenance/ decommissioning activities of the Project. This Impact Assessment identifies and evaluates the potential impacts that the proposed Project may have on the biophysical and socio-economic environments, and develops mitigation/ management measures that will be implemented to avoid, minimize or reduce these impacts and enhance positive impacts.

Table 3 provides an overview of likely aspects arising from each of the key Project activities and considers their likely interaction with socio-economic and environmental resources and receptors.

The significance of impact on terrestrial flora has been assessed to be Major both pre- and post-mitigation, as the Project will result in some loss of highly sensitive habitats and species. An extensive list of mitigation measures has been proposed to minimise the loss, however the location of the proposed mine expansion suggests there will a degree of habitat loss. The other major impacts relate to Occupational Health and Safety (Unplanned Event), however this can be mitigated to Moderate with strict operational controls.

Other negative impacts associated with the proposed development have been mitigated to a level which is deemed appropriate for the construction phase to proceed.

Table 0-3 Summary of the significance of identified impacts of the proposed Project

Impact	Significance Pre Mitigation	Residual Impact Significance
Air Quality: Decreased Local Ambient Air Quality due to Dust Emissions	Moderate (receptors within 200m of the Project site)	Minor (receptors within 200m of the Project site)
Ambient Noise and Vibration: Increase in the Ambient Noise Levels	Minor	Minor
Soils and Geology: Loss of Soil Resources as a result of Site Clearance and Construction Activities	Moderate	Minor
Terrestrial Flora: Loss of Medium-High and High Sensitivity Habitats and Associated Species	Major	Moderate
Terrestrial Flora: Loss of Medium-Low and Low Sensitivity Habitats and Associated Species	Moderate	Minor
Terrestrial Flora: Loss of Plant Species of Conservation Concern	Major	Minor
Terrestrial Flora: Reduced Ecological Function and Degradation due to Altered Soil Surfaces	Major	Major
Terrestrial Flora: Increase in Alien Invasive Vegetation	Moderate	Minor
Terrestrial Fauna: Faunal Habitat Loss of Medium, High Sensitivity areas	Moderate	Moderate
Terrestrial Fauna: Loss of Individuals of Fauna due to mining activities.	Moderate	Minor
Groundwater: Impact of Contaminants on the Groundwater Resource	Moderate	Minor
Groundwater: Impact of Contaminants on the Groundwater Resource	Moderate	Minor
Groundwater: Impact of Contaminants on Groundwater Users	Negligible	Negligible
Groundwater: : Impact of Drawdown or Dewatering on the Groundwater Resource	Moderate	Moderate
Groundwater: : Impact of Drawdown or Dewatering on Groundwater Users	Negligible	Negligible
Employment, Skills Enhancement and Local Business Opportunities	Positive	Positive
Loss of Employment, Skills Enhancement and Local Business Opportunities	Major	Moderate
Community Health and Safety: Impacts Associated with the Presence of the Workforce and Jobseekers	Moderate	Minor
Community Health and Safety: Pressure on Social Infrastructure and Services	Minor	Minor
Community Health and Safety: Impact on Human Health due to Air Emissions	Minor	Negligible
Community Health and Safety: Impact on Human Health due to Air Emissions	Minor	Minor
Worker Health and Safety and Rights: Risk to Workers' Health and Safety due to Hazardous Activities	Moderate	Minor
Traffic: Increase in Traffic Volumes	Moderate	Minor
Archaeology and Cultural Heritage	Minor	Minor
Unplanned Events: Occupational Health and Safety Hazards	Major	Moderate
Unplanned Events: Accidental Spills of Equipment Fuel, Oils, and Chemicals on Soils	Moderate	Minor
Unplanned Events: Accidental Spills of Equipment Fuel, Oils, and Chemicals on Groundwater	Minor	Negligible
Unplanned Events: Vehicle Accidents	Moderate	Minor

Environmental Management Programme

The objective of the EMPr is to describe measures and actions that will be implemented to eliminate or reduce key environmental concerns/ impacts to acceptable levels for all elements of Project's activities. Details of these mitigations measures are included in Section 8.

BMM will ensure the following in order for the appropriate implementation of the EMPr:

- *Training and Environmental Awareness:* BMM will identify, plan, monitor, and record training needs for personnel whose work may have a significant adverse impact upon the environment or social conditions. Key staff will therefore be appropriately trained in key areas of environmental and social management and operational control with core skills and competencies being validated on an on-going basis.
- *Record Keeping:* BMM will control HSE documentation, including management plans; associated procedures; and checklists, forms and reports, through a formal procedure. All records will be kept on site and kept in both hard copy and soft copy formats.
- *Grievance Mechanisms:* The management of grievances is a vital component of stakeholder management and an important aspect of risk management for the project, since grievances can be an indication of growing stakeholder concerns (real and perceived).
- *Monitoring Programme:* Monitoring will be conducted to ensure compliance with regulatory requirements as well as to evaluate the effectiveness of operational controls and other measures intended to mitigate potential impacts. Monitoring parameters are included in the EMPr.
- *Auditing:* Beyond the routine inspection and monitoring activities conducted, audits will be carried out internally by BMM to ensure compliance with regulatory requirements. The audit shall be performed by qualified staff and the results shall be reported to the Site management to be addressed.
- *Corrective Action:* Potential impacts and associated risks should be identified. Investigating a 'near miss' or actual incident after it occurs can be used to obtain valuable lessons and information that can be used to prevent similar or more serious occurrences in the future.
- *Reporting:* BMM will provide appropriate documentation of EHS related activities, including internal inspection records, training records, and reports to the DMR as required.

Conclusion

It is considered that suitable effort has been made to accommodate the mitigation measures recommended during the EIA process, to the extent that is practically possible, without compromising the economic viability of the proposed Project. The implementation of the mitigation measures detailed in the EMPr, including monitoring, will provide a basis for ensuring that the potential positive and negative impacts associated with the establishment of the Project are respectively enhanced and mitigated to a level which is deemed adequate for the Project to proceed.

In summary, based on the findings of this assessment, ERM is of the opinion that the Swartberg Mine Expansion should be authorised, contingent on the mitigation measures and monitoring of potential environmental and socio-economic impacts as outlined in the EIA Report and EMPr being implemented.

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Acronyms and Abbreviations

Acronym	Description
ALARP	As Low As Reasonably Practicable
ANFO	Ammonium nitrate fuel oil
ARD	Acid rock drainage
BAP	Biodiversity Action Plan
BAR	Basic Assessment Report
BID	Background Information Document
BMM	Black Mountain Mining
CBA	Critical Biodiversity Area
CDW	Community Development Workers
CoCs	Contaminants of Concern
DAoI	Direct Area of Influence
DEA	Department of Environmental Affairs
DEA&DP	Department of Environmental Affairs and Development Planning
DM	District Municipality
DMA	District Management Area
DMR	Department of Mineral Resources
DSR	Draft Scoping Report
DWA	Department of Water Affairs
EAP	Environmental Assessment Practitioner
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
EIR	Environmental Impact Report
EMPr	Environmental Management Program
EPC	Engineering Procurement Construction
ERM	Environmental Resources Management
GDP	Gross Domestic Product
GNR	Government Notice Regulation
HDPE	High density polyethylene
HV	High Voltage
IAoI	Indirect Area of Influence
I&AP's	Interested and Affected Parties
IDP	Integrated Development Plan
IRP	Integrated Regional Plan
ktpa	kilo tonnes per annum
LED	Local Economic Development
LHOS	Long-hole open stoping
LM	Local Municipality
LOM	Life of Mine
MAE	Mean annual evaporation
MAMSL	Metres above mean sea level
MBGL	Meters below ground level
MF	Monitoring Forum
MRPDA	Mineral and Petroleum Resources Development Act
MR	Mining Right
Mtpa	Million tonnes per annum
Mt	Million tonnes
MW	Mega Watt
NCDM	Northern Cape District Municipality
NCPGDS	Northern Cape Provincial Growth and Development Strategy
NDM	Namakwa District Municipality
NDP	National Development Plan
NEMA	National Environmental Management Act
NEMBA	National Environmental Management: Biodiversity Act
NEMPAA	National Environmental Management: Protected Areas Act
NEMWA	National Environmental Management: Waste Act
NEMAQA	National Environmental Management: Air Quality Act
NFEPA	National Freshwater Ecosystem Priority Areas
NGA	National Groundwater Archive
NHRA	National Heritage Resources Act
NID	Notice of Intent to Develop
NWA	National Water Act
OCHSA	Occupational Health and Safety Act
PPE	Personal Protective Equipment

PPP	Public Participation Process
ROM	Run Of Mine
SAHRA	South African Heritage Resources Agency
SANS	South African National Standards
SDF	Spatial Development Framework
SDFP	Spatial Development Framework Plan
S&EIR	Scoping and Environmental Impact Report
TDS	Total Dissolved Solids
TPH	Total Petroleum Hydrocarbon
TSF	Tailings Storage Facility
VOCs	Volatile Organic Compounds
WML	Waste Management Licence
WRD	Waste Rock Dump
WUL	Water Use Licence

1. INTRODUCTION

1.1 Project Background

Black Mountain Mining (Pty) Ltd (herein referred to as BMM), part of the global Vedanta Resources Plc., intends to expand the Swartberg Mine at the existing Black Mountain Mine, located 10 km west of the town of Aggeneys, Northern Cape Province. The proposed expansion of the Swartberg Mine includes the expansion of the existing decline and the development of three more open pits (the *Project*). It should be noted that the footprint of the existing Black Mountain Mine will not be expanded. The current Swartberg Mine is authorised through a previous Environmental Authorisation from the Department of Mineral Resources (NCS 30/5/1/2/3/2/1/517 EM). An environmental approval for the development of a decline and the establishment of an open pit with associated workshops and infrastructure is included in the existing Authorisation.

BMM is a producer of Copper, Lead and Zinc concentrates in the Northern Cape. BMM currently produces ore from two underground mines; the Deeps mine and the Swartberg Mine (both located at Black Mountain Mine). Extensive exploration in the vicinity of Swartberg to determine the extent of the orebody, has opened up the possibility of expanding the existing underground mine and establishing new open pits at Swartberg to levels on par with, or exceeding, the current Deeps mine. A pre-feasibility study completed in April 2017 concluded that the mining of the identified orebody at Swartberg is financially viable. The bulk of the current ore production, approximately 1.3 million tonnes per annum (Mtpa), is produced from Deeps mine, and 400 kilo tonnes per annum (Ktpa) from the Swartberg operations. The Black Mountain Mine complex also includes an existing ore processing plant, mine offices, maintenance facilities and other associated services and infrastructure necessary to sustain the existing underground operations. The Deeps Life of Mine (LOM) is scheduled to extend to March 2021. To secure the future of mining at BMM, it is proposed to ramp-up ore production from Swartberg Mine to a minimum of 1.7 Mtpa before Deeps mine is mined out. The expansion will advance the Swartberg LOM within the existing Mining Right Area (MR 517) by at least 19 years.

The expansion of Swartberg Mine will consist of the expansion of the current underground mine and three new open pit mines, which will result in a total of 150,000,000 tons of ore being mined from the Swartberg over the 19 year LOM. Of this expected tonnage, approximately 18,000,000 tons of lead and copper concentrate will be extracted. Lead and copper concentrate will be transported via existing rail and/or road networks and exported via the Port of Saldahna in the Western Cape. BMM has a long term view to mine additional resources to ensure mining operations at Black Mountain Mine remain viable.

1.2 Previous Mining History and Environmental Authorisations

1.2.1 Existing Mining Right

BMM is the holder of a mining right (MR 517) convened in terms of item 7 of Schedule II to the Mineral and Petroleum Resources Development Act, 28 of 2002. This mining right entitles BMM to mine the Black Mountain Mine for copper, lead, zinc and associated minerals in, on and under Remainder of Portion 1 of the farm Aggeneys 56, Portion 4 of the farm Zuurwater 62 and Portion 1 of the farm Koeries 54, situated in the Magisterial/ Administrative District of Namaqualand. The mining right has been issued for a period of 30 years from 19 August 2008, extending until 18 August 2038.

1.2.2 Existing Environmental Authorisations for Black Mountain Mine

Table 1-1 shows the various existing environmental authorisations for the Black Mountain Mine, copies of which have been attached in *Annex F*.

Table 1-1 Existing Environmental Authorisations for Black Mountain Mine

Authorisation	Environmental Framework	Reference	Relevant Area	Competent Authority
Approval of waste disposal activities	NEMA EIA Regulations, 2014 (as amended) and NEMWA list of waste Management Activities, 2008 (as amended) for existing waste facilities on Black Mountain Mining (Pty) Ltd.	NCS 30/5/1/2/3/2/1 (517) PR	Black Mountain Mine (Pty) Ltd	Department of Mineral Resources
Approval of development of new Swartberg Decline	Environmental Authorisation in terms of the National Environmental Management Act, 1998 (Act 107 of 1998) as Amended and National Environmental Management: The Impact Regulation, 2014 on Remainder of Aggeneys No 56, Portion 4 of Zuurwater No 62 and Remainder of Rozynenbosch No 41 and Portion 4 of Koeris No 54.	NCS 30/5/1/2/3/2/1/517 EM	Portion 1 of the Farm Koeris No. 54, Portion 14 of the Farm Zuurwater No. 62, remainder and Portion 1 of the Farm Aggeneys No. 56 and Remainder of Rozynenbosch 41, Magisterial District of Namaqualand, Northern Cape Region	Department of Mineral Resources
Approval of amended EMP	Approval of an amendment to the Approved Environmental Management Programme in terms of section 102 of the MPRDA.	NCS 30/5/1/2/3/2/1/517 EM	Portion 1 of the Farm Koeris No. 54, Portion 14 of the Farm Zuurwater No. 62, remainder and Portion 1 of the Farm Aggeneys No. 56 Magisterial District of Namaqualand, Northern Cape Region	Department of Mineral Resources

Authorisation	Environmental Framework	Reference	Relevant Area	Competent Authority
DENC approval for establishment of Open pit and associated infrastructure	Granting of the Environmental authorisation for GN.R544: Activity 9(1), 13, 18 (i), 26, 6, 15 & GN.R546: Activities 12, 13 ii (cc), 14, 16 (iv) (ii) (ff), 19 (ii) (ee). The re-establishment of the Swartberg Open Pit mine for Lead, Copper and Zinc for export purposes.	NC/EIA/02/NAM/KHA/ AGG1/2014	Black Mountain Mine (Pty) Ltd	Department Environment Natur Conservation Northern Cape
Water Use Licence	Licence for water uses 21(a), (e), (g) and (j) for a period of 15 years subject to the terms and conditions set out in the licence.	14/D82C/EGJ/171716/2/7/ D82C/C1	Black Mountain Mine (Pty) Ltd	Department of Water & Sanitation
Water Use Licence	Licence for water uses 21(a), (e), (g) and (j) for a period of 15 years subject to the terms and conditions set out in the licence.	14/D82C/EGJ/1717	Black Mountain Mine (Pty) Ltd: Vedanta	Department of Water & Sanitation
Waste: General Waste Disposal Site: ECA Permit	Establish, provide or operate a waste disposal site of all types of wastes excluding hazardous and toxic wastes, nuclear, mining waste, medical waste and scheduled pharmaceutical products.	B33/2/450/12/P145	Portion of the remainder of the portion 1 of the Farm Aggeneys 56	Department of Water & Sanitation
Waste: General Waste Disposal Site: ECA Permit	Establish, provide or operate a waste disposal site of all types of wastes excluding hazardous and toxic wastes, nuclear, mining waste, medical waste and scheduled pharmaceutical products.	B33/2/450/12/P146	Portion of Portion 4 of the Farm Zuurwater 62	Department of Water & Sanitation

1.3 Purpose of this Report

Environmental Resources Management Southern Africa Pty Ltd. (ERM) has been appointed by BMM to conduct the Environmental Impact Assessment (EIA) process in terms of the National Environmental Management Act (NEMA), Act No. 107 of 1998, as amended (hereafter referred to as NEMA). This Environmental Impact Assessment Report (EIA) has been compiled as part of the EIA process in accordance with the regulatory requirements stipulated in the EIA Government Regulations promulgated in terms of Section 24(5) of the NEMA.

A typical EIA is undertaken in three phases; namely Scoping Phase, Specialist Study Phase and Impact Assessment Phase. The objective of the Scoping Phase, undertaken in 2018, was to identify the potentially significant environmental and social issues relating to the establishment/ construction, operation and decommissioning of the proposed development that should be addressed in the EIA. This was done through desktop review of available project and baseline information, initial engagement with key stakeholders (and other public consultation initiatives) as well as a site reconnaissance.

The Scoping Report included a description of the proposed project, infrastructure and activities, alternatives considered, and the EIA methodology. A description of the stakeholder engagement process and the key issues raised by stakeholders through the consultation activities were also presented. These issues have informed the development of the Plan of Study for EIA which defines the detailed studies to be undertaken as part of the specialist studies phase.

The Draft Scoping Report documented the findings of the Scoping Phase and was disclosed for a 30 day comment period from 8 November to 10 December 2018. All comments received during this time were addressed and included in the Final Scoping Report, which was submitted to the DMR for review on 18 January 2019.

The Final Scoping Report was approved on 2 April 2019.

The purpose of this EIA is to present the following:

- A detailed description of the proposed Project and relevant Project alternatives;
- The EIA process and a legal review of legislation and guidelines pertinent to the proposed Project and associated Impact Assessment Report;
- A detailed baseline review of the physical, biological and socio-economic characteristics of the Project area;
- An assessment of impacts to the physical, biological and socio-economic environments related with the different phases (construction, operational and decommissioning phases) of the proposed Project;
- Mitigation measures that aim to avoid/ minimise/ manage the severity of identified impacts; and
- An assessment of cumulative impacts associated with Project-related developments in the Project area.

In terms of the identification of the competent authority, NEMA, states the following:

The competent authority in respect of the activities listed in this part of the schedule is the competent authority in the province in which the activity is to be undertaken, unless:

a) *it is an application for an activity contemplated in section 24C(2) of the Act, in which case the competent authority is the Minister or an organ of state with delegated powers in terms of section 42(1) of the Act;*

b) *the listed or specified activity is or is directly related to-*

   i. *prospecting or exploration of a mineral or petroleum resource; or*

   ii. *extraction and primary processing of a mineral or petroleum resource.*

As such, based on the proposed project, the regulations as stated above, and as confirmed with the Department of Mineral Resources (DMR), the DMR is the competent authority for this application.

Box 1.1 Contact Details of Competent Authority

Department of Mineral Resources

Deidre Karstens (Case officer)

Hopley Centre, cnr of Van der stel & Van Riebeeck Streets, Springbok

Phone (027) 712 8160

Fax (027) 712 1959

mineral resources
Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

1.4 Project Proponent

BMM engages in mining operations in South Africa and produces primarily zinc concentrates, as well as lead, copper, and silver concentrates. BMM operates the Gamsberg, Swartberg, and Deeps mines and currently employ 1,667 individuals through direct employment and business partners. The contact details for the applicant are presented in *Box 1.2* below.

Box 1.2 Contact Details of Project Proponent

Black Mountain Mining Company (Pty) Ltd

Pieter David Venter (Environmental Manager)

Address: Penge Rd, Aggeneys, 8893

Tel: +27 54 983 9802

Email: PVenter@vedantaresources.co.za

1.5 The Environmental Assessment Practitioner (EAP) Team

ERM is a global environmental consulting organisation employing over 5,000 people in over 150 offices, in more than 40 countries. ERM Southern Africa employs over 150 environmental consultants across three offices: Johannesburg, Durban and Cape Town.

The requirement for environmental consultants to act independently and objectively is a well-established principle in South African law. The EIA regulations (GN R.326), specifically state:

"that an EAP (environmental assessment practitioner) (must have) no business, financial, personal or other interest in the activity, application or appeal in respect of which that EAP is appointed in terms of these Regulations other than fair remuneration for work performed in connection with that activity; or that there are no circumstances that may compromise the objectivity of that EAP in performing such work."

ERM is a privately owned company registered in South Africa. ERM has no financial ties to, nor is ERM a subsidiary, legally or financially, of BMM. Remuneration for the services by the Proponent in relation to this EIA is not linked to an approval by the decision-making authority. Furthermore, ERM has no secondary or downstream interest in the development.

The role of the environmental consultants is to provide credible, objective and accessible information to government and other stakeholders, so that an informed decision can be made about whether the project should proceed or not.

The ERM team selected for this Project possess the relevant expertise and experience to undertake this EIA. As such, ERM has signed the legally required declaration of independence to function as an objective Environmental Assessment Practitioner (EAP). The CVs and details of the Independent Environmental Practitioner are presented in Annex A.

The contact details of the EAP for the application are presented in *Box 1.3* and the core EIA team members involved in this EIA are listed in *Table 1-2.*

Box 1.3 Contact Details of the EAP

Environmental Resources Management Southern Africa (Pty) Ltd.

Stephanie Gopaul

Address: Postnet Suite 90, Private Bag X12, Tokai, 7966, Cape Town, South Africa

Tel: +27 21 681 5400, Fax: +27 21 686 0736

Email: Stephanie.gopaul@erm.com

Table 1-2 The EIA Team

Name	Role	Qualifications, Experience
Philip Johnson	Partner in Charge	BSc. (Hons), MSc, PIEMA, 14 years
Brendon Solik	Project Manager	B Soc Sci (hons), MSc 5 years
Stephanie Gopaul	Technical Specialist	BSc, MSc, 12 years

1.6 Impact Assessment Report Regulations as per EIA Regulations 2017

Table 1-3 indicates where the legislated content required in an EIA, can be found in this EIA Report.

Table 1-3 Legislated Content of Impact Assessment Report (GNR 326) and Corresponding Sections in this Report

Legislated Content- Appendix 2 Section 3	Report Section
1. (a) details of-	
(i) the EAP who prepared the report	Chapter 1.5
(ii) the expertise of the EAP, including a curriculum vitae	Chapter 1.5 & Annex A
(b) the location of the development footprint of the activity on the approved site as contemplated in the accepted scoping report including: (i) the 21 digit Surveyor General code of each cadastral land parcel; (ii) where available, the physical address and farm name; (iii) where the required information in items (i) and (ii) is not available, the coordinates of the boundary of the property or properties;	Chapter 2.1
(c) a plan which locates the proposed activity or activities applied for at an appropriate scale (including coordinates) (i) a linear activity, a description and coordinates of the corridor in which the proposed activity or activities is to be undertaken; or (ii) on land where the property has not been defined, the coordinates within which the activity is to be undertaken	Chapter 2.2
(d) a description of the scope of the proposed activity, including-	
(i) all listed and specified activities triggered;	Chapter 3.3
(ii) a description of the activities to be undertaken, including associated structures and infrastructure	Chapter 2.4
(e) a description of the policy and legislative context within which the development is located and an explanation of how the proposed development complies with and responds to the legislation and policy context	Chapter 3
(f) a motivation for the need and desirability for the proposed development including the need and desirability of the activity in the context of the preferred development footprint within the approved site as contemplated in the accepted scoping report;	Chapter 2.11
(g) a motivation for the preferred development footprint within the approved site as contemplated in the accepted scoping report;	Chapter 2.10
(h) a full description of the process followed to reach the proposed development footprint within the approved site as contemplated in the accepted scoping report including:	Chapter 2.10
(i) details of all the development footprint alternatives considered;	Chapter 2.10
(ii) details of the public participation process undertaken in terms of regulation 41 of the Regulations, including copies of the supporting documents and inputs;	Chapter 5.6 & Annex B,C,D
(iii) a summary of the issues raised by interested and affected parties, and an indication of the manner in which the issues were incorporated, or the reasons for not including them;	Chapter 5.6
(iv) the environmental attributes associated with the development footprint alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects;	Chapter 4 & 7
(v) the impacts and risks identified for each alternative, including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts- (aa) can be reversed; (bb) may cause irreplaceable loss of resources; and (cc) can be avoided, managed or mitigated.	Chapter 7
(vi) the methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks;	Chapter 6
(vii) positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community that may be affected focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects	Chapter 7
(viii) the possible mitigation measures that could be applied and level of residual risk	Chapter 7
(ix) if no alternative development footprints for the activity were investigated, the motivation for not considering such; and	Chapter 2

Legislated Content- Appendix 2 Section 3	Report Section
(x) a concluding statement indicating the location of the preferred alternative development footprint within the approved site as contemplated in the accepted scoping report;	Chapter 2
(i) a full description of the process undertaken to identify, assess and rank the impacts activity and associated structures and infrastructure will impose on the preferred development footprint on the approved site as contemplated in the accepted scoping report through the life of the activity including:	Chapter 2.11
(ii) a description of all environmental issues and risks that were identified during the environmental impact assessment process; and	Chapter 7
(iii) an assessment of the significance of each issue and risk and an indication of the extent to which the issue and risk could be avoided or addressed by the adoption of mitigation measures;	Chapter 7
(j) an assessment of each identified potentially significant impact and risk, including:	
(i) cumulative impacts;	Chapter 7
(ii) the nature, significance and consequences of the impact and risk;	Chapter 7
(iii) the extent and duration of the impact and risk;	Chapter 7
(iv) the probability of the impact and risk occurring;	Chapter 7
(v) the degree to which the impact and risk can be reversed;	Chapter 7
(vi) the degree to which the impact and risk may cause irreplaceable loss of resources; and	Chapter 7
(vii) the degree to which the impact and risk can be mitigated;	Chapter 7
(k) where applicable, a summary of the findings and recommendations of any specialist report complying with Appendix 6 to these Regulations and an indication as to how these findings and recommendations have been included in the final assessment report;	Chapter 9
(l) an environmental impact statement which contains—	
(i) a summary of the key findings of the environmental impact assessment:	Chapter 9
(ii) a map at an appropriate scale which superimposes the proposed activity and its associated structures and infrastructure on the environmental sensitivities of the preferred development footprint on the approved site as contemplated in the accepted scoping report indicating any areas that should be avoided, including buffers; and	Annex G
(iii) a summary of the positive and negative impacts and risks of the proposed activity and identified alternatives;	Chapter 9
(m) based on the assessment, and where applicable, recommendations from specialist reports, the recording of proposed impact management outcomes for the development for inclusion in the EMPr as well as for inclusion as conditions of authorisation;	Chapter 8 & 9 Annex H
(n) the final proposed alternatives which respond to the impact management measures, avoidance, and mitigation measures identified through the assessment;	Chapter 3 & 8
(o) any aspects which were conditional to the findings of the assessment either by the EAP or specialist which are to be included as conditions of authorisation;	Chapter 7
(p) a description of any assumptions, uncertainties and gaps in knowledge which relate to the assessment and mitigation measures proposed;	Chapter 7
(q) a reasoned opinion as to whether the proposed activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation;	Chapter 9
(r) where the proposed activity does not include operational aspects, the period for which the environmental authorisation is required and the date on which the activity will be concluded and the post construction monitoring requirements finalised;	n/a
(s) an undertaking under oath or affirmation by the EAP in relation to-	
(i) the correctness of the information provided in the reports;	Annex A
(ii) the inclusion of comments and inputs from stakeholders and I&APs;	Annex A
(iii) the inclusion of inputs and recommendations from the specialist reports where relevant; and	Annex A
(iv) any information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested or affected parties;	Annex A
(t) where applicable, details of any financial provision for the rehabilitation, closure, and ongoing post decommissioning management of negative environmental impacts;	Annex I
(u) an indication of any deviation from the approved scoping report, including the plan of study, including	

Legislated Content- Appendix 2 Section 3	Report Section
(i) any deviation from the methodology used in determining the significance of potential environmental impacts and risks; and	n/a
(ii) a motivation for the deviation;	n/a
(v) any specific information that may be required by the competent authority;	n/a
(w) any other matters required in terms of section 24(4)(a) and (b) of the Act.	n/a

1.7 Report Structure

The remainder of this report is organised as follows:

- Chapter 2: Project Description
- Chapter 3: Administrative Framework
- Chapter 4: Baseline
- Chapter 5: EIA Process
- Chapter 6: Impact Assessment Methodology
- Chapter 7: Impact Assessment
- Chapter 8: Environmental Management Programme (EMPr)
- Chapter 9: Conclusion
- Chapter 10: References

In addition, the report includes the following annexures:

- Annex A: Details of Environmental Assessment Practitioner and Declaration of Independence
- Annex B: Stakeholder Engagement Material
- Annex C: Meeting Materials
- Annex D: Comments and Responses
- Annex E: Authority Communication
- Annex F: Proof of Approval for Existing Authorisations
- Annex G: Layout Plans and Maps
- Annex H: Standalone EMPr
- Annex I: Financial Provision for Closure
- Annex J: Black Mountain Mine Social and Labour Plan
- Annex K: Specialist Reports

2. PROJECT DESCRIPTION

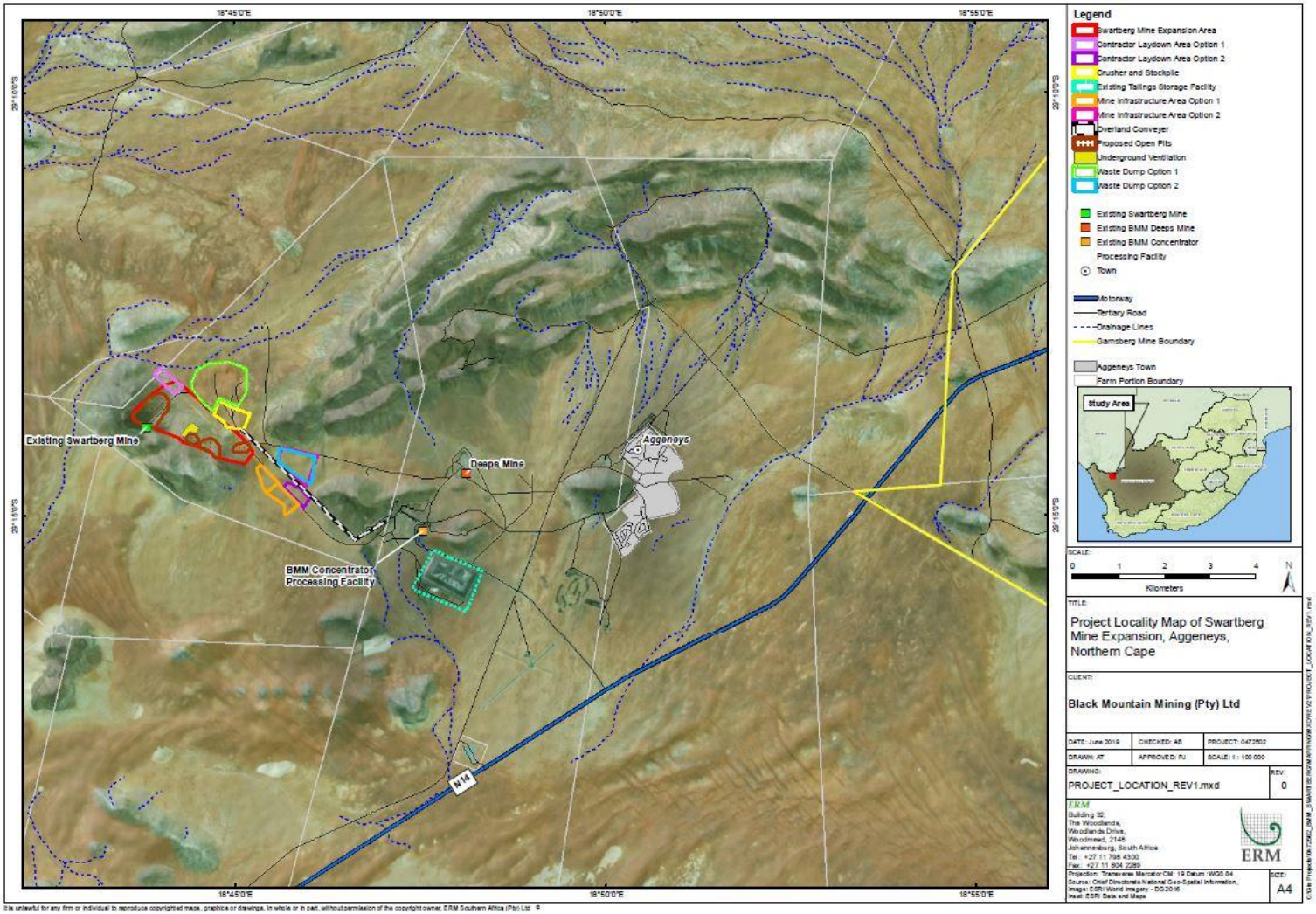
2.1 Project Location

The Project site is located in the Northern Cape Province of South Africa, approximately 10 km west of the town of Aggeneys, between the existing towns of Pofadder and Springbok. The Project site falls within the Black Mountain Mine, which is owned by BMM. *Table 2-1* shows the details of the property where the Project will be located and *Figure 2.1* illustrates the Project location.

Table 2-1 Property Details

Farm Name	Zuurwater 62
Portion Number	Portion 4
SG21 Code	C05300000000006200004
Local Municipality	Khai-Ma Local Municipality
Magisterial District	Namaqualand [C053]
District Municipality	Namakwa District Municipality

Figure 2.1 Project Location Map



2.2 Need and Desirability

2.2.1 Overview

BMM has a long term view to mine additional resources to ensure that the mining continues at the Black Mountain Mine beyond the LOM of Deeps Mine. Therefore the Project is key to ensure that mining continues at BMM, and will have an expected life of mine of 19 years with future potential for the possible extension of this period.

2.2.2 Employment

BMM employs in excess of 1,600 persons, operating as the largest private employer in the Namakwa region and it is a stable employer for the last 30 years. Approximately 80% of the employees are local, with 62% from Namakwa, Khai-Ma and Nama Khoi municipal areas. Should the proposed expansion not occur, approximately 837 permanent employees would be at risk of losing their jobs, with an additional 830 business partners at risk. A number of these business partners also have active contracts with the BMM Gamsberg Mine, and should the proposed Swartberg Mine expansion not occur, a reduction in revenue might be experienced.

2.2.3 Regional Mining Contribution

Mining is a major gross domestic product (GDP) contributor and provides 22% of the provincial economy, followed by agriculture at 7%, manufacturing at 3%, and construction at 2% (Stats SA, 2016). In addition, The Northern Cape contributed 6% of the national mining GDP (Stats SA, 2016). Stats SA reported that mining contributed 40,000 real jobs in 2014, which was up from 22,000 in 2003 (StatsSA, 2016). BMM is one of the mining operations that has contributed to stable employment and economic growth in the area.

2.2.4 Contribution to Service Delivery and Infrastructure

BMM's current contribution to the local service delivery and infrastructure includes:

- Residential accommodation is provided by the mine to the majority of employees. Aggeneys currently houses the existing BMM workforce of approximately 837 permanent employees and a significant number of business partner staff.
- Basic service provision to the town of Aggeneys is maintained by BMM for all residents. Monitoring of resources such as water, energy as well as waste and its recycling takes place continually to enable sustainable management of resources by all the users.
- As part of BMM operation water infrastructure has been developed which provides potable water is provided to Pofadder, Pella, Aggeneys and surrounding farmers (a total of approximately 11,200 people). This infrastructure was subsequently transferred to the Pella water board and Sedibeng Water.
- The public provincial gravel road of 160 km from the N14 to Loop 10 railroad siding was 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 (SLP) currently implement four projects, affecting approximately 9,000 persons positively with a total spend of approximately R 16.5 million over five years. This SLP will shortly reach the end of its 5 year period. BMM intends to implement another SLP, similar to the current, which will also include a total spend on R 19.5

million over a 5 year period. This SLP will continue to focus on primary health care, education and SMME development

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

2.2.5 Summary

BMM has contributed substantially to local and regional economic growth. The Aggeneys community alone was largely developed as a result of the BMM operations. Mining operations in the Northern Cape Province contribute the highest percentage towards the GDP, followed by the agriculture and manufacturing sectors. Given the crucial role played by the BMM operations both on a local and regional scale, should the proposed mine expansion not occur, the Northern Cape economy faces major employment and development risks.

2.3 Project Components

BMM intends to establish the Project with resultant waste rock dumps (WRDs), mine machinery fleet, workshops and supporting infrastructure to enable mining and handling of the ore towards the concentrator processing plant where the mine ore will be processed. The existing Deeps Mine concentrator processing plant will be upgraded to enable processing of the Swartberg ore, which is metallurgically different from the Deeps Mine feedstock.

The Port of Saldanha will be used for exporting products. As the Swartberg Mine is seen as a replacement for the current Deeps mine, the facilities at Port of Saldanha should not require an upgrade as no significant additional net volume is anticipated. Product will be transported via trucks to the Port.

The expanded mining operations and associated infrastructure will include the following:

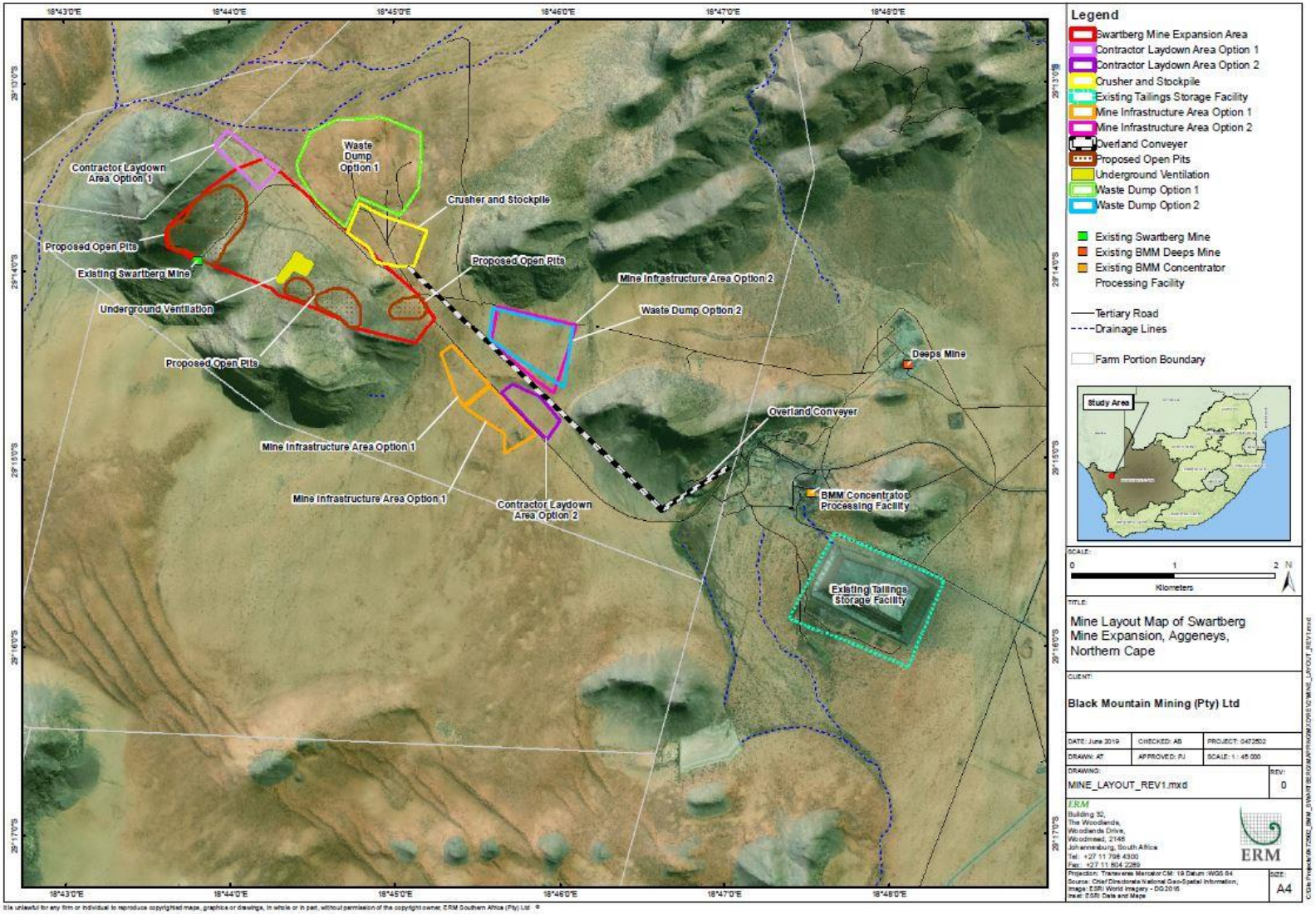
- Four open pits;
- Explosives storage area and ammonium nitrate and emulsion silos;
- Primary crusher;
- Conveyor system network;
- Waste rock dumps;
- Mine bulk fuel and lubricant storage facilities
- Mine store yard;
- Engineering workshops;
- Power lines;
- Water treatment and disposal infrastructure;
- Surface water lines with storage tanks and take offs;
- Laydown areas and vehicle parking;
- Service and wash bays;
- Waste transfer points;
- Concrete batch plant; and
- Paste backfill plant.

The current processing plant and related infrastructure include the following:

- Upgrade to the crushing circuit;
- Upgrades to the milling circuit;
- Increase in flotation capacity by increasing the float cell size;
- Upgrade to pumping and services infrastructure;
- Tailings dam expansion or new facility; and
- Return water dam at Tailings Storage facility (TSF).

Figure 2.2 illustrates the indicative Mine layout including Plant Layout.

Figure 2.2 Indicative Mine Layout



2.4 Construction Phase

The first phase of the Project will involve the clearance of vegetation (between 120 and 200 ha), site earthworks and excavation. Internal site access roads will need to be constructed in order to facilitate the clearing and excavation. Stockpile and laydown areas will be identified and prepared. Internal site access roads constructed during the site preparation phase will be used to transport the heavy plant equipment required during the construction phase.

The preparation and excavation of the site will be followed by the construction of ancillary facilities. The Construction Phase activities will include the phased establishment of infrastructure, establishment of the expanded mine (both underground and open pits) and associated infrastructure and upgrading of the concentrator processing plant. Plant expansion will include replacement of the current mill with a larger capacity mill and increasing the float cell size to increase the capacity and throughput rate. As far as possible current infrastructure will be utilised.

Construction phase on-site staff of approximately 300 will be housed at the temporary housing facility in Aggeneys, by utilising accommodation established for the Gamsberg project. The existing road between Deeps Mine and Swartberg Mine will be widened by approximately 15 m and will be used during the construction phase.

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

- Upgrading/ widening of internal site access routes by 15 m for approximately 8 km;
- Site clearance;
- Earth-moving, levelling, grading and excavations;
- Topsoil stockpiling and management;
- Blasting (approximately twice per month);
- Installation of equipment;
- Construction of all mine infrastructure and facilities;
- Construction of bulk services facilities (i.e. power infrastructure, waste facilities, water handling system and wastewater treatment); and
- Transport of workers and materials to the Project site.

A construction camp will be established during the construction phase of the Project. The following infrastructure will be needed for the construction camp:

- Office complex;
- Toilets and eating areas;
- Workshops;
- Servicing areas;
- Temporary storage of materials and laydown area;
- Bulk fuel storage (500 m^3);
- Bulk lubricant storage (20 m^3); and
- Truck yard and vehicle parking.

It is expected that the following equipment and vehicles will be required during the construction phase:

- Dump trucks;
- Front end loaders;
- Shovels;
- Excavators;
- Road rollers;
- Water bowsers;
- Dozer; and
- Blasting equipment and materials.

2.5 Mining Phase (Operational Phase)

Based on current estimations, a total of 150,000,000 tons of ore will be mined from the Swartberg Mine over the 19 year LOM. Of this expected tonnage, approximately 18,000,000 tons of lead and copper 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.

During the Operational Phase, the mine will be operated on a continuous basis (7 days a week, 24 hours a day on a 12 hour shift system) using approximately 280 workers. General maintenance and servicing of the facility will also take place on a regular basis. As open pit areas are mined, fully mined areas will be concurrently rehabilitated. The pits will be backfilled with waste rock as the resource becomes depleted. The fourth pit will not be backfilled however, as it will serve as the new decline entrance.

The conceptual mine work plan will be refined throughout the process taking into consideration the environmental, health, safety and social and labour considerations.

Core processes of the mining phase include the following:

- Open pit mining;
- Underground mine expansion;
- Ammonium nitrate and emulsion storage;
- Drilling and blasting activities;
- Loading and haulage of overburden and ore;
- Crushing and processing activities;
- Conveying processed ore;
- Waste rock dumping;
- Processing of ore including milling, stockpiles, flotation, dewatering and wastewater management (Tailings Storage facility and Pollution Control Dams); and
- Stockpiling and export of product.

2.5.1 Open Pits

Four open pits (three small pits and one larger pit) are proposed at the Swartberg Mine. The conventional open pit mining method is planned for the open pits. This will include drilling, blasting, loading and hauling rocks from the open pit to the waste rock dump or Run of Mine (ROM) pad.

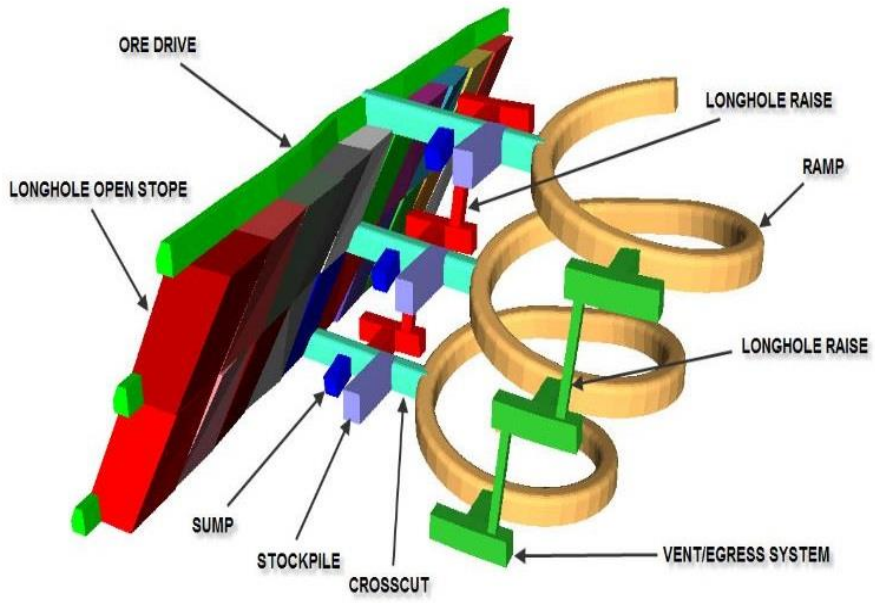
Mining equipment involved will be typical for open pit mining and will include drill rigs to prepare the blast blocks for extraction of the ore and waste rock. After blasting, the material will be loaded by excavators onto dump trucks (60 t – 100 t capacity) for transport to either the waste rock dump or the ROM pad in the case of ore. As the open pits progressively extend deeper, a series of benches will be established.

2.5.2 Underground Mine Expansion

The proposed underground mining method for Swartberg consists of the longhole mining method (*Figure 2.3*). This will entail the development of ore drives at different levels and the extraction of ore between these levels.

To re-establish access to the underground mine two declines will be developed to allow for a secondary escape. One decline as per the existing authorisation will be developed from the surface to Tank hill. The second decline will potentially be from the side wall in the fourth open pit.

Figure 2.3 Illustration of Proposed Mining Method



Source: AMC Consultants (2017)

2.5.3 Explosive Storage Area and Ammonium Nitrate and Emulsion Silos

To access the ore, blasting by explosives will take place. On average, blasting will be undertaken once a day for underground operations and at a minimum once a week for open cast operations. The current explosives magazine facility will be utilised. This facility covers a total area of approximately 4 hectares and is 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 m².

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.

2.5.4 Drilling and Blasting

Drilling and blasting of rock faces will be required to excavate the ore and overburden waste in the pit. 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. Details of drilling and blasting patterns for the Mine are not defined at this stage but will confirmed in the open pit mine design. It will consist of drilling a blast block in a grid pattern of approximately 1m by 1m.

2.5.5 Load and haul of Overburden Core

Loading and hauling of ore and overburden waste will be performed in the pits 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. 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).

2.5.6 Primary Crusher

Upon stripping of overburden, the ore will be transported via haul trucks to the primary crusher located adjacent to the open pit. The bulk ore will be transported to the primary crusher; which will have a total processing capacity of 2.5 Mtpa.

2.5.7 Conveyor System Network

Currently two options are available for transporting ore from Swartberg Mine: either via the extension of the current conveyor infrastructure or utilisation of the existing haul road via 40t/ 50t trucks. The proposed conveyor system will primarily comprise underground crushing, an incline conveyor to lift ore from underground to the portal, and an overland conveyor to transport ore from the portal to the current Broken Hill surface crushing plant for the underground portion of the mine. The surface conveyor and Swartberg crusher plant will be constructed during the open pit phase of the mining at Swartberg.

The overland conveyor is a system of belt conveyors mounted on structural steel frames that transfer ore from the portal area to the Broken Hill crushing plant. The overland conveyor will accept ore from the underground conveyor at the portal transfer tower. Ore from the transfer tower can be directed to a stockpile at the portal or directly onto the belt. A reclaim conveyor is located at the portal to move ore from the stockpile to the overland conveyor. This configuration provides flexibility to allow for surface haul trucking of ore or to allow shifting waste to the surface using the decline conveyor.

The incline conveyors accept crushed material from the underground crusher and move it to the portal transfer tower. These are belt conveyors hung from the back with the carry and return idlers mounted on steel frames.

2.5.8 Waste Rock Dumps

An estimated 74.1 Million tons of waste rock will be generated during the LOM from the open pits, which will be trucked to the waste rock dump. The underground operation will generate an estimated 2.6 Million tons of waste.

Three potential options exist for the waste rock dumps namely:

- Placement on the current sand dune mine area; and
- Placement on a site to the south east of the proposed open pits.

In addition, the underground waste can potentially be utilised for void filling and would not necessarily all be brought to surface.

2.5.9 Processing Concentrator Plant

The existing processing plant will be utilised for the Swartberg expansion project. Upgrades to improve throughput will be made to enable processing of 2.5 Mtpa ore.

The concentrator processing plant area consists of the following:

- Milling circuit;
- Ore stockpile;
- Flotation;
- Dewatering, filtration and copper and concentrate handling;
- Tailings facility; and
- Pollution control dams.

Milling Circuit

The current milling circuit consists of a crusher contained in the crusher building. The crusher is fed by coarse ore from the coarse ore silos and feeds ore into the fine ore silos. Milling is performed to reduce broken ore to a size at which the minerals can be liberated (valuable mineral grain exposed) from the ore.

Flotation

In the flotation process, milled ore mixed with water (pulp) are passed through a series of agitating tanks. Various reagents 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 three flotation modules, namely Copper floatation, Lead floatation and Zinc flotation.

Dewatering, Filtration and Concentrate Handling

The dewatering process comprises two stages; thickening and filtration. A thickener is a large cylindrical tank with a conical bottom and 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.

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 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 a safe pipeline.

Tailings Dam

The treatment of 2.5 Mtpa run of mine ore is expected to lead to approximately 1.7 Mtpa of tailings material. The mineral wastes (tailings) will be sent to the thickener to reduce the water contents and then pumped to a tailings dam. 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.

The current tailings dam will be utilised for the disposal of waste. The current facility has a footprint area of 86ha and is unlined. Drainage measures were incorporated in the design such that the potential for seepage into the groundwater is minimised.

Pollution Control Dams

Pollution control dams will be constructed according to the final design and location of the pits. Four pollution control dams will be constructed during the construction phase of the project. These will all be lined with a 1 mm to 1.5 mm high density polyethylene (HDPE) lining. An additional four dams will be constructed by the operational phase and therefore have a cumulative total storage capacity of approximately 20 000 m^3.

2.5.10 Associated Mine Infrastructure

Associated infrastructure is required for the daily operations of the Project. All associated infrastructure will be located within the approved mine area and consists of the following:

- Mine bulk fuel and lubricant storage;
- Engineering workshops (new workshops to cater for the open cast equipment as the current workshops are geared for underground equipment);
- Power supply and substation network (to be upgraded for the proposed project);
- Water supply system and storage dams (to be upgraded for the proposed project);
- Process water dams;
- Storm water management infrastructure to be constructed at the Swartberg Mine;
- Fire control systems;
    - Waste and wastewater facilities;
    - Waste sorting, re-use and recycling;
    - Domestic waste facility;
    - Temporary hazardous waste facility;
    - Sewerage treatment facility;
- Administrative Buildings;
- Potential paste backfill plant and
- Water treatment plant.

2.6 Export

Concentrate will be transported by road from the processing plant to a storage shed in Saldanha where the concentrate will be stockpiled in a covered shed for bulk shipment as per commercial sales to prospective International clients. Prospective clients include smelters in China, Korea and Europe.

2.7 Decommissioning and Closure

The proposed Project has a 19 year LOM; after which, all infrastructure will be dismantled and removed. Machinery, steel and dismantled materials will be recycled where possible and disposed of at licensed disposal sites. In addition, the underground mine will be partially filled, and the open pits will be backfilled where possible and rehabilitated, except for the pit where the decline will be established. Socio-economic plans will be implemented to reduce the impact of closure.

2.8 Project Schedule and Life of Mine

Site preparation is expected to begin in 2020 and the LOM is expected to be at least 19 years.

2.9 Emissions and Waste

2.9.1 Noise Emissions

Construction

The key temporary noise sources during construction phase will be from the excavation, blasting (as part of preparation of the mine), earth moving equipment, mobile machinery, vehicles, and plant upgrading activities. It is anticipated that upgrading of the plant and construction of new facilities will take place between the working hours of 07H00 to 19H00. Traffic associated with the transport of construction materials and construction workers will result in increased noise levels along transport route.

Operations

Operational phase activities will result in noise generated by blasting and earth moving equipment, and the operation of a crusher and a conveyor.

2.9.2 Air Emissions

Construction

Temporary air emissions will result from excavation, earth moving equipment, mobile machinery and vehicles during the construction phase. These include wind-blown dust and fugitive emissions.

Operations

Blasting activities at the mine and the transport of materials to the processing plant will result in dust generation. In addition, machinery and vehicles will also generate emissions into the atmosphere. Dumps and stockpiles may also be a source of wind-blown dust if not properly designed and maintained or concurrently rehabilitated to a reasonable extent.

2.9.3 Waste Generation

Non-mineral Waste Management

Domestic waste from the business partners' camp and the construction operations will be separated. Paper and plastics will be recycled, with the remaining domestic wastes 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 200 m^2 respectively.

A total of 3 to 5 ton/ month of domestic waste are expected to be generated during construction. Domestic wastes will be stored within the business partner's campsite, 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.

Hazardous Waste

Hazardous waste will mainly include oil contaminated wastes, used fuel products 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.

It should be noted that BMM currently has an authorised waste management contractor on site, who is 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 that cannot be bio-remediated or recycled will be disposed of at the Vissershok hazardous waste facility. Proof must be obtained from each contractor as to the final disposal location and volume of domestic and hazardous wastes.

Wastewater

Existing facilities on site will be used to manage wastewater from the construction and operations of the expanded mine. All raw sewage from the administration offices, ablution blocks and effluent from the workshops will be collected and transferred under gravity to the sewage pond. Lift stations will be used to transfer the grey water to existing treatment facilities at the Deeps mine where required.

Dewatering

The Swartberg Mine, in general, can be described as dry with a limited amount of ground water needing to be brought to surface. Some bleed and flush water from the backfill will also need to be managed. It is assumed that the amount of water that will be brought to surface is 720 m^3 per day.

The dewatering system for Swartberg will be a series of staged, submersible pumps installed along the conveyor decline. Each pump will be staged together using HDPE lines until the water is discharged on surface. Solids entrained in the system will also be sent to the pollution control dams.

The dewatering system will comprise of the following:

- Staged slurry pumps with hardened impellers;
- Size the pumps for a 30 or 60 metre lift with the system curve / pump curve intersection to the right of the maximum efficiency operating point;
- Minimize the line size installed – use parallel smaller lines rather than one larger line if required;

- Sumps installed up the conveyor gallery also allow dewatering of various lenses along the way;
- One pump feeds into one discharge line – interconnection of pumps shall be avoided;
- Standardisation of pump selection shall be implemented to simplify maintenance and spares;
- A simple sump design that allows swift change out of the submersible pump;
- Staged pumps allow for the use of HDPE pipe as pressures are low; and
- Sump design shall enable the dense particles to settle out and for the solids to be periodically disposed of into the underground voids.

2.10 Resource Use

2.10.1 Water

The Sedibeng Pella Water is the official water service provider for the towns of, inter alia, Aggeneys and Pofadder. Pella Water 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 and the mining operations. Water will be drawn from existing municipal infrastructure during construction and operation. Operational water requirements are anticipated to be 80,000 m^3 per month.

2.10.2 Power

The construction phase is expected to require a temporary 4 MVA supply point on the existing Swartberg 66 kV line. The electricity will be supplied to the construction site via a 5 km overhead line and 4 x 500 kVA miniature substations. One of the substations will be in a fixed position at the construction camp and the other three will be movable units on the construction site. An additional 66 kV line need to constructed to ensure mining from both open pits and underground and ultimately full production from underground.

This transmission line will continue to evacuate power to the mine during operations.

2.10.3 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 campsite, for the duration of construction. The lubricant and oil containers will also be stored within a bunded area of approximately 10 m^2.

The mine bulk storage tank farm will be constructed for operations and located adjacent to the Mine workshop area. The estimated storage will be 600 m^3 and stored in a bunded area in Above Ground Storage tanks. Tank installations will be installed according to applicable SANS Standards.

2.11 Process Followed to Reach the Preferred Project Alternative

One of the objectives of an EIA is to investigate alternatives to the project. In relation to a proposed activity, Alternatives means different means of meeting the general purpose and requirements of the activity (EIA Regulations, 2014 as amended GNR 326). This section presents the alternatives considered as part of the development plans for the Project and describes the process followed to reach the preferred alternative.

As required in terms of Appendix 2 of the 2014 EIA Regulations (as amended),, impacts and risks associated with alternative locations and technologies have be identified. There are no viable activity alternatives (due to the nature of this Project), however a description of the technology alternatives are described below.

2.11.1 Location Alternatives

There is no location alternative to the mine as it is dependent on the location of the orebody that will be mined.

As there are no location alternatives, a comparison of the alternatives is not possible.

2.11.2 Layout Alternative

Three potential waste rock dumps (WRDs) were identified during the Project's feasibility study and are considered layout alternatives (see *Figure 2.2*).

Alternative sites for the waste rock dump include:

- Placement on the current sand dune mine area (Site A);
- Placement on a site to the south east of the proposed open pits (Site B); and
- Placement on the south of the large open pit and west of the two centre pits (Site C).

An analysis of the alternatives is included in *Table 2-2.*

Table 2-2 Analysis of Layout Alternatives

Key Environmental Impacts Identified	Alternative	Nature of Impact	Description of Preliminary Assessment	Mitigation
Air Quality	This impact is consistent between Site A, Site B and Site C.	This will include construction related impacts such as dust emissions during construction and operations	This impact is likely to occur, is considered local in extent and long-term in duration. The significance of this impact is likely to be moderate without mitigation given the proximity to the source of emissions	Standard mitigation measures are available to reduce emissions.
Noise	This impact is consistent between Site A, Site B and Site C.	Noise from construction activities may have an impact on sensitive receptors. Noise from blasting (operations) may have an impact on sensitive receptors. Noise and vibration from construction and operation traffic along main transport/access routes.	This impact is likely to occur, is considered local in extent and long-term in duration. The significance of this impact is likely to be moderate without mitigation given the existing noise in the area and the minimal sensitive receptors.	Standard and inbuilt mitigation measures are available to reduce emissions.
Flora and Fauna	Site A	Clearance of vegetation for the construction of the mine and associated infrastructure will lead to an impact on terrestrial ecosystems. The area fall within a CBA, however surveys were undertaken to establish the sensitivity of the area. The vegetation sensitivity of this Site A is low as it is modified habitat and Faunal habitat sensitivity is low for Site A	The impact rating is likely to be greater for site B and C than Site A. This impact is likely to occur, is considered national in extent (due to the loss of CBA) and permanent in duration. Based on the sensitivity of the environment the impact is likely to be major in significance.	Mitigation including minimising the area required to be cleared, avoidance and demarcation of particularly sensitive habitats is possible and may reduce the significance of the impact. Additional specialist input is required in order to confirm the mitigation measures and ratings.
	Site B	Clearance of vegetation for the construction of the mine and associated infrastructure will lead to an impact on terrestrial ecosystems. The majority of the area is has a low to medium sensitivity. However there is a thin strip of high botanical sensitivity along a rocky outcrop.		

Key Environmental Impacts Identified	Alternative	Nature of Impact	Description of Preliminary Assessment	Mitigation
	Site C	Clearance of vegetation for the construction of the mine and associated infrastructure will lead to an impact on terrestrial ecosystems. Site C predominantly ranges from low to medium vegetation sensitivity with small patches of high sensitivity. Faunal sensitivity is medium to high for Site C		
Groundwater quality	The impact is consistent with Site A, Site B and Site C	Sites A, B and C are located immediately adjacent to the mine pit and contaminated seepage from the waste rock is expected to partly flow into the pits. 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. Further, toe seepage is expected to occur at the base of the WRDs following rain events. This seepage is expected to be contaminated. The sensitivity of the groundwater resource is 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. Impacts are expected to be moderate.	Mitigation measures required to reduce the impact on groundwater quality include the following: ■ Prior to construction of WRDs (enlarged foot print area), the ground of the facility's footprint should be prepared to reduce the hydraulic conductivity of the material. ■ Toe drains (interception trenches) along the base of both WRDs to intercept drainage and convey to a return water dam.

Key Environmental Impacts Identified	Alternative	Nature of Impact	Description of Preliminary Assessment	Mitigation
Socio-economic	This impact is consistent between Site A, Site B and Site C.	***Community Health Safety and Security*** Equipment and activities will create noise and vibration and changes to air quality during construction, operations and demolition that could impact human health; Movement of materials and workers during construction, operation and demolition could impact public safety.	This impact is likely to occur, will be regional in scale and long-term in duration. The significance of the impact is likely to be moderate without mitigation.	Adhere to the national/ and provincial noise regulations. Adherence to national/ and provincial air quality regulations and standards. Additional specialist input is required in order to confirm the mitigation measures and ratings. This is a stakeholder perceived impact and it's not anticipated to actually occur; however, should it occur, the project proponent, should, in collaborate with local/ and provincial health services to monitor changes in health outbreaks. Should such be observed – disease or illness specific measures will be developed and implemented.
	This impact is consistent between Site A, Site B and Site C.	***Worker Health & Safety*** Hazardous construction operational or decommissioning activities could impact worker health and safety; and Handling of hazardous materials could impact worker health and safety.	The impact is unlikely to occur, would be local in scale and temporary in duration should they occur. Significance prior to mitigation is likely to be moderate.	Standard mitigation measures are available for the prevention of health and safety incidents. Adherence to the Occupational Health and Safety Act (Act No. 85 of 1993) will be required. Additional specialist input is required in order to confirm the mitigation measures and ratings.

Key Environmental Impacts Identified	Alternative	Nature of Impact	Description of Preliminary Assessment	Mitigation
	This impact is consistent between Site A, Site B and Site C.	***Local Community Demographics*** Influx of workers looking for opportunities and the presence of a construction workforce from outside of the local Project area will result in a change in demographics of the local communities.	This impact is likely to occur, will be regional in scale and long-term in duration. The significance of the impact is likely to be moderate without mitigation.	Working with local government (specifically Ward Councilors), the project proponent will carry out monitoring of settlements to determine patterns of in-migration, understand the origins, characteristics and motivations of in-migrants, and identify the impacts of in-migration, and will use the results to develop an in-migration management plan should it be required. Additional specialist input is required in order to confirm the mitigation measures and ratings.
	This impact is consistent between Site A, Site B and Site C.	***Local and Macro Economy*** Procurement of goods and services required by the Project during construction, operation and decommissioning of the Project and the presence of workers in the area may enhance the local economy both directly and indirectly. In addition, the development of the Project will replace operations of the Deeps Mine when it reaches its life of mine in 2021.	This positive impact will occur, will be regional in scale and long-term.	Mitigation measures include utilisation of local labour and sourcing of local materials as far as possible. Additional specialist input is required in order to confirm the mitigation measures and ratings.
	This impact is consistent between Site A, Site B and Site C	*Traffic* Transport of materials and equipment and waste during the construction, operation and decommissioning stages could impact traffic patterns.	This impact is likely to occur, will be local in scale and long-term in duration. The impact is likely to be minor without mitigation.	Large construction vehicles to not utilise public roads during peak hours. Damage to public roads caused by large construction vehicles must be repaired immediately.

Key Environmental Impacts Identified	Alternative	Nature of Impact	Description of Preliminary Assessment	Mitigation
	This impact is consistent between Site A, Site B and Site C	*Cultural/Heritage Resources* Construction activities could have an impact on local cultural sites (paleontological); and The presence of workers in the Project area, transportation of materials and equipment to the construction sites may impact on cultural areas. Isolated quartz flakes were found on both alternatives and both of low sensitivity ratings.	This impact is possible, would be regional in extent should finds occur and permanent in duration should they be damaged. Significance prior to mitigation is likely to be minor/moderate.	Standard mitigation measures such as chance finds procedures, demarcation of heritage sites are easily implementable and will be identified during the specialist study.
Risk (Non-Routine Impacts)	This impact is consistent between Site A, Site B and Site C	Additional storage of dangerous goods on site will include diesel for construction and operation related activities. Leaks or accidental releases of diesel or chemicals during construction and operation activities could impact on soil and groundwater. Accidental release of natural gas during transportation via pipeline could be a risk to surrounding receptors.	The impact is unlikely to occur, would be local in scale and temporary in duration should they occur. Significance prior to mitigation is likely to be moderate.	Standard mitigation measures are available for the prevention of accidental releases during transportation and storage of dangerous goods. An emergency response plan will be required for the project.

Summary of Risks for Layout Alternative

The placement of the waste rock dump site to the south east of the proposed open pits presents a lower technical risk due to the proximity of the open pits to the waste rock dump site (i.e. a shorter distance to transport waste rock). However, the sand mine dune area is a previously disturbed area and represents a lower ecological value, and therefore minimal environmental risk. Neither options differ in their impact on the socioeconomic environment.

Based on the above the Sites A and C are the preferred Alternatives.

2.11.3 Technology Alternatives

A mining method selection study was undertaken by BMM 2018 in order to determine most appropriate mining method to be used.

Assumptions and Inputs

The deposits being mined at Swartberg have, in general, the following characteristics relevant to the selection of the mining method:

- Moderate dip;
- Moderate to narrow width;
- Relatively low grade; and
- Generally competent HW and FW.

A key requirement of the analysis was to achieve ore production at rates that sustain ore feed to the existing processing plant. This will require the selected mining method to be highly productive. It is noted that non-entry underground stoping methods are now accepted industry practice for both safety and productivity reasons. In addition, only modern mechanized mining methods have been considered

Mining Method Assessment

The potential mining methods for the Project can initially be categorised as follows:

- Open pit methods;
- Caving methods;
- Open-stoping methods; and
- Drifting methods.

Table 2-3 assesses the different mining methods.

Table 2-3 Mining Method Options

Alternative Mining Method	Description	Advantages	Nature of Impact	Preliminary Assessment	Mitigation
Open Pit	Open-pit mines are used when deposits of commercially useful ore or rocks are found near the surface; that is, where the overburden (surface material covering the valuable deposit) is relatively thin or the material of interest is structurally unsuitable for tunnelling.	Access to ore which cannot be extracted by underground mining. This ore could be extracted at the same time as the Swartberg underground infrastructure is being developed and be used to replace diminishing ore supply from Deeps.	■ Noise and dust emissions from blasting and transporting. ■ Groundwater contamination from WRDs. ■ Generation of open pit voids. ■ Generation of surface WRDs.	■ These impacts are possible and will be localised. ■ Noise and dust generation will be temporary. ■ Significance of before mitigation is moderate to major.	■ Dust suppression during operations will minimise dust. ■ Infilling of mined out open pit voids of the smaller pits. ■ Rehabilitation of the waste rock dumps will prevent impact in longer term.
Underground-Open stoping	Long hole stoping is a highly selective and productive method of mining and can cater for varying ore thicknesses and dips (0 - 90 degree).	Mining methods suitable to type of deposit. High productivity and safer production method.	■ This mining method will create large open voids underground in the region of 30m x 15m x 60m and will be localised. ■ The impact will be localised impacting underground stability. ■ Impact on Ground water levels.	■ This impact will occur as it is the most preferable and safe mining method. ■ Significance prior to mitigation is likely to be negligent, as it will not affect the surface.	■ Paste fill and backfill with waste rock of open voids underground to ensure local stability.
Underground-Drifting	Cut and fill stoping, drift and fill stoping employed as either overhand and underhand sequences and post pillar cut and fill stoping.	These methods are considered suitable for high value ore with a variety of orebody conditions and geometry but are less productive and higher cost than open stoping methods.	■ This mining method will create an underground void and the impact will be localised underground stability. ■ Impact on ground water levels.	■ This impact is likely to occur but will create a permanent localised impact. ■ Significance prior to mitigation is likely to negligent as this mining method will not affect the surface.	■ Hanging wall support using long anchors and roof bolts will improve local stability. ■ Paste fill and backfill with waste rock of open voids underground to ensure local stability.

Source: Information provided by BMM (2019)

Summary of Risks for Technology Alternative

Broadly, open pit mining is considered to have greater environmental impacts than underground mining. However, due to the type of ore body at Swartberg, it is not possible to only undertake underground mining. Therefore, a combination of both open pit and underground mining will be undertaken.

2.11.4 No-Go Alternative

The no-go alternative would mean that the project does not go ahead (with respect to air, noise, flora, fauna and others), however, in this case the no-go alternative would likely mean that BMM Mine would likely shut down by 2021.

BMM shut down could have major negative socio-economic consequences on the local and regional communities and economies.

Summary of Risk for No-Go Alternative

The no-go alternative presents a low environmental risk as the Project would not commence and the current environmental conditions will remain the same. However, the no go alternative presents a high socioeconomic risk as the Project will become a significant employer once operational. The no-go option does not present any technical risks.

2.11.5 Summary

The location of the mine is dependent on the location of the ore body and existing mining operations and therefore different locations were not considered. However, different waste dump locations have assessed. The prefeasibility study undertook a mining method alternatives assessment where different mining methods have been assessed and modelled. The outcomes of the assessment indicated that a combination of open pits and underground mining was the preferred mining method. If the expansion did not go ahead the potential environmental impacts associated with the Project would not occur, however it would likely mean that the Black Mountain Mine would shut, resulting in significant job losses and economic disruption.

3. ADMINISTRATIVE FRAMEWORK

3.1 Introduction

This section provides an overview of legislation, guidelines and information documents that have informed the scope and content of this report and the approach to the EIA process.

3.2 Constitution of the Republic of South Africa (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.

3.3 National Environmental Management Act (No. 107 of 1998)

The National Environmental Management Act, as amended (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 Environmental Authorisation process in South Africa is governed by NEMA (No. 107 of 1998) as amended, and the Environmental Impact Assessment (EIA) Regulations of 2014 as amended, promulgated under NEMA. The relevance of this legislation is summarised below.

3.3.1 NEMA Environmental Authorisation

Chapter 5 of NEMA, as amended, outlines the general objectives and implementation of Integrated Environmental Management. This provides a framework for the integration of environmental issues into the planning, design, decision-making and implementation of plans and projects that are likely to have a detrimental effect on the environment. Whilst Section 23 sets out the basic objectives and principles of the IEM procedure, Section 24 sets out how these objectives and principles are to be accomplished.

Regulations governing the environmental authorisation process have been promulgated in terms of NEMA and include the following:

- Environmental Impact Assessment Regulations (GNR 326/2017);
- Environmental Impact Assessment Regulations Listing Notice 1 (GNR 327/2017);
- Environmental Impact Assessment Regulations Listing Notice 2 (GNR 325/2017); and
- Environmental Impact Assessment Regulations Listing Notice 3 (GNR 324/2017).

Activities that trigger GNR 327 and GNR 324 require a Basic Assessment Report (BAR) process to be undertaken, whereas activities identified in terms of GNR 325 will require a full Scoping and Environmental Impact Assessment (S&EIA) process. GNR 326 sets out the general procedure to follow when conducting either a BAR or S&EIA process.

Numerous listed activities have been identified for this Project in terms of all the NEMA listing notices. In instances where all the listing notices are triggered (as in this Project), GNR 325 requirements will take precedent and the Project will be subject to a full Scoping & Environmental Impact Assessment process prior to commencement of any of the associated activities.

Section 24(C) of the Act defines the competent decision-making authority, which is normally the provincial environmental department. However, in cases where the Project footprint transverses territorial boundaries, the National DEA becomes the competent authority'.

Table 3-1 lists the potential listed activities from the NEMA Environmental Impact Assessment Regulations Listing Notice 1, 2, 3 of 2017 for the Project.

Table 3-1 Triggered Listed Activities

Activity	Listed Activity	Project Trigger
EIA Regulations Listing Notice 1 of 2017 (GNR R327 of 2017) – Basic Assessment		
Activity 9	The development of infrastructure exceeding 1000 metres in length for the bulk transportation of water 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.	Water and storm water infrastructure will be constructed for the operation of the underground mine and the open pits. Infrastructure required includes: ■ Diversion of water from the entrance of the underground mine and open pits. ■ Pipelines from the underground mine to Pollution Control Dams as part of dewatering activities. ■ Connection of Pollution Control Dams to existing Tailings Storage Facility. ■ Connection of mining operations to water treatment facilities. ■ Extension of existing surface water infrastructure from the ore processing facility to the Swartberg Mine. The length of the bulk water infrastructure will be greater than 1,000 m, the internal diameter greater than 0.36 metres.
Activity 21	Any activity including the operation of that activity which requires a mining permit in terms of section 27 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002), including - (a) associated infrastructure, structures and earthworks, directly related to the extraction of a mineral resource[,] ; or [including activities for which an exemption has been issued in terms of section 106 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)] (b) the primary processing of a mineral resource including winning, extraction, classifying, concentrating, crushing, screening or washing; but excluding the secondary processing of a mineral resource, including the smelting, beneficiation, reduction, refining, calcining or gasification of the mineral resource in which case activity 6 in Listing Notice 2 applies.	BMM is the holder of a mining right (MR 517) convened in terms of item 7 of Schedule II to the MRPDA. This mining right entitles BMM to mine the Black Mountain Mine for copper, lead, zinc and associated minerals in, on and under Remainder of Portion 1 of the farm Aggeneys 56, Portion 4 of the farm Zuurwater 62 and Portion 1 of the farm Koeries 54. The mining right has been issued for a period of 30 years from 19 August 2008, extending until 18 August 2038. BMM intends to expand the existing Swartberg Mine (on Portion 4 of the farm Zuurwater 62) and develop a further three open pits. BMM will extract ore from the Swartberg Mine and process it at the existing concentrator plant on the Black Mountain Mine. 150,000,000 tons of ore will be mined from the Swartberg Mine over the 19 year Life of Mine.
Activity 25	The development and related operation of facilities or infrastructure for the treatment of effluent, wastewater or sewage with a daily throughput capacity of more than 2 000 cubic metres but less than 15 000 cubic metres.	A wastewater treatment plant will be constructed as part of the Project. The wastewater treatment facility will have a throughput capacity of between 2,000 and 15,000 m^3.

Activity	Listed Activity	Project Trigger
Activity 34	The expansion [or changes to] of existing facilities or infrastructure for any process or activity where such expansion [or changes] will result in the need for a permit or licence or an amended permit or licence in terms of national or provincial legislation governing the release of emissions, effluent or pollution, excluding- (i) where the facility, infrastructure, process or activity is 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 National Environmental Management: Waste Act, 2008 applies; [or] (ii) the expansion of [or changes to] existing facilities or infrastructure for the treatment of effluent, wastewater, polluted water or sewage where the capacity will be increased by less than 15 000 cubic metres per day; or (iii) the expansion is directly related to aquaculture facilities or infrastructure where the wastewater discharge capacity will be increased by 50 cubic meters or less per day.	The general, industrial and hazardous waste from Swartberg Mine is included in the existing authorised EMPr and is regarded as licenced (See *Annex F* for proof of approval). Existing wastewater treatment plant on the Black Mountain Mine will be expanded. The capacity of the existing wastewater treatment plant will be less than 15,000 m^3
Activity 56	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 where widening or lengthening occur inside urban areas.	The existing internal road between the ore processing plant and the Swartberg Mine will upgraded by expanding the existing road by 13.5 m and for approximately 10 km.
EIA Regulations Listing Notice 2 of 2017 (GNR 325 of 2017) - Full Scoping and EIR		
Activity 4	The development and related operation of facilities or infrastructure, for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of more than 500 cubic metres.	The development of bulk fuel storage of approximately 600 m^3 for Swartberg Mine operations
Activity 15	The clearance of an area of 20 hectares or more of indigenous vegetation, excluding where such clearance of indigenous vegetation is required for- (i) the undertaking of a linear activity; or (ii) maintenance purposes undertaken in accordance with a maintenance management plan.	Clearance of more than 20 hectares (between 100 and 200 ha) of indigenous vegetation for the establishment of the Swartberg underground mine expansion, open pits, and associated infrastructure.

Activity	Listed Activity	Project Trigger
Activity 17	Any activity including the operation of that activity which requires a mining right as contemplated in section 22 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002), including- (a) associated infrastructure, structures and earthworks, directly related to the extraction of a mineral resource [,] ; or (b) [including activities for which an exemption has been issued in terms of section 106 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)] the primary processing of a mineral resource including winning, extraction, classifying, concentrating, crushing, screening or washing; but excluding the secondary processing of a mineral resource, including the smelting, beneficiation, reduction, refining, calcining or gasification of the mineral resource in which case activity 6 in this Notice applies.	BMM is the holder of a mining right (MR 517) convened in terms of item 7 of Schedule II to the MRPDA. This mining right entitles BMM to mine the Black Mountain Mine for copper, lead, zinc and associated minerals in, on and under Remainder of Portion 1 of the farm Aggeneys 56, Portion 4 of the farm Zuurwater 62 and Portion 1 of the farm Koeries 54. The mining right has been issued for a period of 30 years from 19 August 2008, extending until 18 August 2038. BMM intends to expand the existing Swartberg Mine (on Portion 4 of the farm Zuurwater 62) and develop a further three open pits. BMM will extract ore from the Swartberg Mine and process it at the existing concentrator plant on the Black Mountain Mine. 150,000,000 tons of ore will be mined from the Swartberg Mine over the 19 year Life of Mine.
Activity 19	The removal and disposal of minerals contemplated in terms of section 20 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002), including— (a) associated infrastructure, structures and earthworks, directly related to prospecting of a mineral resource [,] ; or (b) including activities for which an exemption has been issued in terms of section 106 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)] the primary processing of a mineral resource including winning, extraction, classifying, concentrating, crushing, screening or washing; but excluding the secondary processing of a mineral resource, including the smelting, beneficiation, reduction, refining, calcining or gasification of the mineral resource in which case activity 6 in this Notice applies.	BMM is the holder of a mining right (MR 517) convened in terms of item 7 of Schedule II to the MRPDA. This mining right entitles BMM to mine the Black Mountain Mine for copper, lead, zinc and associated minerals in, on and under Remainder of Portion 1 of the farm Aggeneys 56, Portion 4 of the farm Zuurwater 62 and Portion 1 of the farm Koeries 54. The mining right has been issued for a period of 30 years from 19 August 2008, extending until 18 August 2038. BMM intends to expand the existing Swartberg Mine (on Portion 4 of the farm Zuurwater 62) and develop a further three open pits. BMM will extract ore from the Swartberg Mine and process it at the existing concentrator plant on the Black Mountain Mine. 150,000,000 tons of ore will be mined from the Swartberg Mine over the 19 year Life of Mine.

Activity	Listed Activity	Project Trigger
Activity 21	Any activity including the operation of that activity associated with the primary processing of a mineral resource including winning, reduction, extraction, classifying, concentrating, crushing, screening and washing but excluding the smelting, beneficiation, refining, calcining or gasification of the mineral resource in which case activity 6 in this Notice applies	BMM is the holder of a mining right (MR 517) convened in terms of item 7 of Schedule II to the MRPDA. This mining right entitles BMM to mine the Black Mountain Mine for copper, lead, zinc and associated minerals in, on and under Remainder of Portion 1 of the farm Aggeneys 56, Portion 4 of the farm Zuurwater 62 and Portion 1 of the farm Koeries 54. The mining right has been issued for a period of 30 years from 19 August 2008, extending until 18 August 2038. BMM intends to expand the existing Swartberg Mine (on Portion 4 of the farm Zuurwater 62) and develop a further three open pits. BMM will extract ore from the Swartberg Mine and process it at the existing concentrator plant on the Black Mountain Mine. 150,000,000 tons of ore will be mined from the Swartberg Mine over the 19 year Life of Mine.
Activity 24	The development and related operation of facilities or infrastructure for the treatment of effluent, wastewater or sewage with a daily throughput capacity of 15 000 cubic metres or more.	A water treatment plant will be constructed as part of the Project. The wastewater treatment facility will have a throughput capacity of greater than 15,000 cubic metres.
EIA Regulations Listing Notice 3 of 2017 (GNR 324 of 2017) - Basic Assessment		
Activity 12	The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan g. Northern Cape i. 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; ii. Within critical biodiversity areas identified in bioregional plans; iii. 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; or iv. On land, where, at the time of the coming into effect of this Notice or thereafter such land was zoned open space, conservation or had an equivalent zoning.	Clearance of more than 300 m^2 (about 136 ha) of indigenous vegetation for the establishment of the Swartberg underground mine expansion, open pits, and associated infrastructure.

Activity	Listed Activity	Project Trigger
18	The widening of a road by more than 4 meters or the lengthening of a road by more than 1 kilometre g. Northern Cape i. In an estuary; ii. Outside urban areas: (aa) A protected area identified in terms of NEMPAA, excluding conservancies; (bb) National Protected Area Expansion Strategy Focus areas; (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) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;	The existing internal road between the ore processing plant and the Swartberg Mine will upgraded by expanding the existing road by 13.5 m and for approximately 10 km.
EIA Regulations Listing Notice 1 of 2017 (GNR R327 of 2017) – Basic Assessment		
Activity 9	The development of infrastructure exceeding 1000 metres in length for the bulk transportation of water 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	Water and storm water infrastructure will be constructed for the operation of the underground mine and the open pits. Infrastructure required includes: Diversion of water from the entrance of the underground mine and open pits. Pipelines from the underground mine to Pollution Control Dams as part of dewatering activities. Connection of Pollution Control Dams to existing Tailings Storage Facility. Connection of mining operations to water treatment facilities. Extension of existing surface water infrastructure from the ore processing facility to the Swartberg Mine. The length of the bulk water infrastructure will be greater than 1,000 m, the internal diameter greater than 0.36 m.

Activity	Listed Activity	Project Trigger
Activity 21	Any activity including the operation of that activity which requires a mining permit in terms of section 27 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002), including - (a) associated infrastructure, structures and earthworks, directly related to the extraction of a mineral resource[,] ; or [including activities for which an exemption has been issued in terms of section 106 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)]	BMM is the holder of a mining right (MR 517) convened in terms of item 7 of Schedule II to the MRPDA. This mining right entitles BMM to mine the Black Mountain Mine for copper, lead, zinc and associated minerals in, on and under Remainder of Portion 1 of the farm Aggeneys 56, Portion 4 of the farm Zuurwater 62 and Portion 1 of the farm Koeries 54. The mining right has been issued for a period of 30 years from 19 August 2008, extending until 18 August 2038.
	(b) the primary processing of a mineral resource including winning, extraction, classifying, concentrating, crushing, screening or washing; but excluding the secondary processing of a mineral resource, including the smelting, beneficiation, reduction, refining, calcining or gasification of the mineral resource in which case activity 6 in Listing Notice 2 applies.	BMM intends to expand the existing Swartberg Mine (on Portion 4 of the farm Zuurwater 62) and develop a further three open pits. BMM will extract ore from the Swartberg Mine and process it at the existing concentrator plant on the Black Mountain Mine. 150,000,000 tons of ore will be mined from the Swartberg Mine over the 19 year Life of Mine.
Activity 25	The development and related operation of facilities or infrastructure for the treatment of effluent, wastewater or sewage with a daily throughput capacity of more than 2 000 cubic metres but less than 15 000 cubic metres	A wastewater treatment plant will be constructed as part of the Project. The wastewater treatment facility will have a throughput capacity of between 2000 and 15 000 cubic metres.
Activity 34	The expansion [or changes to] of existing facilities or infrastructure for any process or activity where such expansion [or changes] will result in the need for a permit or licence or an amended permit or licence in terms of national or provincial legislation governing the release of emissions, effluent or pollution, excluding-	The general, industrial and hazardous waste from Swartberg Mine is included in the existing authorised EMPr and is regarded as licenced (See Annex F for proof of approval).
	(i) where the facility, infrastructure, process or activity is 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 National Environmental Management: Waste Act, 2008 applies; [or]	Existing wastewater treatment plant on the Black Mountain Mine will be expanded. The capacity of the existing wastewater treatment plant will be less than 15 000 cubic metres.
	(ii) the expansion of [or changes to] existing facilities or infrastructure for the treatment of effluent, wastewater, polluted water or sewage where the capacity will be increased by less than 15 000 cubic metres per day; or	
	(iii) the expansion is directly related to aquaculture facilities or infrastructure where the wastewater discharge capacity will be increased by 50 cubic meters or less per day.	

Activity	Listed Activity	Project Trigger
Activity 56	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 where widening or lengthening occur inside urban areas.	The existing internal road between the ore processing plant and the Swartberg Mine will upgraded by expanding the existing road by 13.5 m and for approximately 10 km.
EIA Regulations Listing Notice 2 of 2017 (GNR 325 of 2017) - Full Scoping and EIR		
Activity 4	The development and related operation of facilities or infrastructure, for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of more than 500 cubic metres.	The development of bulk fuel storage of approximately 600 m^3 for Swartberg Mine operations
Activity 15	The clearance of an area of 20 hectares or more of indigenous vegetation, excluding where such clearance of indigenous vegetation is required for- (i) the undertaking of a linear activity; or (ii) maintenance purposes undertaken in accordance with a maintenance management plan.	Clearance of more than 20 hectares of indigenous vegetation for the establishment of the Swartberg underground mine expansion, open pits, and associated infrastructure.
Activity 17	Any activity including the operation of that activity which requires a mining right as contemplated in section 22 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002), including- (a) associated infrastructure, structures and earthworks, directly related to the extraction of a mineral resource [,] ; or (b) [including activities for which an exemption has been issued in terms of section 106 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)] the primary processing of a mineral resource including winning, extraction, classifying, concentrating, crushing, screening or washing; but excluding the secondary processing of a mineral resource, including the smelting, beneficiation, reduction, refining, calcining or gasification of the mineral resource in which case activity 6 in this Notice applies.	BMM is the holder of a mining right (MR 517) convened in terms of item 7 of Schedule II to the MRPDA. This mining right entitles BMM to mine the Black Mountain Mine for copper, lead, zinc and associated minerals in, on and under Remainder of Portion 1 of the farm Aggeneys 56, Portion 4 of the farm Zuurwater 62 and Portion 1 of the farm Koeries 54. The mining right has been issued for a period of 30 years from 19 August 2008, extending until 18 August 2038. BMM intends to expand the existing Swartberg Mine (on Portion 4 of the farm Zuurwater 62) and develop a further three open pits. BMM will extract ore from the Swartberg Mine and process it at the existing concentrator plant on the Black Mountain Mine. 150,000,000 tons of ore will be mined from the Swartberg Mine over the 19 year Life of Mine.

Activity	Listed Activity	Project Trigger
Activity 19	The removal and disposal of minerals contemplated in terms of section 20 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002), including— (a) associated infrastructure, structures and earthworks, directly related to prospecting of a mineral resource [,] ; or (b) including activities for which an exemption has been issued in terms of section 106 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)] the primary processing of a mineral resource including winning, extraction, classifying, concentrating, crushing, screening or washing; but excluding the secondary processing of a mineral resource, including the smelting, beneficiation, reduction, refining, calcining or gasification of the mineral resource in which case activity 6 in this Notice applies.	BMM is the holder of a mining right (MR 517) convened in terms of item 7 of Schedule II to the MRPDA. This mining right entitles BMM to mine the Black Mountain Mine for copper, lead, zinc and associated minerals in, on and under Remainder of Portion 1 of the farm Aggeneys 56, Portion 4 of the farm Zuurwater 62 and Portion 1 of the farm Koeries 54. The mining right has been issued for a period of 30 years from 19 August 2008, extending until 18 August 2038. BMM intends to expand the existing Swartberg Mine (on Portion 4 of the farm Zuurwater 62) and develop a further three open pits. BMM will extract ore from the Swartberg Mine and process it at the existing concentrator plant on the Black Mountain Mine. 150,000,000 tons of ore will be mined from the Swartberg Mine over the 19 year Life of Mine.

3.4 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 discussed above, BMM 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). Due to the proposed expansion of the 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.

An EMPr is included in Chapter 8 of this Report and as a standalone report (*Annex H*). Black Mountain Mines existing Social and Labour Plan (SLP), and Financial Provision for Closure for the rehabilitation of land disturbed by mining activities are included *Annex J* and *Annex I* respectively.

3.5 Consolidated Permitting Requirements

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

- National Environmental Management: Biodiversity Act (No. 10 of 2004) (NEMBA); and
- National Heritage Resources Act (No. 25 of 1999).

Table 3-2 Consolidated Permitting Requirements

Law	Requirements	Project Relevance	Authority
National Environmental Management Waste Act (59 of 2008)	Section 19 of NEMWA provides for the listing of waste management activities that have, or are likely to have a detrimental effect on the environment. In accordance with this, GN 921 of 29 November 2013 lists waste management activities for which a waste management licence (WML) is required in terms of Section 20 of the Act. Furthermore, it classifies each of the waste management activities into different categories, with more onerous provisions assigned for activities that are regarding as being more detrimental to the environment. In this regard, 'Category A' activities require a NEMA BAR process to be conducted prior to commencement. 'Category B' activities require a full S&EIR process to be conducted, while 'Category C' activities are wholly exempt from the WML permitting process, as long as they show compliance with a set of prescribed standards.	BMM currently holds a Waste Management Licence (WML) for the current Mining Right. The general, industrial and hazardous waste from Swartberg Mine is included in the existing authorised EMPr and is regarded as licenced (See *Annex F* for DMR approval).	Not applicable.
National Environmental Management Biodiversity Act (10 of 2004)	Part 1 of Chapter 4 of NEMBA discusses the protection of threatened or protected ecosystems. In this section, the Minister or the provincial environmental MEC may publish a national or provincial list of ecosystems that are threatened and in need of protection. Subsequently, the Minister can identify by notice in the Gazette, any process or activity in a listed ecosystem as a 'threatening process'. Once so identified, the threatening process is regarded as an activity requiring an EIA to be carried out in terms of section 24(2) (b) of NEMA.	Biodiversity specialist studies will be part of the EIA and any threatened ecosystems will be identified through the specialist studies.	DENC
National Heritage Resources Act (25 of 1999)	Section 38 (1) of the NHRA requires any person who intends to undertake a development which exceeds 5000 m² in extent or 300 m in length to notify the responsible heritage resources authority, viz. the South African Heritage Resources Agency (SAHRA) or the relevant provincial heritage agency. The applicable authority will in turn indicate whether or not a full Heritage Impact Assessment (HIA) would need to be undertaken.	Before undertaking the development the South African Heritage Resources Agency (SAHRA) will have to be informed of the planned construction activities (via submission of a Notice of Intent to Develop (NID). The footprint of the Project will be 370 Ha.	SAHRA

Law	Requirements	Project Relevance	Authority
National Water Act (36 of 1998)	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.	It is expected that a water use licence will be required, although this will be run as a separate process.	DWS.
National Environmental Management Waste Act (59 of 2008)	Section 19 of NEMWA provides for the listing of waste management activities that have, or are likely to have a detrimental effect on the environment. In accordance with this, GN 921 of 29 November 2013 lists waste management activities for which a waste management licence (WML) is required in terms of Section 20 of the Act. Furthermore, it classifies each of the waste management activities into different categories, with more onerous provisions assigned for activities that are regarding as being more detrimental to the environment. In this regard, 'Category A' activities require a NEMA BAR process to be conducted prior to commencement. 'Category B' activities require a full S&EIR process to be conducted, while 'Category C' activities are wholly exempt from the WML permitting process, as long as they show compliance with a set of prescribed standards.	BMM currently holds a Waste Management Licence (WML) for the current Mining Right. The general, industrial and hazardous waste from Swartberg Mine is included in the existing authorised EMPr and is regarded as licenced (See *Annex* F for DMR approval).	Not applicable.
National Environmental Management Biodiversity Act (10 of 2004)	Part 1 of Chapter 4 of NEMBA discusses the protection of threatened or protected ecosystems. In this section, the Minister or the provincial environmental MEC may publish a national or provincial list of ecosystems that are threatened and in need of protection. Subsequently, the Minister can identify by notice in the Gazette, any process or activity in a listed ecosystem as a 'threatening process'. Once so identified, the threatening process is regarded as an activity requiring an EIA to be carried out in terms of section 24(2) (b) of NEMA.	Biodiversity specialist studies are part of this Report and impact on biodiversity are assed in Section 7.	DENC

Law	Requirements	Project Relevance	Authority
National Heritage Resources Act (25 of 1999)	Section 38 (1) of the NHRA requires any person who intends to undertake a development which exceeds 5000 m² in extent or 300 m in length to notify the responsible heritage resources authority, viz. the South African Heritage Resources Agency (SAHRA) or the relevant provincial heritage agency. The applicable authority will in turn indicate whether or not a full Heritage Impact Assessment (HIA) would need to be undertaken.	Before undertaking the development the South African Heritage Resources Agency (SAHRA) will have to be informed of the planned construction activities (via submission of a Notice of Intent to Develop (NID). The footprint of the Project will be 370 Ha.	SAHRA
National Water Act (36 of 1998)	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.	It is expected that a water use licence will be required, although this does not fall part of this scope of work and is run as a separate concurrent process.	DWS

3.6 Other Applicable Legislation, Policies and/or Guidelines

3.6.1 National Legislation

National legislation relevant for the Project (in addition to those presented in preceding sections) is listed below.

- National Water Act (36 of 1998);
- Mine Health and Safety Act (29 of 1996);
- Noise Control Regulations under the Environmental Conservation Act (73 of 1989);
- Major Hazard Installation Regulations (GNR. 692 of 30 July 2001);
- Hazardous Substances Act (56 of 1973); and
- Explosives Act (15 of 2003).

Applicable provisions from these laws and regulations will be incorporated into the design and implementation of the Project.

3.7 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 summarised below.

3.7.1 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.

3.7.2 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; and
- 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. 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.

3.7.3 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 for the agricultural development in selected groups of targeted areas namely:

- Hydroponic and organic crop production next to the Orange River, agriculture 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.

It 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.

3.7.4 Khai Ma Integrated Development Plan (2012-2017)

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 (2012-2017) 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.

3.7.5 Khai Ma Rural Spatial Development Framework Plan (2010)

The Khai Ma Spatial Development Framework (SDF) is currently under review and 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. 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.

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.

3.7.6 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 as developed by the Western Cape Department of Environmental Affairs and Development Planning (2010).

4. BASELINE

To provide a baseline against which the impacts of the Project can be assessed, a description of the existing physical, biological, social and health conditions has been summarized in this Chapter. The baseline data have been derived from the following sources:

- *Primary data collection*: Various specialists conducted impact assessment studies for the proposed Project activities. The specialist studies include the Heritage Impact Assessment (Morris *et al*, 2019), Flora Impact Assessment (Strohbach, 2018), Fauna Impact Assessment (Todd, 2019) and the Groundwater Impact Assessment (GHT Consulting, 2019);
- *Secondary data*: data available from previous studies conducted around the area, the Gamsberg ESIA Report drafted by ERM in 2013, and existing published or government resources; and
- *Stakeholder engagement*: engagement with relevant stakeholders.

4.1 Area of Influence

The IFC Performance Standards require project proponents to identify and manage environmental and social risks and impacts within the Project Area of Influence (AoI). The AoI is defined in IFC Performance Standard 1 as:

The area likely to be affected by: (i) the project and the client's activities and facilities that are directly owned, operated or managed (including by contractors) and that are a component of the project;(ii) impacts from unplanned but predictable developments caused by the project that may occur later or at a different location; or (iii) indirect project impacts on biodiversity or on ecosystem services upon which Affected Communities' livelihoods are dependent.

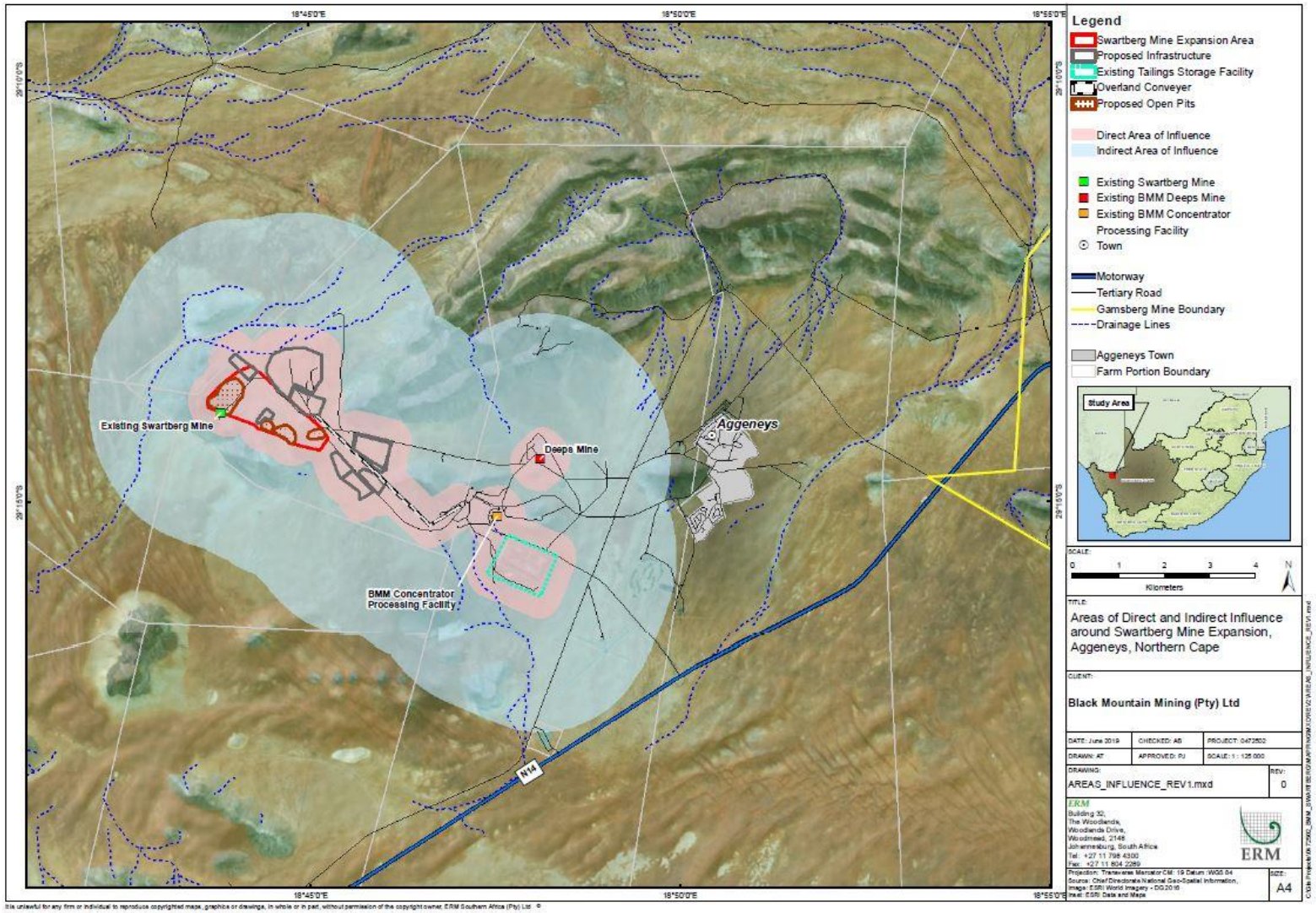
Associated facilities, which are facilities that are not funded as part of the project and that would not have been constructed or expanded if the project did not exist and without which the project would not be viable.

Cumulative impacts that result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted.

In the context of this Project, the Direct Area of Influence (DAoI) includes the Project mining footprint, and the surrounding areas likely to be directly affected by the Project activities during construction, operation, and decommissioning phases. Areas that will be impacted by the construction of access roads, health and safety impacts (including disturbance from noise and dust during construction), and construction camps and in-migration of job opportunists into the local area is also included in the DAoI.

The Indirect Area of Influence (IAoI) includes areas within a wider radius (3km) of the Project site, which may be affected by the Project, although to a lesser extent. The IAoI and DAoI are collectively referred to as the Project area (*Figure 4.1*).

Figure 4.1 Project Area of Influence



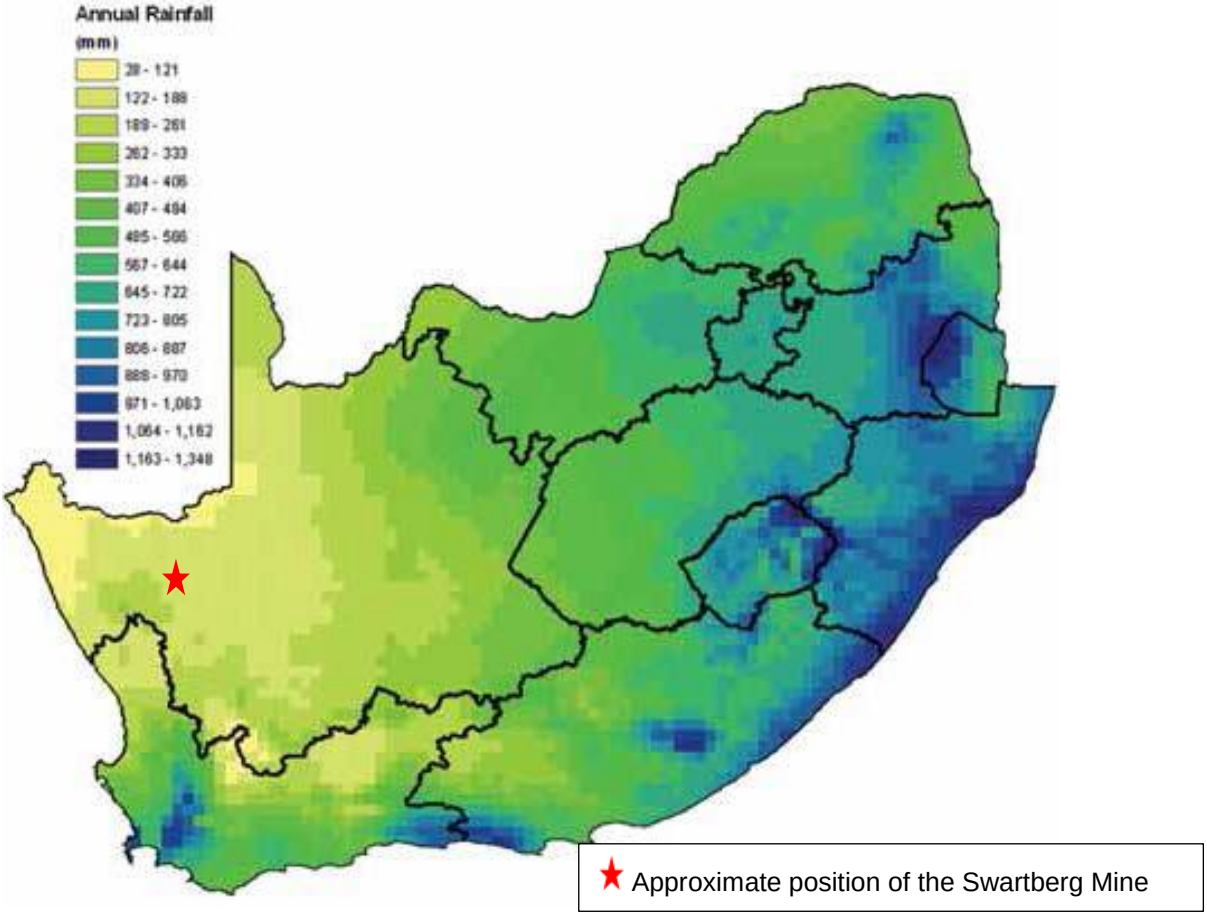
4.2 Biophysical Baseline

4.2.1 Climate

Precipitation

The Project area is located in the Northern Cape Province of South Africa, comprising a portion of the Kalahari Desert (*Figure 4.2*). The Project area falls within the Bushmansland and Namaqualand areas, which experience summer and winter rainfall respectively (Gamsberg ESIA, 2013).

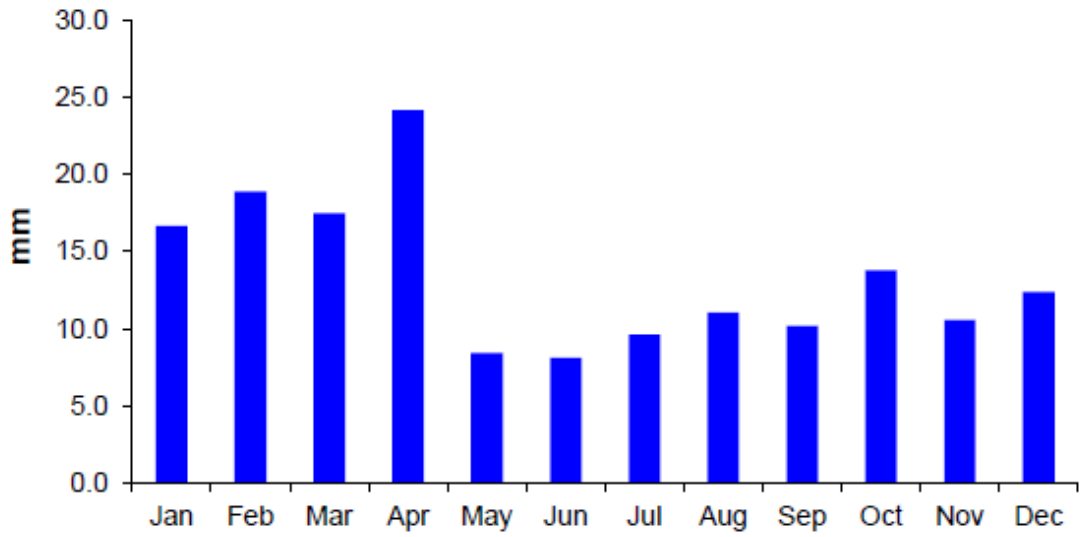
Figure 4.2 Average Rainfall over South Africa



Source: Gamsberg ESIA, 2013

Aggeneys receives an average of 98 mm of rainfall per annum, while Pella and Pofadder receive an average of 77 and 117 mm of rainfall per annum, respectively (Gamsberg ESIA, 2013). Between the years 1986 to 2012, the Swartberg Mine region was recorded to receive greater than 75 % of its annual rainfall between January and June (± 68 mm), with the months of January, February and April receiving the majority of this rainfall. Aggeneys experienced its highest mean monthly rainfall during April (approximately 24 mm), over a period from 1986 to 2012 (*Figure 4.3)*.

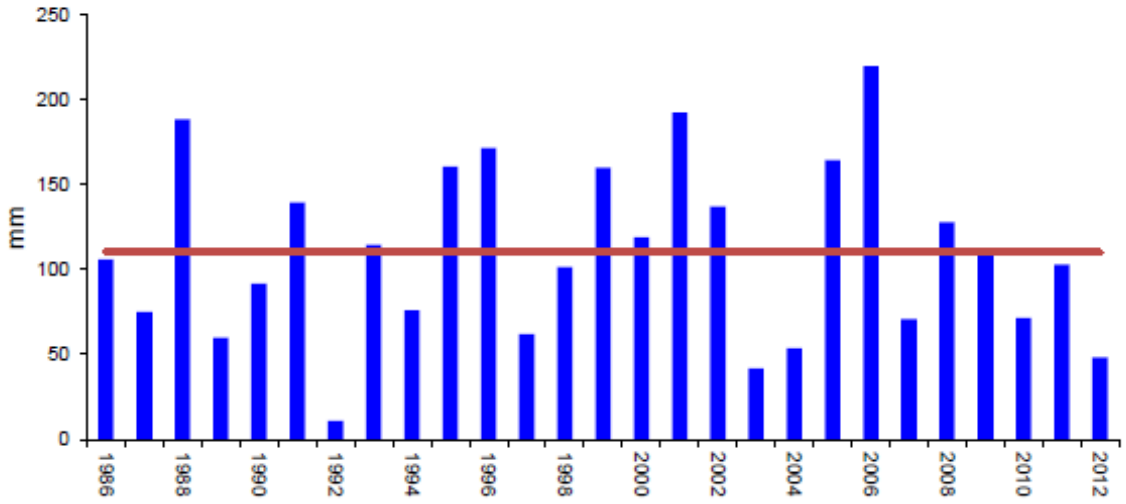
Figure 4.3 Average Monthly Precipitation in Aggeneys (1986 - 2012)



Source: Gamsberg ESIA, 2013

The lowest mean monthly rainfall was experienced in Aggeneys during May and June during the period between 1986 and 2012. In general, annual precipitation in the region is highly variable (*Figure 4.4*).

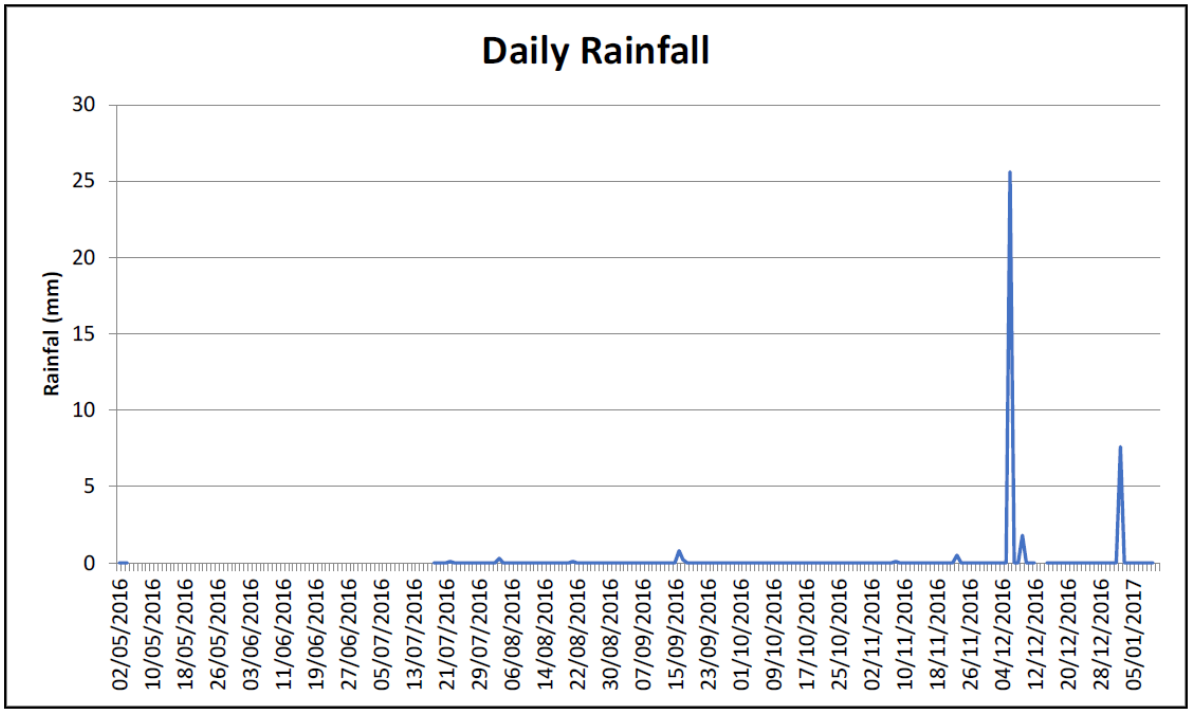
Figure 4.4 Total Annual Precipitation in Aggeneys (1986 - 2012)



Source: Gamsberg ESIA, 2013

During the period between July 2016 to January 2017, the peak rainfall recorded at the BMM site was in December 2016 with over 25mm of rainfall (*Figure 4.5*). This is substantially lower than the recorded rainfall between 1986 and 2012. The total rainfall recorded by BMM at the station during this period was 37mm.

Figure 4.5 Daily Rainfall Data Recorded at Black Mountain Mine (July 2016 to January 2017)



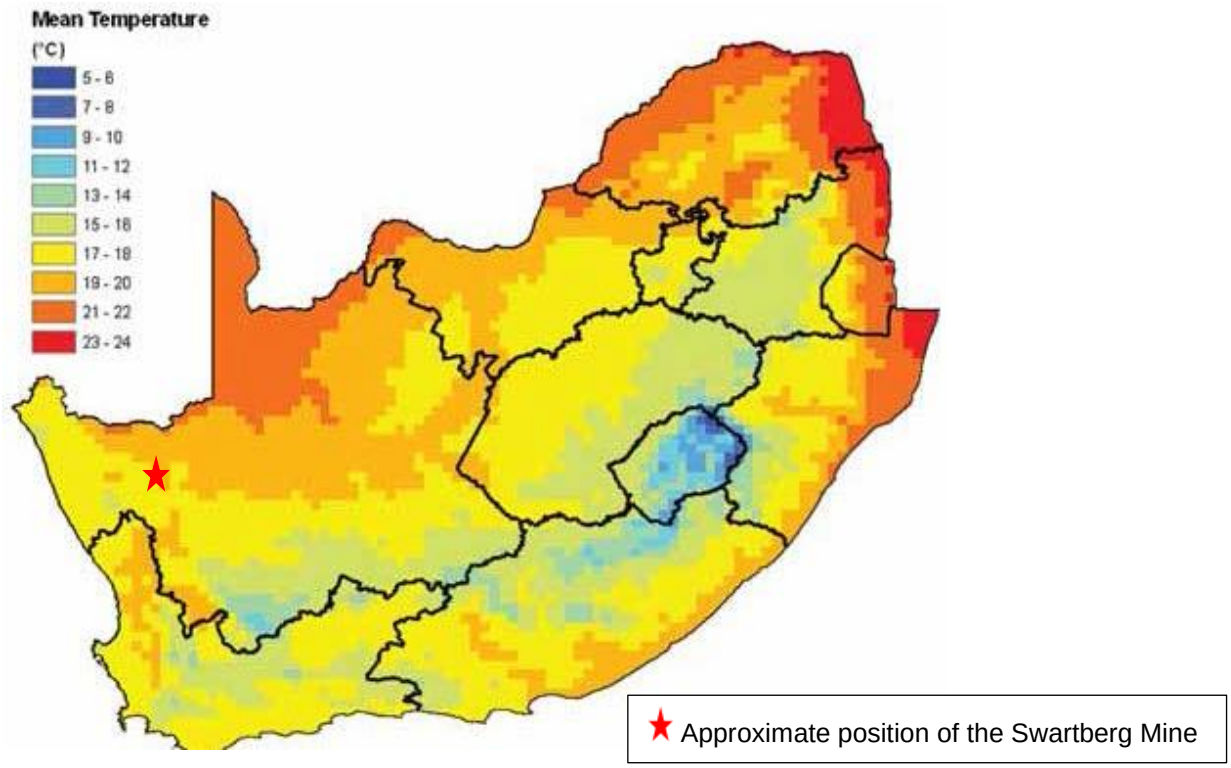
Source: Liebenberg-Enslin and von Reiche (2017)

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 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 a minimum of -3 °C to a maximum of +40.8 °C based on historic records from 1961 - 1990 and 2000 - 2012 (*Figure 4.6*).

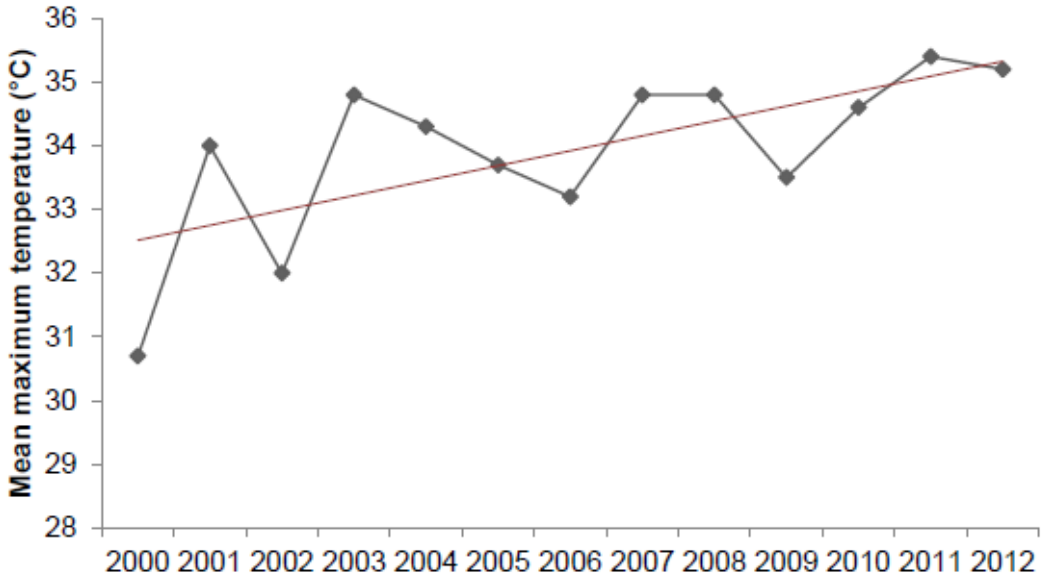
Summers (November to March) are very hot with recorded mean maximum temperatures (from 1961-1990) being 30+°C. January is the hottest month, with mean maximum temperatures, between 2000 and 2012, ranging from 30.7 to 35.4 °C (*Figure 4.7*). Recordings have shown a general trend of recorded January temperatures increasing by approximately 2.8 °C over the period 1961 to 2012 (*Figure* 4.7).

Figure 4.6 Average Annual Temperature over South Africa



ESIA, 2013

Figure 4.7 Mean Maximum Temperature in Pofadder for January between 2000 and 2012



Source: Gamsberg ESIA, 2013

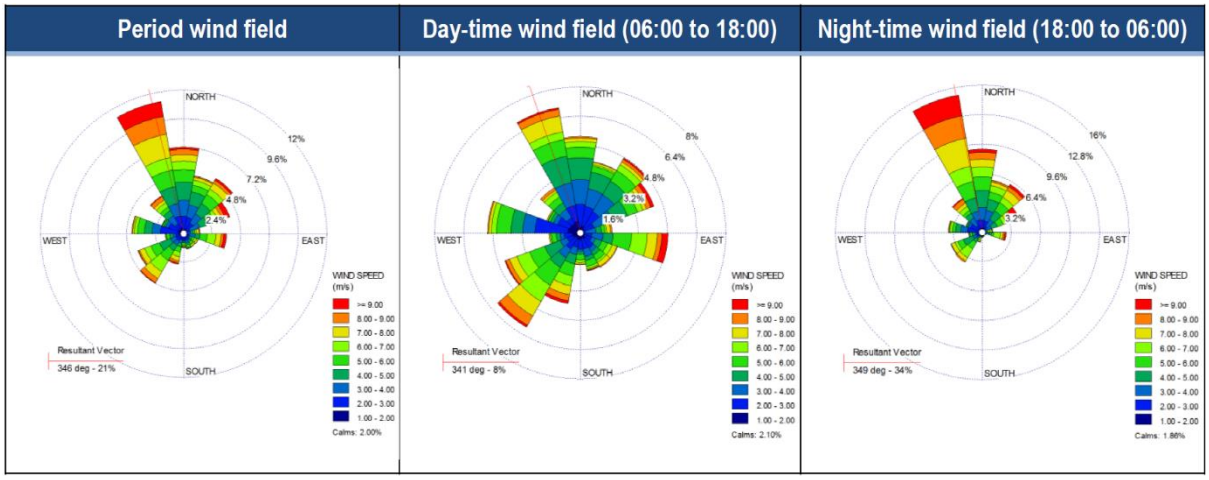
During winter, mean maximum temperatures range from 17.8°C to 20°C; days are cool and nights are cold. The minimum winter temperatures experienced in Pofadder and Springbok can vary from -1°C to

– 13 °C, with significant temperature reductions at night time. June is the coolest month with a mean temperature of 12.1 °C and a mean maximum temperature of 17.8 °C.

Wind

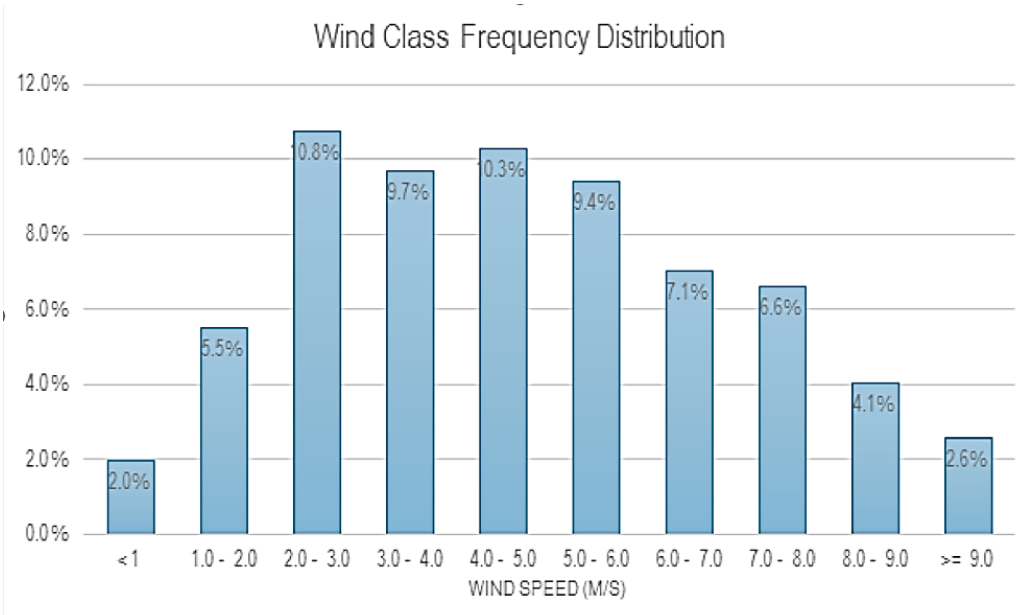
Data from the BMM meteorological station between July 2016 and January2017 indicated that the prevailing wind is from a northerly and north-north-westerly direction. Daytime airflow varies with predominantly north-north-westerly, south-westerly and east-south-easterly winds (Liebenberg-Enslin and von Reiche, 2017). At night, winds are mostly from the north-northwest. The average wind speed over the July 2016 to January 2017 period was 4.7 m/s (Liebenberg-Enslin and von Reiche, 2017). *Figure 4.8* illustrates the wind roses for the period July 2016 to January 2017 and *Figure 4.9* illustrates the wind class frequency distribution.

Figure 4.8 Wind Roses Data for the BMM Meteorological Station



Source: Liebenberg-Enslin and von Reiche (2017)

Figure 4.9 Wind Class Frequency Distribution



Source: Liebenberg-Enslin and von Reiche (2017)

Evaporation

The mean annual evaporation (MAE) for the proposed Project area is 2,650 mm and average monthly evaporation is set out in *Table 4-1* below.

Table 4-1 Average Monthly Evaporation (mm) (Gamsberg ESIA, 2013)

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

4.2.2 Air Quality

The sources of atmospheric pollutants in this area are anticipated to be from the current BMM mining activity, the vehicle traffic and dust from the haul roads or unpaved roads. The largest contributor to particulate emissions in the area is the BMM. The majority of these particulate emissions are generated during the operations of the mine (Liebenberg-Enslin and von Reiche, 2017). The proposed Swartberg opencast mining operations are anticipated to generate the most particulate emissions during the operational phase of the project.

Another major source of emissions in the area comes from unpaved roads. The force of the movement of vehicles on unpaved roads results in particulate matter left suspended in the atmosphere. Dust emissions in unpaved roads is depended on the silt loading on the roads as well as the vehicle traffic present at the time (Liebenberg-Enslin and von Reiche, 2017).

Dust

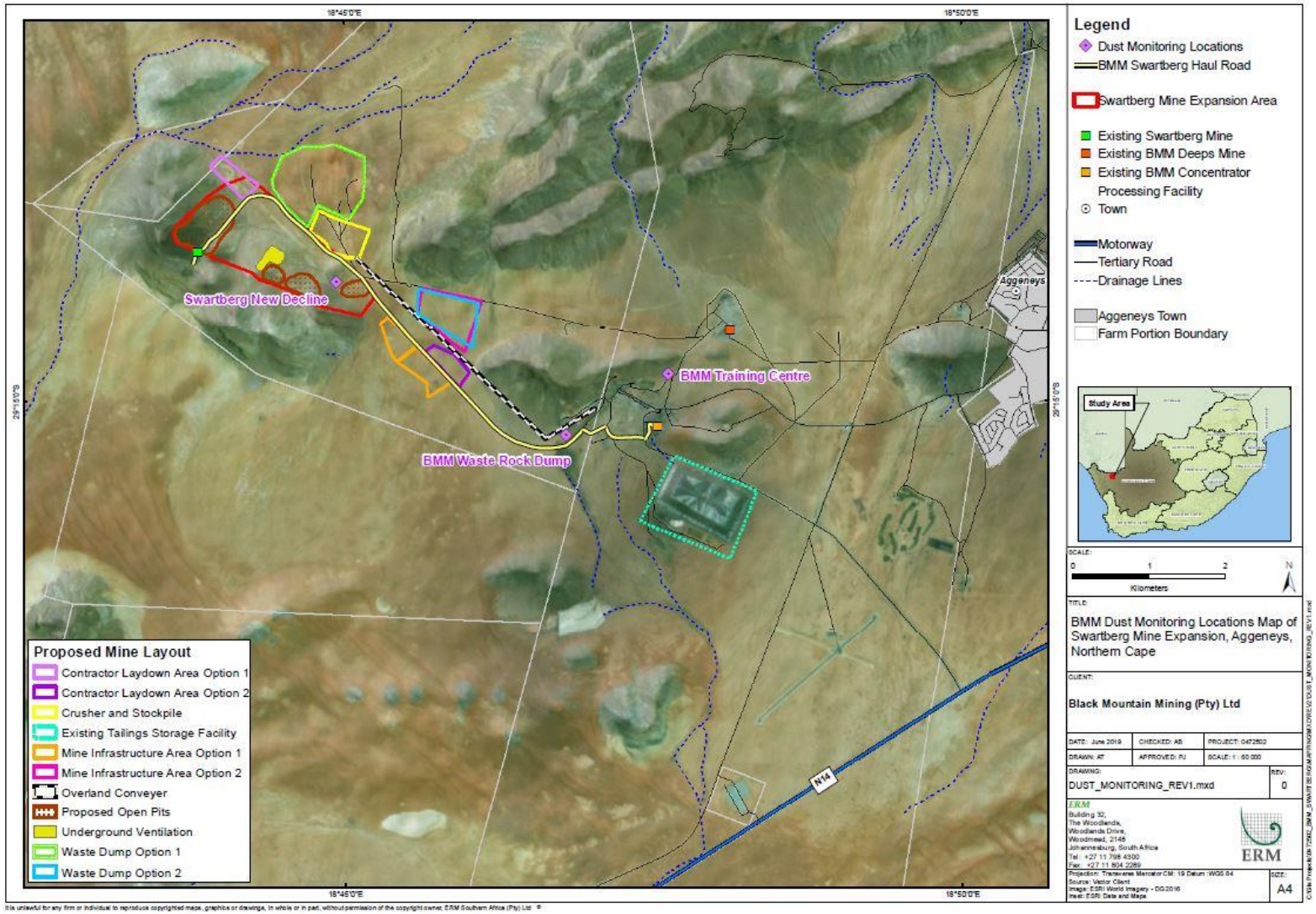
As part of BMM's existing Dust Fall-out Monitoring Programme, the dust levels of four sites around the mine are understood to be monitored on a daily basis. The dust data is compiled and reported on in a monthly dust monitoring report to show monthly averages. These averages should not exceed the acceptable dust fall rate stated in the National Dust Control Regulations, 2013, as set out in Table 4-2.

The four dust fall monitoring units are as follows:

- BMM Waste Rock Dump.
- BMM Swartberg Haul Road.
- BMM Training Centre.
- BMM Swartberg New Decline.

The location of the dust monitoring units is displayed in *Figure 4.10*.

Figure 4.10 The location of BMM's Dust Monitoring Station



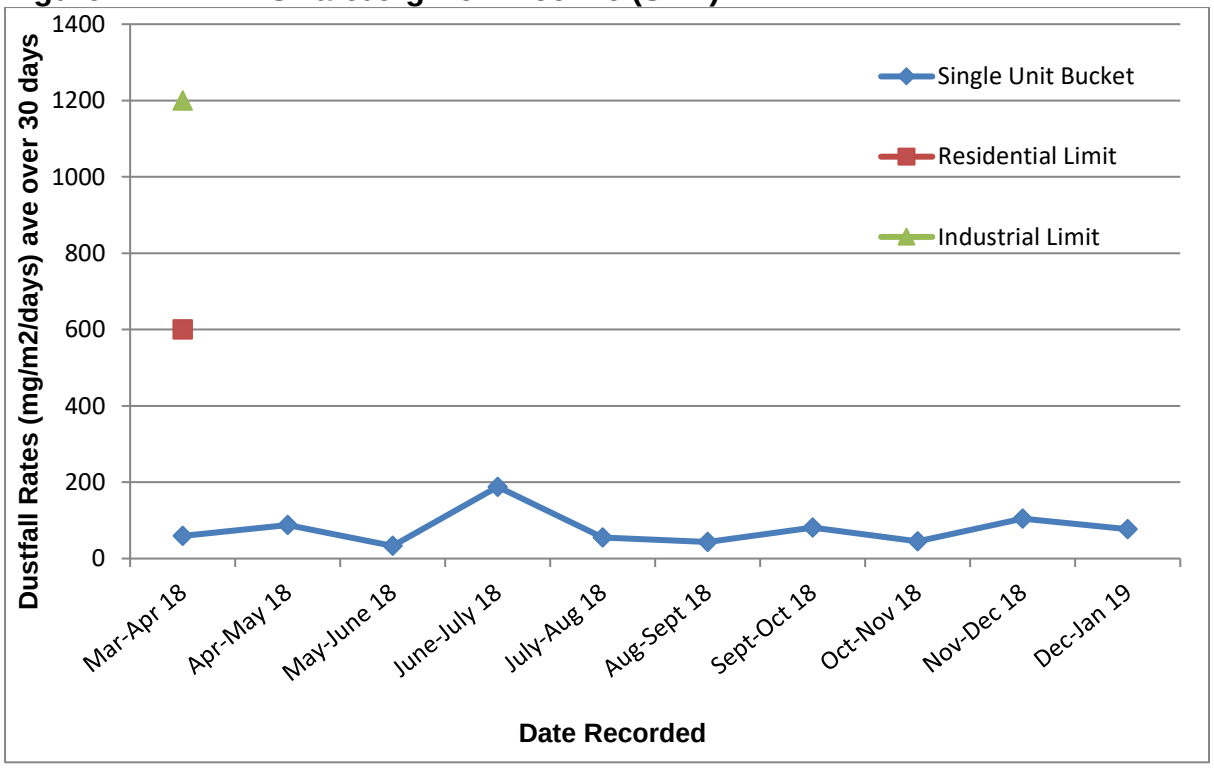
The standard for the acceptable dust fall rate according to the National Dust Control Regulations, 2013, is set out in *Table 4-2*.

Table 4-2 Acceptable Dust fall Rates

Restriction Areas	Dustfall rate (D) (mg/m2/day) – averaged over 30 days.	Permitted frequency of exceeding dust fall rate
Residential area	D < 600	Two within a year, not sequential months.
Non-residential area	D < 1200	Two within a year, not sequential months.

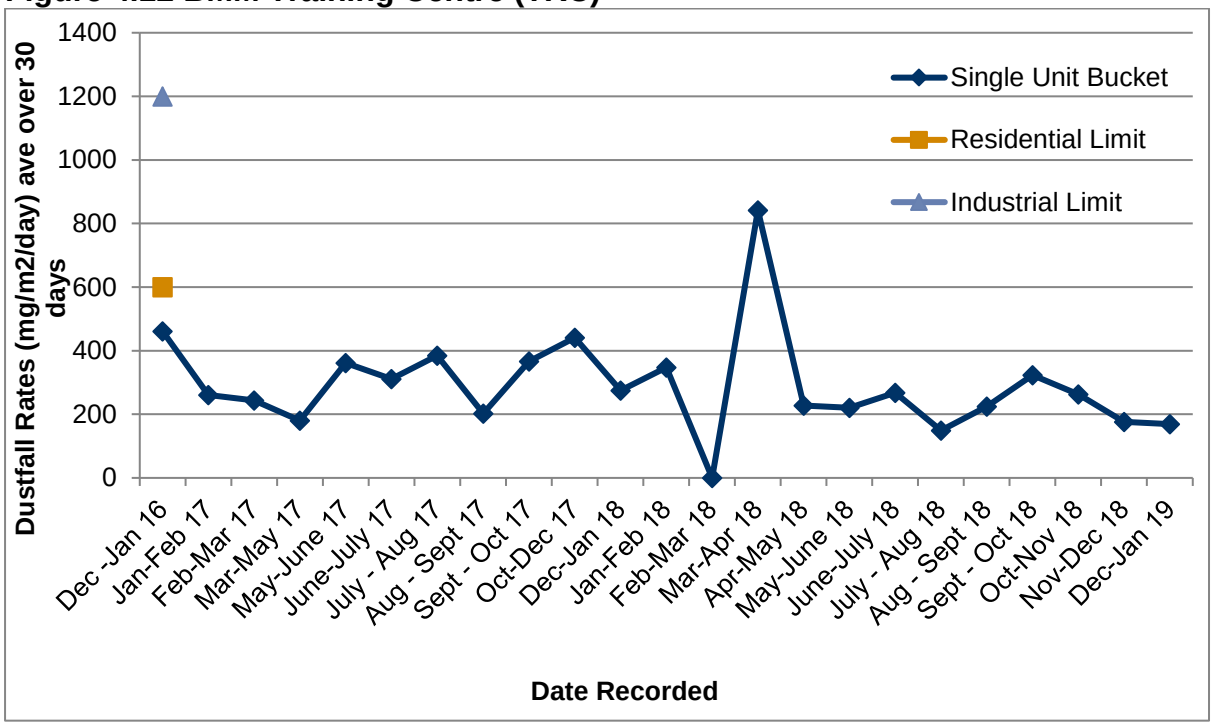
Dust monitoring data from the BMM Swartberg New Decline (SND) over the period from March 2018 to January 2019 is displayed in *Figure 4.11*. The recorded dust levels fell under the permitted dust fall rates, for residential areas (600 mg/m_2/day) and for industrial areas (1200 mg/m_2/days), according to the fall-out dust standards from National Dust Control Regulations, 2013.

Figure 4.11 BMM Swartberg New Decline (SND)



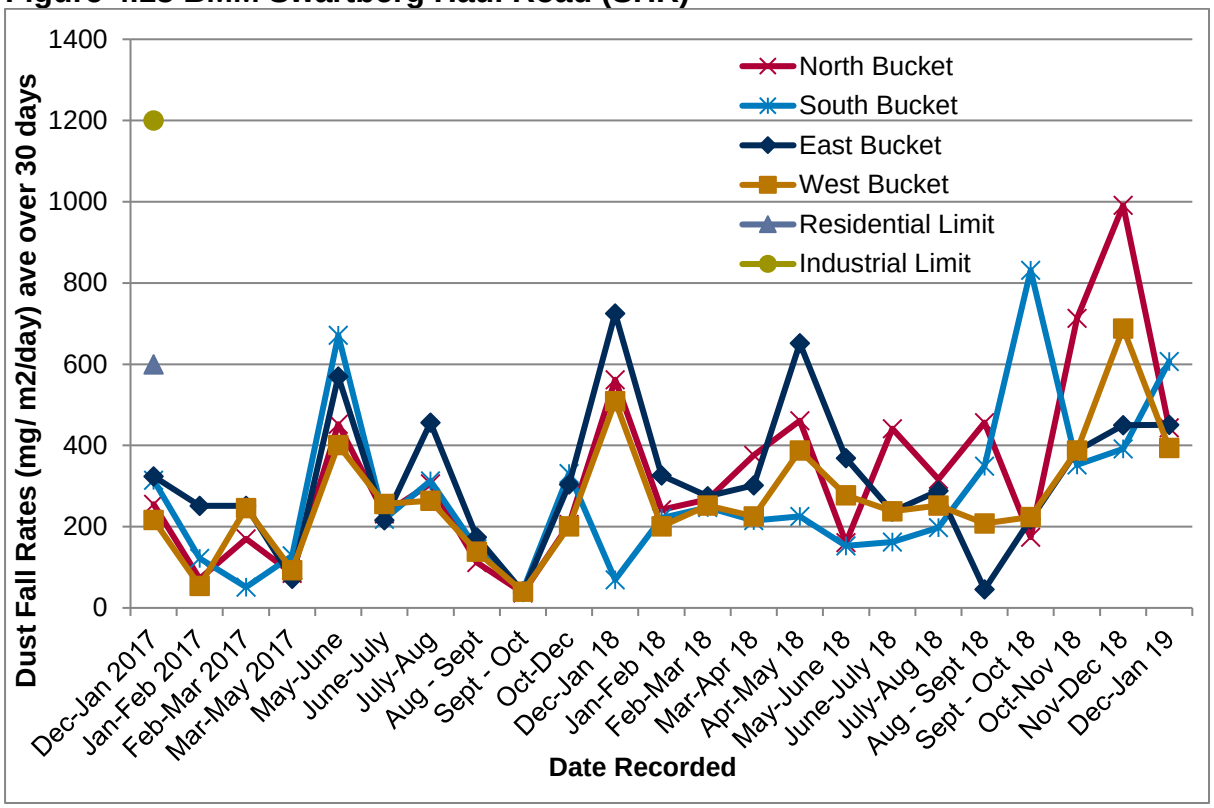
Dust monitoring data from the BMM Training Centre (TRC) over the period from December 2016 to January 2019 is displayed in *Figure 4.12*. The recorded dust levels fell well under the permitted dust fall rates, for residential areas (600 mg/m^2/day) and for industrial areas (1200 mg/m^2/days), according to the fall-out dust standards from National Dust Control Regulations, 2013.

Figure 4.12 BMM Training Centre (TRC)



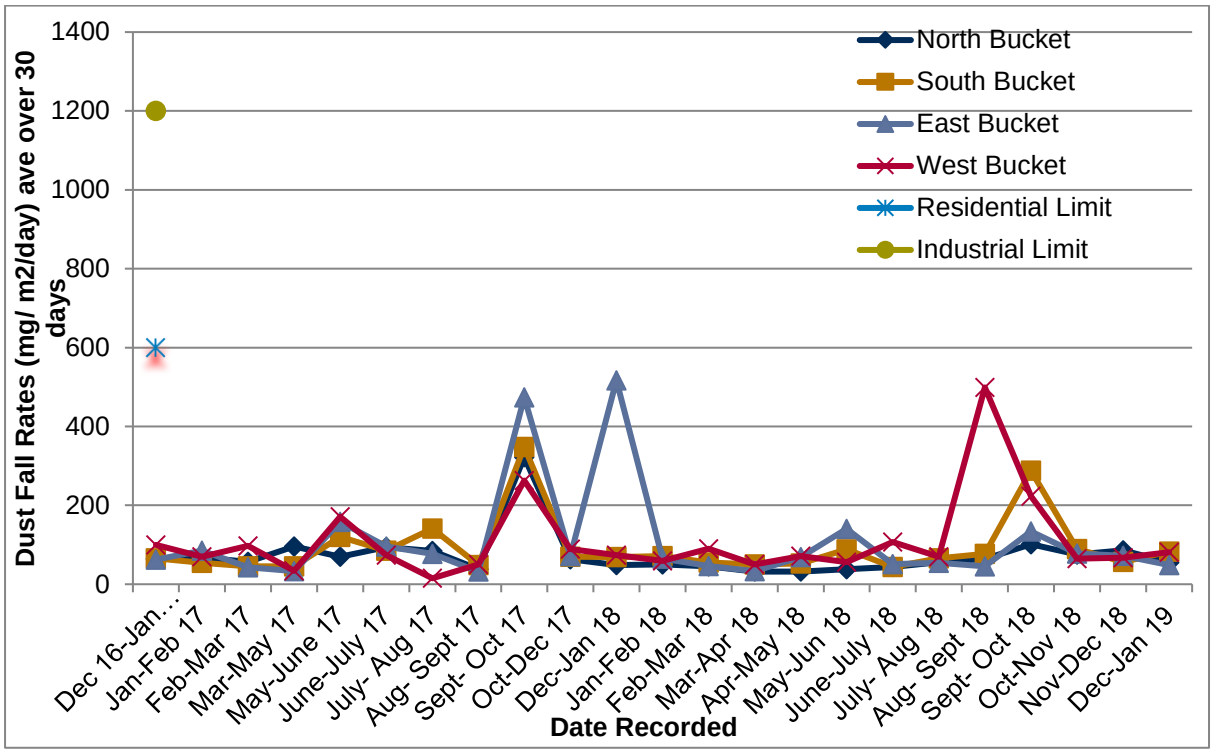
Dust monitoring data from the BMM Swartberg Haul Road (SHR) over the period from December 2016 to January 2019 is displayed in *Figure 4.13*. The recorded dust levels fell predominantly under the dust fall limites for residential areas (600 mg/m_2/day) (except during March-April 2018). Recorded dust levels fell under permitted dust fall rates or industrial areas (1200 mg/m_2/days), according to the fall-out dust standards from National Dust Control Regulations, 2013.

Figure 4.13 BMM Swartberg Haul Road (SHR)



Dust monitoring data from the BMM Waste Rock Dump (WRD) over the period from December 2016 to January 2019 is displayed in Figure 4.14. The recorded dust levels fell under the dust fall limits for industrial areas (1,200 mg/m_2/days), according to the fall-out dust standards from National Dust Control Regulations, 2013.

Figure 4.14 BMM Waste Rock Dump (WRD)



4.2.3 Noise

The areas around the BMM mining area are sparsely populated, and only a limited number of noise-sensitive receptors are situated within the immediate surroundings. Sensitive receptors in the area include the town of Aggeneys and a few farm houses, north of the site.

A noise study was undertaken by Demos Dracoulides on behalf of Parsons Brinckerhoff Africa (Pty) Ltd for the existing Swartberg Mine operations in 2014. The following conclusions were made about the baseline noise environment:

- The noise environment of the area bordering the Swartberg mining area is that of typical rural districts with one major road (N14) and local secondary roads. The daytime and night-time levels away from the above-mentioned roads were within the SANS guideline for Rural districts of 45 dB(A) and 35 dB(A) respectively.
- The current noise levels at Aggeneys were above the guidelines for Rural but within the SANS and WHO guidelines for Urban residential districts of 55 dB(A) and 45 dB(A) for daytime and night-time respectively.
- The main noise contributors within the extended area of the project were primarily the vehicular traffic on the N14 and the existing Black Mountain mine operations. During night-time, most of these sources were still the main contributors, however, at certain locations the frog and insect activity also contributed significantly to the local noise levels.

It is assumed that the noise environment has not changed significantly since this assessment was undertaken.

4.2.4 Geology

Regional Geology

The Project area is situated in the Northern Cape's tectonically bound terrains namely the Bushmanland Terrane which forms part of the Namaqua Orogeny and is composed of basement granitic and gneissic rocks from the Proterozoic Eon (1200 – 1000 Ma). The rocks have been subjected to various phases of metamorphic deformation. The area also consists of metasedimentary, metavolcanic and intrusive rock units.

Rozendaal (1982) and Praekelt *et al*. (1994) reported that due to the rapid facies changes and sedimentological characteristics a relatively shallow water environment for the deposition of the Aggeneys and Gams Ore Formations were favoured with the depositional conditions varying between oxidising and reducing.

The ore assemblages and host rocks were intensely affected by medium to high-grade metamorphism and poly-phase deformation. Four phases of deformation were recognised in the Bushmanland area and the main episode of deformation was during a period of the highest degree metamorphism resulting in large open synformal features, fractures and shear zones. Joubert (1986) suggested that these structures represent the final phase of uplift for the area exposing the high-grade rock of the Bushmanland and Namaqualand.

The lower lying plains consist of various depths of surficial cover of wind-blown sand, dunes, scree rubble, sandy soil, calcrete and alluvium of Quaternary and Tertiary age. There are also a number of pale channels filled with this material. Gneiss, quartzite and schist underlie these surficial deposits.

Local Mine Geology

The stratigraphy of the Swartberg deposit is contained within a major recumbent isoclinal synformal fold which extends into the basal gneisses. This fold dips towards the north east. As a result of this folding event the succession of the stratigraphy is overturned or reversed. The general stratigraphy of the site is summarised in *Table 4-3*. *Figure 4.15* shows the regional and local geology of the Project site.

Table 4-3 Summary of Stratigraphic Succession of Swartberg

Stratigraphic Unit			Thickness (m)
Aggeneys Ore Formation: (Stratigraphic Top)			
7	Baritic-sulphidic quartzite, massive sulphide, garnet-quartzite, magnetite-amphibolite	Lower Orebody	(0 – 17)
6	Baritic quartz schist	Upper Orebody	(5 – 25)
5	Magnetite-barite rock		(10 – 25)
4	Magnetite amphibolite		(0 – 45)
3	Magnetite quartzite		(0 – 20)
2	Mixed zone consisting of gradations between garnet quartzite and quartz schist	Copper Lenses	(30 – 65)
1	Banded quartz schist		(10 – 25)
White Quartzite Formation			
Aluminium Schist Formation			
Pink Gneiss Formation (Stratigraphic Bottom)			

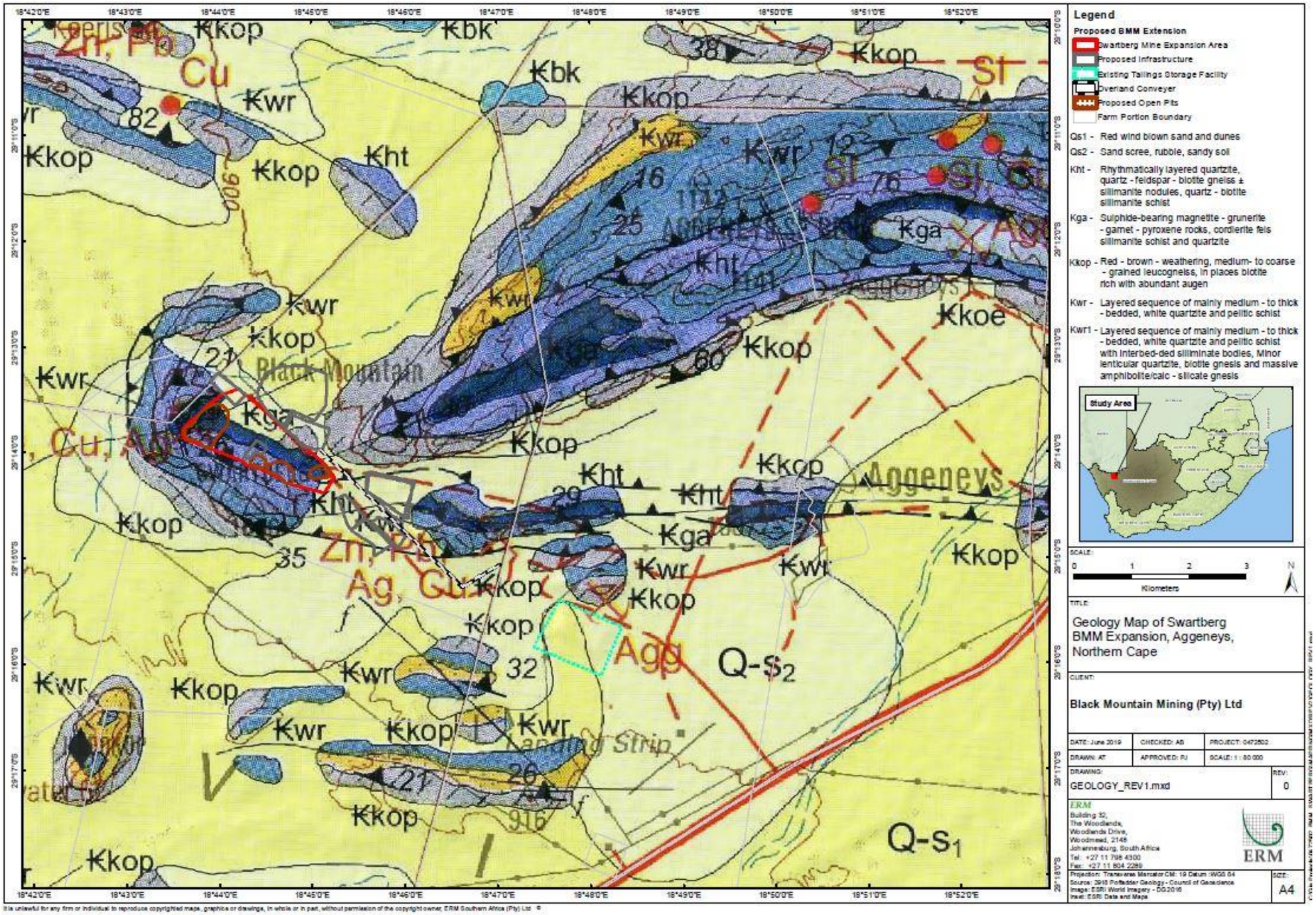
Source: GHT Consulting, 2019

A series of quartzite, schist, gneisses and pegmatites is found in the areas as seen in *Figure 4.15*. The strike and dip of these rocks were reported to be east-west orientated and steeply dipping to the north. The quartzite is the most resistant to erosion from the east-west trending range of hills surrounding the site area namely, Swartberg,Tank Hill, Saddleback Hill, Broken Hill, Maanhaarkop and Froneman-se-Kop. The hard rock geology is covered by sands, calcareous sands, gravels and calcrete of various thicknesses over a large area of the site.

The general geology which includes Swartberg, Old Shaft Area and Deeps can be summarised into the following main lithologies of importance:

- Rhythmatically layered quartzite, quartz-feldspar-biotite gneiss, sillimantite nodules, quartz-biotite sillimanite schist (Lithology Code: Kht);
- Sulphide bearing magnetite, gunerite-garnet-pyroxene rocks, cordierite fels sillimantite schist (Lithology Code: Kga);
- Red brown weathering, medium to coarse grained leucogneiss, in places biotite rich with abundant augen (Lithology Code: Kkop); and
- Red windblown sand and dunes (Lithology Code: Qs1) / Sand scree, rubble, sandy soil (Lithology Code: Qs2).

Figure 4.15 Geological Map for the Black mountain Mining Region



Source: GHT Consulting, 2019

4.2.5 Hydrology

The rainfall patterns, driving the hydrological cycles, indicate a relatively low rainfall of between 100mm and 200mm per year. The rainfall events are erratic and annual rainfall seldom results in river systems flowing. Extreme rain events or a good rainfall year with sufficient follow-up rain could result in the Aggeneys Berge catchment flowing out towards the lower lying plains (Endemic Vision Environmental Services, 2017).

Freshwater and wetland information was extracted from the National Freshwater Ecosystem Priority Areas assessment (NFEPA). The Black Mountain mine falls within the Orange River Gorge (28) freshwater priority area. In terms of surface hydrology categories by the Department of Water Affairs, South Africa is divided into a number of drainage regions. The Aggeneys farm 56 within the Lower Orange water management area and the Big Syncline Valley sub-catchment. The surface area is further investigated in terms of national data bases to look for the presence of any listed hydrological features that may be directly or indirectly affected by the Project (Endemic Vision Environmental Services, 2017).. According to the latest NFEPA categorization, there is no permanent river or hydrological feature in the Project area (Endemic Vision Environmental Services, 2017).

In terms of hydrological habitats, washes are found in the Project area. The vegetation of washes are described in *Section 4.2.7.*

4.2.6 Groundwater

The Swartberg Mine is likely to be situated in relatively stagnant hydrogeological setting. Vegter (2006) which found that groundwater level changes as large as 40 metres have been observed in boreholes on a major drainage divide. The regional water levels indicate that groundwater flow does takes place, while the aquifer storage is limited, and recharge events are occasional.

Regional Groundwater Levels

The groundwater level data obtained for the regional area around the mining site included data from the National Groundwater Archive (NGA), exploration boreholes and monitoring boreholes. The regional water levels ranged between 3.5 and 108 meters below ground level (mbgl) with an average groundwater level of 33.7 mbgl. These water levels were measured over a long period of time (1981 to 2002) and were therefore only used as an indication of water levels on a regional scale. The average groundwater elevation for the Project area was calculated to be 781 metres above mean sea level (mamsl) and ranged between 671 and 945 mamsl. The shallow water levels are however often the influence of the upper Quaternary (primary) aquifer system (water level a combination of the upper and lower aquifer) or artificial recharge from surface water bodies.

Newly taken groundwater levels for Gamsberg Mine and surrounding farm area as well as groundwater levels for Black Mountain indicates that the average groundwater levels around the BMM mine is on average for 31 mbgl or 865 mamsl.

Local Groundwater Levels

Groundwater level testing was conducted for the privately owned farms in the Aggeneys district in the vicinity of the Gamsberg Mine and BMM using BMM's monitoring boreholes. Each of the boreholes were given reference numbers for ease of reference when analysing the results. The results of February 2019, BMM groundwater levels can be viewed in *Table 4-4* and *Table 4-5* below and illustrated in *Figure 4.16* . The results of the groundwater elevations for BMM are as follows:

- The monitoring boreholes of BMM indicates that the groundwater has mostly been stable over time in this region. Boreholes N13, M5, AD14, AD15, AD19, BH4, BH5 and M6 indicates stable to slightly

decreasing groundwater level trends. Stable to slightly increasing groundwater levels were observed for boreholes AD24, N6, M9, AD21, AD9, and M18.

- The groundwater elevations of BMM have been disturbed unnaturally by mining activities, which includes artificial recharge (pouring into) to the local groundwater aquifer as well as dewatering (Shafts and Declines). Naturally, the groundwater levels in an area should be a direct replica of the topographical elevations. However, it was noted that in this particular area, the groundwater levels do not mimic the topographical elevations. This suggests that there have been unnatural disturbances to the groundwater levels either by dewatering activities or artificial recharges into the local aquifer as seen in mining operations.
- In terms of groundwater depth and elevation in general the groundwater table is shallowest in the vicinity of the Tailings Dam and Reed Beds due to artificial recharge. It is deepest in the vicinity of the Swartberg Mine due to dewatering effects. Background groundwater depths of the gneiss aquifer is between 35 to 45 meters below ground level (AD9, AD19, N13, N4, N14 and N12.

Table 4-4 Part A: Groundwater Level and Elevation Results for Black Mountain Mining (GWL for February 2018)

Borehole Name		Quaternary Sub-catchment	Owner	Date	Elevation (mamsl)	Datum Level (m)	Aquifer Monitored	Water Level Type	Static Water Level (mbgl)	Static Water Elevation (mamsl)	Ground Water Level Tread	Comments
1	N13	D82C	BMM	2018/10/29	846.14	0.300	Gneiss Aquifer/ Waste Rock (15m)	Static Water Level	57.50	788.94	Stable to Slightly Decreasing GWL Trend	Limited local dewatering effects at Deeps Shaft
2	N14	D82C	BMM	2018/10/29	845.46	0.450	Gneiss Aquifer/ Waste Rock (15m)	Static Water Level	55.75	790.16	Stable GWL Trend	Limited local dewatering effects at Deeps Shaft
3	AD24	D82C	BMM	2018/10/24	818.00	0.510	Upper Quatenary Aquifer	Static Water Level	4.94	813.55	Stable to Slightly Decreasing GWL Trend	Shallow GWL due to artificial recharge from reed beds
4	M3	D82C	BMM	2018/10/24	811.90	0.340	Gneiss Aquifer	Static Water Level	4.73	807.51	Stable GWL Trend	Shallow GWL due to artificial recharge from reed beds
5	M8	D82C	BMM	2018/10/24	822.72	0.160	Gneiss Aquifer	Static Water Level	6.94	815.94	Stable GWL Trend	Shallow GWL
6	N6	D82C		2018/10/24	818.33	0.720	Upper Quatenary Aquifer	Static Water Level	4.84	814.21	Stable to Slightly Decreasing GWL Trend	Shallow GWL due to artificial recharge from increased recharge at rock waste stockpile
7	M4	D82C	BMM	2018/10/24	800.77	0.060	Gneiss Aquifer	Static Water Level	9.72	791.11	Stable GWL Trend	Shallow GWL due to artificial recharge from evaporation dam
8	M5	D82C	BMM	2018/10/24	802.80	0.060	Gneiss Aquifer	Static Water Level	9.34	793.52	Stable to Slightly Decreasing GWL Trend	Shallow GWL due to artificial recharge from evaporation dam
9	M9	D82C	BMM	2018/10/24	818.60	0.170	Gneiss Aquifer	Static Water Level	48.54	770.23	Stable to Slightly Decreasing GWL Trend	Unaffected GWL borehole situated in gneiss aquifer
10	N8	D82C	BMM	2018/10/24	799.53	0.190	Gneiss Aquifer	Static Water Level	13.02	786.70	Stable GWL Trend	Shallow GWL due to artificial recharge from evaporation dam
11	AD14	D82C	BMM	2018/10/25	848.68	0.780	Gneiss Aquifer	Static Water Level	17.95	831.51	Stable to Slightly Decreasing GWL Trend	Borehole seem to be unaffected by dewatering
12	AD15	D82C	BMM	2018/10/25	921.92	0.375	Gneiss Aquifer	Static Water Level	61.10	861.20	Stable to Slightly Decreasing GWL Trend	Potenteially affected by dewatering. More GWL data needed to confirm
13	AD20	D82C	BMM	2018/10/25	870.30	0.480	Gneiss Aquifer	Static Water Level	Dry	~	Borehole Dewatered	Aquifer dewatered by decline
14	AD21	D82C	BMM	2018/10/25	908.20	0.200	Gneiss Aquifer	Static Water Level	50.72	857.68	Stable to Slightly Decreasing GWL Trend	Potenteially affected by dewatering. More GWL data needed to confirm
15	M1	D82C	BMM	2018/10/25	884.33	0.205	Quartzite/ Schist Aquifer	Static Water Level	Dry	~	Borehole Dewatered	Aquifer dewatered by decline
16	N1	D82C	BMM	2018/10/25	n/a	0.000	Quartzite/ Schist Aquifer	Static Water Level	~	~	~	~
17	N3	D82C	BMM	2018/10/25	n/a	0.155	Quartzite/ Schist Aquifer	Static Water Level	Dry	~	Borehole Dewatered	Aquifer dewatered by decline
18	AD17	D82C	BMM	2018/10/25	887.97	0.175	Quartzite/ Schist Aquifer	Static Water Level	Dry	~	Borehole Dewatered	Aquifer dewatered by decline
19	AD19	D82C	BMM	2018/10/25	865.13	0.300	Gneiss Aquifer	Static Water Level	46.16	819.27	Decreasing GWL Trend	Potenteially affected by dewatering. More GWL data needed to confirm
20	AD22	D82C	BMM	2018/10/25	831.67	0.430	Gneiss Aquifer	Static Water Level	Dry	~	~	Borehole dry. Affected by dewatering

BMM Site (Deeps Shaft Operations)

BMM Mine Site (Old Shaft Area)

BMM Mine Site (Plaatjies Vlei Area)

BMM Mine Site (Swartberg Operations)

Source: GHT Consulting, 2019

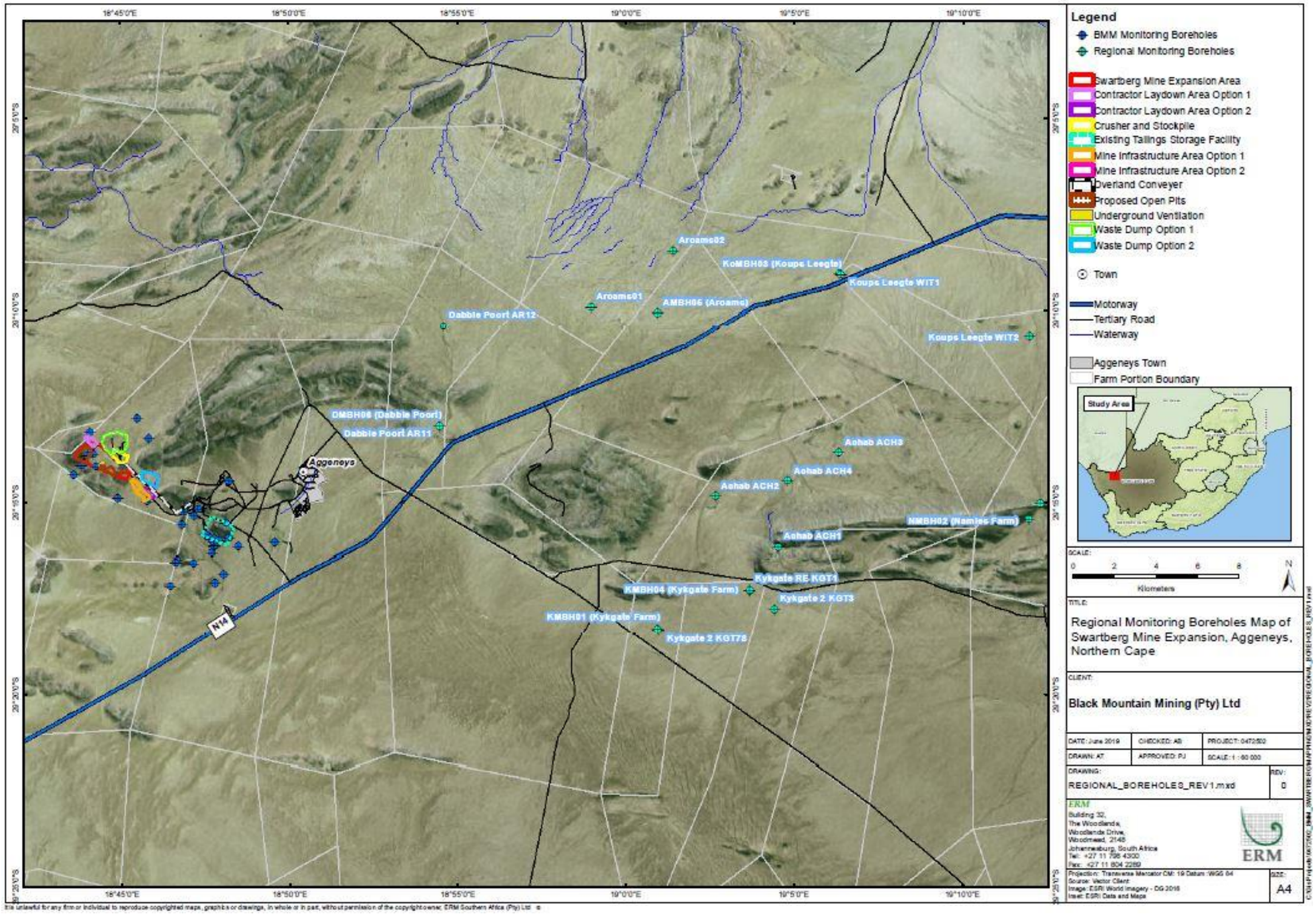
Table 4-5 Part B: Groundwater Level and Elevation Results for Black Mountain Mining (GWL for February 2018)

Borehole Name		Quaternary Sub-catchment	Owner	Date	Elevation (mamsl)	Datum Level (m)	Aquifer Monitored	Water Level Type	Static Water Level(mbgl)	Static Water Elevation (mamsl)	Ground Water Level Tread	Comments
21	AD10	AD10	BMM	2018/1024	815.21	0.170	Upper Quaternary Aquifer	Static Water Level	1.45	813.93	Stable GWL Trend	Shallow GWL due to artificial recharge from TSF
22	AD8	AD8	BMM	2018/10/24	795.93	8.180	Gneiss Aquifer	Static Water Level	Dry	~	~	~
23	AD9	AD9	BMM	2018/1025	797.43	0.380	Gneiss Aquifer	Static Water Level	35.99	761.82	Slightly Increasing GWL Trend	Shallow GWL due to artificial recharge from TSF
24	BH2	BH2	BMM	2018/10/25	801.02	0.220	Upper Quaternary Aquifer	Static Water Level	7.01	794.23	Stable GWL Trend	Shallow GWL due to artificial recharge from TSF
25	BH4	BH4	BMM	2018/1026	802.47	0.120	Upper Quaternary Aquifer	Static Water Level	5.98	796.61	Stable to slightly decreasing GWL Trend	Shallow GWL due to artificial recharge from TSF
26	BH5	BH5	BMM	2018/10/26	802.92	0.390	Upper Quaternary Aquifer	Static Water Level	6.15	797.16	Stable to slightly decreasing GWL Trend	Shallow GWL due to artificial recharge from TSF
27	M6	M6	BMM	2018/1027	803.41	0.090	Upper Quaternary Aquifer	Static Water Level	3.89	799.61	Stable to slightly decreasing GWL Trend	Shallow GWL due to artificial recharge from TSF
28	M7	M7	BMM	2018/10/27	809.27	0.310	Upper Quaternary Aquifer	Static Water Level	7.45	808.13	Stable GWL Trend	Shallow GWL due to artificial recharge from TSF
29	N10	N10	BMM	2018/1028	807.94	0.060	Upper Quaternary Aquifer	Static Water Level	14.05	793.95	Stable GWL Trend	Shallow GWL due to artificial recharge from TSF
30	M18	M18	BMM	2018/10/28	804.65	0.755	Upper Quaternary Aquifer	Static Water Level	1.79	808.61	Stable GWL Trend	Shallow GWL due to artificial recharge from TSF
31	M19	M19	BMM	2018/1029	804.18	1.091	Upper Quaternary Aquifer	Static Water Level	4.11	801.16	Stable GWL Trend	Shallow GWL due to artificial recharge from TSF
32	M20	M20	BMM	2018/10/29	805.08	0.770	Upper Quaternary Aquifer	Static Water Level	4.79	801.06	Stable GWL Trend	Shallow GWL due to artificial recharge from TSF
33	M21	M21	BMM	2018/1030	805.34	0.700	Upper Quaternary Aquifer	Static Water Level	5.49	800,55	Stable GWL Trend	Shallow GWL due to artificial recharge from TSF
34	N12	N12	BMM	2018/10/29	813.05	0.185	Gneiss Aquifer	Static Water Level	39.68	773.56	Stable GWL Trend	Groundwater level may be influenced by artificial recharge from golf course irrigation or sewage ponds
35	AD23	AD23	BMM	2018/10/27	844.35	0.430	Gneiss Aquifer	Static Water Level	75.63	769.15	Stable GWL Trend	GWL may be influenced in downward trends when new decline is constructed
36	N4	N4	BMM	2018/10/27	831.70	0.100	Gneiss Aquifer	Static Water Level	43.05	788.75	Stable GWL Trend	GWL may be influenced in downward trends when new decline is constructed

BMM Mine Site (Tailing Dam Facility, TSF)
Aggeneys Tom Sewage Ponds
BMM Mine Site (General Waste Site)

Source: GHT Consulting, 2019

Figure 4.16 Groundwater Monitoring Boreholes



Source: GHT Consulting, 2019

Groundwater Quality

In general the regional groundwater quality results indicate that the groundwater is suitable for livestock water (sheep in general) but not suitable for domestic use, which pertain especially to drinking uses if untreated (GHT Consulting, 2019).

The quality of water from BMM monitoring boreholes was tested against the Human Drinking Standards (South African National Standards, SANS241-2015 and SANS241-2006). It was found that the groundwater of BMM is not suitable for domestic purposes and livestock watering due to the high chemical content found in it.

The groundwater of the monitoring boreholes of BMM are classified as “ARS” (inorganic water quality). What this means is that the water is unsuitable for consumption according to SANS241-1:2015. The water quality was tested for the following constituents contributing to its inorganic water quality status: Electrical Conductivity (EC), Total Dissolved Solids (TDS), Sodium (Na), Calcium (Ca), Magnesium (Mg), Potassium (K), Chloride (Cl), Sulphate (SO4), Fluoride (F), Nitrate (NH3-N, lesser extent), Zinc (Zn, lesser extent), Lead (Pb, lesser extent) and Manganese (Mn, lesser extent). The Total Petroleum Hydrocarbon (Total TPH) below detection limit, <382.0 µg/L (GHT Consulting, 2019).

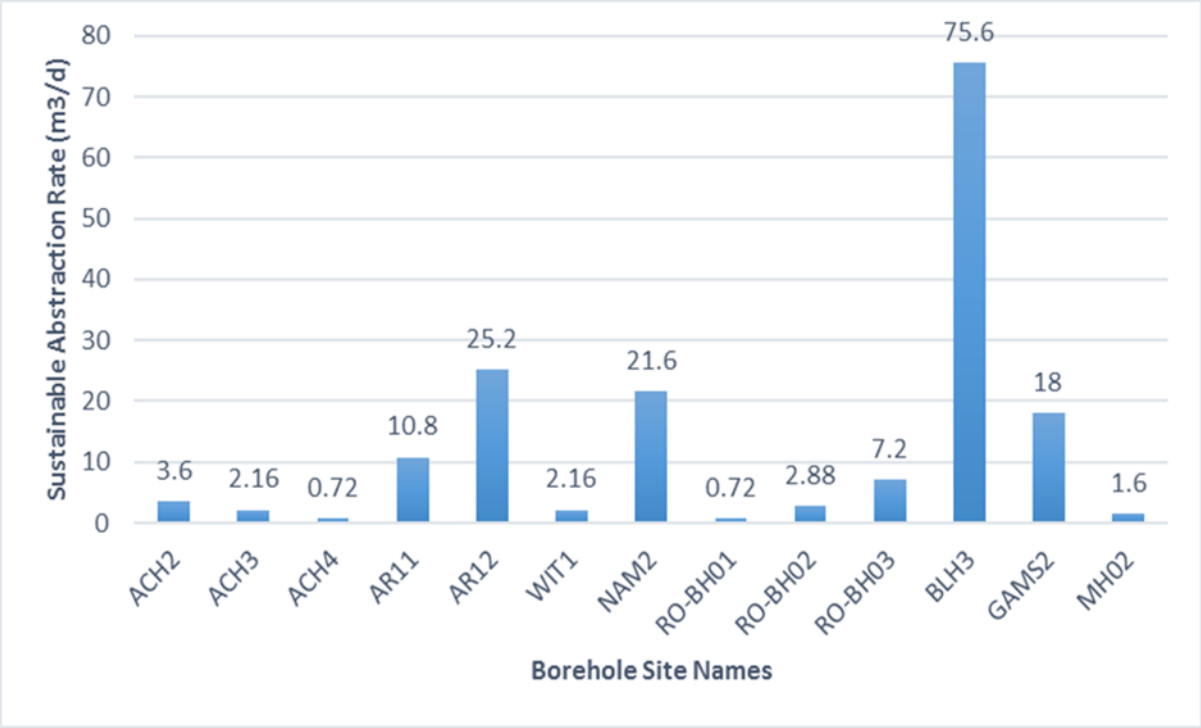
In terms of agricultural use, monitoring results of the boreholes classified the groundwater as unsuitable for livestock watering. In other words, the water could not be used to water the agricultural fields that livestock use for feeding (according to South African Water Quality Guidelines, Volume 5 - Agricultural Use: Livestock Watering) due to elevated concentrations of Total Dissolved Solids (TDS), Sulphate (SO4) and to a minor extent due to calcium (Ca), chloride (Cl) and Nitrate (NO3-N).

Current Groundwater Use

Groundwater serves as a key water source, especially for livestock farmers in the Project area. Groundwater resources in the Namakwa District are more abundant than surface water features. Based on estimated projections, a total of ±75 000 m^3/annum of groundwater is abstracted on the western side of Swartberg Mine, primarily for livestock watering and to a lesser extent domestic use at the farm houses of the farmers and farm workers[1]. The boreholes present in the region have sustainable yield in the order of between 0.02 and 0.70 L/s (Figure 4.17), which are likely to experience seasonal variations based on rainfall patterns. Higher yielding boreholes are scarce, but they do exist for instance monitoring borehole BLH3 on the Gamsberg Mine Lease that has an aquifer tested sustainable yield of 2.10 L/s (GHT Consulting, 2019).

[1] This was calculated based on the hydro-census analysis undertaken in 2010 by SRK Consulting for the various boreholes, wells and springs as well as aquifer test pumping performed on the production farm boreholes in 2017 / 2018.

Figure 4.17 Recommended sustainable abstraction rates of the aquifer tested farm boreholes.



Source: GHT Consulting, 2019

4.2.7 Flora

Regional Vegetation Overview

The study area is situated in the Nama-Karoo biome. The vegetation types covering the study area are Namaqualand Klipkoppe Shrubland (SKn1), Bushmanland Inselberg Shrubland (SKr18) and Bushmanland Sandy Grassland (Nkb4). In the wider area around the study area, Bushmanland Arid Grassland (NKb 3), and Aggeneys Gravel Vygieveld (SKr19) can be found (Mucina and Rutherford 2006). According to Mucina and Rutherford (2006), these vegetation types can be shortly described as follows:

- **Aggeneys Gravel Vygieveld** is found on flat or slightly sloping plains (appearing as distinctly white surface quartz layers against the background of red sand or reddish soil) and supporting sparse, low-growing vegetation dominated by small to dwarf leaf-succulents of the families Aizoaceae, Crassulaceae, Euphorbiaceae, Portulacaceae and Zygophyllaceae, with some perennial component. Eragrostis nindensis and Stipagrostis ciliata are the dominant perennial grasses. Common succulents include Avonia species, Ruschia divaricata, Euphorbia gregaria, Hypertelis salsoloides, Kleinia longiflora and Psilocaulon subnodosum.
- **Bushmanland Arid Grassland** constitutes sparsely vegetated extensive to irregular plains, consisting of grassland dominated by white grasses (Stipagrostis species). In places low shrubs of Salsola or Zygophyllum change the vegetation structure. In years of abundant rainfall rich displays of annual herbs can be expected.
- **Bushmanland Inselberg Shrubland** has both succulent (Aizoaceae, Asphodelaceae, Crassulaceae, Euphorbiaceae, Zygophyllaceae) as well as non-succulent (mainly Asteraceae) elements, with sparse grassy undergrowth (Aristida, Eragrostis, Stipagrostis) and is found on

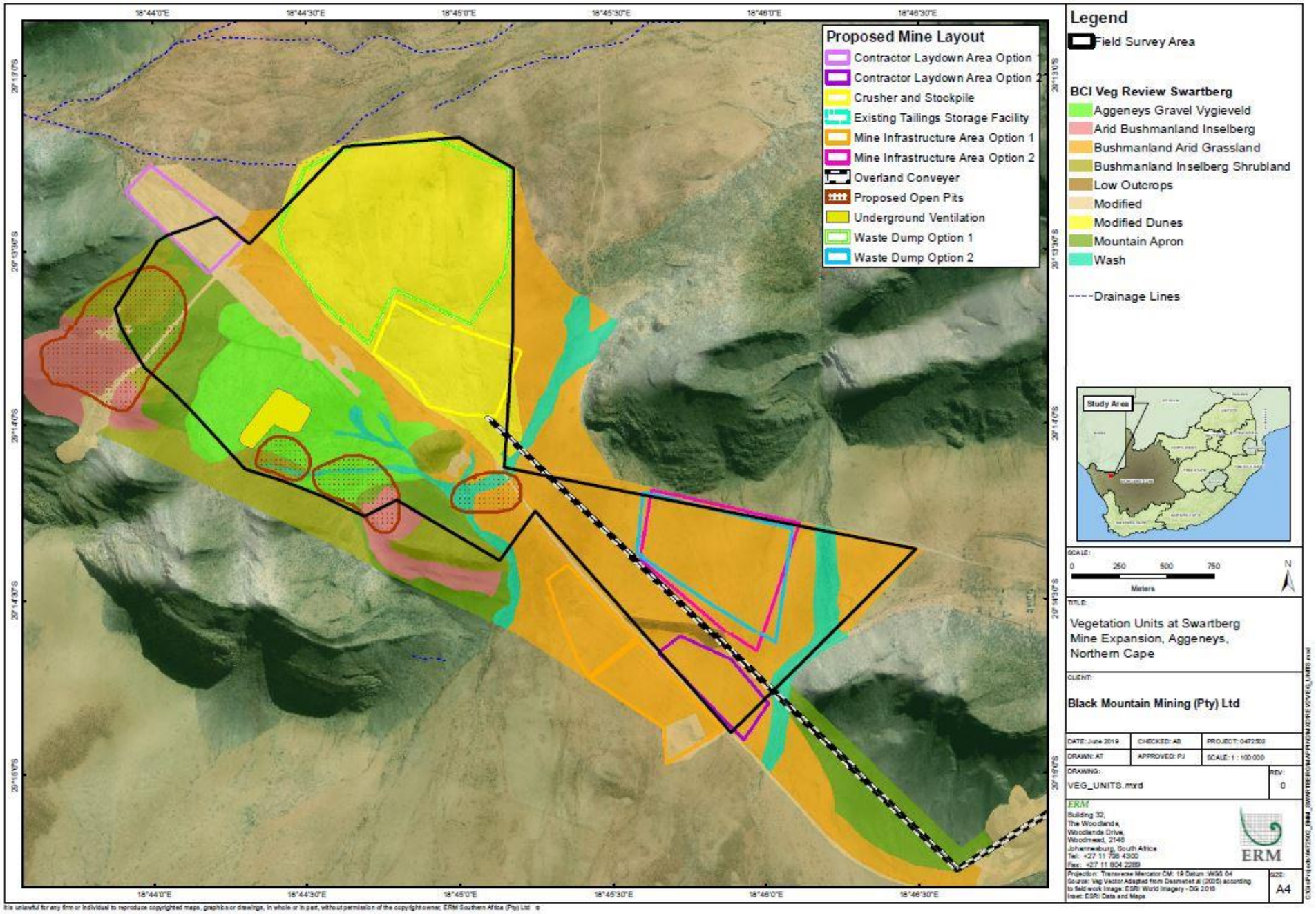
mostly steep slopes and upper ridges of the inselbergs. Common species include Boscia foetida, Ruschia divaricata, Euphorbia gariepina, Kleinia longiflora, Othonna euphorbioides, Psilocaulon subnodosum, Tetragonia reduplicata and Tylecodon rubrovenosus.

- **Bushmanland Sandy Grassland** is found on sandy grassland plains with white grasses (Stipagrostis, Schmidtia) dominating and abundant drought-resistant shrubs. After rainy periods rich displays of ephemeral spring flora (Grielum humifusum, Gazania lichtensteinii) can occur. Other common species include Rhigozum trichotomum, Sisyndite spartea and Eriocephalus species.
- **Namaqualand Klipkoppe Shrubland** is considered as Least Threatened, although only about 6-8% of a target 28% is formally protected. It consists of a complex of very variable landscapes of granite and gneiss boulder koppies and granite domes. Vegetation is dominated by 1-3 m high shrubs with ericoid or succulent leaves. Small trees include Pappea capensis and Aloidendron dichotomum, whilst prominent shrubs include Didelta spinosa, Cotyledon orbiculata and Montinia caryophyllacea. Most of the Swartberg north of the study area and the south-western slopes can be ascribed to this vegetation type, although current mapping (SANBI BGIS 2018) only shows a small portion of Swartberg currently as being part of this vegetation type.

Delineations of the vegetation types of South Africa are approximate, based on large-scale extrapolation of little-available field data, hence elements of all above vegetation types is possible (and was confirmed) within the study area. Vegetation naturally occurs in gradually transitioning mosaics, hence the above delineation (Figure 4.18) should be taken as approximate only. A more detailed delineation of the study area and surroundings was done by Desmet et al. (2005) as part of the BIR, where above vegetation types were further subdivided according to more specific habitat features. As indicated by Desmet et al. (2005), their delineation was based on a large amount of fieldwork conducted, but for the Land Portion Zuurwater no specific ground-survey information was available at the time, hence their delineation of plant associations and habitat types is based on extrapolation of data to the wider area with the help of available remotely sensed data.

Vegetation units were mapped only as far as the anticipated physical footprint of the mine was indicated (i.e. extent of open-pit and waste rock dump). At the time of the survey, remnants of short-lived annual forbs were still visible, and several short-lived succulents were also still present after some rainfall in the preceding months. However, it can be anticipated that after sufficient rainfall, more than the current total of 165 indigenous species can be expected to occur within the Project area.

Figure 4.18 The Approximate Delineation of Plant Associations Observed



Source: Strohbach, 2019

A large portion of the proposed open pit area is covered by undulating and dissected plains coming off the Swartberg Mountain scree slopes in a north-easterly direction, and merging into the surrounding sandy plains. The less-disturbed plains are covered with a mosaic of patches - some covered densely with smaller, whitish quartz pebbles, others covered with larger rock fragments (mostly quartzite and magnetite) and occasional low rocky ridges. Surface soil is limited, but rather accumulated in patches between rock fragments (*Figure 4.19*).

Overall the vegetation structure is dominated by a succulent shrub component, interspersed with Quiver trees and smaller areas appearing more 'open', where low succulent shrubs and few isolated dwarf succulents can be found. The Aggeneys Gravel Vygieveld in the study area is dissected with various small and larger ephemeral drainages, some coming off the mountain, many too small to map, which converge into a larger ephemeral wash to the south-east of the study area.

These plains have in the past been disturbed by past exploration and the construction of water- and electrical infrastructure. A large portion of these plains have been used historically for the original Aggeneys mining and exploration camp – with a multitude of tracks, foundation remnants, old infrastructure and clearly compacted sections still remaining. Only the portion of these plains reaching 'deeper' into the mountain are still in a pristine condition. These different sections, therefore, have different sensitivities based on their condition and biodiversity, as well as their proximity to the more sensitive Bushmanland Inselberg Shrubland (in which case they are seen as a buffer to protect the larger inselberg from dust and other indirect impacts from mining).

Being on the northern (warmer) side of Swartberg, this portion of the Aggeneys Vygieveld does not have nearly as high a diversity – especially in dwarf succulents - as expected and compared to similar habitats around Gamsberg and other Vedanta-owned farms, and thus should be seen as more of a transition zone rather than high-conservation-value Aggeneys Gravel Vygieveld.

The only higher sensitivity feature of this habitat is the number of Quiver trees (Aloidendron dichotomum), ranging from relatively young to rather old trees. There is an ongoing steady decline of Quiver trees as a result of climatic change (Foden *et al.* 2007), and this is also evident in this particular Quiver population: there is hardly any new recruitment – no specimens smaller than 40 cm – as opposed to other populations visited in the region. Further, a number of younger and old specimens have been found dead or senile, which was not the case in other areas visited within the Vedanta properties.

A large proportion of the succulent shrub-flora consists of short-lived or common species, which should be able to re-establish after rehabilitation, and therefore there is no need to relocate such species. Other species are more rare or threatened, and must be relocated.

Figure 4.19 Typical views of Aggeneys Gravel Vygieveld in the Project Area

Bushmanland Inselberg Shrublands

Desmet et al. (2005) describe the Bushmanland Inselberg Shrubland sub-vegetation type as including all vegetation communities on all inselbergs. They do acknowledge that it is a diverse and heterogeneous unit with numerous distinct vegetation communities that relate to the specific habitats – slope, aspect and geology - associated with inselbergs. They are further divided into north-slopes, south-slopes and other micro-habitats, which allow the persistence of unique flora. The cooler southern slopes are known to have the most diverse floristic composition, although these slopes fall outside the area investigated. Rather, the Project area is situated on the harsher north-eastern side of the Swartberg Mine. The geology of the different types of Koppies studied does show differences in geological make-up and species composition, and it was decided to divide these inselbergs into three types according to the dominant species composition, which was strongly influenced by the position of

these habitats within the broader landscape. *Table 4-6* details the most prominent species which were recorded within the vicinity of the Project area.

Table 4-6 The Most Prominent Species Recorded on the Landscape Surrounding the Project Area

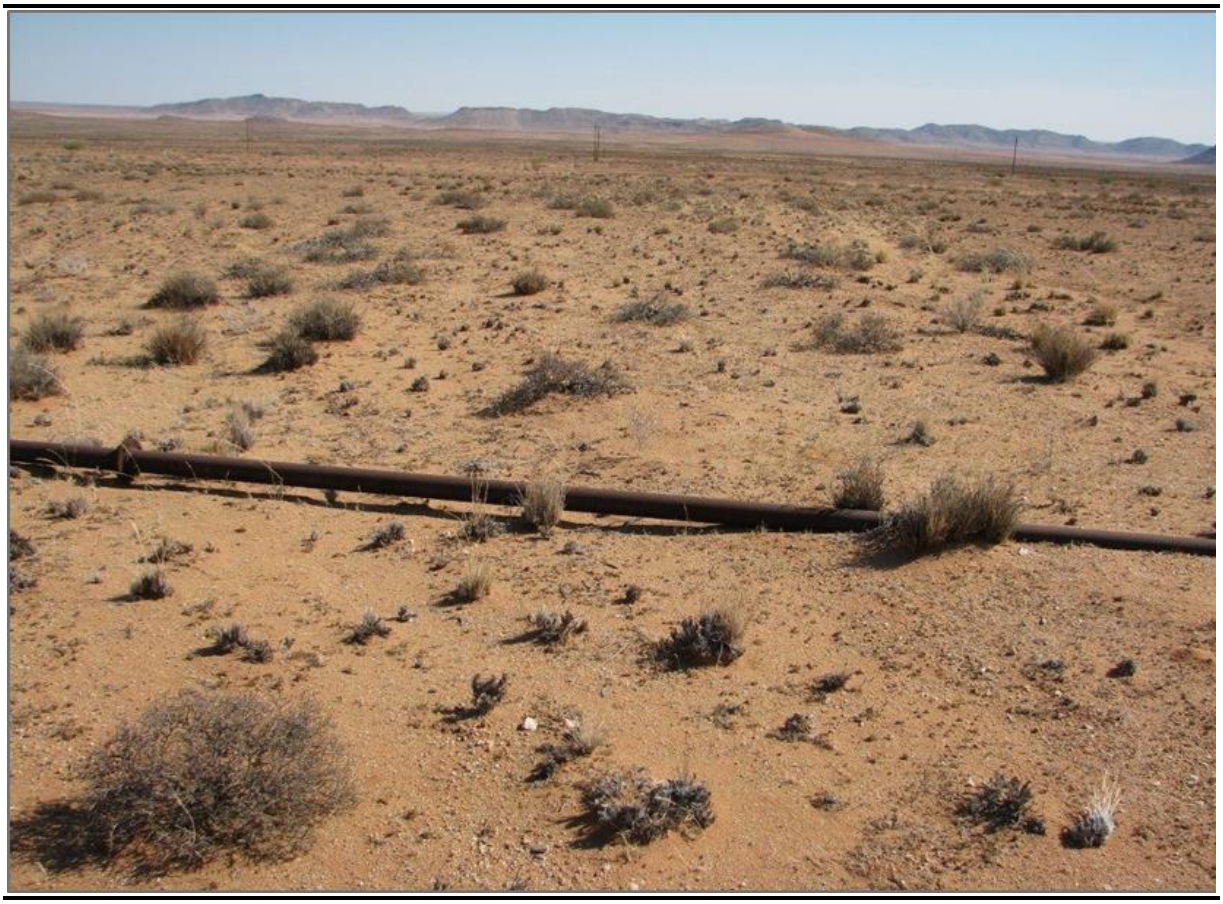
Growth Form	Species
Aggeneys Gravel Vygieveld	
Woody shrubs and trees	*Rhigozum trichotomum*
Dwarf shrubs	*Eriocephalus ambiguus, Galenia crystalline*
Grasses	*Enneapogon desvauxii*
Forbs	*Aptosimum spinescens, Heliophila cf. lactea, Hypertelis salsoloides*
Succulents	*Ruschia cf. robusta, Zygophyllum dregeanum, Euphorbia gregaria, Tetragonia reduplicata, Aloidendron dichotomum (Aloe dichotoma* – Quiver tree), *Ruschia muricata, Zygophyllum dregeanum* Unique Dwarf Succulents: *Anacampseros filamentosa, Avonia albissima, Avonia papyracea subsp. papyracea, Dinteranthus puberulus*
Observed species diversity	72 of which: 71 Indigenous species, including: 1 Red-Data species 5 endemic species 24 protected species 1 Exotic and/or alien invasive species
Bushmanland Inselberg Shrublands	
Woody shrubs and trees	*Boscia foetida subsp. foetida, Commiphora gracilifrondosa, Diospyros ramulosa, Montinia caryophyllacea, Ozoroa dispar, Searsia burchellii*
Dwarf shrubs	*Eriocephalus pauperrimus, Berkheya canescens, Pteronia mucronata*
Grasses	*Enneapogon desvauxii, Panicum arbusculum, Stipagrostis anomala*
Forbs	*Forsskaolea candida*
Succulents	*Portulacaria namaquensis, Ruschia divaricata, Euphorbia* species Unique Dwarf Succulents: *Adromischus alstonii, Anacampseros filamentosa, Avonia recurvata* subsp. *minuta, Conophytum fulleri, Stapelia similis, Larryleachia cactiformis, Tylecodon rubrovenosus*
Observed species diversity	102 of which: 102 Indigenous species, including: 3 Red-Data species 4 endemic species (2 narrow-endemics – restricted to these environments) 29 protected species
Mountain Aprons	
Woody shrubs and trees	*Boscia foetida subsp. foetida, Commiphora gracilifrondosa, Rhigozum trichotomum*
Dwarf shrubs	*Galenia crystallina, Tripteris sinuata, Dyerophytum africanum, Eriocephalus microphyllus, Pteronia mucronata*
Grasses	*Stipagrostis ciliata, Danthoniopsis ramosa, Eragrostis nindensis, Panicum arbusculum, Stipagrostis anomala*
Forbs	*Aptosimum spinescens, Heliophila cf. deserticola*
Succulents	*Cynanchum pearsonianum, Ruschia cf. robusta, Zygophyllum dregeanum, Euphorbia gregaria, Ruschia divaricate*
Observed species diversity	70 species of which:

Growth Form	Species
	70 Indigenous species, including: 2 Red-Data species 3 endemic species 16 protected species
Low Outcrops	
Woody shrubs and trees	*Rhigozum trichotomum, Boscia foetida subsp. foetida, Lycium cinereum*
Dwarf shrubs	*Eriocephalus pauperrimus, Hermannia spinosa, Hermbstaedtia glauca, Limeum aethiopicum , Monechma genistifolium*
Grasses	*Enneapogon desvauxii, Enneapogon scaber, Panicum arbusculum*
Forbs	*Forsskaolea candida, Heliophila cf. deserticola, Didelta carnosa var. carnosa*
Succulents	*Kleinia longiflora, Mesembryanthemum arenosum, Portulacaria fruticulosa, Ruschia cf. robusta, Ruschia divaricate*
Observed species diversity	46 of which: 46 Indigenous species, including: 0 Red-Data species 8 protected species (but geophytes may be present after rains)
Washes	
Woody shrubs and trees	*Rhigozum trichotomum, Boscia albitrunca, Pappea capensis, Ehretia alba*
Dwarf shrubs	*Dyerophytum africanum, Indigofera heterotricha, Monechma incanum, Salsola* species
Grasses	*Stipagrostis ciliata, Stipagrostis hochstetteriana, Stipagrostis namaquensis, Stipagrostis obtuse*
Forbs	*Acanthopsis hoffmannseggiana, Aptosimum spinescens, Blepharis furcata, Chascanum garipensis, Dicoma capensis, Didelta carnosa var. carnosa*
Succulents	*Mesembryanthemum subnodosum, Mesembryanthemum coriarium, Mesembryanthemum guerichianum, Zygophyllum chrysopteron, Tetragonia reduplicata*
Observed species diversity	79 of which: 79 Indigenous species, including: 2 Red-Data species 2 endemic species 13 protected species (including several ruderal species)

Bushmanland Arid grassland on Sandy Gravel Plains

At the eastern periphery of the proposed open-pit mining area, as well as the plains south east of Swartberg (Waste Rock Dump Alternative 1) are covered with a mixture of fine gravel and sand mixed with this finer gravel. Small patches of quartz- and calcrete pebbles occur south of the small outcrop, but these do not host a significantly unique dwarf succulent flora, nor could they be described as Aggeneys Gravel Vygieveld. Overall the soil layer appears to be eroding after significant rainfall events, with very shallow gullies visible all over, but only few more distinct washes present. The vegetation is largely dominated by shrub-like grasses and succulent shrubs, of which many are short-lived and may appear or disappear for several years depending on prevailing rainfalls. Occasionally larger trees and woody shrubs such as *Rhigozum trichotomum* (Driedoring) and *Parkinsonia africana* (Green-hair-thorn) can be found. *Table 4-6* details the most prominent species which were recorded within the vicinity of the Project area.

Figure 4.20 Typical View of Bushmanland Arid Grassland in the Project Area



Modified Dunes

The area immediately east/north-east of the proposed opencast mining area would appear to have been part of the Bushmanland Sandy Grassland, where – as defined by Mucina and Rutherford (2006) – red soils would be > 300 mm deep. From communication with mine staff it would appear that the area was originally covered with low dunes, but has been used over many years to mine sand for various purposes. Currently the area can only be described as modified dunes, as there are still numerous tracks across the area, and the topography has been clearly modified from extensive groundworks. Despite the significant past disturbances, vegetation typical of the Bushmanland Sandy Grassland has re-established – most notably a moderate layer of hard, shrub-like grasses. Occasionally tall woody shrubs are still present, whilst a low presence of the alien invasive plants has been – mostly coming from some of these species being part of the gardens of the original Aggeneys Mining Camp just north-east of Swartberg (abandoned and demolished after flooding because of an extreme rainfall event). *Table 4-6* details the most prominent species which were recorded within the vicinity of the Project area.

Figure 4.21 Typical View of Modified Dunes in the Project Area

Washes

The washes in the Project area are relatively varied in nature, all ephemeral (i.e. flowing only for a short time after sufficient precipitation) draining in a south-westerly direction off the northern slopes of Swartberg as well as the mountain east of Swartberg. Although many smaller drainage systems exist off the slopes, only the larger washes with either or all of the following characteristics were mapped, based on the following characteristics:

- Distinct apron of denser, higher and woody vegetation able to persist from higher sub-surface water availability;
- Distinct bed consisting of coarse sand – even if it is interspersed with boulders – the latter showing clear signs of fluvial erosion; and
- Distinct incision from the surrounding landscapes.

The species assemblage showed that some species are unique to this ecosystem, or at least only able to persist under the more favourable conditions of the washes in the otherwise very arid surroundings. *Table 4-6* details the most prominent species which were recorded within the vicinity of the Project area.

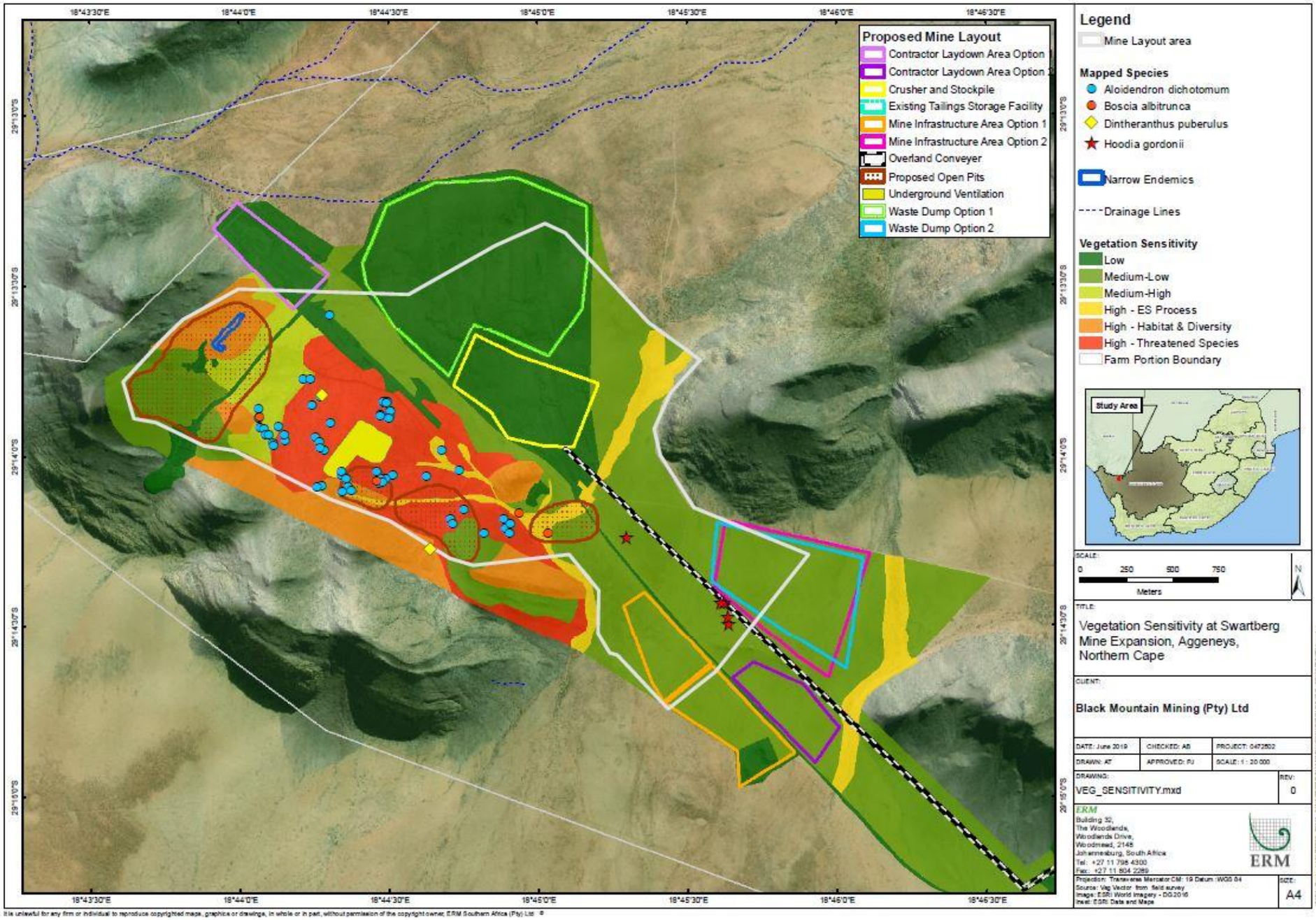
Modified Plains

Areas with extensive past or relatively recent groundworks, including disturbed areas adjacent to large gravel roads, have been observed on the transition areas between the Aggeneys Gravel Vygieveld, the Mountain Apron and the Bushmanland Arid Grassland. Although some vegetation has re-established here, including a small Quiver Tree, the soils remain compacted and vegetation, where present, is dominated by ruderal and common species. It would appear that without more specific rehabilitation works, the natural regeneration of vegetation as it may have originally been will remain limited. Apart from the one quiver tree there, this vegetation type has not been described in further detail, and overall vegetation sensitivity in its current state is regarded as low (Strohbach, 2018). *Table 4-6* details the most prominent species which were recorded within the vicinity of the Project area.

Species of Conservation Concern

The map (Figure 4.22) below illustrates the Project area and alternative sites with an overlay of vegetation sensitivity found in the area as well as some species of conservation concern.

Figure 4.22 Vegetation Sensitivity Map and localities of Some Species of Conservation Concern



Source: Strohbach, 2018

Alien Invasive Plant Species

In general, the occurrence of alien and invasive species within the Project area is very low. However, past and current land-use and related disturbances have made the open areas within the entire Project area prone to invasion by undesirable alien plant species. The latter often happens unintentionally through wind- or bird-distributed seed, or seeds distributed by the movement of soils and materials contaminated with seeds of such plants, or movement of machinery. In addition, species such as Mesquite had been planted as part of the initial Aggeneys settlement, from where seed may gradually spread (Strohbach, 2018).

Table 4-7 Alien Invasive Species observed within the Project Area

Category 1b	Category 3	CARA Indicators of Bush Encroachment
Salsola kali	*Prosopis glandulosa*	*Rhigozum trichotomum*
*Argemone ochroleuca**		
*Datura stramonium**		
*Pennisetum setaceum**		

* Species occurring in the area (road verges) with a high risk to become established
Source: Strohbach, 2018

4.2.8 Fauna

Mammals

The mammalian community at the Project site is likely to be of moderate diversity. Although more than 50 species of terrestrial mammals are known from the wider area, the extent and habitat diversity of the Project site is relatively low and would not support a very wide range of mammals. Species that can be confirmed present in the area based on previous site visits to the area include Caracal, Black-backed Jackal, African Wildcat, Cape Fox, Chacma Baboon, Rock Hyrax, South African Ground Squirrel, Steenbok, Duiker, Springbok, Gemsbok, Cape Porcupine, Yellow Mongoose, Cape Grey Mongoose, Small-spotted Genet, Striped Polecat, Cape Hare, Red Rock Rabbit, Springhare, Aardvark, Aardwolf, Round-eared Elephant Shrew, Western Rock Elephant Shrew, Namaqua Rock Mouse, Pygmy Rock Mouse and Hairy-footed Gerbil.

Species associated with the rocky outcrops of the area include Rock Hyrax, Klipspringer, Pygmy Rock Mouse, Namaqua Rock Mouse and Western Rock Elephant Shrew. The open plains which characterise the majority of the Project area are likely to be dominated by species associated with open hard or sandy ground such as various gerbils including the Hairy-footed Gerbil, Cape Hare, Steenbok, Cape Fox, Bat-eared Fox, Aardvark and Aardwolf. There are also burrows of Ground Squirrels and Yellow Mongoose at the site and these appear to be the most common fauna within the Project area.

The only small mammal captured at the site was the Hairy-footed Gerbil, *Gerbillurus paeba (Figure 4.23).* This species is widespread across the arid and semi-arid parts of the country and is restricted to the sandy pediments of the Project site.

Figure 4.23 Hairy-footed Gerbil (Gerbillurus paeba) captured on the Project Site

Source: Strohbach, 2018

Two listed species may occur in the Project area, the Black-footed cat *Felis nigripes* (Vulnerable) and Leopard *Panthera pardus* (Vulnerable). Given the existing levels of anthropogenic disturbance in the Project area, it is not likely that the Leopard is very active in the Project area. The Project site is however broadly suitable for the Black-footed Cat which favours a mix of open and more densely vegetated areas. This species is however widely distributed across the arid and semi-arid areas of South Africa

Reptiles

Although reptile diversity in the Project area is high with as many as 60 species known. However, a much smaller subset of these are likely to be present within the Project site. Species observed at the site are typical of the area and include Verrox's Tent Tortoise, Western Rock Skink, Western Three-striped Skink, Namaqua Sand Lizard, Spotted Desert Lizard, Southern Rock Agama and Plain Sand Lizard. Conditions at the time of the site visit were not ideal for reptiles, given the prolonged drought that the area has been experiencing and the likely depressing effect this is likely to have had on local reptile populations. However, the rocky hills and gravel plains were observed to have a higher density and diversity of reptiles present, as compared to the sandy plains. There are only two listed species recorded in the Project area, Good's Gecko (VU) and the Speckled Padloper (VU).

Reptiles observed at the Project site include Verrox's Tent Tortoise, Western Three-striped Skink, Western Rock Skink and Variegated Skink (*Figure 4.24*)

Figure 4.24 Reptiles observed on the Project Site

From top left, Verrox's Tent Tortoise, Western Three-striped Skink, Western Rock Skink and Variegated Skink.

Amphibians

Only eight frog species are known in the Project area and this is likely to be an overestimate of the number of amphibian species likely to be present within the Project site as there is no natural perennial water in or near the site. The only species likely to be present within the site would be species that are relatively independent of water such as the Karoo Toad and possibly the Paradise Toad. The ephemeral drainage lines are likely to be the most important areas for amphibians, but given the extreme drought conditions which characterise the area, there are not likely to be any parts of the site that are of high importance for amphibians.

Avifauna

A total of 56 bird species have been recorded in the broader Project area, based on limited Southern African Bird Atlas Project (SABAP) 2 surveys (2 pentads, 3 cards). An additional 14 species may occur in the area based on the proximity of their distributions to the broader proposed mining area based on SABAP 2 and older SABAP 1 data (Harrison *et. al*., 2007). Hence, an approximate total of 70 species may occur, of which one species is considered endemic to South Africa, ten species are near-endemic, while five species are listed as nationally threatened.

The bird assemblage recorded within the Project site is fairly typical of the Succulent and Nama-Karoo Biomes. During the field survey a total of 41 bird species were recorded. 20 species were recorded at the sandy plains, and 22 species at the quartz foothills. Slightly more species were recorded along transects at the quartz foothills than the sandy plains. Both the number of detections and total number of individuals recorded along transects were higher at the quartz foothills. However, there was also

greater variation in the number of individuals recorded along transects at this site, which was primarily due to the large numbers of Lark-like Bunting *Emberiza impetuani* and Namaqua Sandgrouse *Pterocles namaqua* attracted to artificial water sources (mostly leaking water pipes).

The quartz foothills supported a number of species typical of course gravel environments, such as Karoo Long-billed Lark *Certhilauda subcoronata*, Sabota Lark *Calendulauda sabota*, and Cape Bunting *Emberiza capensis* (*Table 4-9*). In addition to the birds recorded during transect surveys, other species of importance that were noted include Cinnamon-breasted Warbler *Euryptila subcinnamomea* (restricted mostly to rocky ridges) and Verreaux's Eagle *Aquila verreauxii*. Species which were only recorded at the sandy plains in fair numbers include Ant-eating Chat *Myrmecocichla formicivora* and Chat Flycatcher *Bradornis infuscatus*.

Summary of transect results for sandy plains and quartz foothills on the Project site during the field survey are described in *Table 4-8*.

Table 4-8 Summary of Transect results for Sandy Plains and Quartz Foothills

Transect	Sandy plains			Quartz foothills		
	No. of species	**No. of detections**	**No. of individuals**	**No. of species**	**No. of detections**	**No. of individuals**
1	9	15	30	14	20	66
2	8	17	42	6	13	101
3	5	8	35	8	21	104
4	7	13	46	8	14	33
5	10	14	26	14	18	28
Average	**7.8**	**13.4**	**35.8**	**10.0**	**17.2**	**66.4**
Std. deviation	**1.9**	**3.4**	**8.3**	**3.7**	**3.6**	**36.1**

Summary of species recorded along line transects at the sandy plains and quartz foothills during the field survey of the Project site with respect to the number of detections per species, the total number of birds detected per species is described in *Table 4-9.*

Table 4-9 Summary of species recorded along line transects

Species	Sandy plains		Quartz foothills	
	No. of detections	No. of birds	No. of detections	No. of birds
Barbet, Acacia Pied	1	2	3	3
Bokmakierie	4	6	2	2
Bunting, Cape	-	-	4	4
Bunting, Lark-like	15	48	25	144
Canary, White-throated	1	1	5	11
Chat, Ant-eating	4	8	-	-
Chat, Familiar	-	-	1	1
Chat, Karoo	1	1	-	-
Cisticola, Grey-backed	2	3	3	3
Crombec, Long-billed	1	1	1	1
Eremomela, Yellow-bellied	1	1	-	-
Finch, Scaly-feathered	2	16	1	2
Fiscal, Southern	2	3	2	2
Flycatcher, Chat	2	3	-	-
Lark, Grey-backed Sparrow-	7	40	3	5
Lark, Karoo Long-billed	-	-	5	7
Lark, Sabota	-	-	4	4
Prinia, Black-chested	-	-	1	1
Robin, Karoo Scrub	-	-	1	1
Sandgrouse, Namaqua	1	2	8	65
Sparrow, Cape	1	2	-	-
Starling, Pale-winged	10	27	1	2
Sunbird, Dusky	1	1	1	1
Tit, Grey	1	1	1	2
Tit-Babbler, Layard's	-	-	1	1
Warbler, Rufous-eared	1	2	-	-
Weaver, Sociable	-	-	8	62
Wheatear, Mountain	9	11	5	8
Totals	**67.0**	**179.0**	**86**	**332.0**

A number of endemic (1) and near-endemic species (10) are known to occur in the broader Project area, and may occur at the Project site. The following species are known from the region, the endemic Red Lark *Calendulauda burra* (also red-listed as Vulnerable), the near-endemic Sclater's Lark *Spizocorys sclateri* (listed as Near-threatened), Black-headed Canary *Serinus alario*, Black-eared Sparrowlark *Eremopterix australis,* Karoo Thrush *Turdus smithi*, Grey Tit *Melaniparus afer*, Layard's Tit-babbler *Sylvia layardi,* Jackal Buzzard *Buteo rufofuscus*, Southern Double-collared Sunbird *Cinnyris chalybeus*, Fairy Flycatcher *Stenostira scita* and Cinnamon-breasted Warbler. Of these species, only Red Lark and Sclater's Lark are red-listed, have limited geographical distributions and specific habitat requirements (Hockey *et al*., 2005). These species were not detected during the field survey, most likely due to the absence of locally suitable habitat. Although Red Lark favours sandy plains with good grass coverage (Hockey *et al*., 2005), they are almost exclusively recorded in the Aggeneys area where there

are red sand dunes. They are a highly conspicuous species and should have been readily detected if present at the sandy plains site. Sclater's Lark prefers sparsely vegetated stony plains and open areas of quartz gravel with extensive bare patches (Hockey *et al*., 2005), which were absent from the Project site.

A number of red-listed species are likely to occur in the Project area, and include Martial Eagle *Polemaetus bellicosus* (Endangered), the endemic Red Lark (Vulnerable), Verreaux's Eagle (Vulnerable), Lanner Falcon *Falco biarmicus* (Vulnerable), Secretarybird *Sagittarius serpentarius* (Vulnerable), and the near-endemic Sclater's Lark (Near-threatened). Besides Red Lark and Sclater's Lark, Verreaux's Eagle and Lanner Falcon have a high probability of occurring, whereas Secretarybird has a low probably of occurrence, based on SABAP2 reporting. A pair of Verreaux's Eagle were seen in the broader Project area during the field survey, and likely breed in the area, while Lanner Falcon is occasionally detected throughout the region. These species, including Secretary bird, have large home ranges are thus unlikely to be affected by the proposed mining and stockpiling activities.

The Project site lies within the Haramoep and Black Mountain Important Bird Area (IBA), which is one of the few sites offering protection to the globally threatened Red Lark (Marnewick *et al*., 2015). Although much of the land within this IBA is natural, vast areas have been impacted by overgrazing and degradation, while facing new threats from renewable energy developments, mining and climate change. Although this biome contains 16 of the 23 Namib-Karoo biome-restricted species, only five (5) of these were recorded at the Project site, namely Layard's Tit-babbler (near-endemic), Pale-winged Starling *Onychognathus nabouroup*, Karoo Long-billed Lark, Karoo Chat *Cercomela schlegelii* and Cinnamon-breasted Warbler (near-endemic). All of these species, except for Karoo Chat, are common throughout the region and mostly restricted to rocky and mountainous areas, and are thus unlikely to be threatened by the proposed mining activities. Karoo Chat is considered marginal to the sandy plains of the region, and occurs more commonly southwards throughout the Nama Karoo. With respect to red-listed species, no Red Lark *Calendulauda burra* (Vulnerable, endemic) or Sclater's Lark *Spizocorys sclateri* (Near-threatened, near-endemic) were recorded at the sites, while the habitats represented are also not the preferred habitat types for these species.

The IBA is important for nomadic larks that occur seasonally (Marnewick *et al*., 2015). A limitation of the study is that the area was surveyed when conditions would have not been favourable for many nomadic species due to the prevailing dry conditions. However, many of these species occur over vast areas, such as Black-eared Sparrowlark, Grey-backed Sparrowlark, and Black-headed Canary.

Faunal Habitats

Sandy Plains

The majority of the WRD B consists of sandy plains dominated by various *Stipagrostis* species including *S.brevifolia*, *S.ciliata* and *S.obtusa*, with various shrubs present including *Sisyndite spartea*, *Rhigozum trichotomum* and *Parkinsonia africana*. This is a widespread habitat both within the site and more broadly within the wider Aggeneys area. In general, the fauna species associated with this habitat are common, widespread species. It is not considered to be highly sensitive, as it is common and it is also not associated with any species of particular conservation concern. The loss of habitat within the plains habitat is not seen as being highly significant as this habitat is widely available and there are few endemic or specialised species associated with this habitat.

Gravel Plains

The majority of the Project site consists of gravel plains and lower slopes (*Figure 4.25*). Common species include *Ruschia* sp. *Euphorbia gregaria*, *Sarcostemma viminale*, *Aloe dichotoma*, *Searsia burchelli* and *Boscia foetida* subsp*. foetida*. Apart from the greater vegetation diversity, this area also has greater faunal diversity and abundance. This is related to the greater variety of habitats present, which includes some rocky outcrops which provide shelter for reptiles, drainage lines which attract

mammals and greater vegetation structural diversity which attracts birds. The gravel plains are considered more sensitive than the sandy plains. This is also a much more restricted habitat than the sandy plains and as such is considered more vulnerable to cumulative impacts. The gravel plains of the site are considered moderate sensitivity for fauna and are of above average significance for reptiles in particular, but are also important for birds and mammals.

Figure 4.25 Photo of Gravel Plains Habitat

Rocky Hills

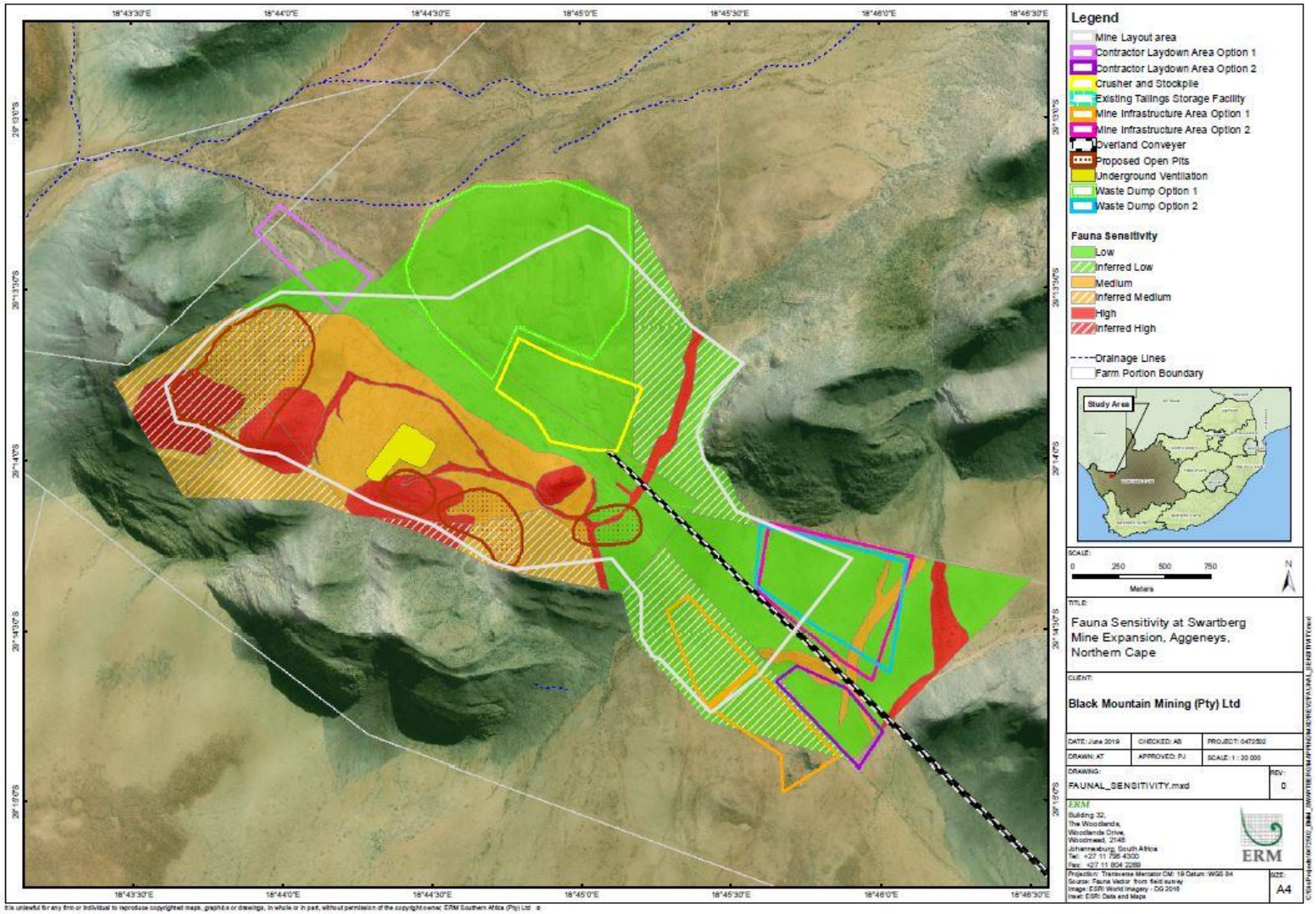
The rocky outcrops and mountains flanking the Project site are considered sensitive from a faunal perspective as these areas are home to a variety of species not found elsewhere. There are numerous mammals, reptiles and birds that are associated with the rocky hills and which are not commonly found on the adjacent plains. This includes mammals such as Klipspringer, Red Rock Rabbit and numerous small mammals, reptiles including several locally endemic geckos and other species which seek shelter among the rocks and a variety of bird species and in particular raptors such as Verreaux's Eagles and Lanner Falcon. In general, these species also use the adjacent lower slopes and gravel plains to varying degrees and as such are also likely to be impacted to some degree by habitat loss within the adjacent gravel plains areas. Although there is some extent of this habitat within Project site, the overall potential loss of habitat within the rocky hills due to the development is low. The rocky hills of the site are considered sensitive for fauna as they are home to a high diversity of species, many of which are not found within the other habitats of the broader Project area.

Figure 4.26 Photo of Rocky Hills Habitat

Site Sensitivity Assessment

The faunal sensitivity map for the Project area is illustrated below. The plains of the Project site are considered low sensitivity. The gravel plains and some of the smaller rocky outcrops are considered Medium sensitivity on account of their higher faunal value and diversity. The drainage lines of the site are considered to be High sensitivity due to their high value as faunal habitat and the more general hydrological function they perform. The larger rocky outcrops and steep hills of the site are considered to be High sensitivity.

Figure 4.27 Faunal Sensitivity Map for the Project Area



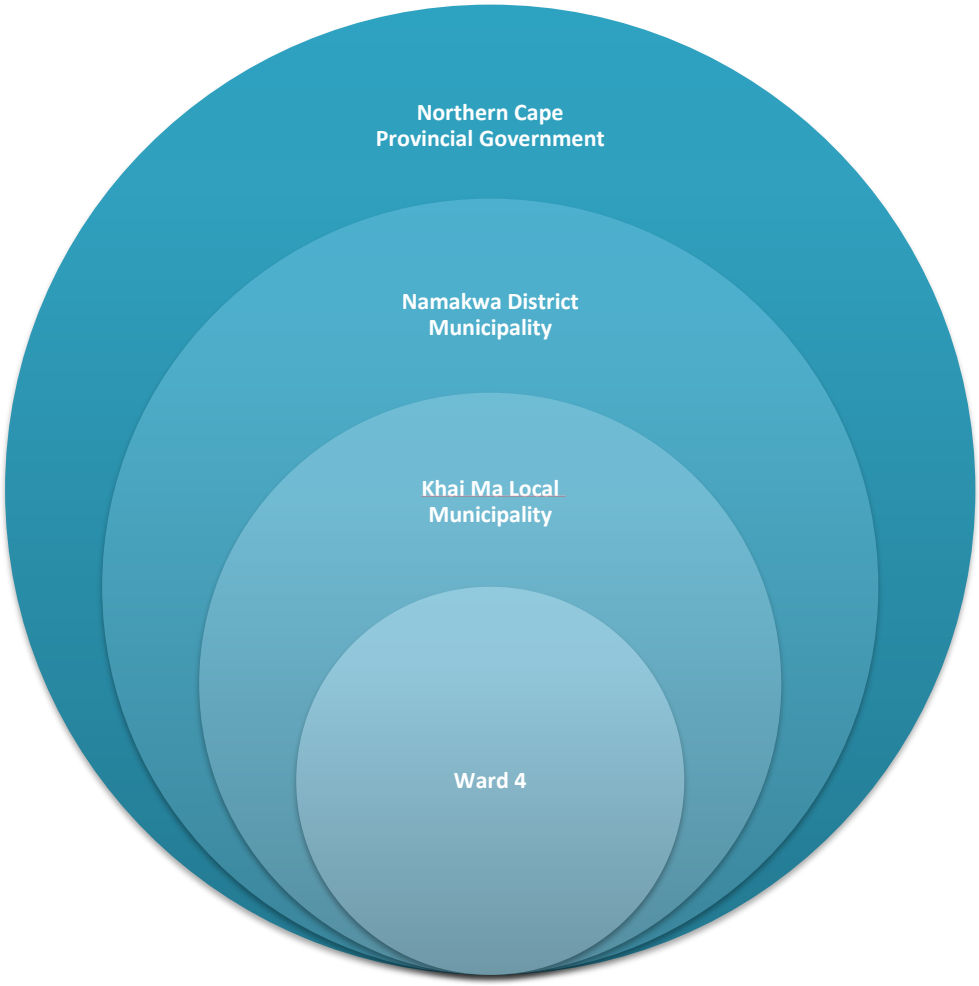
4.3 Socio-economic Baseline

The socio-economic baseline provides a demographic, cultural and economic overview of the Project area and also describes the physical infrastructure and services available in the surrounding communities. 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. Information was gathered for this section by gathering secondary data on socioeconomic characteristics at the national, state and local level. It is important to note that information used to draft this chapter was taken from government official documents. It is assumed that these documents were drafted using statistical information from the most recent census which was conducted in 2011.

4.3.1 Administrative Structure

The Project area is situated in the Northern Cape Province, approximately 11 km west of Aggeneys town. Other towns closest to this project site include Pofadder (approximately 65 km west of the project site) and Springbok (approximately 108 km south east of the project site) along the N14. The Project is located in Ward 4 of the Khai Ma Local Municipality, which falls within the Namakwa District Municipality. This administrative structure is illustrated in *Figure 4.28*.

Figure 4.28 Administrative Structure



Source: IDP (2012-2017)

Northern Cape Province

The Northern Cape Province is the largest province of South Africa, occupying a total area of 372 889 km^2 which amounts to 30% of the country's total land area (Provincial Spatial Development Framework (PSDF), 2017). The Northern Cape has five District Municipalities comprising Pixley Ka Seme, Frances Baard, Namakwa, Siyanda and Kgalagadi. These five District Municipalities are made up of twenty-six local municipalities. The major towns in these District Municipalitys 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.

Namakwa District Municipality

The Namakwa District Municipality is the largest District Municipality in South Africa. The Namakwa District Municipality 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 Namakwa District Municipality were managed as District Management Areas[1]. The Namakwa District Management Area has been subsumed by five of the six local municipalities since the local government elections in 2011. Only the Richtersveld Local Municipality was not affected by changes to its municipal boundaries[2]. The executive authority of the Namakwa District Municipality rests with the Executive Mayor.

The regional centre of the Namakwa District Municipality is Springbok. Strategic development within the Namakwa District Municipality is aligned with the Northern Cape Provincial Growth and Development Strategy 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 Namakwa District Municipality has shifted from the provision of infrastructure and basic services to socio-economic development and the spatial identification of areas with development potential.[3]

Local Municipalities

Khai Ma local Municipality

The Swartberg Mine falls into the Khai-Ma Local Municipality. Khai-Ma Local Municipality is a low capacity municipality, which shares its executive and legislative authority with the Namakwa District Municipality. It is divided into four wards, of which the Project falls within ward 4. This LM comprises five towns, namely: Pofadder, Aggeneys, Pella, Witbank and Onsepkans. The main town in the Khai-Ma Local Municipality is Pofadder, which is both an economic hub and the seat of local government.

The role of the Local Municipality is to monitor and manage service delivery to settlements within its jurisdiction, implement plans and policies of the Namakwa District Municipality and to carry out the development objectives outlined within the Local Economic Development.

Khai-Ma Local Municipality 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. 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] 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).

Settlements in the Project's Area of Influence

Table 4-10 below lists all the settlements within the Project's AoI as well as their distance from the Project Mine boundary.

Table 4-10 List of Settlements in the Project AoI

Settlement	Proximity from the Project Site
Aggeneys	11km
Pella	53km
Pofadder	65km
Onseepkans	112km
Springbok	108km

Aggeneys

Aggeneys is situated 11 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 Local Municipality. Aggeneys has the largest concentration of people in close proximity to the project location with an estimated population of 2053 people (Khai-ma Municipality IDP, 2012/2017). 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 (Gamsberg ESIA, 2013).

Pella

Pella is 53 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. Pella has a population of 1425 people with an estimated 355 households (Khai-Ma Municipality IDP, 2012/2017). The key livelihood activities in Pella are in the agricultural sector. People engage in subsistence farming on the banks of the Orange River. 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.

Pofadder

Pofadder is the administrative seat of the Khai Ma Local Municipality and has developed as an agricultural service centre for the surrounding farming community. It is approximately 65 km from the Project site on the N14. It has an estimated population of 2919 people and 733 households (Khai-Ma Municipality IDP, 2012/2017). 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 (Khai Ma IDP, 2010-2011).

Onseepkans

Onseepkans is a small border post settlement situated 1125 km from the mine, en-route to Namibia. Onseepkans has three settlements namely Melkbosrand, Viljoensdraai and Sending. Onseepkans has

an estimated population of 912 people with 204 households (Khai-Ma Municipality IDP, 2012/2017). 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.

Springbok

Springbok is the major economic centre of the region and is the seat of the Namakwa DM. It is situated approximately 108 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. 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 (Gamsberg ESIA, 2013).

4.3.2 Demographic Profile

Northern Cape Province

The Northern Cape has a population of 1,145,861 people (Stats SA, 2012). 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. 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 (Stats SA, 2012).

Despite the large area covered by the Namakwa District Municipality (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 (Stats SA, 2012). The population distribution for the Namakwa District Municipality is shown in *Table 4-11.*

Table 4-11 Namakwa District Population Distribution between 1996 and 2011

Municipality	1996 Population	2001 Population	2011 Population
Richtersveld Local Municipality	12 819	10 125	11 982
Karoo Hoogland Local Municipality	12 387	10 512	12 588
Kamiesberg Local Municipality	11 064	10 754	10 187
Khai Ma Local Municipality	9 550	11 469	12 465
Hantam Local Municipality	19 942	20 351	21 578
Nama Khoi Local Municipality	43 841	44 900	47 041
Namakwa District Municipality	**109 603**	**108 111**	**115 842**

Source: Stats SA, 2012

Khai-Ma Municipality

The estimated population for Khai-Ma Local Municipality is 12 465 people. This number has increased by 996 people since the 2001 census (Stats SA, 2012). It is sparsely populated, with +/- one person per square kilometre. A majority of the Khai-Ma Local Municipality population is found in the Khai-Ma rural area, followed by Pofadder and Aggeneys. The population distribution is illustrated in *Table 4-12.*

Table 4-12 Population and Household Figures per Town

Towns	Population Number	Current Households
Aggeneys	2053	666
Khai-Ma rural	4035	1404
Onseepkans	912	204
Pella	1425	355
Pofadder	2919	733
TOTALS	11344	3362

Source: IDP, 2012/2017

The majority of the population in this Local Municipality fall within the 15 to 34 year old age group with 2208 males and 1844 females. The number of senior citizens (over 65) is relatively low with only 254 males and 333 females (IDP, 2012/2017).

4.3.3 Economic Profile

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.

Economic Output, Growth and Development Trends

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.

The mining sector contributed the most towards the province's Gross Domestic Product (GDP) with 27% in the year 2011. 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 % of its iron-ore, 93 % of its lead and 99 % of its manganese (Gamsberg ESIA, 2013). 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 (Gamsberg ESIA, 2013).

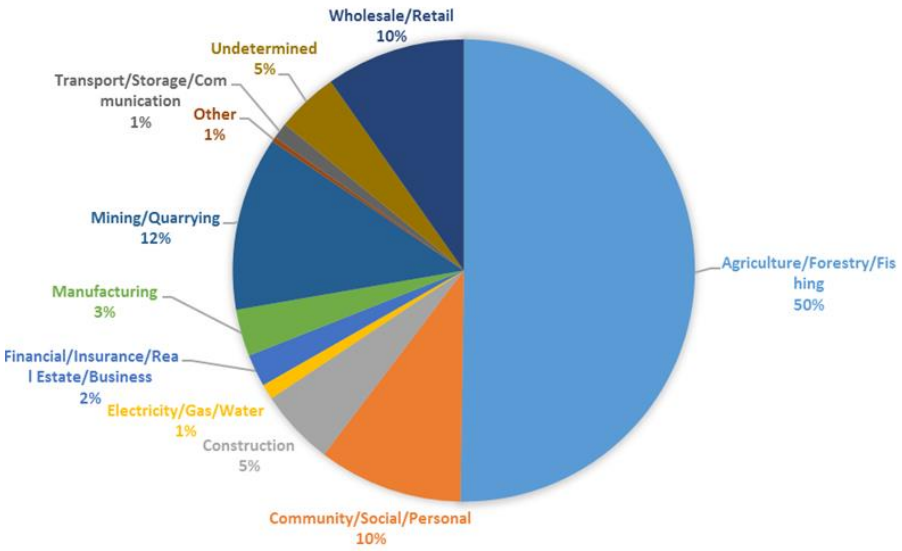
The existing Black Mountain Mine adjacent to Aggeneys is the dominant mine in the area although there are also other minor quarries and diggings.

Employment

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 Gamsberg ESIA, 2013).

The Khai-Ma population is predominantly employed in the agriculture/forestry/fishing industry with a total of 1870 people employed in those industries. The mining/quarrying industry employs 453 people in the Khai-Ma population (IDP, 2012/2017). *Figure 4.29* below summarises the employment distribution in the Khai-Ma Local Municipality.

Figure 4.29 Employment Distribution in the Khai-Ma Local Municipality



Source: IDP, 2012/2017

4.3.4 Education

Northern Cape Province

The average number of adults with schooling in the Northern Cape is lower than that found in the whole of South Africa. The Northern Cape has approximately 19.7% of the adult population without schooling compared to the 18.1% in the whole of South Africa. The increased access to higher education in the province since 2001 was owed to the awarding of the Premier's bursary fund which increased from R5.6 million in 2006 to R16.9 million in 2007(PSDF, 2012). Due to the lack of education in the Northern Cape Province, it has led to the province producing the smallest number of highly skilled professionals in South Africa with only 11.1% (PSDF, 2012).

Khai-Ma Municipality

The education levels in the Khai-Ma Local Municipality have been summarised in Table 4-13.

Table 4-13 Education Level in the Khai-Ma Local Municipality

Education Level	Percentage (%) of Population
None	15.57%
Some primary	27.27%
Complete primary	8.75%
Some secondary	28.05%
Grade 12	9.15%
Higher	2,20%

Source: IDP, 2012/2017

A list of schools in Pella, Aggeneys, Onseepkans and Springbok is provided in *Table 4-14*. Pella 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.

Table 4-14 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	2	1
Indirect Area of Influence			
Onseepkans	1	2	0
Springbok	Not known	11	4

Source: Black Mountain Mining, 2010, Gamsberg Final Baseline Socio-economic Report. Report no.: 396036/5.

4.3.5 Health

HIV/AIDS

Out of a total of approximately 5.4 million people in South Africa, nearly 48 million were recorded to be HIV positive in the middle of 2006. This was a total of 11% of the South African population infected with HIV. The Northern Cape Province was recorded to have the lowest number of HIV positive people residing in one province. It was estimated that one in ten people in the province were HIV positive in the year 2008 – this made up about 7% of the Northern Cape population at the time (Khai Ma SDF, 2010). Records show that the number of HIV positive pregnant women has decreased substantially from the year 2007 (from 7.3% to 2.2%) in the Namakwa District (Khai Ma SDF, 2010). The Khai ma Local Municipality also experiences health challenges such as tuberculosis and substance abuse. Although the Local Municipality is aware of the potential mining related health challenges which may be prominent in the area, these are still under investigation and thus statistics are not available at this time (Khai Ma SDF, 2010).

Health Facilities

In the Northern Cape Province, the provincial hospitals are located in Springbok and Upington. Most settlements in the Local Municipality have primary healthcare clinics or mobile clinics which regularly visit communities.

In Aggeneys, Pella, Pofadder and Springbok the primary healthcare clinics are functional. Where the doctor is unable to assist patients, they are referred to Springbok Hospital. According to women previously interviewed in Aggeneys, Pella and Pofadder, the health care service provided is inadequate where concerns included:

- 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.

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. The mobile clinic provides health care services to the surrounding farms.

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 ambulances, which collect patients from Pella, Aggeneys, Witbank and Onseepkans. 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 (Gamsberg ESIA, 2013).

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 for consultations (Gamsberg ESIA, 2013). The state owned clinic in Aggeneys does not receive adequate government support. Due to limited government support, the clinic is currently receiving assistance from BMM and the private clinic in Aggeneys (Gamsberg ESIA, 2013).

Pella Medical Services and Facilities

The clinic has trained nurses who are paid by the Department of Health. All healthcare services are free of charge including the provision of medicine. 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 (Gamsberg ESIA, 2013).

Onseepkans Medical Services and Facilities

The clinic at Onseepkans operates in the same fashion as the clinic at Pella. 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 (Gamsberg ESIA, 2013).

Summary of Health Challenges

The health challenges highlighted in the Khai-Ma Local Municipality include the following (IDP, 2012/2017):

- HIV/AIDS increase & TB increase;
- High rate of teenage pregnancies;
- Lack of sufficient and qualified staff – limited skills amongst current nurses and nursing sisters;
- Lack of sufficient facilities to render a proper health service to all communities;
- Irregular and insufficient service rendered by mobile clinic at Witbank; and
- Lack of necessary health equipment and medication at clinics.

4.3.6 Land Use

The current land use for the Project is mining and it is zoned as such. The surrounding area is used as grazing land (cattle, sheep and goats) for the nearby farmers in the surrounding communities.

4.3.7 General Infrastructure and Services

The bulk services and infrastructure in the Khai Ma Local Municipality 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 Namakwa District Municipality as well as Khai Ma Local Municipality. A number of infrastructure needs have been identified as reported in the Namakwa District Municipality 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.

Water

Of the households in the Khai-Ma Local Municipality area 92 % have access to piped water inside their dwelling or yard. All households in Pella, Pofadder and Aggeneys are serviced by the Pelladrift Water treatment works, which was established in 1974. The Pelladrift Water Treatment Works is currently being managed by Sedibeng Water and maintained by BMM, which is the largest consumer of water in the area... 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 Treatment Works is responsible for water purification and distribution to its key clients including, BMM, Khai Ma Local Municipality, and individual farmers. The Khai Ma Local Municipality supplies water to the towns of Pofadder and Pella.

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. 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 (Gamsberg ESIA, 2013).

Access to basic services such as water and sanitation and the removal of waste have been detailed in *Table 4-15.* Further to this, housing and access to electricity in the Khai-Ma Local Municipality has also been summarised.

Table 4-15 Number of people with Access to Water in the Project Area

Type	Aggeneys	Onseepkans	Pella	Pofadder	Rural	Total	% of Total
Piped water inside dwelling	733	7	92	365	195	1305	38
Piped water inside yard	3	151	247	336	944	1681	50
Piped water on community stand: distance less than 200 m from dwelling	2	2	1	17	43	65	2
Piped water on community stand: distance greater than 200 m from dwelling	15	1	2	13	56	87	3
Borehole	0	0	0	1	36	37	1
Spring	0	0	0	0	2	2	0
Rain-water tank	0	0	0	0	32	32	1
Dam/pool/stagnant water	0	1	0	0	16	17	1
River/stream	0	33	3	0	51	87	3
Water vendor	0	1	0	0	9	10	0
Other	0	8	9	1	20	38	1
Not applicable (homeless)	0	0	0	0	0	0	0

Source: IDP, 2012/2017

Housing

A community survey done in 2007 revealed that the Northern Cape Province had 264 653 households and 1 058 060 people. Approximately 85.5% of the Namakwa District Municipality households were formal dwellings whereas 5.1% were informal dwellings. The survey further reveal a housing backlog of approximately 51 570 houses in the Northern Cape (PSDF, 2012).

It is estimated that the Local Municipality 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. The number of informal dwellings has increased in the municipality from 40 in 2001 to 131 in 2011, which is a threefold increase (Gamsberg ESIA, 2013).

Table 4-16 illustrates service deliver per household.

Table 4-16 Service Delivery in the Project Area

Community	No of Households	Water	Electricity	Sanitation	Bucket	Refuse	Housing
Pofadder	808	48	230	-	-	-	205
Pella	685	48	-	166	166	-	463
Onseepkans	345	40	53	-	-	-	196
Witbank	77	17	77	-	-	77	86
Aggeeneys	556	-	-	-	-	-	-
Total Households	2471	1053	360	213	166	77	950

Source: IDP, 2012/2017

Policing and Crime

The major safety and crime related challenges encountered in the Khai-Ma Local Municipality include the following according to the IDP (2012/2017):

- Lack of accommodation for police officials;
- Increase in crime, e.g. family abuse and robberies, rape and related to alcohol and drug abuse;
- Lack of office space for police duties;
- No fire / Disaster Management Centre, facilities, station or personnel available in Pofadder or surrounding areas;
- No permanent traffic police office in the area to reduce accidents; and
- Satellite Station need in Blyvooruitsig due to distance.

4.3.8 Paleontological, Agricultural and Heritage Resources

The environment in question is arid, comprising relatively flat drainage plains with inselbergs such as the Aggeneys Mountains, Black Mountain and Gamsberg rising above the plains in the wider landscape. In the immediate vicinity hills feature prominently. The landscape is sparsely vegetated, making any surface archaeological traces highly visible. The area investigated includes generally deflated lower slopes of the Swartberg hills, strewn with scree gravitating down-slope, and parts of adjacent dune fields and sandy plains.

The description of heritage features in the region are described through three eras:

- Colonial Frontier;
- Later Stone Age; and
- Pleistocene: Middle and Earlier Stone Age.

Colonial Frontier

The eighteenth- and nineteenth-century records for this region (Penn 2005) include the travelogues of George Thompson (1827) and E.J. Dunn (1931, Robinson 1978), who visited the area in 1824 and 1872 respectively. Place names were becoming fixed in this colonial frontier period (in a cadastral sense, on maps and in farm names), many such names having Khoe-San origins encapsulating vestiges of precolonial/indigenous social geography. A much more prominent appreciation is now emerging concerning the history of genocide against the Bushmen in this area (Anthing 1863), with certain mountainous areas (like Gamsberg and Namiesberg near Aggeneys) being likely massacre sites, referred to by Dunn in 1872 (Robinson 1978) and, more obliquely, by Anthing (1863; de Prada-Samper 2011). Actual massacre sites may ultimately be impossible to identify.

Later Stone Age

Late Holocene Later Stone Age (LSA) sites are the predominant archaeological trace noted in past surveys in the Aggeneys-Pofadder region (Morris 1999a-b, 2000a-c, 2001, 2010, 2011, 2013). Beaumont *et al*. (1995) have shown, with reference to the LSA, that “virtually all the Bushmanland sites so far located appear to be ephemeral occupations by small groups in the hinterland on both sides of the [Orange] river” (1995:263). This was in sharp contrast to the substantial herder encampments along the Orange River floodplain itself (Morris & Beaumont 1990), which reflected the “much higher productivity and carrying capacity of these bottom lands.” “Given choice, the optimal exploitation zone for foragers would have been the Orange River.” The appearance of herders in the Orange River Basin, Beaumont *et al*. argue, led to competition over resources and ultimately to marginalisation of hunter-gatherers, some of whom then occupied Bushmanland, probably mainly in the last millennium, and focused their hunting and gathering activities around the limited number of water sources in the region. Surveys have located signs of human occupation mainly in the shelter of granite inselbergs, on red

dunes which provided clean sand for sleeping, or around the seasonal pans (Beaumont *el al*. 1995:264). Possibly following good rains, herders moved into the Orange River hinterland, as attested archaeologically at sites with ample pottery near Aggeneys and, east of Pofadder, at Schuitdrift South – Morris 1999a). However, Thompson (1824) refers to herder groups settled at the stronger springs such as Pella dispersing during periods of drought to smaller springs in the region, which could equally well account for the traces referred to here. At such times competition between groups over resources and stress within already marginalised hunter-gatherer society, must have intensified.

Grinding grooves have been found on rock outcrops in the Aggeneys/Gamsberg area (Morris 2011) and rock paintings are known from a boulder site alongside the Aggeneys/Black Mountain aggregate quarry (Morris 2011). Important engraved cupule sites have been identified at two sites on Black Mountain Mining mine, Aggeneys, and near the south western foot of the Swartberg on Zuurwater 62 (Morris 2013).

Pleistocene: Middle and Earlier Stone Age

Beaumont *et al*. (1995:240-1) note a widespread low density stone artefact scatter of Pleistocene age across areas of Bushmanland to the south where raw materials, mainly quartzite cobbles, were derived from the Dwyka till. Systematic collections of this material made at Olyvenkolk, south west of Kenhardt and Maans Pannen, and east of Gamoep, could be separated out by abrasion state into a fresh component of Middle Stone Age (MSA) with prepared cores, blades and points, and a large aggregate of moderately to heavily weathered Earlier Stone Age (ESA).

Beaumont *et al*. have shown that “substantial MSA sites are uncommon in Bushmanland” (1995:241): and those that have been documented thus far have generally yielded only small samples (Morris & Beaumont 1991; Smith 1995).

The ESA included Victoria West cores on dolerite, long blades, and a very low incidence of handaxes and cleavers. The Middle (and perhaps in some instances Lower) Pleistocene occupation of the region that these artefacts reflect must have occurred at times when the environment was more hospitable than today. This is suggested by the known greater reliance of people in Acheulean times on quite restricted ecological ranges, with proximity to water being a recurrent factor in the distribution of sites (Morris 2018).

No substantial sites have been found previously in the survey area. Only very sparse localized scatters of stone tools have been seen in places, with limited traces in the hills (e.g. an MSA site at the top of Gamsberg) or at the bases of hills. ESA including a Victoria West core on quartzite and isolated handaxes at various locales has been noted within the Gamsberg basin (Morris 2010) and on surrounding plains (e.g. Morris 2011, 2012, 2016).

Site Observations

Table 4-17 and *Figure 4.31* illustrate the observations and importance of findings on the Project site.

Table 4-17 Plotted Artefact Scatters and Observations made

	Observation	Importance
1	Small flat area at south end of hill with small scatter of LSA quartz flakes	LOW
2	OES (LSA) on western talus of hill	LOW
3	OES (LSA) – near 20th century prospecting evaporation pond	LOW
4	Possible MSA quartz flakes	LOW
5	Quartz flakes	LOW
6	LSA flakes, quartz and OES, exotic to the immediate vicinity at top of a low rocky hill.	LOW
7	Large flaked quartz proximal end of handaxe	LOW
8	Handaxe	LOW
9	Large number of OES pieces scattered in a small area – perhaps one disintegrated eggshell.	LOW
10	Low density of flaked quartz on hilltop	LOW
11	[This site is outside the area of expected impact] Engraved cupule site in non-perennial waterfall; 3 lower grindstones nearby; fragments of pottery and jaspilite stone tools about 30 m away. The presence of the portable lower grindstones provides an association not noted at other cupule sites in the area.	HIGH
12	[This site is outside the area of expected impact] Colonial era stone walled dwelling structures. LSA stone artefacts in the vicinity are made on river-derived (rolled) raw material, along with OES.	MEDIUM
13	OES with a few LSA stone artefacts	LOW
14	Large ESA flakes occurring in relatively high density	MEDIUM
15	Isolated quartz biface, possibly Fauresmith – in palaeodune	LOW
16	Quartz and CCS flakes LSA, MSA in palaeodune	LOW
17	LSA flakes	LOW

A low density of late Holocene Later Stone Age and Pleistocene Middle and Earlier Stone Age material was found in the Project area. All occurrences were in isolated locales across the Project area. In one instance a relatively higher density than usual of ESA material was found upslope from the Project site. None of the occurrences noted (other than observations 11 and 12) are regarded as being of more than Low Archaeological Importance.

Figure 4.30 illustrates onsite findings.

Figure 4.30 Archaeological Findings in the Project Area

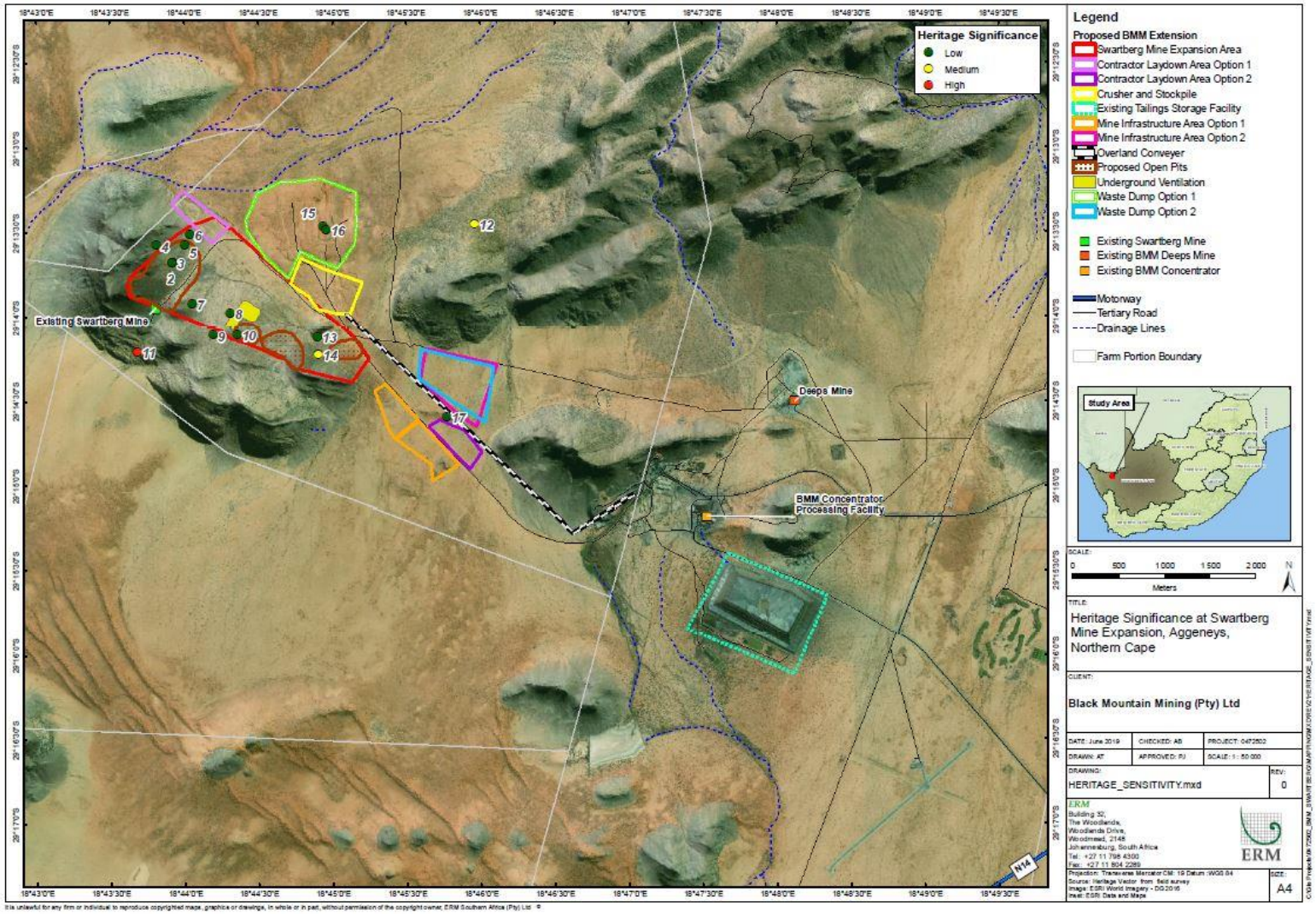
Lower grindstones adjacent to the cupule engravings

Quartzite biface

ESA cores and flakes

Quartz flakes

Figure 4.31 Archaeological Observations



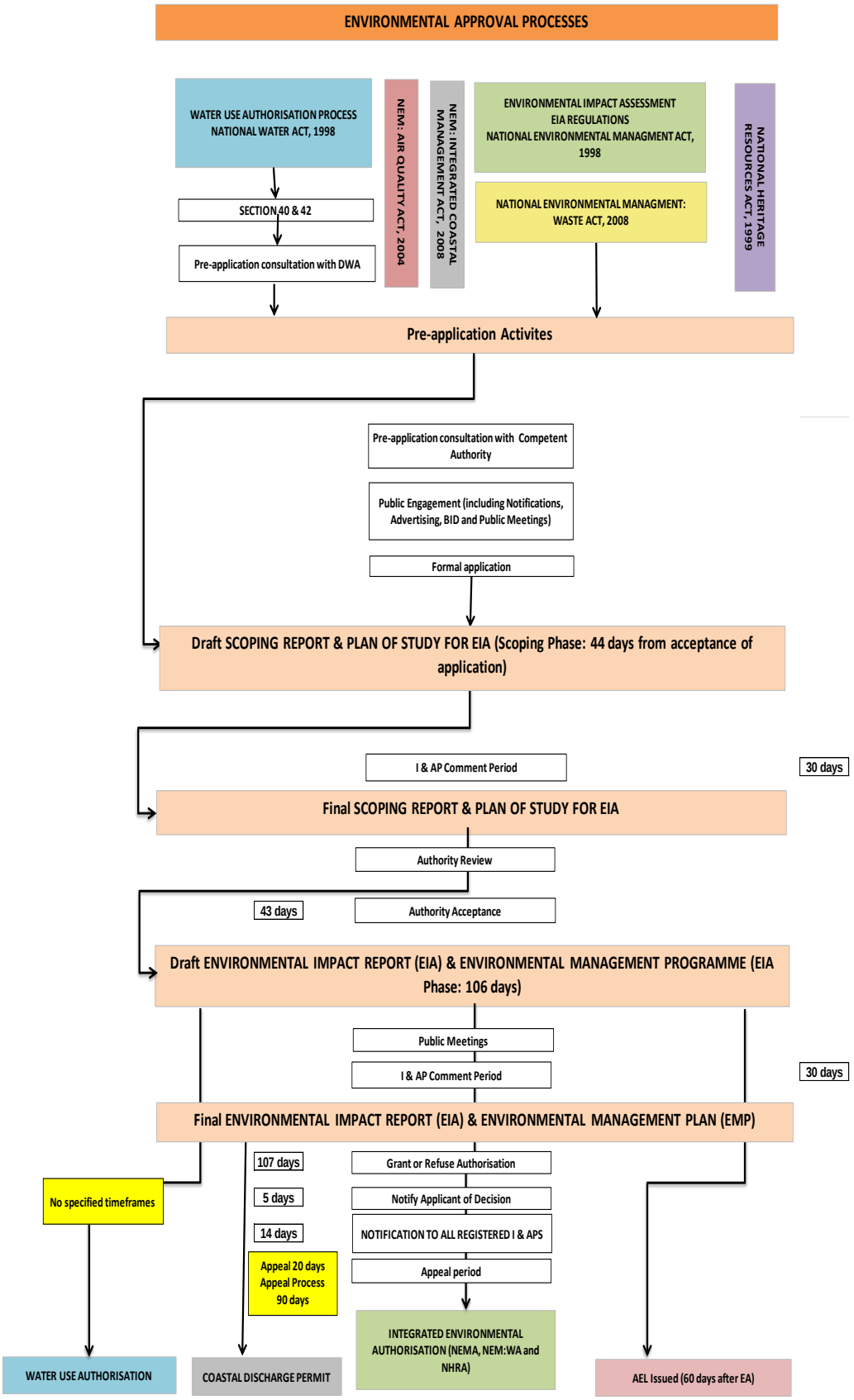
5. EIA PROCESS

5.1 Introduction

EIA is a systematic process that identifies and evaluates the potential impact a proposed Project may have on the physical, biological, and social environment and develops mitigation measures that will be incorporated in order to eliminate, minimise or reduce these impacts.

As described in *Chapter 3*, the process in South Africa is regulated by the NEMA and associated Environmental Regulations. The overall Scoping and EIA process is illustrated in *Figure 5.1*. This EIA process that is being undertaken for the project is aligned with the requirements of the 2014 EIA Regulations, as amended.

Figure 5.1 Integrated Environmental Impact Assessment Process



5.2 Approach to the EIA Process

The EIA process is initiated through a pre-assessment Public Participation Process (PPP). The pre-assessment process is not a mandatory requirement in terms of the 2014 EIA regulations (as amended) but a beneficial option for the client and EAP in order to identify key stakeholders and Interested and Affected Parties (I&APs) as well as to identify any fatal flaws at the onset of a project.

This phase is followed by the scoping phase, as shown in *Figure 5.1*. During the scoping phase the Terms of Reference for the full EIA is formulated, and requirements from the authorities clarified and any potential issues and concerns identified via consultation.

After completion of the scoping phase, detailed specialist studies have been undertaken to address issues identified during the scoping phase. Specialists have provided baseline information in their particular field of expertise for the Project area, and identified which project actions will result in significant impacts. Consultants have also suggested ways in which these negative impacts could be mitigated, to reduce their severity.

This EIA Report has been submitted for public review, during which time ERM present the key findings to all Interested and Affected Parties (I&APs). All comments made by I&APs are captured in a Comments and Response Report, and in this report, responses to all issues and concerns raised during the public review period are provided.

All recommendations cited in the EIA report must be detailed in an Environmental Management Programme report (EMPr), which defines the mitigation actions to be implemented. EMPs are recognised as important tools for the sound environmental management of projects.

5.3 Scoping Phase

A principal objective of the scoping phase is to identify the key environmental, social and health issues and those Project activities with the potential to contribute to, or cause, impacts to the environmental and social receptors.

At the scoping stage, the key issues were identified (together with input from key stakeholders) and understood to a level which allowed the definition of the Plan of Study for the EIA. Issues that are not relevant were scoped out. This allowed the resources for the EIA to be focused on collecting required information and identifying significant impacts while carrying out specialist studies and stakeholder engagement activities in an effective and efficient manner.

Specifically, the objectives of the scoping phase are to:

- Understand the legislative context and establish a description of baseline conditions;
- Identify project alternatives and preferred options for the proposed development;
- Identify stakeholders, and plan or initiate communication with these stakeholders so as to gather issues of concern;
- Identify potential significant impacts; and
- Develop the Plan of Study for the EIA which sets out the proposed approach to the EIA, potential impacts to be evaluated and methodology to be used.

The following steps have been undertaken as part of the scoping phase:

- Desktop review;
- Site visit;
- Public participation (see further detail in Section 5.6);
- Preparation of the Draft Scoping Report;
- Submission of application form;
- Release of Draft Scoping Report for public comment;
- Finalisation of Scoping Report; and
- Submission of the Final Scoping Report to DMR.

5.3.1 Desktop Review

An initial review of available information was conducted. The desktop review included the following tasks:

- Initial review of relevant legislative and guidance documents;
- Identification and review of available secondary data;
- Development of an outline description of the planned Project activities; and
- Development of a plan for stakeholder engagement.

5.3.2 Public Participation

Details of the public participation process are provided in *Section 5.6.*

5.3.3 Scoping Report

In accordance with the regulatory requirements stipulated in GNR 326 of the 2014 EIA Regulations (as amended), the Scoping Report (including Plan of Study), was compiled as part of the EIA process.

The draft Scoping Report was made available to stakeholders through the Project website, selected libraries, and hard copies provided on request for a period of 37 days (8 November 2018 - 14 December 2018).

After the public comment period a Comments and Responses Report (CRR) was compiled incorporating all comments received during the stipulated comment period. The final Scoping Report (including Plan of Study) was then submitted to the Department of Mineral Resources (DMR) on 18 January 2019 for their consideration. The approval of the Final Scoping Report was on the 11 March 2019 and was received by ERM on the 2 of April 2019.

5.3.4 Submission of Application Form

The EIA application form was submitted to the competent authority and the DMR reference is NCS 30/5/1/2/2/(517) DMR. In terms of the 2014 EIA Regulations (as amended), the final Scoping Report is to be submitted to the Competent Authority within 43 days of receipt of the acknowledgement letter. As such, the acknowledgement letter was received by ERM on 13 November 2018, and the final Scoping Report submitted to the DMR on 18 January 2019.

5.4 Specialist Study Phase

A number of specialist studies were identified to assess various potential impacts. The findings of these studies have been incorporated into this EIA (and attached as *Annex K*) which will close out the Integration and Assessment Phase. The findings of the specialist studies have been used to substantiate the baseline study in Chapter 4. Additionally, the specialist study findings have been further detailed in the Impact Assessment chapter (Chapter 7).

5.5 Integration and Assessment Phase

The final phase of the EIA is the Integration and Assessment Phase. The assessment of impacts proceeds through an iterative process considering three key elements:

- Prediction of the significance of impacts that are the consequence of the proposed development on the natural and social environment.
- Development of mitigation measures to avoid, reduce or manage the impacts.
- Assessment of residual significant impacts after the application of mitigation measures.

The Draft EIA was made available to I&APs for a 30-day public comment period between the 8th of April 2019 and the 13th of May 2019. Registered I&APs were notified of the release of the Draft EIA and where the report can be reviewed.

A public meeting was held in Aggeneys on 16 April 2019 where the findings of the specialist studies and outcomes of the integration and assessment phase were to be presented and discussed. No stakeholders attended this meeting. An additional meeting was held with surrounding farmers (who are registered as I&APs) on 15 April 2019. A biodiversity focus group meeting was held on Thursday, 2 May 2019, in order to facilitate discussion and feedback on important potential impacts. Meeting minutes of this focus group meeting are attached as Annex C. Lastly, a stakeholder engagement meeting was held with the Department of Environment Northern Cape on 14 May 2019.

Comments received on the Draft EIA have been assimilated and the EIA project team have provided appropriate responses to all comments. A Comments and Responses Report has been appended to the Final EIA, which has been submitted to DMR for decision-making.

All registered I&APs will be notified when an EA has been issued by DMR. A 90-day (maximum time should an appeal be submitted) appeal period will follow the issuing of the Environmental Authorisation.

5.5.1 Proposed Timeframes for the EIA

The process schedule for the EIA is presented in *Table 5-1.*

Table 5-1 EIA Schedule

Task	Timing
Stakeholder Comment on Draft Scoping Report and Plan of Study for EIA	8 November -14 December 2018
Finalise Scoping Report and Plan of Study for EIA and submit to DMR	18 January 2019
Acceptance of Scoping Report received from DMR	03 March 2019
Specialist studies	12 November 2018 - 20 March 2019
Prepare Draft EIA and EMP	March 2019
Stakeholder Comment on Draft EIA and EMP	8 April - 13 May 2019
Finalise and submit EIA and EMP to DMR	June 2019

5.6 Public Participation

5.6.1 Public Participation Objectives

Public consultation is an inclusive and culturally appropriate process which involves sharing information and knowledge, seeking to understand the concerns of others and building relationships based on collaboration. It allows stakeholders to understand the risks, impacts and opportunities of the Project in order to achieve positive outcomes.

The public participation process is designed to provide information to, and receive feedback from, interested and affected parties (I&AP) for use throughout the EIA process; thus providing organisations and individuals with an opportunity to raise concerns and make comments and suggestions regarding the proposed project. By being part of the assessment process, stakeholders have the opportunity to influence the project layout and design, input into mitigation measures and technical solutions.

The main objectives of public are:

- To ensure that adequate and timely information is provided to those potentially affected by the Project;
- To provide these groups with sufficient opportunity to voice their opinions and concerns; and
- To ensure that comments are received in a timely manner so that they can be taken into account in project decisions.

5.6.2 Legislative Context

Public participation with regard to EIAs in South Africa is determined by the principles of the National Environmental Management Act (NEMA) (Act 107 of 1998, as amended) and elaborated upon in the Public Participation guideline (2017) in terms of the NEMA EIA Regulations, which states that: “Public participation process means a process in which potential interested and affected parties (I&APs) are given an opportunity to comment on, or raise issues relevant to, the application.”

Public participation is required for an environmental authorisation process in terms of the EIA Regulations GN R.326 (2017).

5.6.3 Public Participation Activities

Table 5-2 details the public participation tasks that have been undertaken and the planned activities as part of the EIA phase.

Table 5-2 Public Participation Tasks

Activity	Description and Purpose
Pre-Application Phase	
Preparation of a preliminary stakeholder database	A preliminary database has been compiled of authorities (local and provincial), Non-Governmental Organisations, neighbouring landowners and other key stakeholders (refer to *Annex B*). This database of registered I&APs will be maintained and updated during the ongoing EIA process.
Preparation and Distribution of a Background Information Document (BID)	BIDs were distributed via email and post to all registered I&APs. See *Annex C*. The BID provides an introduction to the Project and the EIA process.
Pre Application Meeting with the DMR	A pre-application meeting was held with Deidre Karsten (of the DMR) on the 10th of October 2018. The purpose of the meeting was to notify the DMR of the Project and garner feedback on the Project to be included in the EIA process. Meeting minutes were included in *Annex C* of this Report.
Scoping Phase	
Erection of Site Notices	Site notices were placed at the following locations: ■ Pofadder Community Centre; ■ Public notice board next to the OK Supermarket in Aggeneys; and ■ At the entrance to the Project site. Proof of site notices are included in *Annex B.*
Project Website	A website was created for the Project where key contact information as well as the Draft Scoping Report were made available: (https://www.erm.com/bmm-swartberg-mine-expansion-eia)
Release of Draft Scoping Report for Public Comment	The draft Scoping Report was released for a 30-day public comment between 8 November and 14 December 2018. Notifications were sent to all stakeholders on the database and the report was made available online (https://www.erm.com/bmm-swartberg-mine-expansion-eia and in the Pofadder Public Library, Aggeneys Public Library, and the Black Mountain Office in Aggeneys (See *Annex B* for Proof of DSR availability in the Public Libraries). Acknowledgement of submission of the Draft Scoping Report to the DMR are included in *Annex E*.
Public Meetings	I&APs were invited to attend a public meeting at the Aggeneys North Recreation Club on 15 November 2018 in order for ERM to present the proposed Project and solicit input from stakeholders into the scoping process. Stakeholders were notified of this meeting on 1 November 2018. At the request of the Khai Mai Municipal Council, further public meetings were held at the Onseepkans Community Hall, Pofadder Community Hall and the Pella Community Hall on 11 December 2018. Stakeholders were notified of meetings by means of a notification letter (sent on 4 December 2018), public notices placed in Pofadder community centre and through verbal invitations from the Municipal Council. The notification of the additional public meeting included a reminder of the public comment period. Attendance registers for the meeting are included in Annex C of this Report and a summary of discussions held are included in the section below.
Development of a Comments and Response Report	All comments received during the Scoping consultation period were recorded into the Comment and Response Report (*Annex D*) of this Report.
Newspaper Adverts	An advertisement, advertising the commencement of the commenting period was placed in Die Namakwalander (Afrikaans) and in Die Burger (English) on the 7th of November 2018 (*Annex B*).

Activity	Description and Purpose
Key Stakeholder Meetings	Individual meetings with key stakeholders were also undertaken. These included surrounding farm owners Hester Maasdorp and Deon Maasdorp on the 15th of November 2018 at Zuur Water Farm, Jasper Mostert on the 17 of November 2018, and the Khai Mai Municipal Council on the 13th of November 2018. Attendance registers of the key stakeholder meetings were included in *Annex C* of the final Scoping Report.
Impact assessment Phase	
Release of draft EIA and EMPr for Public Comment	The draft EIA and EMPr document was made available for a 30-day comment period to stakeholders and the relevant authorities. The 30-day comment period was from 4 April to 13 May 2019. A notification letter was sent on 8 April to all registered I&APs on the project database. This letter served to invite I&APs to comment on the draft EIA. Newspaper adverts were placed in local newspapers notifying stakeholders of the availability of the Draft EIA report for review and inviting them to public meetings. All comments received have been included in this final EIA Report.
Availability of draft EIR	The Report was made available on the project website: https://www.erm.com/bmm-swartberg-mine-expansion-eia, on request from ERM, and at the following public locations: • Aggeneys Public Library • Poffadder Public Library • Black Mountain Mining Office, Penge Road, Aggeneys • Department of Mineral Resources, Springbok
Stakeholder Meetings	A public meeting was held during the EIA phase to gather comments on the draft EIA as its development progresses. This public meeting was held in Aggeneys on 16 April 2019. No stakeholders attended this meeting. A stakeholder meeting was also held with neighbouring farmers in the area on 15 April 2019 to discuss the Project. Meeting minutes are attached as Appendix C,
Authority Meeting	An authority meeting was held during the EIA phase with the Department of Environmental Affairs Northern Cape on 14 May 2019. Meeting minutes have been attached as Appendix C.
Focus Group Discussions	A biodiversity focus group meeting was held on Thursday, 2 May 2019, in order to facilitate discussion and feedback on important potential impacts. Meeting minutes are attached as Appendix C.
Submission of Final EIR	The Final Report has been submitted to the Competent Authority on 20 June 2019 for decision making.
Notification of Decision	I&APs will be notified of the decision with regards to the EA and the statutory appeal period. An advertisement will be placed to advertise the EA.

5.6.4 Summary of Scoping Engagement

Public Meetings

Public meetings held at the Aggeneys North Recreation Club (15 November 2018) and Onseepkans Community Hall (11 December 2018) did not attract any stakeholders. ERM considers that the lack of involvement from Aggeneys stakeholders is due to the fact that the Swartberg project is very well known to all the inhabitants of the town, which is dependent on the existence of the mine. Onseepkans is approximately 100 km from Aggeneys and the interest in the Project was very low. ERM did, however, use the opportunity to meet with the principal of the Onseepkans primary school and municipal staff to explain the Project to them. Approximately fifty BID documents were provided to the school and municipal office to distribute amongst community members.

The Pofadder public meeting was attended by two stakeholders representing the Wilderness Foundation Africa. Their main concerns related to the impact on Bushmanland Inselberg Shrubland vegetation types, specifically the dwarf succulent flora, and consideration by ERM of the National Protected Area Expansion Strategy and Northern Cape Critical Biodiversity Areas (2017) database during the undertaking of the assessment.

At the Pella public meeting four stakeholders arrived to discuss issues related to an existing water pipeline located to the west of town. No comments on questions were raised regarding the proposed Project.

Summary of Meetings with Surrounding Farmers

Discussions held with surrounding farm owners raised the issue of the Project impact on their water resources and an increase in dust levels on the properties immediately adjacent to the mine. Both these concerns relate to the impact of the Project on their livelihoods as sheep farmers. The very low carrying capacity of the veld and severe drought has placed a strain on sheep farming practises and the availability of vegetation for food. Increased dust from open pit mines may impact on the suitability of the grassland vegetation type which sheep use for grazing. In addition, the availability of water is crucial to both the farmers and their livestock. Mr. Deon Maasdorp water supply is augmented by the mine via a pipeline to his property.

Summary of Meeting with Municipal Council

A meeting with the Khai Mai Municipality was undertaken on the 13th of November 2018 at the Khai Mai Municipal offices in Pofadder. The Project was explained to the Council and the Project BIDs were handed out. Comments focussed on the following:

- Involvement of Onseepkans, Pofadder, and Pella. The Council requested that engagement with these three communities take place as they are indirectly affected by the Project. As result of this request, public meetings in Pella, Pofadder, and Onseepkans were arranged (described above).
- Employment: Council members wanted to understand how the Project would affect employment in the broader area. It was explained that as the Project is ultimately seen as ‘replacement’ for the current operations at Deeps mine, there would be temporary increase in employment during construction and potentially a small increase during operations.
- Communication of the Project: Consultants should continue to communicate Project activities with the council members.

Summary of Comments Received from Stakeholders

Two sets of comments were received on the Draft Scoping Report; one from the DEA: Biodiversity Conservation, and one from the Wilderness Foundation Africa. The Directorate Biodiversity Conservation recommended that a Terrestrial Ecological Impact Assessment Report be compiled, and that a Wetland Delineation be undertaken. They also advised that any species listed in terms of TOPs and Red Data list must not be disturbed or removed without a permit from relevant authorities.

The Wilderness Foundation Africa suggested that the National Protected Area Expansion Strategy for public comment as well as the Northern Cape Critical Biodiversity Areas (2017) database be taken into consideration.

5.6.5 Summary of IA Engagement

Public Meetings

The public meetings held at the Aggeneys North Recreation Club (16 April 2019) did not attract any stakeholders. ERM considers that the lack of involvement from Aggeneys stakeholders is due to the fact that the Swartberg project is very well known to all the inhabitants of the town, the residents of which are dependent on the existence of the mine.

Meeting with Surrounding Farmers

During previous discussions held with surrounding farm owners, the issue of the Project impact on water resources and increase in dust levels on the properties immediately adjacent to the mine were raised. Both these concerns relate to the impact of the Project on their livelihoods as sheep farmers. The very low carrying capacity of the veld and severe drought has placed a strain on sheep farming practises and the availability of vegetation for food. Increased dust from open pit mines may impact on the suitability of the grassland vegetation type which sheep use for grazing. In addition, the availability of water is crucial to both the farmers and their livestock. Mr. Deon Maasdorp's water supply is augmented by the mine via a pipeline to his property. During follow-up meetings held on 15 April 2019, ERM provided feedback to Mr. Maasdorp on the findings of the ERM impact assessment, which found that it is highly unlikely for dust to travel to, and settle upon, their farm, due to the distance involved. The impact of dust on the surrounding farmers is therefore considered to be low. Similarly, the impact on groundwater resources is considered to be low, as described in the relevant section of the document. The meeting with Ms. Maasdorp was brief, but held in a very positive and collaborative fashion.

Meeting with DENC

An authority meeting with the Department of Environmental Affair Northern Cape (DENC) was held on the 16th of May 2019 in Kimberly. DENC suggested that BMM plan future mining activities in a holistic manner, in order to properly evaluate the cumulative impacts on mining in the Study area.

DENCE requested that an air quality and waste management plan for all BMM operations in the broader study area be compiled, and that they be given access to 'raw' monitoring data to ensure 3rd party reporting is accurate. BMM agreed to make this data available.

DENC recommended that an offset is required, and that all existing offsets (Gamsberg) and any new offsets must be proclaimed exploration free as well as planned mining activities should have minimal impacts on offset areas. It was agreed that ERM would calculate the offsets against the vegetation units described in the CBA mapping, and have presented offset arguments in this Final EIA (below and in *Section 8*) and the DENC will comment on this.

Biodiversity Focus Group Meeting

A biodiversity focus group meeting was held on Thursday, 2nd of May 2019, in order to facilitate discussion and feedback on what had been identified as potentially important potential impacts. Only one participant who attended the meeting was a representative from the Wilderness Foundation. The issue of whether or not an offset will be required for the project was raised. It was agreed that no offset needs to be implemented as part of the Project for the reasons listed below.

1. Swartberg is a highly impacted area where mining activities and past development (first town and runway) have severely impacted the biodiversity value of the area.
2. This area was excluded by Phil Desmet and Mark Botha when the Gamsberg Offsets was developed due to the impacted condition of the area.

3. The Swartberg mining area is not situated in a CBA1 area as was the case with Gamsberg that triggered a Offset.
4. Mining activities will be to the east of the Swartberg Mountain and will not impact on the western slopes.
5. The project team have already agreed to placement of infrastructure based on Vegetation sensitivity, except for the open pits, which is not movable.

A search and rescue plan will be implemented prior to construction and ERM will demonstrate that the Gamsberg offset covers the losses that will be occur as a result of the Swartberg Expansion Project. The notification letter for this meeting, as well as the meeting minutes are attached as *Annex B* and *Annex C*.

Summary of Comments Received from Stakeholders

SAHRA requested that any application be submitted electronically on the website, as no hard copy, posted or emailed applications will be accepted.

Terry Smale, chairman of the Mesemb Study Group noted that *Conophytum ratum* is present in the study area, and is threatened by mining activities; and thus requested that these special species are taken into account during the EIA process.

A community member shared his frustration with the lack of business opportunities for local businesses.

6. IMPACT ASSESSMENT METHODOLOGY

An EIA process methodology should minimise subjectivity as far as possible and accurately assess the Project impacts. In order to achieve this ERM has followed the methodology defined below.

6.1 Assumptions and Limitations

Impact Assessment is a process that aims to identify and anticipate possible impacts based on past and present baseline information. As the EIA deals with the future there is, inevitably, some uncertainty about what will actually happen in reality. Impact predictions have been made based on field surveys and with the best data, methods and scientific knowledge available at this time. However, some uncertainties could not be entirely resolved. Where significant uncertainty remains in the impact assessment, this is acknowledged and the level of uncertainty is provided.

In line with best practice, this EIA has adopted a precautionary approach to the identification and assessment of impacts. Where it has not been possible to make direct predictions of the likely level of impact, limits on the maximum likely impact have been reported and the design and implementation of the project (including the use of appropriate mitigation measures) will ensure that these are not exceeded. Where the magnitude of impacts cannot be predicted with certainty, the team of specialists has used professional experience to judge whether a significant impact is likely to occur or not. Throughout the assessment, this conservative approach has been adopted to the allocation of significance.

6.2 Impact Identification and Characterisation

An ‘impact’ is any change to a resource or receptor caused by the presence of a Project component or by a Project-related activity. Impacts can be negative or positive. Impacts are described in terms of their characteristics, including the impact’s type and the impact’s spatial and temporal features (namely extent, duration, scale and frequency). Terms used in this EIA process are described in *Table 6-1.*

Table 6-1 Impact Characteristics

Characteristic	Definition	Terms
Type	A descriptor indicating the relationship of the impact to the Project (in terms of cause and effect).	**Direct** - Impacts that result from a direct interaction between a planned Project activity and the receiving environment/receptors (ie, between occupation of a site and the pre-existing habitats or between an effluent discharge and receiving water quality). **Indirect** - Impacts that result from other activities that are encouraged to happen as a consequence of the Project (ie, in-migration for employment placing a demand on resources). **Induced** - Impacts that result from other activities (which are not part of the Project) that happen as a consequence of the Project. **Cumulative** - Impacts that act together with other impacts (including those from concurrent or planned future third party activities) to affect the same resources and/or receptors as the Project.
Duration	The time period over which a resource / receptor is affected.	**Temporary** - (period of less than 3 years -negligible/ pre-construction/ other). **Short term** - (period of less than 5 years ie, production ramp up period). **Long term** -impacts that will continue for the life of the Project, but ceases when the Project stops operating. **Permanent** - (a period that exceeds the life of plant – ie, irreversible.).
Extent	The reach of the impact (ie, physical distance an impact will extend to)	**On-site** - impacts that are limited to the Project site. **Local** - impacts that are limited to the Project site and adjacent properties. **Regional** - impacts that are experienced at a regional scale. **National** - impacts that are experienced at a national scale. **Trans-boundary/International** - impacts that are experienced outside of South Africa.
Scale	Quantitative measure of the impact ie, the size of the area damaged or impacted, the fraction of a resource that is lost or affected, etc.).	Quantitative measures as applicable for the feature or resources affects. No fixed designations as it is intended to be a numerical value.
Frequency	Measure of the constancy or periodicity of the impact.	No fixed designations; intended to be a numerical value or a qualitative description.

6.3 Determining Magnitude

Once impacts are characterised they are assigned a ‘magnitude’. Magnitude is a function of some combination (depending on the resource/ receptor in question) of the following impact characteristics:

- Extent;
- Duration;
- Scale; and
- Frequency.

Magnitude (from small to large) is a continuum. Evaluation along the continuum requires professional judgement and experience. Each impact is evaluated on a case-by-case basis and the rationale for each determination is described. Magnitude designations for negative effects are: Negligible, Small, Medium and Large.

The magnitude designations themselves are universally consistent, but the definition for the designations varies by issue. In the case of a positive impact, no magnitude designation has been assigned as it is considered sufficient for the purpose of the impact assessment to indicate that the Project is expected to result in a Positive impact.

Some impacts will result in changes to the environment that may be immeasurable, undetectable or within the range of normal natural variation. Such changes are regarded as having no impact, and characterised as having a Negligible Magnitude.

Determining Magnitude for Biophysical Impacts

For biophysical impacts, the semi-quantitative definitions for the spatial and temporal dimension of the magnitude of impacts used in this assessment are provided below.

- **Large Magnitude Impact** affects an entire area, system (physical), aspect, population or species (biological) and at sufficient magnitude to cause a significant measureable numerical increase in measured concentrations or levels (to be compared with legislated or international limits and standards specific to the receptors) (physical) or a decline in abundance and/ or change in distribution beyond which natural recruitment (reproduction, immigration from unaffected areas) would not return that population or species, or any population or species dependent upon it, to its former level within several generations (physical and biological). A High Magnitude impact may also adversely affect the integrity of a site, habitat or ecosystem.
- **Medium Magnitude Impact** affects a portion of an area, system, aspect (physical), population or species (biological) and at sufficient magnitude to cause a measurable numerical increase in measured concentrations or levels (to be compared with legislated or international limits and standards specific to the receptors) (physical) and may bring about a change in abundance and/or distribution over one or more plant/animal generations, but does not threaten the integrity of that population or any population dependent on it (physical and biological). A moderate magnitude impact may also affect the ecological functioning of a site, habitat or ecosystem but without adversely affecting its overall integrity. The area affected may be local or regional.
- **Small Magnitude Impact** affects a specific area, system, aspect (physical), group of localised individuals within a population (biological) and at sufficient magnitude to result in a small increase in measured concentrations or levels (to be compared with legislated or international limits and standards specific to the receptors) (physical) over a short time period (one plant/animal generation or less, but does not affect other trophic levels or the population itself), and localised area.

Determining Magnitude for Socio-Economic Impacts

For socio-economic impacts, the magnitude considers the perspective of those affected by taking into account the likely perceived importance of the impact, the ability of people to manage and adapt to change and the extent to which a human receptor gains or loses access to, or control over socio-economic resources resulting in a positive or negative effect on their well-being. The quantitative elements are included into the assessment through the designation and consideration of scale and extent of the impact.

6.3.1 Determining Receptor Sensitivity

In addition to characterising the magnitude of impact, the other principal step necessary to assign significance for a given impact is to define the sensitivity of the receptor. There are a range of factors

to be taken into account when defining the sensitivity of the receptor, which may be physical, biological, cultural or human. Where the receptor is physical (for example, a water body) its current quality, sensitivity to change, and importance (on a local, national and international scale) are considered.

Where the receptor is biological or cultural, its importance (local, regional, national or international) and sensitivity to the specific type of impact are considered. Where the receptor is human, the vulnerability of the individual, community or wider societal group is considered. As in the case of magnitude, the sensitivity designations themselves are universally consistent, but the definitions for these designations will vary on a resource/receptor basis. The universal sensitivity of receptor is Low, Medium and High.

For ecological impacts, sensitivity is assigned as Low, Medium or High based on the conservation importance of habitats and species. For the sensitivity of individual species, *Table 6-2* presents the criteria for deciding on the value or sensitivity of individual species.

For socio-economic impacts, the degree of sensitivity of a receptor is defined as the level of resilience (or capacity to cope) with sudden social and economic changes (*Table 6-3*).

Table 6-2 Biological and Species Value/Sensitivity Criteria[1]

Value / Sensitivity	Low	Medium	High
Criteria	Not protected or listed as common / abundant; or not critical to other ecosystem functions i.e., key prey species to other species).	Not protected or listed but may be a species common globally but rare in South Africa with little resilience to ecosystem changes, important to ecosystem functions, or one under threat or population decline.	Specifically protected under South African legislation and/or international conventions e.g. CITIES Listed as rare, threatened or endangered e.g. IUCN

Table 6-3 Socio-Economic Sensitivity Criteria

Sensitivity	Low	Medium	High
Criteria	Those affected are able to adapt with relative ease and maintain pre-impact status.	Able to adapt with some difficulty and maintain pre-impact status but only with a degree of support.	Those affected will not be able to adapt to changes and continue to maintain-pre impact status.

6.3.2 Assessing Significance

Once magnitude of impact and sensitivity of a receptor have been characterised, the significance can be determined for each impact. The impact significance rating will be determined, using the matrix provided in *Figure 6.1*.

[1]Note: The criteria are applied with a degree of caution. Seasonal variations and species lifecycle stage will be taken into account when considering species sensitivity. For example, a population might be deemed as more sensitive during the breeding/spawning and nursery periods. This table uses listing of species ie, IUCN) or protection as an indication of the level of threat that this species experiences within the broader ecosystem (global, regional, local). This is used to provide a judgement of the importance of affecting this species in the context of Project-level changes.

Figure 6.1 Impact Significance

Magnitude of Impact	Sensitivity/Vulnerability/Importance of Resource/Receptor		
	Low	**Medium**	**High**
Negligible	Negligible	Negligible	Negligible
Small	Negligible	Minor	Moderate
Medium	Minor	Moderate	Major
Large	Moderate	Major	Major

The matrix applies universally to all resources/ receptors, and all impacts to these resources/ receptors, as the resource/ receptor-specific considerations are factored into the assignment of magnitude and sensitivity/ vulnerability/ importance designations that enter into the matrix. *Box 6.1* provides a context for what the various impact significance ratings signify.

Box 6.1 Context of Impact Significances

An impact of **Negligible** significance is one where a resource/receptor (including people) will essentially not be affected in any way by a particular activity or the predicted effect is deemed to be 'imperceptible' or is indistinguishable from natural background variations.
An impact of **Minor** significance is one where a resource/receptor will experience a noticeable effect, but the impact magnitude is sufficiently small and/or the resource/receptor is of low sensitivity/ vulnerability/ importance. In either case, the magnitude should be well within applicable standards.
An impact of **Moderate** significance has an impact magnitude that is within applicable standards, but falls somewhere in the range from a threshold below which the impact is minor, up to a level that might be just short of breaching a legal limit. Clearly, to design an activity so that its effects only just avoid breaking a law and/or cause a major impact is not best practice. The emphasis for moderate impacts is therefore on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP). This does not necessarily mean that impacts of moderate significance have to be reduced to minor, but that moderate impacts are being managed effectively and efficiently.
An impact of **Major** significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. An aim of IA is to get to a position where the Project does not have any major residual impacts, certainly not ones that would endure into the long-term or extend over a large area. However, for some aspects there may be major residual impacts after all practicable mitigation options have been exhausted (ie, ALARP has been applied). An example might be the visual impact of a facility. It is then the function of regulators and stakeholders to weigh such negative factors against the positive ones, such as employment, in coming to a decision on the Project.
Positive impacts provide resources or receptors, most often people, with positive benefits. It is noted that concepts of equity need to be considered in assessing the overall positive nature of some impacts such as economic benefits, or opportunities for employment.

6.4 Mitigation Potential and Residual Impacts

A key objective of an EIA process is to identify and define socially, environmentally and technically acceptable and cost effective measures to manage and mitigate potential impacts. Mitigation measures are developed to avoid, reduce, remedy or compensate for potential negative impacts, and to enhance potential environmental and social benefits.

The approach taken to defining mitigation measures is based on a typical hierarchy of decisions and measures, as described in *Box 6.2*.

The priority is to first apply mitigation measures to the source of the impact (ie, to avoid or reduce the magnitude of the impact from the associated Project activity), and then to address the resultant effect to the resource/receptor via abatement or compensatory measures or offsets (ie, to reduce the significance of the effect once all reasonably practicable mitigations have been applied to reduce the impact magnitude).

Once mitigation measures are declared, the next step in the impact assessment process is to assign residual impact significance. This is essentially a repeat of the impact assessment steps discussed above, considering the assumed implementation of the additional declared mitigation measures. The approach taken to defining mitigation measures is based on a typical hierarchy of decisions and measures, as described in *Box 6.2.*

Box 6.2 Mitigation Hierarchy

Avoid at Source; Reduce at Source: avoiding or reducing at source through the design of the Project ie, 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 ie, pollution control equipment).
Abate at Receptor: if an impact cannot be abated on-site then control measures can be implemented off-site ie, traffic measures).
Repair or Remedy*:* some impacts involve unavoidable damage to a resource ie, material storage areas) and these impacts require repair, restoration and 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 ie, financial compensation for degrading agricultural land and impacting crop yields).

6.4.1 Residual Impact Assessment

Once mitigation measures are declared, the next step in the impact assessment process is to assign residual impact significance. This is essentially a repeat of the impact assessment steps discussed above, considering the assumed implementation of the additional declared mitigation measures.

6.4.2 Cumulative Impacts

A cumulative impact is one that arises from a result of an impact from the Project interacting with an impact from another activity to create an additional impact.

How the impacts and effects are assessed is strongly influenced by the status of the other activities (ie, already in existence, approved or proposed) and how much data is available to characterise the magnitude of their impacts.

The approach to assessing cumulative impacts is to screen potential interactions with other projects on the basis of:

- Projects that are already in existence and are operating;
- Projects that are approved but not as yet built or operating; and
- Projects that are a realistic proposition but are not yet built.

6.5 Assessing Significance of Risks for Accidental Events

The methodology used to assess the significance of the risks associated with accidental events differs from the impact assessment methodology. Risk significance for accidental events is based on a combination of the likelihood (or frequency) of incident occurrence and the consequences of the incident should it occur. The assessment of likelihood and consequence of the event also includes the existing control and mitigation measures for this project.

The assessment of likelihood takes a qualitative approach based on professional judgement, experience from similar projects and interaction with the technical team.

The assessment of consequence is based on specialists' input and their professional experience gained from similar projects.

Definitions used in the assessment for likelihood and consequence are set out in *Box 6.3*.

Box 6.3 Risk Significance Criteria for Accidental Events

Likelihood

Likelihood describes the probability of an event or incident actually occurring or taking place. It is considered in terms of the following variables:

- **Low:** the event or incident is reported in the telecommunication industry, but rarely occurs;
- **Medium:** the event or incident does occur but is not common; and/or
- **High:** the event or incident is likely to occur several times during the project's lifetime.

Consequence

The potential consequence of an impact occurring is a combination of those factors that determine the magnitude of the unplanned impact (in terms of the extent, duration and intensity of the impact). Consequence in accidental events is similar to significance (magnitude x sensitivity) of planned events and is classified as either a:

- **Minor consequence:** impacts of Low intensity to receptors/resources across a local extent, that can readily recover in the short term with little or no recovery/remediation measures required;
- **Moderate consequence:** impacts of Low to Medium intensity across a local to regional extent, to receptors/resources that can recover in the short term to medium term with the intervention of recovery/remediation measures; or
- **Major consequence**: exceeds acceptable limits and standards, is of Medium to High intensity affecting receptors/resources across a regional to international extent that will recover in the long term only with the implementation of significant/remediation measures.

Once a rating is determined for likelihood and consequence, the risk matrix in *Table 6.4* is used to determine the risk significance for accidental events. The prediction takes into account the mitigation and/or risk control measures that are already an integral part of the project design, and the management plans to be implemented by the project.

Table 6-4 Accidental Events Risk Significance

Risk Significance Rating				
Likelihood		**Low**	**Medium**	**High**
Consequence	**Minor**	Minor	Minor	Moderate
	Moderate	Minor	Moderate	Major
	Major	Moderate	Major	Major

It is not possible to completely eliminate the risk of accidental events occurring. However, the mitigation strategy to minimise the risk of the occurrence of accidental events is outlined in *Box 6.4.*

Box 6.4 Mitigation Strategy for Accidental Events

Control: aims to prevent or reduce the risk of an incident happening or reduce the magnitude of the potential consequence to As Low as Reasonably Possible (ALARP) through:

- Reducing the likelihood of the event ie, preventative maintenance measures, emergency response procedures and training);
- Reducing the consequence;
- A combination of both of the above;
- Recovery/ remediation: includes contingency plans and response;
- Emergency Response Plans; and
- Tactical Response Plans.

7. IMPACT ASSESSMENT

7.1 Introduction

This *Chapter* presents each of the impacts identified and includes an overview of the impact description and assessment. Activities during the construction of the mine and associated facilities, and operational and decommissioning phases of the Project are considered in the following sections.

7.1.1 Project and Associated Activities

The following activities are associated with the construction, operation and decommissioning phases of the Project:

Construction Phase

- Site clearing and topsoil stockpiling;
- Construction of site access roads;
- Earthworks, excavation and preparation of the mine;
- Upgrading of processing plant;
- Waste generation, collection, transport and disposal;
- Wastewater generation, transport, treatment and disposal;
- Transport of materials, people and equipment to site;
- Water uptake/diversion/abstraction;
- Handling of hazardous materials;
- Use of lighting during construction;
- Establishment of construction camp/workshop; and
- Employment and procurement of goods and services.

Operational Phase

- Operation and maintenance of processing plant;
- Operation of the open pits;
- Operation of underground mine;
- Operation of waste rock dump and stock piles;
- Operation of TSF and PCD's;
- Solid waste generation, collection, transport and disposal;
- Wastewater generation, transport, treatment and disposal;
- Transport of materials, people and equipment to site;
- Transport of product from the site;
- Surface water abstraction;
- Handling of hazardous materials;
- Lighting during operations; and
- Employment and procurement of goods and services.

Decommissioning Phase

- Vehicle movements and traffic;
- Demolition of buildings and removal of infrastructure;
- Mine rehabilitation;
- Waste generation and disposal;
- Wastewater generation and disposal; and
- Loss of employment.

Potential Accidents and Unplanned Events

- Impacts to community health and safety;
- Impacts on worker health and safety;
- Accidental releases of equipment fuels and oils; and
- Traffic accidents.

7.1.2 Resources and Receptors

For this project, the following main resources and receptors are considered relevant:

- *Physical Environment*: ambient air quality, global climate, noise, vibration, groundwater quality, surface water quality, hydrology, geohydrology, soil, topography, landscape and visual, use of natural resources.
- *Biological Environment*: terrestrial habitats, terrestrial flora, terrestrial fauna.
- *Human Environment*: community health, safety and security; local community; road traffic and transportation; cultural heritage; aesthetics; tourism/recreation; employment and income; economy; public utilities.

7.2 Air Quality

The key impact on air quality resources within the Project area is the decrease in local ambient air quality due to dust emissions generated by construction, operations, and decommissioning activities.

7.2.1 Construction, Operations, and Decommissioning Phases: Decreased Local Ambient Air Quality due to Dust Emissions

Impact Description

Dust emissions may result from the Project site during construction, operations, and decommissioning due to:

- Earth moving activities and ground preparation;
- Traffic, and movement of vehicles over open ground and on unpaved roads;
- Overburden stockpiles from Project activities;
- Waste rock dump operations;
- Resource extraction, transport, and conveying to the processing plant; and

- Decommissioning of infrastructure and rehabilitation.

Dust emissions are likely to result in increased dust soiling and increases in ambient concentrations of PM_{10} at nearby sensitive receptors. In addition, emissions of NO_2 and PM_{10} will increase due to increased traffic during the establishment and operations of the Project, in particular if access routes are unpaved. Dust generation from roads will primarily be from Heavy Goods Vehicles (HGVs) associated with transportation of materials and equipment. Blasting and drilling during operations will also result in dust emissions.

Impact Assessment

The United States Environmental Protection Agency (USEPA) (1) states, in relation to dust emissions:

"… [dust particles 10-30µm in diameter] are likely to settle within a few hundred feet [30-90m]… from the edge of the road or other point of emission."

Ameliorating weather conditions such as rainfall and wind speed should also be considered, as dust emissions are negligible during wet and calm periods. The USEPA also state that precipitation of greater than 0.2mm/hr will effectively attenuate dust; and wind speeds of >5.3m/s are typically required to lift dust from open surfaces. This will be lower for dust generated by mechanical means (i.e. during excavation and due to the movement of vehicles over unpaved surfaces), at around 3m/s.

On this basis:

- At all but the most extreme wind speeds, dust will typically travel a maximum of 200m from source before falling from the air column;
- At the highest wind speeds, dust is unlikely to travel more than 500m from source; and
- With rainfall of >0.2mm/hour dust emissions are likely to be effectively attenuated.

The assessment of the potential for a worsening local ambient air quality due to dust emissions is undertaken with due consideration of these weather factors, the proximity of receptors to dust sources, and the duration of dust generation activities. Based on these factors, an assessment methodology for air quality impacts on receptors during construction and operations is presented in *Table 7-1.*

(1) United States Environmental Protection Agency (1995) AP-42 Section 13.2 Fugitive dust sources: http://www.epa.gov/ttn/chief/ap42/ch13/final/c13s02.pdf

Table 7-1 Dust Risk Matrix

Likely Magnitude of Impacts	Conditions
High: Likely major significant impact	■ Receptor within 200m of dust source ■ Dust generating activities for >12 months ■ Downwind for >10% of the year where wind and rainfall conditions promote dust generation
Medium: Likely moderate significant impact	■ Receptor within 200m of dust source ■ Dust generating activities for <12 months ■ Downwind for >10% of the year where wind and rainfall conditions promote dust generation
Low: Likely minor significant impact	■ Receptor within 200m of dust source ■ Dust generating activities for <12 months ■ Downwind for 2-5% of the year where wind and rainfall conditions promote dust generation
	■ Receptor within 500m of dust source ■ Dust generating activities for >12 months ■ Downwind for 2-5% of the year where wind and rainfall conditions promote dust generation
Low: Insignificant impact	■ Receptor > 500m of dust source ■ Receptor 200m - 500m from dust source ■ Downwind for <12 months of the year where wind and rainfall conditions promote dust generation

The construction phase of the Project will take approximately 24 months and the dry conditions in the Project area are conducive to dust generation (high temperatures and low rainfall). The average wind speed over the July 2016 to January 2017 period was 4.7 m/s and with winds greater than 5 m/s occurring 29.8% of the time. The available data indicates frequent winds from a northerly and north-north-westerly direction. Daytime airflow varies with predominantly north-north-westerly, south-westerly and east-south-easterly winds. At night, winds are mostly from the north-northwest. Aggeneys Town is approximately 8.5 kilometres from the Project site in an easterly direction (i.e. not in the prevailing wind direction).

Using *Table 7-1* above, construction activities will occur for longer than 12 months and prevailing conditions promote dust generation. Therefore, high magnitude impacts are likely to occur within 200m of the Project site. There are no sensitive socio-economic receptors within this area as it falls within the current BMM mining area. Dust fall impacts on flora are covered in section *7.5*.

Table 7-2 describes the assessment of the impact on air quality.

Table 7-2 Impact Assessment: Decreased Local Ambient Air Quality due to Dust Emissions from Construction, Operations, and Decommissioning Activities

Rating of Impacts Before Mitigation		
Characteristic	**Designation**	**Summary of Reasoning**
Nature	Direct Negative	The impact is a result of primary project activities and the receiving environment.
Extent	Local	The impacts are limited to the Project site and adjacent properties.
Duration	Long Term	Impacts may occur during the construction phase and continue into the operational and decommissioning phases.
Scale	Local	200m radius around Project site.
Frequency	Constant	Project activities will occur regularly through Project phases
Impact Magnitude: High		
Sensitivity/Vulnerability/Importance of the Resource/Receptor: Low		
Reversibility- Medium		
Significance Rating Before Mitigation: Moderate within 200 m of activities and within the BMM mining area		

Mitigation and Management Measures

The control and mitigation of dust can be achieved through the following measures:

- Take all reasonable measures to minimise the generation of dust as a result of project development activities to the satisfaction of the EO.
- As far as practically possible, blasting should only be done under low- or no-wind conditions.
- Vehicle speeds must not exceed 40 km/h along dust roads or 20 km/h when traversing unconsolidated and non-vegetated areas;
- Haul trucks should not exceed 80km/h on the haul road.
- Vehicles must be kept clean to avoid tracking dirt around and off the site.
- Vehicles transporting friable materials must be covered.
- Where feasible, surface binding agents must be used on exposed open earthworks and roads.
- Vegetation clearance must be phased to minimise the area of exposed soil.
- Topsoil stockpiles must planted to bind the soil and minimise dust.
- The design of stockpiles should be optimised to retain a low profile with no sharp changes in shape.
- Drop heights of material must be minimised were possible.
- Where possible, wind breaks should be erected around high- dust generating activities.
- For significant areas of excavation or exposed ground, dust suppression measures must be used to minimise the spread of dust.

Residual Impacts

With the implementation of the above-mentioned mitigation measures, the residual impact will be minor for all receptors within 200 m of the Project site (

Table 7-3).

Table 7-3 Pre- and Post- Mitigation Significance for Air Quality

Impact	Project Phase	Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Reduction in Local Ambient Air Quality due to Dust Emissions	**Construction, Operation, and Decommissioning**	**MODERATE** (for receptors within 200m of the Project site)	**MINOR** (for receptors within 200m of the Project site)

7.3 Ambient Noise and Vibration

Key impacts from noise emissions as a result of the Project are identified as follows:

- Noise impacts from construction activities and associated traffic; and
- Operational noise impacts from resource extraction (open pit mining), transport, crushing and conveying to the processing plant.

7.3.1 Construction, Operational, and Decommissioning Phase: Increase in the Ambient Noise Levels

Impact Description

During the construction phase, the main potential impacts on the acoustic environment are related to the noise emissions from construction machinery and construction vehicles being used for the following:

- *Site preparation*: this includes significant noise-producing activities such as vegetation clearance, topsoil removal and earthworks. These activities will require heavy construction vehicles and equipment (excavators, dozers, rollers, dump trucks).
- *Civil works and establishment of the mine*: this includes significant noise-producing activities such as excavation (through mechanical means and blasting).
- *Traffic:* the movement of vehicles for transport of materials and personnel on local roads and/or new access roads will generate noise emissions.

During the operations phase, noise will be generated by the following activities:

- *Drilling and Blasting:* Daily blasting at the open pits throughout construction and operations.
- *Traffic:* the movement of vehicles for transport of materials to and from the open pits and personnel on local roads will generate some noise.
- *Operational equipment:* Additional noise will be generated by the crusher, conveyor system and processing plant and other new machinery in addition to the existing noise from the existing processing equipment.

During decommissioning phase noise will be generated through dismantling of infrastructure and rehabilitation.

All of the activities mentioned above have the potential to result in an increase in the background noise level and thus impact receptors located in the proximity of the Project.

Impact Assessment

Table 7-4 describes the impact assessment of Project activities resulting in an increase in ambient noise levels.

Table 7-4 Impact Assessment: Construction, Operation and Decommissioning: Increased Ambient Noise Levels

Rating of Impacts Before Mitigation		
Characteristic	**Designation**	**Summary of Reasoning**
Nature	Direct Negative	The impact is a direct result of primary project activities on the receiving environment.
Extent	Local	The impacts are limited to the Project site and adjacent properties.
Duration	Long term	Impacts will occur through construction and daily during operations.
Scale	Project area	Noise impacts are unlikely to extend beyond 5km.
Frequency	Continuous	Impacts will occur through construction and daily during operations.
Impact Magnitude: Medium		
Sensitivity/Vulnerability/Importance of the Resource/Receptor: Low		
Reversibility- Medium		
Significance Rating Before Mitigation: MINOR		

Mitigation and Management Measures

The control and mitigation of noise emissions during the construction and operational phases will be achieved by implementing the following measures:

- Business Partners must keep noise level within acceptable limits, Restrict the use of sound amplification equipment for communication and emergency only.
- All diesel-powered construction and earth moving equipment must be well maintained. This must include the regular inspection and, if necessary, replacement of intake and exhaust silencers. Any change in the noise emission characteristics of equipment must serve as trigger for withdrawing it for maintenance.
- Vendors must be required to guarantee optimised equipment design noise levels.
- A mechanism to monitor noise levels, record and respond to complaints and mitigate impacts should be developed and implemented.
- Use of quieter powered mechanical equipment (PME) should be considered, where possible.
- Use of noise barriers/enclosures should be considered, where possible.
- Vibrating equipment such as crushers must be installed on vibration isolation mountings.
- Individual vehicle engine, transmission and body noise/vibration should be minimised through the implementation of an equipment maintenance program.
- Maintain road surfaces regularly to avoid corrugations, potholes etc.
- Avoid unnecessary idling times.
- Minimise the need for trucks/equipment reversing. This will reduce the frequency at which reverse warnings occur.
- Any complaints received by Business Partners regarding noise must be recorded and communicated. Where possible or applicable, provide transport to and from the site on a daily basis for construction workers.

Residual Impact

With the implementation of the above-mentioned mitigation measures, the residual impact will remain minor, largely due to the distance from sensitive receptors (*Table 1.5*).

Table 7-5 Pre- and Post- Mitigation Significance for Noise

Impact	Project Phase	Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Noise Emissions from Establishment Activities	**Construction and Operations**	**MINOR**	**MINOR**

7.4 Soils and Geology

The key impact on soils as a result of the Project is the loss of soil resources as a result of site clearance and construction activities.

7.4.1 Construction Phase: Loss of Soil Resources as a result of Site Clearance and Construction Activities

Impact Description

The construction of the mine expansion will take up to 24 months to complete and includes earthworks and site clearance. These activities would result in the following impacts:

- Soil compaction;
- Topsoil loss due to clearing, water and wind erosion (and sediment release to land and water); and
- Alteration of natural drainage patterns.

Approximately 136 ha of land is required for the Project. These areas will be cleared of vegetation to ground level with preliminary excavation of the Project Site taking place. Stripped topsoil within the Project Site will be stockpiled for future use in rehabilitation and re-vegetation. The Project Site will be graded and levelled, and cut and fill operations will be managed such that there will be minimal excess spoil. Compaction and increased erosion from increased exposure to wind and water are likely to cause changes in the soil structure and degradation of soil quality. Vegetation cover is the most important physical factor protecting soil from erosion by water and wind.

However, erosion may occur when surface water flow comes into contact with areas of bare soil, especially on sloped terrain or running down inefficiently sloped stockpiles. The impact of erosion through water run-off could potentially increase the sediment load of nearby surface water bodies.

In addition, the compaction of the subsoils through site grading and levelling, and the presence of heavy vehicles and machinery during establishment, will result in lower permeability of the soil and therefore decrease infiltration and increase run-off, altering the natural drainage characteristics of the soil. Without appropriate measures, run-off from hard standing areas (roads and the Project Site in addition to exposure to wind and rainfall) may increase erosion. Land capability and productivity may also be reduced within the Project site.

Impact Assessment

Table 7-6 describes the impact assessment of Project activities on soils and geology.

Table 7-6 Impact Assessment: Construction: Loss of Soil Resources as a result of Site Clearance and Mine Construction

Rating of Impacts Before Mitigation		
Characteristic	**Designation**	**Summary of Reasoning**
Nature	Direct Negative	The impact is a result of primary project activities on the receiving environment
Extent	Local	Impacts will be restricted to the Project area
Duration	Permanent	Impacts will occur during the construction phase and will be permanent
Scale	± 136 ha	The impacts will be limited to the Project site
Frequency	Once off	Topsoil clearing will be done during the construction phase
Impact Magnitude: Medium		
Sensitivity/Vulnerability/Importance of the Resource/Receptor: Medium		
Reversibility- Low		
Significance Rating Before Mitigation: MODERATE		

Mitigation and Management Measures

Many of the impacts to soil and land capability cannot be mitigated further, because they result from the physical land-take footprint of the development. However, measures can be implemented to help minimise impacts, including the following:

- Develop and implement a Soil Erosion, Control and Reinstatement Plan.
- Restrict extent of disturbance within the Project Site to the extent practicable.
- Minimise the period of exposure of the soil surface, including stockpiles, by revegetating temporary-use areas as soon as practicable after construction activities.
- Stockpiled soil must not to be compacted.
- Stockpiles are to be protected from erosion by keeping the stockpiles as low as possible with gentle gradients, and by planting as soon as possible.
- Topsoil stockpiles must not exceed 2 m in height.

Residual Impact

With the implementation of the above- mentioned mitigation measures, the impact significance is likely to be reduced to minor (*Table 7-7*).

Table 7-7 Pre- and Post- Mitigation Significance for Loss of Soil Resources

Impact	**Project Phase**	**Significance (Pre-mitigation)**	**Residual Impact Significance (Post-mitigation)**
Impact of soils from Site Clearance and Construction Activities	**Construction**	**MODERATE**	**MINOR**

7.5 Terrestrial Flora

Potential impacts concerning terrestrial flora within the Project area are as follows:

- Loss of Habitats of Medium and High Sensitivity and Associated Species;
- Loss of Habitats of Medium to Low Sensitivity and Associated Species;
- Loss of Plant Species of Conservation Concern;
- Reduced Ecological Function and Degradation due to Altered Soil Surfaces;
- Increase in Alien Invasive Vegetation.

7.5.1 Construction and Operation Phase: Loss of Medium-High and High Sensitivity Habitats and Associated Species

Impact Description

The footprint of the proposed mine expansion includes the open pits, waste rock pad and road infrastructure. Whilst at the time of the study no exact layout of new mining infrastructure was provided, it is anticipated that the open pits will, to a large extent, affect habitats of medium-high, high and very high sensitivity. A small area of such habitats will also be affected by the waste rock pad Alternative 1.

These sensitive/conservation significant areas include following habitats:

- Aggeneys Gravel Vygieveld (undisturbed areas, High sensitivity);
- Bushmanland Inselberg Shrubland (High sensitivity), including the Northern Koppies;
- Largely intact Mountain Aprons (Medium - High sensitivity); and
- Washes and Slightly Disturbed Mountain Aprons (Medium - High sensitivity).

Impact Assessment

Table 7-8 describes the impact assessment of Project activities on the Loss of Medium-High, High and High Sensitivity habitats and species.

Table 7-8 Impact Assessment: Construction: Loss of Medium-High, High Sensitivity Habitats and Associated Species

Rating of Impacts Before Mitigation		
Characteristic	**Designation**	**Summary of Reasoning**
Nature	Direct Negative	The impact is a result of primary project activities on the receiving environment.
Extent	Regional	Through direct, indirect, induced and cumulative impacts, the availability of unique habitats, and habitats suitable to species with a narrow distribution (narrow endemics) will be reduced and/or negatively affected.
Duration	Permanent	The unique habitats cannot be restored through rehabilitation efforts. It is also not certain if the Opencast Pit or Rock Dumps will eventually be obliterated, but affected areas are likely to result in permanently modify habitats
Scale	± 136 ha	The impacts will be limited to the mine footprint area, approximately 125 ha of irreplaceable habitat will be lost to the mine footprint.
Frequency	Continuous	Once the original habitat is significantly modified, its configuration cannot be re-created or ever fully restored.
Impact Magnitude: Large		
Sensitivity/Vulnerability/Importance of the Resource/Receptor: High		
Reversibility- Low The infrastructure footprint extends over some highly sensitive and irreplaceable habitats, and the loss of such habitats will be permanent.		
Significance Rating Before Mitigation: MAJOR		

Mitigation and Management Measures

- All stockpiled material must be maintained and kept clear of weeds and alien vegetation growth by undertaking regular weeding and control methods.
- Where possible, avoid any physical destruction of the Koppies north of the current Swartberg Decline Access Road.
- Minimise clearing and operations in habitats with a Very High to Medium-High sensitivity rating.
- Avoid any direct activities on any surrounding or adjacent areas with sensitive vegetation or any adjacent or nearby riparian habitats (except the clearing of alien invasive species).
- Where clearing for access purposes is essential, the maximum width to be cleared within the servitude must be in accordance to distance as agreed between the land owner and the EA holder.
- Avoid blocking and/or destruction of the washes to the south-east of the study area, and those coming off plains and mountains north-east of the study area.
- Avoid placing the waste rock pad within natural habitats.
- Use existing gravel roads and already disturbed areas to access mining operations as far as possible to avoid the creation of new roads or access routes across natural areas.
- No open fires may be lit for cooking or any other purposes, unless in specifically designated and secured areas.

- Avoid and/or minimise the loss of species of conservation concern by conducting a thorough pre-construction survey.
- Only a registered pest control operator may apply herbicides on a commercial basis and commercial application must be carried out under the supervision of a registered pest control operator, supervision of a registered pest control operator or is appropriately trained.
- A daily register must be kept of all relevant details of herbicide usage.
- No herbicides must be used in estuaries.
- The pre-construction survey must be followed by implementing the necessary Search and Rescue actions prior to any groundworks taking place, whilst allowing planning that will minimise the destruction of indigenous trees and/or species of conservation concern.
- Development and implement a detailed Plant Search- and Rescue, and Monitoring Plan in areas where infrastructure development impact on vegetation before any groundworks taking place.
- Delineate all permissible areas so that all movement of vehicles and heavy machinery can be restricted to permissible areas, these being designated access roads, maintenance roads, turning points and parking areas. No off-road driving beyond designated areas will be allowed.
- Design and create berms to stop runoff from the mining areas and waste-rock dump during/after periodic/ extreme rainfall events from entering directly into existing washes.
- Keep the clearing of natural vegetation to a minimum.
- Cleared indigenous shrubs and trees can be shredded and used as mulch on top of topsoil stockpiles or on rehabilitated areas.
- Ensure topsoils, where available, are first removed and correctly stored for rehabilitation purposes.
- Reduce fragmentation of natural habitat by keeping long-term or permanently impacted areas as close together as possible (but avoiding the blockage of or increased impact on sensitive habitats), e.g. by using waste rock pad Alternative 2, which is closer to the planned open pits, thus also reducing transport requirements.
- Parking and operational areas should be regularly inspected for oil spills and covered with an impermeable or absorbent layer (with the necessary storm water control) if oil and fuel spillages are likely to occur.
- Reinforce portions of existing access routes that are prone to erosion or seasonal inundation, create structures or low banks to drain the access road rapidly during rainfall events, yet preventing erosion of the track and surrounding areas.
- Install adequate drainage structures to ensure that water flows are never concentrated or blocked.
- If filling material is to be used, this should be sourced from areas free of invasive species, and alien plant control measures are to be applied to all areas used for sourcing of fill materials.
- Areas of high conservation significance in close proximity but outside the physical mining footprint need to be clearly demarcated with appropriate barriers and signage to ensure no further encroachment or disturbance. Any infringements will be reported and appropriate penalties are to be enforced on transgressing staff or Business partners.
- - Alien invasive vegetation must be removed according to a plan (in line with relevant municipal and provincial procedures, guidelines and recommendations) and disposed of at a recognised waste disposal facility.

- Efforts will be taken to minimise the footprint of short-duration activities and/or linear infrastructure. Efforts to minimise such footprints will include grouping all infrastructure to the same servitude and/or as close as possible to existing and planned long-term physical disturbances. This will also reduce fragmentation due to mining operations.
- Rehabilitate and revegetate all areas that have been disturbed as soon as practically possible. This will be according to a Rehabilitation Plan that needs to be compiled by a suitably qualified specialist and complement the current Biodiversity Management Plan (BMP). It will include the following:
  - Installation of erosion control structures.
  - Re-vegetation measures of disturbed/modified areas using indigenous shrubs and grasses only.
  - Special attention will be paid to ensuring that critical topography is reconstructed as far as practical. into existing washes.

Residual impacts

Habitat loss will still occur as a residual impact but could be reduced with effective mitigation as discussed above. Based on the estimated areas of loss, approximately 125 ha of irreplaceable habitat will be lost to the mine footprint. Even with mitigation, mining will result in a permanent and irreversible loss of habitat (*Table 7-9).*

Table 7-9 Pre- and Post- Mitigation Significance for Loss of Medium-High, High Sensitivity Habitats and Associated Species

Impact	Project Phase	Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Loss of Habitat and Associated Species from Site Clearance	**Construction and Operations**	**MAJOR**	**MODERATE**

7.5.2 Construction and Operation Phase: Loss of Medium-Low and Low Sensitivity Habitats and Associated Species

Impact Description

The footprint of the proposed mine expansion that will impact on habitats with medium-low to low sensitivity includes the portions of the opencast pit, new ventilation shaft, waste rock pad, crusher and ore stockpile, contractor's laydown area, mining infrastructure and ore transport route. Although the use of the alternatives where available and preferred from an ecological perspective, will be a mitigation measure in itself, the use of either will have impacts and will need mitigation measures to be in place, hence both are evaluated below.

Habitats of Medium-Low to Low sensitivity include following:

- Arid Bushmanland Inselberg,
- Disturbed Aggeneys Gravel Vygieveld,
- Bushmanland Arid Grassland,
- Low Outcrops,

- Modified Dunes,
- Disturbed or Modified Mountain Aprons and entirely Modified Areas.

Impact Assessment

Table 7-10 describes the impact assessment of Project activities on the loss of medium-low to low sensitivity habitats and associated species.

Table 7-10 Impact Assessment: Construction: Loss of Medium and Low Sensitivity Habitats and Associated Species

Rating of Impacts Pre-Mitigation			
Characteristic	**Designation Portions of Open Pit and Waste Pad Alternative 1**	**Designation Portions of Open Pit and Waste Pad Alternative 2**	**Summary of Reasoning**
Nature	Direct Negative	Direct Negative	The impact is a result of primary project activities on the receiving environment
Extent	Regional	Local	Through direct, indirect, induced and cumulative impacts, the availability and functionality of natural habitats, adjacent and downstream areas may be negatively affected.
Duration	Permanent	Permanent	The functioning of restricted and/or natural habitats cannot be fully restored through rehabilitation efforts, adjacent and downstream habitats may also be negatively affected.
Scale	± 114 ha Medium-Low Sensitivity habitat ± 58 ha Low Sensitivity habitat	± 3.3 ha Medium-Low Sensitivity habitat ± 223 ha Low Sensitivity habitat	
Frequency	Permanent and continuous	Permanent and continuous	Once the original habitat is significantly modified, its configuration cannot be re-created or ever fully restored.
Impact Magnitude if Waste Rock Pad Alternative 1 is used: Low **Impact Magnitude if Waste Rock Pad Alternative 2 is used: Medium**			
Sensitivity/Vulnerability/Importance of the Resource/Receptor: Medium-Low to Low Sensitivity			
Reversibility: The infrastructure footprint extends over natural habitats, whilst also being in very close proximity to highly sensitive and irreplaceable habitats, which will be negatively affected.			
Significance Rating Pre-Mitigation - Waste Pad Alternative 1: MODERATE **Significance Rating Pre-Mitigation - Waste Pad Alternative 2: MODERATE to MINOR**			

Mitigation and Management Measures

- Minimise clearing and operations in natural habitats. For the location of waste rock pads, clearing of natural vegetation within at least 50 m of adjacent habitats with high sensitivity should be avoided.

- Avoid any direct impacts on any surrounding or adjacent area with sensitive vegetation or any adjacent or nearby riparian habitats (except the clearing of alien invasive species).
- Avoid blocking and/or destruction of the washes to the south-east of the study area, and those coming off plains and mountains north-east of the study area.
- Avoid placing the waste rock pad within natural habitats.
- Use existing gravel roads and already disturbed areas to access mining operations as far as possible.
- No open fires may be lit for cooking or any other purposes, unless in specifically designated and secured areas.
- Conducting a thorough pre-construction survey to avoid and/or minimise the loss of species of conservation concern.
- The pre-construction survey must be followed by implementing necessary Search and Rescue actions prior to any groundworks taking place, whilst allowing planning that will minimise the destruction of indigenous trees and/or species of conservation concern.
- Delineate all permissible areas so that all movement of vehicles and heavy machinery can be restricted to permissible areas, these being designated access roads, maintenance roads, turning points and parking areas. No off-road driving beyond designated areas will be allowed.
- Design and create berms to stop runoff from the mining and waste-rock dump during/after periodic extreme rainfall events from entering directly into existing washes.
- Keep the clearing of natural vegetation to a minimum.
- Cleared indigenous shrubs and trees can be shredded and used as mulch on top of topsoil stockpiles or on rehabilitated areas.
- Ensure topsoils, where available, are first removed and retained for rehabilitation purposes. Topsoils should not be stored in heaps higher than 1 m, may never be compacted and the growth of natural vegetation on such piles during storage should be encouraged.
- Wheels of large machinery should be checked prior to entering topsoil storage sites and cleared of seed or any other plant material (especially of species with spiny or bur-like seeds) to reduce the introduction and spread of alien invasive plants. All such plant material removed must be burnt.
- Reduce fragmentation of natural habitat by keeping long-term or permanently impacted areas as close as possible together (but avoiding the blockage of or increased impact on sensitive habitats).
- Parking and operational areas should be regularly inspected for oil spills and covered with an impermeable or absorbent layer (with the necessary storm water control) if oil and fuel spillages are highly likely to occur.
- Reinforce portions of existing access routes that are prone to erosion or seasonal inundation, create structures or low banks to drain the access road rapidly during rainfall events, yet preventing erosion of the track and surrounding areas.
- Install adequate drainage structures to ensure that water flows are never concentrated or blocked in any way.
- If filling material is to be used, this should be sourced from areas free of invasive species, and alien plant control measures are to be applied to all areas used for sourcing of fill materials.
- Areas of high conservation significance in close proximity but outside the physical mining footprint need to be clearly demarcated with appropriate barriers and signage to ensure no further

encroachment or disturbance. Any infringements will be reported and appropriate penalties are to be enforced on transgressing staff or Business partners.

- Efforts will be taken to minimise the footprint of short-duration activities and/or linear infrastructure. Efforts to minimise such footprints will include grouping all infrastructure to the same servitude and/or as close as possible to existing and planned long-term physical disturbances.
- Compilation of a Rehabilitation Plan by a suitably qualified specialist to complement the Biodiversity Management Plan (BMP). It will include the following:
  - Installation of erosion control structures.
  - Re-vegetation of disturbed/modified areas using indigenous shrubs and grasses only.
  - Special attention will be paid to ensuring that critical topography is reconstructed as far as practical.

Residual Impacts

With the implementation of the above mitigation measures, the impact significance is likely to be reduced to minor (*Table 7-11*).

Table 7-11 Pre- and Post- Mitigation Significance for Loss of Medium and Low Sensitivity Habitats and Associated Species

Impact	Project Phase	Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Loss of Medium-Low to Low Sensitivity Habitats	**Construction and Operations**	**MODERATE**	**MINOR**

7.5.3 Construction and Operation Phase: Loss of Plant Species of Conservation Concern

Impact Description

Throughout the study area, numerous occurrences of species of conservation concern have been observed. These range from very slow-growing trees to tiny succulents with very specific and restricted habitat requirements.

Several of these species are unique to the Bushmanland Inselberg Centre of Endemism. It is important that the species of higher conservation importance be either avoided or relocated so they can continue to persist and reproduce. This is especially necessary as in the prevailing arid habitat, suitable recruitment and establishment events (i.e. at least 3 consecutive years of average to above-average rainfall) are very scarce.

Impact Assessment

Table 7-12 describes the impact assessment of Project activities on the loss of plant species of conservation concern.

Table 7-12 Impact Rating: Loss of Plant Species of Conservation Concern Pre-Mitigation

Rating of Impacts Pre-Mitigation

Characteristic	Designation	Summary of Reasoning
Nature	Direct Negative	The impact is a result of primary project activities on the receiving environment.
Extent	Regional	Through direct, indirect, induced and cumulative impacts, the availability of unique habitats, and habitats suitable to species with a narrow distribution (narrow endemics) will be reduced and/or negatively affected. The regional viability of restricted plant populations may be affected.
Duration	Permanent	The unique habitats cannot be restored through rehabilitation efforts.
Scale	At least 18 species of high to moderate conservation concern will be directly affected. ± 302 ha natural habitats will be directly impacted. A much larger area may be indirectly impacted due to dust-particles and/or altered runoff patterns, which could not be determined or evaluated during the present study.	
Frequency	Permanent and continuous	Once the original habitat is significantly modified, its configuration cannot be re-created or ever fully restored.
Impact Magnitude: Large		
Sensitivity/Vulnerability/Importance of the Resource/Receptor: Very High to Medium		
Reversibility: The infrastructure footprint extends over some highly sensitive and irreplaceable habitats and species associated with them, and the loss of such habitats will be permanent. Further, loss of slow-growing species that have a restricted range and a low population growth rate will be affected.		
Significance Rating Pre-Mitigation: MAJOR		

Uncertainties:

- Re-establishment rates of relocated succulents that are restricted to specific habitats, e.g. rock crevices, are not known.
- It is uncertain how all species of conservation concern are best relocated, especially if they grow in localities from which they are difficult to extract (e.g. rocky outcrops and Koppies).
- It is currently not known if and where there will be suitable habitat for relocating such species.

Mitigation and Management Measures

Avoid and Minimise:

- If possible, avoid any physical destruction of the Koppies north of the current Swartberg Decline Access Road. In general, minimise clearing and operations in habitats with a Very High to Medium-High sensitivity rating.
- Avoid and/or minimise the loss of species of conservation concern by conducting a thorough pre-construction survey.
    - It must be followed by implementing necessary Search and Rescue actions prior to any groundworks taking place whilst allowing planning that will minimise the destruction of indigenous trees and/or species of conservation concern
    - Quiver trees should be relocated to:

- Areas where historical disturbances can be rehabilitated and where there are existing viable population of the same species, e.g. around Lemoenplaas Camp or north of the farmhouse of Achab 59.

Reduce:

- The pre-construction survey must be followed by implementing the necessary Search and Rescue actions prior to any groundworks taking place whilst allowing planning that will minimise the destruction of indigenous trees and/or species of conservation concern.
- The following activities will be prohibited for staff and Business Partners or any other person that may be present within or have access to the BMM mining concession area:
  - Purchase or transport of any wildlife/indigenous plant products from local communities or passing traders who cannot prove that they have valid permits for having such plants in their possession.
  - Collection of any plants or plant- products for trade, consumption, medicinal use or cultivation, unless such person has the permission of the mine management as well as a valid permit from the responsible authorities.
- Plants of conservation concern that will be directly affected by planned mining operations could be used for research purposes, if this will not critically reduce the viability of natural populations, and only with the necessary permits and permissions from the responsible authorities and BMM management.
- Any unauthorised driving to areas not directly affected by the mine, but which may contain species of conservation concern and/or natural habitat within the BMM mining concession, will not be allowed.

Rehabilitate:

- Rehabilitate and revegetate all areas that have been disturbed as soon as practically possible and continue progressively during all phases of mining.
- Where possible, rescued plants can be used as part of the rehabilitation efforts.

Residual impacts

Habitat and potential species loss – or loss of rescued plants - will still occur as a residual impact but could be reduced with effective mitigation as discussed above. Based on the estimated areas of loss, up to 300 ha of natural and partially irreplaceable habitat will be lost to the mine footprint. Even with mitigation, mining will result in a permanent and irreversible loss of habitat that would be suitable for the re-establishment of such species (*Table 7-13*).

Table 7-13 Pre- and Post- Mitigation Significance for Loss of Plant Species of Conservation Concern

Impact	Project Phase	Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Loss of Plant Species of Conservation Concern	Construction and Operations	MAJOR	MINOR

7.5.4 Construction and Operation Phase: Reduced Ecological Function and Degradation due to Altered Soil Surfaces

Impact Description

Soil surfaces will be altered significantly in a direct manner by the mining operations, changing not only topography, but all soil surface roughness, soil surface texture and most likely also soil surface chemistry. Indirectly, soil surfaces inside and outside the physical mine footprint will be impacted at least by some degree by dust generated from blasting practices, as well as other activities related to the excavation and movement of materials. Although the scale and possible severity of these impacts cannot be determined at this stage, it will still be necessary to evaluate this impact as it may affect biodiversity adjacent and downstream of the mining footprint. This is due to altered moisture infiltration, altered micro-habitats, possible altered soil chemistry and altered soil moisture regimes that will influence plant growth, persistence and regeneration potential.

Impact Assessment

Table 7-14 describes the impact assessment of Project activities on the reduced ecological function and degradation due to altered soil surfaces.

Table 7-14 Impact Rating: Reduced Ecological Function and Degradation due to Altered Soil Surfaces Pre-Mitigation

Rating of Impacts Pre-Mitigation		
Characteristic	**Designation**	**Summary of Reasoning**
Nature	Direct Negative	The impact is a result of primary project activities on the receiving environment.
Extent	Regional	Through direct, indirect, induced and cumulative impacts, the availability of unique habitats, and habitats suitable to species with a narrow distribution (narrow endemics) will be reduced and/or negatively affected.
Duration	Permanent	Habitat configuration cannot be restored through rehabilitation efforts
Scale	medium	At least ± 300 ha, much larger area expected after more data is available on footprint layout.
Frequency	Permanent and continuous	Once the original habitat is significantly modified, its configuration cannot be re-created or ever fully restored.
Impact Magnitude: Large		
Sensitivity/Vulnerability/Importance of the Resource/Receptor: High		
Reversibility: The infrastructure footprint extends over some highly sensitive and irreplaceable habitats, and the loss of such habitats will be permanent.		
Significance Rating Pre-Mitigation: MAJOR		

Mitigation and Management Measures

Avoid and Minimise:

- If possible, avoid any physical destruction of the Koppies north of the current Swartberg Decline Access Road. Minimise clearing and operations in habitats with a Very High to Medium-High sensitivity rating.

- Avoid any direct impacts on any surrounding or adjacent area with sensitive vegetation or any adjacent or nearby riparian habitats (except the clearing of alien invasive species).
- Avoid blocking and/or destruction of the washes to the south-east of the study area, and those coming off plains and mountains north-east of the study area.
- Use existing gravel roads and already disturbed areas to access mining operations as far as possible to avoid the creation of new roads or access routes across natural areas.

Reduce:

- Keep the clearing of natural vegetation to a minimum.
- Indigenous cleared shrubs and trees can be shredded and used as mulch on top of topsoil stockpiles or on rehabilitated areas.
- Reinforce portions of existing access routes that are prone to erosion or seasonal inundation, create structures or low banks to drain the access road rapidly during rainfall events, yet preventing erosion of the track and surrounding areas.
- Install adequate drainage structures to ensure that water flows are never concentrated or blocked in any way.
- Dust levels from blasting and haulage must be controlled and minimised at all times.
    - As far as practically possible, blasting should only be done under low- or no-wind conditions.
    - Once the extent of possible dust deposition has been modelled and is known, it will be advisable to search the area affected for plant species of conservation concern. In areas with a high(er) concentration of such species, dust monitoring programmes, coinciding with monitoring programmes of the plants affected should be implemented to advise management if any immediate remedial action will be required, or if possible offset or relocation measures will need to be implemented if affected species start dying off at increased rates due to dust deposition.
    - Strict speed limits must be set and adhered to in order to reduce dust fall out.

Rehabilitate:

- Prior to rehabilitation, landscaping of disturbed areas needs to be undertaken in a way that ensures sufficient surface roughness, but also blends in with natural runoff and drainage patterns, whilst still preventing the start of rill- or gully erosion.
- As part of rehabilitation, all compacted soils need to be ripped to a depth of at least 30 cm to prevent soil-surface crusting.
- All signs of accelerated erosion after a large rainfall event must be mitigated as soon as possible.
- Rehabilitate and revegetate all areas that have been disturbed as soon as practically possible.

Residual impacts

Habitat modification, dust deposition and associated modification of the soil surface characteristics will still occur as a residual impact, but could be reduced with effective mitigation. With the implementation of the above mitigation measures, the impact significance is likely to be remain Major (*Table 7-15*).

Table 7-15 Pre- and Post- Mitigation Significance for Reduced Ecological Function and Degradation due to Altered Soil Surfaces

Impact	Project Phase	Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Reduced Ecological Function and Degradation due to Altered Soil Surfaces	**Construction and Operations**	**MAJOR**	**MAJOR**

7.5.5 Construction and Operation Phase: Increase in Alien Invasive Vegetation

Impact Description

Disturbance of the natural environment can present a window of opportunity for the establishment of alien invasive species, especially if regenerative material of such species is already present in close proximity or along major transport routes. Introduction of such species is generally accidental, and it will require an ongoing program to control such plants to prevent a build-up of large seedbanks and populations that become large enough to start negatively affecting rehabilitation efforts as well as remaining natural habitats. Current threats are relatively low (see Section 4.4), but should be minimised or obliterated as much as possible.Impact Assessment

Table 7-16 describes the impact assessment of Project activities on increased alien invasive vegetation.

Table 7-16 Impact Rating: Increased Alien Invasive Vegetation Pre-Mitigation

Rating of Impacts Pre-Mitigation		
Characteristic	**Designation**	**Summary of Reasoning**
Nature	Direct Negative	The impact is a result of primary project activities on the receiving environment
Extent	Local	Although a full assessment of alien plants was within the scope of the study, it would appear that current distribution of alien invasive species is limited and at a level where it can be controlled.
Duration	Long-Term to Permanent	It is expected that where such species occur, soil seed banks have already built up that will facilitate ongoing re-establishment that may worsen the infestation if not addressed
Scale	Full assessment of alien distribution was not part of the study, and needs to be done as part of an alien species control plan	
Frequency	Continuous	It is expected that where such species occur, soil seed banks have already built up that will facilitate ongoing re-establishment that may worsen the infestation if not addressed
Impact Magnitude: Medium		
Sensitivity/Vulnerability/Importance of the Resource/Receptor: Currently **Low,** but may affect habitats of Medium-High to High Sensitivity if not addressed		
Reversibility: Alien invasive species infestations are reversible if stringent programmes are put in place		
Significance Rating Pre-Mitigation: MINOR to MODERATE		

Mitigation and Management Measures

Avoid and Mitigate:

- Wheels of large machinery should be checked prior to entering the site and cleared of seed or any other plant material (especially of species with spiny or bur-like seeds). All such plant material removed must be burnt.
- If filling material is to be used, this should be sourced from areas free of invasive species, and alien plant control measures are to be applied to all areas used for sourcing fill materials.

Reduce:

- Conduct a detailed Alien Invasive Survey within the BMM concession area, and if possible also along approximately 20 -50 km of all major access routes leading to the mine. From this:
  - Create and implement a suitable (alien) Invasive Plant Management Plan (following DEA standards for an Alien Management Control Plan).
  - Destruction of regenerative material of cleared alien species by burning in a protected area is encouraged.
  - Be aware of alien species that may be newly introduced to the area and act immediately to eradicate once detected.

Rehabilitate:

- Rehabilitate and revegetate all areas that have been disturbed as soon as practically possible and progressively during all phases of the mine. This will be according to a Rehabilitation Plan to be compiled by a suitably qualified specialist and complement a Biodiversity Action Plan (BAP). It will include the following:
- Re-vegetation measures of disturbed/modified areas using indigenous shrubs and grasses only. The selection of species used for rehabilitation may not include any species that are not suitable to the receiving environment (i.e. must occur there naturally), and also no species that are indicative of habitat degradation..

Residual Impact

Any physical disturbance and movement of man and machinery always present opportunities for alien invasive plants to become established. Currently this can be controlled, but will require a permanent ongoing effort to ensure that alien invasive species do not become a major problem to manage.

With the implementation of the above mitigation measures, the impact significance is likely to be reduced to minor (*Table 7-17)*

Table 7-17 Pre- and Post- Mitigation Significance for Increased Alien Invasive Vegetation

Impact	Project Phase	Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Increased Alien Invasive Vegetation	**Construction and Operation**	**MODERATE**	**MINOR**

7.6 Fauna

Potential impacts concerning terrestrial flora within the Project area are as follows:

- Loss of Habitats of Medium, High and Very High Sensitivity;

- Loss of Individuals of Faunal Species of Conservation Concern; and
- Cumulative Impact of Habitat Fragmentation and Reduced Landscape Connectivity for Fauna.

7.6.1 Construction and Operation Phase: Faunal Habitat Loss of Medium, High and Very High Sensitivity areas

Impact Description

The footprint of the proposed mine expansion includes the Opencast Pit, Waste Rock Pad and possible increased road infrastructure. Within the expanded mine area in particular, there are numerous high value faunal habitats such as drainage lines, rocky outcrops and steep mountain slopes.

Impact Assessment

Table 7-18 describes the impact assessment of the Loss of High, High and Very High Sensitivity Habitats as a result of Project activities.

Table 7-18 Pre- Mitigation Impact Rating: Faunal Habitat Loss within Medium, High and Very High Sensitivity Habitats and Associated Species

Rating of Impacts Pre-Mitigation		
Characteristic	**Designation**	**Summary of Reasoning**
Nature	**Direct**	The impact is a result of primary project activities and the receiving environment
Extent	Regional	Through direct, indirect, induced and cumulative impacts, the availability of unique habitats, and habitats suitable to species with a narrow distribution (narrow endemics) will be reduced and/or negatively affected. *With adequate mitigation measures this could be reduced to a Local Extent.*
Duration	Permanent	The high value faunal habitats cannot be easily restored through rehabilitation and should be considered more or less permanent. Furthermore, in the long-term it is uncertain whether the waste rock dump and mine voids would be restored at all and it is highly likely that the activities would result in permanent habitat loss or a significant decrease in faunal habitat value across the affected areas.
Scale	± 200 ha	The size of the Project site (including different WRD options)
Frequency	Permanent and continuous	Once the original habitat is significantly modified, its configuration cannot be re-created or ever fully restored
Impact Magnitude: Large		
Sensitivity/Vulnerability/Importance of the Resource/Receptor: Medium		
Reversibility: Low The infrastructure footprint extends over some highly sensitive and irreplaceable habitats, and the loss of such habitats will be permanent.		
Significance Rating Pre-Mitigation: MODERATE		

Proposed Mitigation Measures

- As far as possible, minimize disturbance and habitat loss within the high and very high sensitivity areas such as drainage lines.
- The final design mine footprint areas should be clearly demarcated and all mining activities restricted to these areas. In the event that the final design differs from that presented in this EIA, an additional walkover of the area to confirm conditions.
- Any exploration trenches, pits or boreholes that pose a danger to fauna should be filled-in or covered to prevent fauna from falling and becoming trapped.
- Use existing gravel roads and already disturbed areas to access mining operations as far as possible to avoid the creation of new roads or access routes across natural habitats.
- No open fires may be lit for cooking or any other purposes, unless in specifically designated and secured areas.
- There should be waste bins with lids distributed at strategic points across the site to ensure that litter is well-managed. No food waste or other waste that might attract fauna should be left exposed.

- There should be a preconstruction search and rescue for fauna prior to vegetation clearing within areas where there are identified fauna resident and which might be killed by construction activities.
- Design and create berms to stop runoff from the mining and waste-rock dump during/after periodic extreme rainfall events from entering directly into existing washes.
- If the site must be lit at night for security purposes, this should be done with downward-directed low-UV type lights (such as most LEDs), which do not attract insects.
- Keep the clearing of natural vegetation to a minimum.
- Reduce fragmentation of natural habitat by keeping long-term or permanently impacted areas as close together as possible (but avoiding the blockage of or increased impact on sensitive habitats).
- Parking and operational areas should be regularly inspected for oil spills and covered with an impermeable or absorbent layer.
- Areas of high faunal significance in close proximity to, but outside the physical mining footprint need to be clearly demarcated with appropriate barriers and signage to ensure no further encroachment or disturbance. Any infringements will be reported and appropriate penalties are to be enforced on transgressing staff or contractors.
- Efforts will be taken to minimise the footprint of short-duration activities and/or linear infrastructure. Efforts to minimise such footprints will include grouping all infrastructure to the same servitude and/or as close as possible to existing and planned long-term physical disturbances. This will also reduce fragmentation due to mining operations.
- Rehabilitate and revegetate all areas that have been disturbed as soon as practically possible and progressively during all phases of the mine. This will be according to a Rehabilitation Plan to be compiled by a suitably qualified specialist and complement a Biodiversity Action Plan (BAP).
- No Threatened or Protected species (ToPs) and/or protected fauna as listed according NEMBA (Act No. 10 of 2004) and relevant provincial ordinances may be removed and/or relocated without appropriate authorisations/permits.
- No poaching must be tolerated under any circumstances.
- No deliberate or intentional killing of fauna is allowed.

Residual impacts

Habitat loss for fauna cannot be comprehensively mitigated and will still occur to some degree regardless of the mitigation applied. Even with rehabilitation and other mitigation, mining will result in some permanent and irreversible loss and degradation of habitat within the mine footprint.

Table 7-19 Pre- and Post-Mitigation Impact Rating: Loss of Medium, High and Very High Sensitivity Faunal Habitats and Associated Species

Impact	Project Phase	Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Loss of Faunal Habitats of Medium, High and Very High Sensitivity	**All Phases**	**MODERATE**	**MODERATE**

7.6.2 Construction and Operation Phase: Loss of Individuals of Fauna due to mining activities.

Impact Description

The proposed mine expansion will involve vegetation clearing, earth moving and blasting for mining and site establishment. This is likely to result in the direct loss of individuals of fauna that are too slow or unable to move away from the construction activities. Some larger fauna, may be able to move away from the site but unable to find suitable habitat elsewhere. Furthermore, the large number of personnel present at the site would pose a risk to some fauna through poaching.

Impact Assessment

Table 7-20 describes the impact assessment of the Loss of individuals of fauna as a result of Project activities.

Table 7-20 Pre- Mitigation Impact Rating: Loss of Individuals of Fauna due to Mining Activities.

Rating of Impacts Pre-Mitigation		
Characteristic	**Designation**	**Summary of Reasoning**
Nature	**Direct**	The impact is a result of primary project activities
Extent	Local	Through direct, indirect and induced impacts, individuals of susceptible fauna will be lost or killed.
Duration	Long-term	An impact on fauna due the mining activities would be highest at site establishment, but would be on-going at a lower level for the duration of the project.
Scale	± 200 ha	Local
Frequency	On-Going	The impact is likely to continue to some degree for the lifetime of the project.
Impact Magnitude: Moderate		
Sensitivity/Vulnerability/Importance of the Resource/Receptor: Medium		
Reversibility: Moderate There would some permanent habitat loss and degradation for fauna, but direct impact would largely cease at the end of the project and the impact would no longer occur to a significant degree, although there could be some residual impact due to mining voids that have not been backfilled etc.		
Significance Rating Pre-Mitigation: MODERATE		

Proposed Mitigation Measures

- Waste bins with lids should be distributed at strategic points across the site to ensure that litter is well-managed. No food waste should be left exposed.
- A preconstruction search and rescue for fauna prior to vegetation clearing must be undertaken within areas where there are identified fauna resident which might be affected by construction activities.
- All fauna threatened by mining activities should be removed to safety by an appropriately trained person.

- All mine staff and contractors should receive an induction highlighting the need to respect the environment, no littering, no persecution of fauna, no illegal hunting, poaching or harvesting of natural products from the environment.
- All construction vehicles should adhere to a low speed limit (30kph for heavy vehicles and 40kph for light vehicles) to avoid collisions with susceptible species such as snakes and tortoises.
- All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner.
- All open water sources such as reservoirs, waste water, evaporation dams etc should be covered with shade cloth, fine mesh or similar to prevent fauna accessing these areas and from falling into the reservoirs and drowning.
- Provide signage to indicate the right of way of fauna such as tortoises. Any roadkill should be recorded and all areas where repeated events occur should be inspected to see if additional mitigation can be applied

Residual impacts

Direct impacts on fauna can be mitigated to some degree although some low-level mortality of susceptible species is likely unavoidable. However, in the long-term this impact can be reduced to a low level through mitigation and avoidance.

Table 7-21 Pre- and Post-Mitigation Impact Rating: Direct Impact on Fauna Species

Impact	Project Phase	Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Direct impact on fauna	**All Phases**	**MODERATE**	**MINOR**

7.7 Groundwater

Potential impacts on groundwater as a result of Project activities within the Project area are as follows:

- Impact of Contaminants on the Groundwater Resource;
- Impact of Water Quality on Groundwater Users;
- Impact of Drawdown or Dewatering on the Groundwater Resource; and
- Impact of Drawdown or Dewatering on Groundwater Users.

7.7.1 Operation Phase: Impact of Contaminants on the Groundwater Resource

Impact Description

Contaminants of Concern (CoCs) related to the mining operation have been identified from the existing groundwater quality data and include salts such as sodium (Na), calcium (Ca), magnesium (Mg), potassium (K), chloride (Cl), sulphate (SO4), manganese (Mn), zinc (Zn), lead (Pb) and nitrates (NO3, surface blasting in opencast pits). No geochemical assessments were performed on the waste rock and fines and it is recommended that these studies be performed to indicate the contamination potential of the waste material and chemical parameters that may be problematic. Further, due to blasting activities in-pit it is expected that large amounts of NO_3 will be released, and possibly diesel, depending on the type of explosives used.

Total Dissolved Solids (TDS) in groundwater emanating from the WRDs was quantified using numerical solute transport modelling. TDS is a conservative tracer, providing an indication of conservative contaminant extent.

End of mining modelled TDS plumes at concentrations exceeding the Quality of Domestic Water Supplies (DWA&F, Second Edition 1998) of 2,400 mg/L are mainly confined to within the immediate area and footprint of the contaminant sources. The plumes are expected to impact an area of 1.77 km^2 (WRDs) and do not extend off-site.

WRDs (Option 1 and Option 2) are located immediately adjacent to the open pits and contaminated seepage from the WRDs is expected to partly flow into the pits. 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 heavy rain events. This seepage is expected to be contaminated.

The TDS leaching from the WRD is predicted to steadily increase in concentration to an average maximum of about 5,500 – 6,500 mg/L on closure (based on the historical groundwater quality data of Deeps / Broken Hill WRD - It is recommended that geochemical assessments/ modelling be performed on the discard rock material of the proposed WRDs). This is significantly higher than TDS concentrations measured in groundwater sampled from hydrocensus boreholes to the east of Swartberg which has a range from 1,260 mg/L. However, water quality impacts are expected to be limited to the immediate area down-gradient of groundwater flow and the footprints of the planned WRDs. Leaching of contaminated water from WRDs will severely alter the groundwater quality within the footprint of these facilities.

The groundwater is considered as an important resource (due to the overall dry climatic conditions and limite surface water in the region) even though natural groundwater quality does not currently meet drinking water or stock watering standards.

Impact Assessment

Table 7-22 describes the impact assessment of Project activities on groundwater quality affecting the groundwater resource during operations.

Table 7-22 Impact Assessment: Operations: Contaminants on the Groundwater Resource

Rating of Impacts Before Mitigation		
Characteristic	**Designation**	**Summary of Reasoning**
Nature	Direct Negative	The impact is a result of primary project activities on the receiving environment
Extent	Local/on site	The extent of the impact is confined to the footprint of the WRDs and the immediate area down gradient of groundwater flow. Therefore the impact is rated as on-site and local.
Duration	Permanent	The expected impact will be permanent (ie irreversible).
Scale	>1.77 km^2	Project activities will severely alter the groundwater quality within the footprint and in the immediate area down-gradient of groundwater flow of the WRDs.
Frequency	Continuous	It is expected that the frequency of the impact will be continuous.
Impact Magnitude: Medium (Impact of Swartberg U/G dewatering cone and planned open pits)		
Sensitivity/Vulnerability/Importance of the Resource/Receptor: Medium		
Reversibility- Low		
Significance Rating Before Mitigation: MODERATE		

Mitigation Measures

In keeping with the mitigation hierarchy, the priority in mitigation is to apply mitigation measures to the source of the impact, the main sources being the planned enlarged footprint and the planned WRDs (Option 1 and Option 2).

No geochemical modelling has been undertaken but existing groundwater data indicates that the WRDs will generate acid rock drainage (ARD), which is expected to seep into groundwater. 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 planned areas of the WRDs. Mitigation measures required to reduce the impact on groundwater quality include:

- Toe seepage from the WRD's 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 that as much water as possible should be recycled and re-used.
- The numerical groundwater flow and transport model should be updated/validated as additional information becomes available (ie SEEP/W model results, geophysics results and hydraulic conductivity of WRDs 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 (WUL) requirements. The current 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 WRDs 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 (WUL) 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. Currently a monitoring network exist for BMM. It is recommended that additional groundwater monitoring boreholes be constructed for the planned WRDs.

Targeted monitoring 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 as well as for planning of the post-closure phase of the Project to ensure appropriate provisions are made.

Residual Impacts

With the implementation of the above mitigation measures, the impact significance is likely to be reduced to minor (*Table 7-23*).

Table 7-23 Pre- and Post- Mitigation Significance for Contaminants on the Groundwater Resource during the Operation Phase

Impact	Project Phase	Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Impact of Groundwater Quality on the Groundwater Resource	Operations	MODERATE	MINOR

7.7.2 Decommissioning Phase: Impact on Groundwater Quality on the Groundwater Resource

Impact Description

The seepage from WRDs are 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 expected to expand further towards the proposed pit areas.

Modelled areal extent of TDS plumes 100 years after mine closure are 3.72 km^2 for the WRDs. The maximum travel distance of 0.75 km is observed from the WRDs in a westerly south-westerly direction.

Impact Assessment

Table 7-24 describes the impact assessment of Project activities on groundwater quality affecting the groundwater resource during and post decommissioning.

Table 7-24 Impact Assessment: Decommissioning: Contaminants on the Groundwater Resource during the Post Closure Phase before Mitigation

Rating of Impacts Before Mitigation		
Characteristic	**Designation**	**Summary of Reasoning**
Nature	Direct Negative	The impact is a result of primary project activities on the receiving environment
Extent	Local/on site	The extent of the impact is confined to the footprint of the WRDs and the immediate area down gradient of groundwater flow. Therefore the impact is rated as on-site and local.
Duration	Permanent	The expected impact will be permanent (ie irreversible).
Scale	>3.72 km^2	The resource/ receptor will remain unaltered except within the Mine footprint and in the immediate area down-gradient of groundwater flow of the WRDs.
Frequency	Continuous	It is expected that the frequency of the impact will be continuous.
Impact Magnitude: Medium (Impact of Swartberg U/G dewatering cone and planned open pits)		
Sensitivity/Vulnerability/Importance of the Resource/Receptor: Medium		
Reversibility- Low		
Significance Rating Before Mitigation: MODERATE		

Mitigation and Management Measures

Operational mitigation measures have to be maintained post closure. Further, final profiling of the 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. Usually DWS Water Use Licence requirements indicate that the mining site and regionally identified boreholes that are off-site of the project area should be monitored (groundwater levels and water quality) for at least 10 years after mine closure.

Residual Impacts

With the implementation of the above mitigation measures, the impact significance is likely to be reduced to minor (*Table 7-25*).

Table 7-25 Pre- and Post- Mitigation Significance for Contaminants on the Groundwater Resource Post Closure

Impact	Project Phase	Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Impact of Groundwater Quality on the Groundwater Resource	**Decommissioning and Post closure**	**MODERATE**	**MINOR**

7.7.3 Operation Phase: Impact of Contaminants on Groundwater Users

Impacts Description

TDS groundwater contamination emanating from WRDs was quantified using numerical solute transport modelling. TDS is a conservative tracer, providing an indication of conservative contaminant extent.

At the end of mining, modelled TDS plumes are usually at concentrations exceeding the Quality of Domestic Water Supplies (DWA&F, Second Edition 1998) of 2,400 mg/L. Plumes are mainly confined within the immediate footprint and the area immediately down-gradient of groundwater flow of the contaminant sources and are not expected to affect any private groundwater users (farm boreholes, Witputs BH, Koeris 54BH1 and Koeris 54BH2).

Impact Assessment

Table 7-26 describes the impact assessment of Project activities on groundwater quality affecting groundwater users during operations.

Table 7-26 Impact Assessment: Operations: Impacts of Contaminants on the Groundwater Users before Mitigation

Rating of Impacts Before Mitigation		
Characteristic	**Designation**	**Summary of Reasoning**
Nature	Direct Negative	The impact is a result of primary project activities on the receiving environment
Extent	Local/on site	The extent of the impact is on-site / local.
Duration	Permanent	The expected impact will be permanent (i.e. irreversible).
Scale	The groundwater resource is expected to remain unaltered except for the footprint and the immediate area down-gradient of groundwater flow of WRDs.	
Frequency	Continuous	It is expected that the frequency of the impact will be continuous.
Impact Magnitude: Negligible		
Sensitivity/Vulnerability/Importance of the Resource/Receptor: Medium		
Reversibility- Low		
Significance Rating Before Mitigation: NEGLIGIBLE		

Mitigation and Management Measures

Groundwater quality should be monitored at the existing (known) private boreholes at regular intervals to confirm modelling results. Should monitoring data confirm an impact on private users, the client will compensate affected famers for their loss, replacing the lost water supply source.

Residual Impacts

With the implementation of the above management measures, the impact significance will remain negligible (*Table 7-27**Error! Reference source not found.***).

Table 7-27 Pre- and Post- Mitigation Significance for Impacts of Contaminants on the Groundwater Users during Operations

Impact	Project Phase	Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Impact of Groundwater Quality on the Groundwater Users	**Operations**	**NEGLIGIBLE**	**NEGLIGIBLE**

7.7.4 Decommissioning Phase: Impact of Contaminants on Groundwater Users

Impact Description

The seepage from WRDs is not expected to stop after mine closure and will continue to expand post-closure.

The modelled areal extent of TDS plumes 100 years after mine closure are 3.72 km^2 for the WRDs. The maximum travel distance of 0.75 km is observed from the WRDs in westerly direction. Private groundwater users are not expected to be impacted by groundwater contamination as plumes remain within farms owned by the client.

Impact Assessment

Table 7-28 describes the impact assessment of Project activities on groundwater quality affecting groundwater users post closure.

Table 7-28 Impact Assessment: Post Closure: Impact of Contaminants on the Groundwater Users Post Closure before Mitigation

Rating of Impacts Before Mitigation		
Characteristic	**Designation**	**Summary of Reasoning**
Nature	Direct Negative	The impact is a result of primary project activities on the receiving environment
Extent	Local/on site	The extent of the impact is confined to the site / local.
Duration	Permanent	The expected impact will be permanent (ie irreversible).
Scale	>3.72 km^2	The groundwater resource is expected to remain unaltered except for the footprint and the immediate area down-gradient of groundwater flow of WRDs.
Frequency	Continuous	It is expected that the frequency of the impact will be continuous.

Impact Magnitude: Negligible
Sensitivity/Vulnerability/Importance of the Resource/Receptor: Medium
Reversibility- Low
Significance Rating Before Mitigation: NEGLIGIBLE

Mitigation and Management Measures

Groundwater quality should be monitored at the existing (known) private boreholes at regular intervals starting prior to or during construction to confirm modelling results. Should monitoring data confirm impact on private users, BMM 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. Usually the DWS Water Use Licence requirements indicate that the mining site and regionally identified boreholes that are off-site of the project area should be monitored (groundwater levels and water quality) for at least 10 years after mine closure.

Residual Impact

With the implementation of the above mitigation measures, the impact significance is likely to remain negligible (*Table 7-29**Error! Reference source not found.***).

Table 7-29 Pre- and Post- Mitigation Significance for Impacts of Contaminants on the Groundwater Users Post Closure

Impact	Project Phase	Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Impact of Groundwater Quality on the Groundwater Users	**Post Closure**	**NEGLIGIBLE**	**NEGLIGIBLE**

7.7.5 Operation Phase: Impact of Drawdown or Dewatering on the Groundwater Resource

Impact Description

The planned open pit mining operation will contribute to the existing dewatering of the aquifer. The Swartberg U/G Workings and a drawdown cone will develop predominantly towards the north-east and to a lesser extent to the south. Increased recharge from the WRD Option 2 may prevent to some extent the drawdown cone propagation towards the east where WRD Option 1 may buffer the propagation of the dewatering cone to the south.

Groundwater modelling suggests that at the end of mining drawdowns or the dewatering cone can be expected to reach approximately 2.5 km to the north-east and 1.2 km to the south. The maximum drawdown in close proximity to the pit is approximately 720 - 760 mbgl.

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 when compared with the South African Water Quality Guidelines (South African National Standards, SANS241-2015

and SANS241-2006). The boreholes to the east of Swartberg were found to be suitable for livestock watering (South African Water Quality Guidelines, Volume 5 - Agricultural Use: Livestock Watering). Farm boreholes closest to the planned project are located in between 4.5km (Koeris 54BH2) and 5.3 km (Witputs BH) away from the planned open pits and existing Swartberg U/G Workings and remain unaffected during operations as the drawdown cone will largely be confined to the project site.

Hydraulic head change is expected to be limited to the Project site and adjacent properties belonging to the BMM. Groundwater levels are not expected to recover after mine closure to the pre-mining state, since the pits will continue to act as a sink to groundwater based on the elevated evaporation rate if not rehabilitated.

The dewatering cone will not fully recover even 100 years after the cessation of mining. The dewatering cone will, however, get smaller with time post closure.

The groundwater model is currently based on a number of conservative assumptions but was calibrated with available data. This implies that reliability of the model predictions is low to medium. However, the model confidence is deemed sufficient to assess conservative impacts and make appropriate mitigation recommendations at the EIA stage of the project.

Impact Assessment

Table 7-30 describes the impact assessment of drawdown or dewatering activities on the Drawdown or Dewatering on the Groundwater Resource during the operation phase.

Table 7-30 Impact Assessment: Operations: Drawdown or Dewatering on the Groundwater Resource before Mitigation

Rating of Impacts Before Mitigation		
Characteristic	**Designation**	**Summary of Reasoning**
Nature	Direct Negative	The impact is a result of primary project activities on the receiving environment
Extent	Local	Groundwater modelling suggests that at the end of mining drawdowns or the dewatering cone can be expected to reach approximately 2.5 km to the north-east and 1.2 km to the south
Duration	Permanent	The expected impact will be permanent (ie irreversible, > 100 years, although the dewatering cone will decrease somewhat in size after closure the dewatering cone will remain.
Scale	2.5 km to the north-east and 1.2 km to the south	The dewatering cone can be expected to reach approximately 2.5 km to the north-east and 1.2 km to the south
Frequency	Continuous	It is expected that the frequency of the impact will be continuous.
Impact Magnitude: Medium (Impact of Swartberg U/G dewatering cone and planned open pits)		
Sensitivity/Vulnerability/Importance of the Resource/Receptor: Medium		
Reversibility- Irreversible - groundwater levels on-site may not recover to a pre-mining state even after 100 years.		
Significance Rating Before Mitigation: MODERATE		

Mitigation and Management Measures

Groundwater level change (drawdown) cannot be mitigated. It is therefore recommended that groundwater levels in the vicinity of the pits as well as in each of the known farm boreholes (Witputs

BH, Koeris 54BH1 and Koeris 54BH2), 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.

Residual Impact

The larger factor controlling the dewatering cone is the Swartberg U/G Workings and as the workings fill-up with groundwater the dewatering cone will decrease over time after mine closure. However, the groundwater levels are not expected to recover fully after mine closure because the pits are likely to continue to act as a groundwater sink due to the high evaporation rates. As such, the impact significance is likely to remain moderate (*Table 7-31*).

Table 7-31 Pre- and Post- Mitigation Significance for Drawdown or Dewatering on the Groundwater Resource during Operations

Impact	Project Phase	Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Impact of drawdown or dewatering on the groundwater resource	**Operations**	**MODERATE**	**MODERATE**

7.7.6 Decommissioning/Post Closure Phase: Impact of Drawdown or Dewatering on the Groundwater Resource

Impact Description

The larger factor controlling the dewatering cone is the Swartberg U/G Workings and as the workings fill-up with groundwater the dewatering cone will decrease over time after mine closure. However, the groundwater levels are not expected to recover fully after mine closure as the pits may continue to act as a groundwater sink due to the high evaporation rates, resulting in a drawdown cone. The maximum drawdown in close proximity to the pit after 100 years is approximately 720 - 760 mbgl.

The three farm boreholes located between 4.5 and 6.2 km away from the planned open pits and existing Swartberg U/G Workings are not expected to experience drawdowns or be impacted by the dewatering cone. Groundwater level change is expected to be limited to the project site and adjacent properties.

Impact Assessment

Table 7-32 describes the impact assessment of drawdown or dewatering activities on the groundwater resource the post closure.

Table 7-32 Impact Assessment: Post Closure: Drawdown or Dewatering on the Groundwater Resource before Mitigation

Rating of Impacts Before Mitigation		
Characteristic	**Designation**	**Summary of Reasoning**

Nature	Direct Negative	The impact is a result of primary project activities on the receiving environment
Extent	Local	Groundwater modelling suggests that at the end of mining drawdowns or the dewatering cone can be expected to reach approximately 2.5 km to the north-east and 1.2 km to the south
Duration	Permanent	The expected impact will be permanent (ie irreversible , > 100 years).
Scale	Drawdown in the pit after 100 years is approximately 720 - 760 mbgl	The impact of the pits will contribute to the existing dewatering cone of the Swartberg U/G Workings, which have severely altered the resource
Frequency	Continuous	It is expected that the frequency of the impact will be continuous.
Impact Magnitude: Medium (Impact of Swartberg U/G dewatering cone and planned open pits)		
Sensitivity/Vulnerability/Importance of the Resource/Receptor: Medium		
Reversibility- Irreversible - groundwater levels on-site may not recover to a pre-mining state even after 100 years.		
Significance Rating Before Mitigation: MODERATE		

Mitigation and Management Measures

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 Impacts

The impact cannot be mitigated and therefore the impact significance for operational and post-closure phases remains largely unchanged as the dewatering cone although smaller may remain after 100 years to some extent (*Table 7-33*).

Table 7-33 Pre- and Post- Mitigation Significance for Drawdown or Dewatering of the Groundwater Resource Post Closure

Impact	Project Phase	Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Impact of drawdown or dewatering of the groundwater resource	**Post Closure**	**MODERATE**	**MODERATE**

7.7.7 Operation Phase: Impact of Drawdown or Dewatering on Groundwater Users

Impact Description

Groundwater is used in the area and represents the sole source of water for a number of farmers. However, private groundwater users are not expected to be impacted during mining as the drawdown cone remains at a distance of more than 1.6 – 2.0 km from the closest existing (known) farm boreholes being (Witputs BH, Koeris 54BH1 and Koeris 54BH2).

Groundwater levels are expected to recover to some extent after mine closure, but it is not expected that the groundwater levels will recover to pre-mining state, since the pits will continue to act as a sink to groundwater.

Impact Assessment

Table 7-34 describes the impact assessment of drawdown or dewatering activities on the groundwater users during operations.

Table 7-34 Impact Assessment: Operations: Drawdown or Dewatering on the Groundwater Users before Mitigation

Rating of Impacts Before Mitigation		
Characteristic	**Designation**	**Summary of Reasoning**
Nature	Direct Negative	The impact is a result of primary project activities on the receiving environment
Extent	Local	Groundwater modelling suggests that at the end of mining drawdowns or the dewatering cone can be expected to reach approximately 2.5 km to the north-east and 1.2 km to the south
Duration	Permanent	The expected impact will be permanent (ie irreversible , > 100 years, although the dewatering cone will decrease in size after closure).
Scale	1.6 – 2.0 km from the closest boreholes	The drawdown cone remains at a distance of more than 1.6 – 2.0 km from the closest existing (known) farm boreholes
Frequency	Continuous	It is expected that the frequency of the impact will be continuous.
Impact Magnitude: Negligible (due to distance of boreholes)		
Sensitivity/Vulnerability/Importance of the Resource/Receptor: Medium		
Reversibility- Irreversible - groundwater levels on-site may not recover to a pre-mining state even after 100 years.		
Significance Rating Before Mitigation: NEGLIGIBLE		

Mitigation and Management Measures

Groundwater level change (drawdown) cannot be mitigated. However, it is 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.

Residual Impacts

As this impact cannot be mitigated the residual impacts remain negligible (*Table 7-35*).

Table 7-35 Pre- and Post- Mitigation Significance for Drawdown or Dewatering on the Groundwater Users

Impact	**Project Phase**	**Significance (Pre-mitigation)**	**Residual Impact Significance (Post-mitigation)**
Impact of drawdown or dewatering on the groundwater users	**Operations**	**NEGLIGIBLE**	**NEGLIGIBLE**

7.7.8 Decommissioning/ Post Closure: Impact of Drawdown or Dewatering on Groundwater Users

Impact Description

Modelling results suggest that the three private boreholes located to the north and west of Swartberg Mine (Witputs BH, Koeris 54BH1 and Koeris 54BH2) will not experience drawdowns post closure as the drawdown cone or dewatering cone will decrease to some extent as the Swartberg U/G Workings start to fill-up.

Hydraulic head change is expected to extend off site but remains local in extent. Groundwater levels are not expected to recover fully to pre-mining state after mine closure, since the pits will continue to act as a sink to groundwater.

Impact Assessment

Table 7-36 describes the impact assessment of drawdown or dewatering activities on the groundwater users post closure.

Table 7-36 Impact Assessment: Post Closure: Drawdown or Dewatering on the Groundwater Users

Rating of Impacts Before Mitigation		
Characteristic	**Designation**	**Summary of Reasoning**
Nature	Direct Negative	The impact is a result of primary project activities on the receiving environment
Extent	Local	Groundwater modelling suggests that at the end of mining drawdowns or the dewatering cone can be expected to reach approximately 2.5 km to the north-east and 1.2 km to the south
Duration	Permanent	The expected impact will be permanent (ie irreversible , > 100 years, although the dewatering cone will decrease somewhat in size after closure).
Scale	1.6 – 2.0 km from the closest boreholes	The drawdown cone remains at a distance of more than 1.6 – 2.0 km from the closest existing (known) farm boreholes
Frequency	Continuous	The impact will be felt for >100 years but will very slowly reduce in extent.
Impact Magnitude: Negligible		
Sensitivity/Vulnerability/Importance of the Resource/Receptor: Medium		
Reversibility- Irreversible - groundwater levels on-site may not recover to a pre-mining state even after 100 years.		
Significance Rating Before Mitigation: NEGLIGIBLE		

Mitigation and Management Measures

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.

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.

Residual Impact

With the implementation of the above mitigation measures, the impact significance remains negligible (*Table 7-37*).

Table 7-37 Pre- and Post- Mitigation Significance for Drawdown or Dewatering on the Groundwater Users

Impact	Project Phase	Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Impact of drawdown or dewatering on the groundwater users	**Post Closure**	**NEGLIGIBLE**	**NEGLIGIBLE**

7.8 Employment, Skills Enhancement and Local Business Opportunities

The Project is expected to generate positive impacts on the local economy and livelihoods in terms of:

- Employment and skills enhancement; and
- Local business opportunities through the procurement of goods and services.

Positive impacts will be associated with the construction and operations phase. However, there is likely to be a reduction in employment once the construction phase is complete, as the termination of construction contracts will occur once construction activities are completed.

Those who have worked on the Project will have an advantage when seeking alternative jobs on similar projects due to the experience and any training received through this Project.

Expansion of Swartberg Mine will also prevent the loss of employment of the current Deeps mining employees as the Deeps employees will be moved over to Swartberg.

7.8.1 Construction and Decommissioning: Employment, Skills Enhancement and Local Business Opportunities

Impact Description

The construction phase will span approximately 24 months and it is expected that approximately 300 direct employment opportunities will be available during the peak of construction. It is anticipated the workers who are currently working on the Gamsberg mine will be able to continue work on this Project. *Table 7-38* indicates the estimated labour positions that will be required during construction.

Table 7-38 Estimated Employment Positions Available During Construction

Employment Position	Number of Positions
Administration and Services	172
Engineers	6
Technicians	5
Skilled	523
Semi-skilled	96
Unskilled	34
Total	845

Construction phase on-site staff will be housed at the temporary housing facility in Aggeneys, which was established for the adjacent Gamsberg project. Other local businesses will benefit during the construction phase as there will be increased spending within the area by the wage labour who will have improved buying power while employed by the Project.

Indirect employment through the construction supply chain will occur as new infrastructure will be required for the Project. Project infrastructure will be procured within South Africa where possible. Local procurement will benefit the hospitality and service industries primarily, such as accommodation, catering, cleaning, transport and security services.

Those who are able to secure employment on the Project will have the opportunity to improve their skills and experience through on-the-job training, and will thereby improve their opportunities for future employment.

Employment numbers during decommissioning are not known at this stage, but it is expected that the make-up of the workforce will be similar to the construction phase.

Impact Assessment

Table 7-39 describes the impact assessment for employment, skills enhancement and local business opportunities during the construction and decommissioning phases.

Table 7-39 Impact Assessment: Construction and Decommissioning: Employment, Skills Enhancement and Local Business Opportunities

Rating of Impacts Before Mitigation		
Characteristic	**Designation**	**Summary of Reasoning**
Nature	Direct and Indirect Positive	The creation of local employment opportunities, skills enhancement and local business opportunities will be a direct, indirect and induced impact.
Extent	Regional	Employment will be created for South Africans at a local and regional level depending on skills and capacity availability; as such, the extent will be regional.
Duration	Short term	The duration will be short-term - for the duration of the construction phase - and work contracts will vary in length, based on the type of work performed.
Scale	Medium	For those who are able to secure employment on the Project the scale will be medium, as they secure an income for the duration of their contract.
Frequency	Constant	The frequency of the impact will be constant for the duration of the construction and decommissioning phases.
Impact Magnitude: Positive		
Sensitivity/Vulnerability/Importance of the Resource/Receptor: High		
Reversibility- NA		
Significance Rating Before Mitigation: POSITIVE		

Enhancement

The objective of enhancement measures is to optimise opportunities for employment of local people, wherever possible, or alternatively that employment of South Africans is prioritised over foreigners.

The following measures will be implemented to ensure that employment of local people is maximised:

- The Mine will establish a Recruitment Policy which prioritises the employment of South African and local residents (originating from the Local Municipality) over foreigners. All contractors will be required to recruit in terms of the Project's Recruitment Policy, where practical.
- The Khâi-Ma Local Economic Development (LED) Forum should be consulted in the process of unlocking opportunities for local businesses.
- The Project will advertise job opportunities and criteria for skills and experience needed through local media, at least three months ahead of recruitment. This information should also be provided to all relevant authorities, community representatives and organisations on the interested and affected party database.
- The Recruitment Policy and Procedure should promote the employment of women as a means of ensuring that gender equality is attained.

No employment will take place at the entrance to the site. Only formal channels for employment will be used.

Residual impacts

With the implementation of the above mitigation measures, the impact significance will remain positive (*Table 7-40**Error! Reference source not found.***).

Table 7-40 Pre- and Post- Enhancement Significance for Employment, Skills Enhancement and Local Business Opportunities

Impact	Project Phase	Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Impact of employment, skills enhancement and local business opportunities	**Construction & Decommissioning**	**POSITIVE**	**POSITIVE**

7.8.2 Operations: Employment, Skills Enhancement and Local Business Opportunities

Impact Description

As the Project is ultimately a 'replacement' for the current operations at Deeps mine, there is likely to only be a small increase in employment numbers during operations.

BMM employs in excess of 1,600 persons across all of their operations, operating as the largest private employer in the Namakwa region and has been a stable employer for the last 30 years. Approximately 80% of the employees are local, with 62 % from Namakwa, Khai-Ma and Nama Khoi municipal areas. Should the proposed expansion not occur, approximately 837 permanent employees would be at risk of losing their jobs, with an additional 830 Business partners at risk. A number of these contractors also have active contracts with the BMM Gamsberg Mine, and should the proposed Swartberg Mine expansion not occur, a reduction in revenue might be experienced

During the Operational Phase, the mine will be operated on a continuous basis (7 days a week, 24 hours a day on a 12 hour shift system) using approximately 280 workers. The majority of these workers already work for BMM.

Similar to the construction phase, local workers are expected to be qualified to fill unskilled and semi-skilled positions at first, whilst a limited number of people may be sufficiently qualified for skilled

positions. Over time, however, local workers will be able to fill more of the semi-skilled and skilled positions as training will be provided by the Project to the local workforce, which will improve skills levels relevant to the Project.

During the operation phase the contracts that were in place during the construction phase will be terminated and procurement opportunities will be centred around maintenance activities, and providing goods and services to the Project. For those companies that meet eligibility criteria, become approved suppliers and enter the supply chain, there will be long-lasting and sustained benefits to the businesses and their employees through increased experience, capacity and training. As such, during the operation phase there will be opportunity for local business growth and development

Impact Assessment

Table 7-41 describes the impact assessment for employment, skills enhancement and local business opportunities during the operations phase.

Table 7-41 Impact Assessment: Operations: Employment, Skills Enhancement and Local Business Opportunities

Rating of Impacts Before Mitigation		
Characteristic	**Designation**	**Summary of Reasoning**
Nature	Direct, Indirect and Induced	The creation of local employment opportunities, skills enhancement and local business opportunities will be a direct, indirect and induced impact
Extent	Local and Regional	Employment will be created for South Africans at a local and regional level depending on skills and capacity availability; as such, the extent will be regional
Duration	Long Term	Employment for the duration of the operational phase
Scale	Medium	For those who are able to secure employment on the Project the scale will be medium, as they secure an income for the duration of their contract
Frequency	Constant	The frequency of the impact will be constant for the duration of the operations phase.
Impact Magnitude: Positive		
Sensitivity/Vulnerability/Importance of the Resource/Receptor: High		
Reversibility- NA		
Significance Rating Before Mitigation: POSITIVE		

Enhancement

The objective of enhancement measures is to optimise opportunities for employment of local people, wherever possible, or alternatively that employment of South Africans is prioritised over foreigners.

The following measures will be implemented to ensure that employment of local people is maximised:

- The Mine will establish a Recruitment Policy which prioritises the employment of South African and local residents (originating from the Local Municipality) over foreigners. All contractors will be required to recruit in terms of the Project's Recruitment Policy, where practical.
- The Khâi-Ma Local Economic Development (LED) Forum should be consulted in the process of unlocking opportunities for local businesses.

- The Project will advertise job opportunities and criteria for skills and experience needed through local media, at least three months ahead of recruitment. This information should also be provided to all relevant authorities, community representatives and organisations on the interested and affected party database.
- The Recruitment Policy and Procedure should promote the employment of women as a means of ensuring that gender equality is attained.
- No employment will take place at the entrance to the site. Only formal channels for employment will be used.

Residual impacts

With the implementation of the above enhancement measures, the impact significance will remain positive (*Table 7-42*).

Table 7-42 Pre- and Post- Mitigation Significance for Employment Creation, Skills Enhancement and Local Business Opportunities

Impact	Project Phase	Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Impact on employment creation, skills enhancement and local business opportunities	**Construction**	**POSITIVE**	**POSITIVE**

7.8.3 Decommissioning: Loss of Employment and Contract Opportunities

Impact Description

At the end of the decommissioning phase, there will be a loss of jobs, as the quarry will be closed. Decommissioning will necessitate elimination of employment positions and subcontractors directly associated with the Project, as well as related economic activities in the region.

Positive impacts to employment and the economy during the operational phases will result in continued development and opportunities to the region. The decommissioning of the project will result in loss of employment and negative socioeconomic impacts.

The extent of impacts will be local and regional since that will be where the majority of the workforce will be sourced. Without initiatives to encourage development and economic diversification, the duration of impacts would be long term. The overall magnitude is considered to be medium and overall significance is

Impact Assessment

Table 7-45 describes the impact assessment for loss of employment, skills enhancement and local business opportunities during the operations phase.

Table 7-43 Impact Assessment: Decommissioning: Loss Employment, Skills Enhancement and Local Business Opportunities

Rating of Impacts Before Mitigation		
Characteristic	**Designation**	**Summary of Reasoning**
Nature	Direct, Indirect and Induced negative	The loss of local employment opportunities, skills enhancement and local business opportunities will be a direct, indirect and induced impact
Extent	Local and Regional	Loss of Employment will occur at a local and regional level
Duration	Short Term	Loss of employment will occur during decommissioning
Scale	Large	Loss will occur for a large proportion of operational staff
Frequency	One off	The frequency of the impact will be occur after decommissioning
Impact Magnitude: Large		
Sensitivity/Vulnerability/Importance of the Resource/Receptor: High		
Reversibility- Medium		
Significance Rating Before Mitigation: MAJOR		

Mitigation Measures

The company should develop a Decommissioning Plan for the ultimate closure of the mine to ensure that all social aspects are considered, including human resource management, retrenchment packages, retraining and transferable skills.

Residual Impact

With the implementation of the above enhancement measures, the impact significance will remain positive *(Table 7-44*).

Table 7-44 Pre- and Post- Mitigation Significance for Loss of Employment Creation, Skills Enhancement and Local Business Opportunities

Impact	**Project Phase**	**Significance (Pre-mitigation)**	**Residual Impact Significance (Post-mitigation)**
Loss of employment creation, skills enhancement and local business opportunities	**Decommissioning**	**Major**	**Moderate**

7.9 Impacts on Community Health and Safety

The presence of the Project could affect the health, safety and security issues of the communities in the area due to a number of reasons including:

- Worker-community interactions;
- In-migration to the area;
- Increased income in the local community that may be used for drugs;
- Alcohol abuse and increase in prostitution;

- The risk of injury associated with construction and decommissioning activities; and
- Increased pressure on health care resources and changes to the environment.

Any community concerns or perceptions with regard to reduced health and physical safety and security by the community need to be addressed.

There are numerous ways in which the development of the Project could impact on community and individual levels of health. The term “health” is used broadly to include physical and mental health and well-being. The expected impacts on community health, safety and security as a result of construction, operation and decommissioning of the Project are:

- Impacts associated with the presence of the Project workforce;
- Impacts associated with an influx of jobseekers; and
- Impact on human health due to air emissions.

7.9.1 Construction, Operation and Decommissioning: Impacts Associated with the Presence of the Workforce and Jobseekers

Impact Description

An increase in disposable income within the Project area could result in a change in spending habits and behaviour resulting in an increase in alcohol and drug abuse, increased incidences of prostitution and casual sexual relations, which pose a threat to community health and safety. Anticipated impacts associated with the presence of the workforce are:

- Increased incidence of alcohol and drug use;
- Increase in the spread of HIV/ Aids and other STIs;
- Increased incidence of teenage or unplanned pregnancies;
- Increased crime levels; and
- Increase in prostitution.

It is estimated that approximately 300 people will be employed during the peak construction phase. The Project will seek to maximise the employment of local people, thereby reducing the size of the external workforce in the area, however, an external workforce will be required. The external workforce (largely comprised of semi-skilled and skilled workers) will be housed within the area (mainly Aggenys). An influx of people into an area typically brings about social change. These changes could cause an increase in vulnerability and increase peoples’ susceptibility to social pathologies such as those that are already in existence in the local community.

A further impact associated with an influx of jobseekers is the potential for social tension, and increased competition for employment. The distribution of employment opportunities between locals and migrants often leads to tension and conflict, especially when locals perceive the migrants to be taking their jobs.

In addition, increased disposable income within the local workforce may result in increased incidences of illegal activities or antisocial behaviours such as prostitution and casual sexual relations as well as increased levels of substance abuse. Abuse of alcohol and drugs often correlates with increased levels of criminal behaviour and violence while under the influence of the substance. Such behaviour increases the number of people indirectly affected by, or vulnerable to, alcohol and drug abuse; and casual sexual relations could lead to increased incidences of HIV/ AIDS.

Impact Assessment

Given that many of the possible social pathologies already exist, it is likely that these will be exacerbated further by Project activities. *Table 7.45* describes the impact assessment for the presence of the workforce and jobseekers during the construction, operations and decommissioning phases.

Table 7-45 Impact Assessment: Construction, Operation and Decommissioning: Presence of the Workforce and Jobseekers

Rating of Impacts Before Mitigation		
Characteristic	**Designation**	**Summary of Reasoning**
Nature	Indirect negative	An increased disposable income may adversely affect health, safety and security of the local community through a likely increase in illegal or antisocial behaviour.
Extent	Local	Within the Project area and surrounds
Duration	Long Term	While the workforce will be in the Project area for a limited time during the construction phase, jobseekers may stay in the area. However, those affected by antisocial behaviour, such as the victims of abuse, women with unwanted pregnancies and people living with HIV/ AIDS, the duration of the impact will be long-term.
Scale	Small	The scale of the impact will be large for those affected as it will lead to a fundamental change in their life, however, the number of people affected is unlikely to be large and thus the scale is small.
Frequency	Ad Hoc	Incidences are likely to occur on an ad hoc basis.
Impact Magnitude: Small		
Sensitivity/Vulnerability/Importance of the Resource/Receptor: High		
Reversibility- Low		
Significance Rating Before Mitigation: MODERATE		

Mitigation and Management Measures

- BMM will ensure that their security personnel work in close collaboration with the police to monitor any illegal activity.
- BMM and its appointed business partners will conform on the current induction programme and Code of Conduct for all workers directly or indirectly employed by the Mine. 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 all communities and traditions;
    - 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 consumption 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

- Description of disciplinary measures for infringement of the Code of Conduct and company rules.

- The Mine will follow the current grievance procedure that is easily accessible to the local community, through which complaints related to business partner or employee behaviour can be lodged and responded to. The Mine will respond in a serious manner to any such complaints.
- The BMM HIV/AIDS Policy and information document for all workers directly related to the Project will apply. The information document will address factual health issues as well as behaviour change issues around the transmission and infection of HIV/AIDS.

Residual impacts

With the implementation of the above mitigation measures, the impact significance is likely to be reduced to minor (*Table 7-46*).

Table 7-46 Pre- and Post- Mitigation Significance for Presence of the Workforce and Jobseekers

Impact	Project Phase	Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Impact of presence of the workforce and jobseekers	**Construction, Operations and Decommissioning**	**MODERATE**	**MINOR**

7.9.2 Construction, Operation and Decommissioning: Pressure on Social Infrastructure and Services

Impact Description

The Project is expected to stimulate in-migration as job-seekers enter the area with the intention of securing employment on the Project. In-migration of people will be further stimulated by the possibility of business opportunities linked to the provision of goods and services to the Project, and by real or perceived opportunities arising from the general increase in economic activity in the area.

It is likely that a number of people will continue to stay in the area irrespective of whether they are able to secure employment and these people may move their families to the area. The expected influx could have an impact on existing social infrastructure – particularly housing, education and health facilities.

Impact Assessment

Table 7-47 describes the assessment of the impact of pressure on social infrastructure and services during the construction, operations and decommissioning phases.

Table 7-47 Impact Assessment: Construction, Operation and Decommissioning: Pressure on Social Infrastructure and Services

Rating of Impacts Before Mitigation		
Characteristic	**Designation**	**Summary of Reasoning**
Nature	Indirect negative	The impacts will be negative as they will place pressure on infrastructure and services and the local government, who will have to provide the services.
Extent	Local	Within the Project area and surrounds
Duration	Short Term	The period of influx is largely limited to the construction phase
Scale	Small	The scale of the impact is likely to be small, Due to the Project site location and the probability workers from the Gamsberg Project being employed during the construction phase it is not expected to attract large numbers of job seekers. In addition,
Frequency	Continuous	Continuous throughout the construction phase but will slow after that
Impact Magnitude: Small		
Sensitivity/Vulnerability/Importance of the Resource/Receptor: Medium		
Reversibility- High - social infrastructure and services can be improved to address the impacts		
Significance Rating Before Mitigation: MINOR		

Mitigation and Management Measures

The Project will implement a grievance procedure that is easily accessible to the local community, through which complaints related to business partner or employee behaviour can be lodged and responded to. The Project will respond in a serious manner to any such complaints. Key steps include:

- Development of an Employment Management Plan.
- Regular Engagement with Khai Ma Municipality to understand impact to the social infrastructure.
- Circulation of contact details of 'grievance officer' or other key Project contact.
- Awareness raising among the local community regarding the grievance procedure and how it works.
- Establishment of a grievance register to be updated and maintained by the Project.

Residual impacts

With the implementation of the above mitigation measures, the impact significance is likely to be reduced to negligible (*Table 7-48*).

Table 7-48 Pre- and Post- Mitigation Significance for Pressure on Social Infrastructure and Services

Impact	**Project Phase**	**Significance (Pre-mitigation)**	**Residual Impact Significance (Post-mitigation)**
Pressure on Social Infrastructure and Services	**Construction, Operations and Decommissioning**	**MINOR**	**MINOR**

7.9.3 Construction and Decommissioning Phase: Impact on Human Health due to Air Emissions and Dust Generation

Impact Description

Most construction and decommissioning activities generate dust, which settles on surrounding properties and land, and is often more of a nuisance than a health issue. The dust is generally coarse, but may include fine respirable particles (PM_{10}) and these are known to be a risk to human health. Exhaust emissions from construction vehicles and equipment typically include particulates (including PM_{10}), carbon monoxide (CO), nitrogen oxides (NO_X), sulphur dioxide (SO_2) and volatile organic compounds (VOCs) including benzene.

Impact Assessment

Table 7-49 describes the assessment of the impact on human health due to air emissions and dust generation during the construction and decommissioning phases.

Table 7-49 Impact Assessment: Construction and Decommissioning: Impacts on Human Health due to Air Emissions and Dust Generation

Rating of Impacts Before Mitigation		
Characteristic	**Designation**	**Summary of Reasoning**
Nature	Direct negative	The impact is a result of primary project activities and the receiving environment
Extent	Local	Pollutants will be limited in dispersion and will occur onsite and around the main transport routes to and from the mine
Duration	Short Term	The period of impact will be limited to the construction and decommissioning phases.
Scale	Small	The scale of the impact is small and will be limited to the site and immediate surrounds.
Frequency	Continuous	Continuous throughout the construction and decommissioning phases
Impact Magnitude: Small		
Sensitivity/Vulnerability/Importance of the Resource/Receptor: Low (site is located in an area with no sensitive receptors located adjacent to the site)		
Reversibility- High		
Significance Rating Before Mitigation: NEGLIGIBLE		

Mitigation

The Project will develop and implement a Grievance Mechanism to address stakeholder concerns related to the Project in a timely manner.

Residual Impact

With the implementation of the above mitigation measures, the impact significance is likely to remain negligible *Table 7.50.*

Table 7-50 Pre- and Post- Mitigation Significance for Impacts on Human Health due to Air Emissions and Dust Generation

Impact	Project Phase	Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Impacts on human health due to air emissions and dust generation	**Construction and Decommissioning**	**NEGLIGIBLE**	**NEGLIGIBLE**

7.9.4 Operations Phase: Impact on Human Health due to Air Emissions

Impact Description

The operation of the processing plant will result in emissions which could negatively affect air quality. Increased emissions of pollutants can result in negative implications for human health, including respiratory diseases and cardiovascular diseases. In order to protect human health, air quality standards have been established and emissions below these standards are considered to have a negligible impact on the health of communities.

The main sources of emission from BMM is, and will be, dust from mining activities and from access roads.

Impact Assessment

Table 7-51 describes the assessment of the impact on human health due to air emissions and dust generation during operations.

Table 7-51 Impact Assessment: Operations: Impacts on Human Health due to Air Emissions and Dust Generation

Rating of Impacts Before Mitigation		
Characteristic	**Designation**	**Summary of Reasoning**
Nature	Direct negative	The generation of dust will directly affect any nearby receptors.
Extent	Local	Pollutants will be limited in dispersion and will occur onsite and around the main transport routes to and from the mine
Duration	Long Term	The period of impact will be for the duration of mining activities
Scale	Small	The scale of the impact is small and will be limited to the site and immediate surrounds.
Frequency	Continuous	Continuous throughout the operations phase, the plant will operate 24 hrs a day, 7 days a week
Impact Magnitude: Medium		
Sensitivity/Vulnerability/Importance of the Resource/Receptor: Low (site is located in an area with no sensitive receptors located adjacent to the site)		
Reversibility- Medium		
Significance Rating Before Mitigation: MINOR		

Mitigation and Management Measures

The Project will develop and implement a Grievance Mechanism to address stakeholder concerns related to the Project in a timely manner.

Residual Impact

With the implementation of the above mitigation measures, the impact significance is likely to remain minor (*Table 7-52*).

Table 7-52 Pre- and Post- Mitigation Significance on Impact on Human Health due to Air Emissions

Impact	Project Phase	Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Human health due to air emissions	**Operations**	**MINOR**	**MINOR**

7.10 Worker Health and Safety and Rights

Workers' rights including occupational health and safety need to be considered to avoid accidents and injuries, loss of man-hours, labour abuses and to ensure fair treatment, remuneration and working and living conditions.

These issues will be considered not only for workers who are directly employed by the Project, but also contractors and workers within the supply chain. The main risks in relation to worker's management and rights are associated with the use of contractors and subcontractors and the supply chain.

The Project is expected to create 300 direct employment opportunities during the peak of the construction period. The majority of workers will be engaged by the contractor and will consist of a semi-skilled to skilled workforce. The operations phase is planned for a lifespan of 19 years, with the option to extend this, and will involve around 845 permanent site employees including skilled and semi-skilled staff.

The expected impacts on worker rights and health and safety as a result of construction, operation and decommissioning activities are as follows:

- Risk to workers health and safety due to hazardous construction and decommissioning activities;
- Risk to workers health and safety due to hazardous operational activities; and
- Violation of workers' rights.

This impact assessment is based on the assumption that no specific Project health and safety policies, procedures and training provisions are in place for construction workers (both contractors and subcontractors) as limited information is available on this at the current Project stage.

7.10.1 Construction and Decommissioning Phase: Risk to Workers' Health and Safety due to Hazardous Construction Activities

Impact Description

Activities during the construction and decommissioning phases could affect worker health and safety. Such activities include the operation of heavy equipment and trucks, working at height, working in confined spaces, construction traffic, use of electric devices, handling of hazardous materials and other hazardous activities. Due to the nature of the activities being undertaken during construction and

decommissioning, worker health and safety is a key risk with the potential for accidents that may result in injuries and fatalities as well as lost man-hours.

Within South Africa, mine worker health and safety falls under the ambit of the Department of Mineral Resources, and is primarily governed through the Mine Health and Safety Act (MHSA) (Act No. 29 of 1996). Employees working informally and those with limited or no awareness of their rights (for example, migrant workers, or those newly entering the labour market) are likely to be most at risk of working in unsafe conditions.

Impact Assessment

Table 7-53 describes the assessment of the risk to workers' health and safety due to hazardous construction activities during construction and decommissioning.

Table 7-53 Impact Assessment: Construction and Decommissioning: Risk to Workers' Health and Safety due to Hazardous Activities

Rating of Impacts Before Mitigation		
Characteristic	**Designation**	**Summary of Reasoning**
Nature	Direct negative	The health and safety of workers is a direct impact.
Extent	Regional	Health and safety aspects affect those directly employed by the Project, as well as people employed in the supply chain.
Duration	Short Term	The period of impact will be for the construction and decommissioning phases only.
Scale	Large	The scale of the impact will be large for anyone adversely affected by a health and safety incident on the Project, as they may experience a temporary loss of work time, or in the worst-case scenario may be rendered permanently unable to work.
Frequency	Continuous	There is a continuous risk to workers health and safety if rules and regulations are not properly adhered to.
Impact Magnitude: Medium		
Sensitivity/Vulnerability/Importance of the Resource/Receptor: Medium (There are laws in place in South Africa to protect worker rights. However, migrant workers, or those newly entering the labour market may not be aware of their rights, and people may be willing to compromise their rights to secure employment in light of high unemployment rates.)		
Reversibility- Medium incidences can be addressed through medical intervention where required and health and safety can be constantly improved to avoid future incidences.		
Significance Rating Before Mitigation: MODERATE		

Mitigation and Management Measures

- The Mine will implement a rigorous induction programme for all employees outlining health and safety risks.
- The Project will comply with all applicable South African legislation in terms of health and safety, and worker rights, which will include access to workman's compensation for loss of income resulting from an onsite incident.
- As part of the business partner and supplier selection process, the Project will take into consideration performance with regard to worker management, worker rights, health and safety as outlined in South African law and the Project's policies.

- The Mine will provide support to business partners and sub-business partners to ensure that labour and working conditions are in line with South African law through capacity building.
- Workers will be provided with primary health care and basic first aid at construction camps /worksites.
- Facilities and operations will be developed, planned and maintained such that robust barriers are in place to prevent accidents. All employees have the duty to stop any works if adequate systems to control risks are not in place.
- In line with the worker code of conduct, employees should not be under the influence of intoxicants which could adversely affect the ability of that employee to perform the work or adversely affect the health and safety of other employees, other persons or the environment.
- The Project will provide of Personal Protective Equipment (PPE), training and monitoring as well as ongoing safety checks and safety audits.
- The Project will implement the current BMM Grievance Mechanism to address employee concerns related to the Project in a timely manner.

Residual Impact

With the implementation of the above mitigation measures, the impact significance is likely to be reduced to minor (*Table 7-54*).

Table 7-54 Pre- and Post- Mitigation Significance for Risk to Workers' Health and Safety due to Hazardous Construction and Decommissioning Activities

Impact	Project Phase	Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Risk to workers' health and safety due to hazardous construction activities	**Construction & Decommissioning**	**MODERATE**	**MINOR**

7.10.2 Operation Phase: Risk to Workers' Health and Safety due to Hazardous Operation Activities

Impact Description

Hazardous activities during the operation phase and regular maintenance activities will include, but are not limited to; the operation of heavy equipment and trucks, use of electrical devices including high voltage, working at height, maintenance of high pressure pipework and vessels and handling of hazardous materials. During these activities the workers will be at risk for accidents and injury.

Impact Assessment

The vulnerability of the workers to this impact is considered low, as there are laws in place in South Africa to protect worker rights and most employees will be highly skilled engineers and technicians, who have likely been educated around their rights and health and safety practices. The impact is therefore considered to be of minor significance.

Table 7-55 describes the assessment of risk to workers' health and safety due to hazardous activities during operations.

Table 7-55 Impact Assessment: Operations: Risk to Workers' Health and Safety due to Hazardous Activities

Rating of Impacts Before Mitigation		
Characteristic	**Designation**	**Summary of Reasoning**
Nature	Direct negative	The health and safety of workers is a direct impact.
Extent	Regional	Will affect those directly employed by the Project, as well as people employed in the supply chain.
Duration	Long Term	The period of impact will be for the duration of mining operations
Scale	Large	The scale of the impact will be large for anyone adversely affected by a health and safety incident on the Project, as they may experience a temporary loss of work time, or in the worst-case scenario may be rendered permanently unable to work.
Frequency	Continuous	Continuous throughout the operations phase, the plant will operate 24 hrs a day, 7 days a week.
Impact Magnitude: Medium		
Sensitivity/Vulnerability/Importance of the Resource/Receptor: Medium (There are laws in place in South Africa to protect worker rights. However, migrant workers, or those newly entering the labour market may not be aware of their rights, and people may be willing to compromise their rights to secure employment in light of high unemployment rates.)		
Reversibility- Medium incidences can be addressed through medical intervention where required and health and safety can be constantly improved to avoid future incidences.		
Significance Rating Before Mitigation: MODERATE		

Mitigation and Management Measures

- The Mine must comply with all applicable South African legislation in terms of health and safety, and worker rights, which will include access to workman's compensation for loss of income resulting from an onsite incident.
- As part of the contractor and supplier selection process the Mine will take into consideration performance with regard to worker management, worker rights, health and safety as outlined in South African law and the Project's policies.
- The Project will provide support to contractors and subcontractors to ensure that labour and working conditions are in line with South African law through capacity building.
- Workers will be provided with primary health care and basic first aid at construction camps /worksites.
- Facilities and operations will be developed, planned and maintained such that robust barriers are in place to prevent accidents. All employees have the duty to stop any works if adequate systems to control risks are not in place.
- In line with the worker code of conduct employees should not be under the influence of intoxicants which could adversely affect the ability of that employee to perform the work or adversely affect the health and safety of other employees, other persons or the environment.
- The Mine will provide Personal Protective Equipment (PPE), training and monitoring as well as ongoing safety checks and safety audits.

- The Mine will develop and implement a Grievance Mechanism to address employee concerns in a timely manner.

Residual Impacts

With the implementation of the above mitigation measures, the impact significance is likely to be reduced to minor (*Table 7-56*).

Table 7-56 Pre- and Post- Mitigation Significance on Risk to Workers' Health and Safety due to Hazardous Operation Activities

Impact	Project Phase	Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Risk to workers' health and safety due to hazardous operation activities	**Operations**	**MODERATE**	**MINOR**

7.11 Traffic Volumes

7.11.1 Construction and Operation: Increase in Traffic Volumes

Impact Assessment

The primary access route to the Project site is the N14 national road that connects the Project site to the 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. 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.

An increase in traffic volumes is expected during construction and operations.

Impact Assessment

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 low for Project activities alone, taking into account vehicle trips to transport workers to and from the site. It is not expected to have a significant impact on the quality of the roads. In addition, during operations material will be transported from the mine Saldanhna bay for export.

Table 7-57 describes the assessment of the impact associated with an increase in traffic volumes.

Table 7-57 Impact Assessment: Construction and Operation: Increase in Traffic Volumes

Rating of Impacts Before Mitigation		
Characteristic	**Designation**	**Summary of Reasoning**
Nature	Direct negative	The increase in traffic volumes will be direct and negative.
Extent	International	The N7 is an important link to Namibia.
Duration	Long Term	The period of impact will be for the duration of construction activities (approximately 24 months) and throughout operations
Scale	600 vehicles per day	The current vehicle count in the area is approximately 600 per day over approximately 600km or road between BMM and the port of Saldanha from where equipment will be transported.
Frequency	Continuous	Continuous throughout the construction phase.
Impact Magnitude: Medium		
Sensitivity/Vulnerability/Importance of the Resource/Receptor: Medium (The N14 and N7 are relatively well maintained, and has medium levels of traffic and there is likely to be sufficient reserve to accommodate the increase in the traffic volumes. However, there is likely to be some disruption due to very large loads being transported.)		
Reversibility- High There are very few other transport options in the area.		
Significance Rating Before Mitigation: MODERATE		

Mitigation and Management Measures

The following mitigation and management measures must be implemented:

- All vehicles will be regularly checked and maintained, including tyre wear.
- Contact details will be displayed on vehicles to allow other road users to report bad driving at any time.
- All drivers will be sensitised about potential accident risks to local users and will be periodically checked for alcohol consumption.
- All driver will be appropriately licensed.
- 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.
- 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.
- The Mine will develop and implement a Grievance Mechanism to address employee concerns related to the Project in a timely manner.

Residual Impact

With the implementation of the above mitigation measures, the impact significance will remain minor Table 7.58.

Table 7-58 Pre- and Post- Mitigation Significance for Increase in Traffic Volumes

Impact	Project Phase	Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Increase in traffic volumes	**Construction and Operations**	**MODERATE**	**MINOR**

7.12 Archeology and Cultural Heritage

7.12.1 Construction, Operation and Decommissioning Phase: Loss of Heritage Resources

Impact Description

The footprint of the proposed mine expansion includes the open pits, waste rock pad and possible increased road infrastructure. At the time of the study no exact layout of new mining infrastructure was provided, however, there is the potential for the open pit to impact on local archaeology and cultural heritage resources.

The archaeological and cultural heritage traces within the areas of the proposed mining extension on Portion 4 of Zuurwater 64 were found to be of generally 'low archaeological importance' by the heritage specialist study (*Annex* K). They nevertheless constitute important archaeological observations with respect to past use of this landscape. Sites beyond the footprint include a highly important cupule engraving site, an Earlier Stone Age (ESA) accumulation that is richer than many found in the area and a circa century-old or older stone walled farming feature. Secondary impacts on the latter should be prevented, and in the case of the ESA site which is closest to the mining edge, minimised or mitigated if endangered. Should the ESA site be threatened it may be recommended that a surface collection be made to preserve a representative sample.

Impact Assessment

Table 7.59 describes the assessment of the impact on archaeology and cultural heritage.

Table 7-59 Impact Assessment: Construction, Operations and Decommissioning: Archaeology and Cultural Heritage

Rating of Impacts Before Mitigation		
Characteristic	**Designation**	**Summary of Reasoning**
Nature	Direct Negative	There is the potential for archaeological and cultural heritage resources to be directly and negatively impacted.
Extent	Local	Possible extent of impact following the expansion and construction activities will be locally restricted to potential damage or destruction as a result of excavations and extractions.
Duration	Permanent	The proposed developments are considered long term. Damage or destruction of archaeological contexts is irreversible and hence permanent.
Scale	± 136 ha	The impacts will be limited to the mine footprint area
Frequency	Continuous	There is the potential for impact for as long as mining activities continue.
Impact Magnitude: Medium		
Sensitivity/Vulnerability/Importance of the Resource/Receptor: Low		
Reversibility- Low Potential permanent loss of archaeological and cultural heritage, where present – but occurrence is generally extremely low density and of low importance.		
Significance Rating Before Mitigation: MINOR		

Mitigation and Management Measures

It is not regarded as necessary that any mitigation should take place for most of the areas identified for development. However, the following mitigation measures have been recommended in the event of any future extensions of roads or other infrastructure

- Development of a facility Environmental Management Programme (EMPr) that takes cognizance of heritage resources in the event of any future extensions of roads or other infrastructure.
- Provision for on-going heritage monitoring in a facility EMPr which also provides guidelines on what to do in the event of any major heritage feature being encountered during any phase of construction/maintenance.
- A Chance Finds Procedure must be developed to ensure that any heritage resource finds are recorded and reported to the appropriate authorities, and if necessary, all work is stopped until the find can be assessed by a relevant specialist. In addition the relevant Heritage Authority should be contacted by the client.
- Should the ESA site be threatened it may be recommended that a surface collection be made to preserve a representative sample.
- Officials from relevant heritage authorities (National and Provincial) must be permitted to inspect the operation at any time in relation to the heritage component of the EMPr.
- All work must cease immediately, if any human remains and/or other archaeological, palaeontological and historical material are uncovered. Such material, if exposed, must be reported to the nearest museum, archaeologist/ palaeontologist (or the South African Police Services), so that a systematic and professional investigation can be undertaken. Sufficient time must be allowed to remove/collect such material before development recommences.

Residual impacts

Even with mitigation, mining may result in a permanent and irreversible loss archaeological resources, even if from an archaeological perspective the observed heritage resources are of Minor significance (including low density occurrence). Therefore, even with the implementation of the above mitigation measures, the impact significance is likely to be remain minor (*Table 7-60*).

Table 7-60 Pre- and Post- Mitigation Significance: Archaeology and Cultural Heritage

Impact	Project Phase	Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Archaeology and Cultural Heritage	**Construction, Operations and Decommissioning**	**MINOR**	**MINOR**

7.13 Unplanned Events

The following Section presents the assessment of impacts resulting from unplanned or non-routine events and those that result from accidents. These are different to impacts from effects that would reasonably be predicted to occur in the normal course of activities during construction, operations, and decommissioning.

Unplanned and accidental events have the potential to occur and therefore the evaluation of impacts for unplanned and accidental event takes into account the likelihood of the event occurring into the impact magnitude. Likelihood is determined as unlikely, possible, or likely based in professional judgement and quantitative information where available.

Given the nature of Project activities, unplanned and accidental events might include:

- Worker Health and Safety;
- Accidental spills of equipment fuel and oils; and
- Vehicle traffic accidents.

If unplanned and accidental events did occur, there would be effects on the biophysical and social environment. The risk of unplanned and accidental events and the potential impacts are described in this Section.

7.13.1 Construction, Operation, and Decommissioning: Occupational Health and Safety

Impact Description

This aspect focuses on the impact of the Project on the Mine Health and Safety (MHS). The main impacts under this aspect include onsite hazards for workers during construction, operations, and decommissioning. The unplanned MHS risks include falling objects, accidental explosions, and exposure to moving vehicles. There could also be a risk of fatigue from working long hours, and without rest. In addition, the transportation of the workers to and from site, and transport of materials poses a risk for the workers, depending on the type and quality of vehicles used, the time of day being transported, the quality of the road and the driver.

Impact Assessment

Table 7.61 describes the impacts of unplanned accidents on occupational health and Safety.

Table 7-61 Impact Assessment: Occupational Health and Safety Hazards during Construction, Operation, and Decommissioning Activities

Rating of Impacts Before Mitigation		
Characteristic	**Designation**	**Summary of Reasoning**
Nature	Direct	The impact may result of primary project activities
Extent	Local	The impact will occur in the Project area
Duration	Permanent	Impacts will occur during the construction phase and continue into the operational and decommissioning phase
Scale	Small	Risks will only be exposed to a small experienced workforce
Frequency	NA	NA
Likelihood	Medium	The activities undertaken by workers are high risk activities
Impact Magnitude: Large		
Sensitivity/Vulnerability/Importance of the Resource/Receptor: High		
Reversibility- Low		
Significance Rating Before Mitigation: Major		

Mitigation

The following management measures must be implemented in the Project's management plans:

- Development or upgrade of an Occupational Health and Safety Management Plan (OHSMP). Inductions, training, H&S records and remediating actions, risk assessments of all activities and provision of PPE.
- The OHSMP should cover all workers on site, including temporary workers and Business partners.
- Carry out regular monitoring and audits of the OHSMP and update as required.

Residual Impacts

With the implementation of the above-mentioned mitigation measures, the residual impact will reduce to Moderate in all phases (*Table 7-62*).

Table 7-62 Pre- and Post- Mitigation Occupational Health and Safety Hazards during Construction, Operation, and Decommissioning Activities

Impact	**Project Phase**	**Significance (Pre-mitigation)**	**Residual Impact Significance (Post-mitigation)**
Occupational Health and Safety (OHS) Hazards	**Establishment**	**MAJOR**	**MODERATE**

7.13.2 Construction, Operation, and Decommissioning: Accidental Spills of Equipment Fuel, Oils, and Chemicals

Impact Description

Various hazardous materials will be used in the course of carrying out Project activities, the main ones being hydrocarbon fuels (diesel), lubricating oils, and chemicals. There is the potential for accidental release in the course of storage and handling of these fuels.

During construction, there is the potential for spills of fuels and oils during fuelling and maintenance of machinery and vehicles. Spills could occur in a number of locations around the site including areas used for maintenance, material and equipment laydown, parking, fuel storage, and fuelling. Spills could also occur along the roads adjacent to the Project Site and along the route for construction traffic. Spills on the site have the potential to affect the terrestrial environment. Operations will include activities that require handling and storage of fuels, oils, and chemicals as part of general operating procedures of the quarry. All hazardous fuels will be stored onsite in a storage facility in a bunded area. Spills from the storage areas due to major spills would affect the terrestrial environments and result in potential deterioration of the quality of groundwater, soil, and sediment. This would in turn have adverse effects on flora and fauna and local groundwater users.

Impact Assessment

The following sections describe and assess the potential consequence of accidental spills on soils and groundwater.

Soils

Table 7-63 illustrates describes the impacts of unplanned spills on the soils in the Project area.

Table 7-63 Impact Assessment: Accidental Spills of Hazardous materials Construction, Operation, and Decommissioning Activities

Rating of Impacts Before Mitigation		
Characteristic	**Designation**	**Summary of Reasoning**
Nature	Direct negative	The impact may result of primary project activities
Extent	Local	The impact will occur in the Project area
Duration	Long term	Impacts will occur during the construction phase and continue into the operational and decommissioning phase
Scale	Medium	If hazardous materials such as fuel were to be released to soil, spread would be mostly limited in extent to the immediate area, however depending on volume and soil permeability at the specific location, material could spread into the subsurface
Frequency	NA	NA
Likelihood	Low	Incidental spills of fuels are infrequent but do occur, most frequently due to malfunction of handling systems, poor practices of workers despite procedures in place and force majeure. Spills are most likely to occur during refilling and transport of the fuels and oils. Large releases of hazardous materials from storage vessels are rare because storage containers are designed and built specifically to prevent release. Overall, it is unlikely that a significant spill would occur under regular operations.
Impact Magnitude: Medium		
Sensitivity/Vulnerability/Importance of the Resource/Receptor: Medium		

Reversibility- High
Significance Rating Before Mitigation: Moderate

Groundwater

Table 7-64 illustrates describes the impacts of unplanned spills on the groundwater in the Project area.

Table 7-64 Impact Rating: Groundwater Quality on the Groundwater Resource during the Construction Phase before Mitigation

Rating of Impacts Before Mitigation		
Characteristic	**Designation**	**Summary of Reasoning**
Nature	**Direct negative**	Activities could have a negative direct impact on groundwater quality.
Extent	Local/on site	The extent of the impact will occur in the Project area
Duration	Permanent	The expected impact will be permanent.
Scale	Medium	It is anticipated that large volumes of chemicals, that have a potential to contaminate groundwater, will be stored/used on site therefore the scale is medium
Frequency	NA	NA
Likelihood	Unlikely	Incidental spills of fuels are infrequent but do occur, most frequently due to malfunction of handling systems, poor practices of workers despite procedures in place and force majeure. Spills are most likely to occur during refilling and transport of the fuels and oils. Large releases of hazardous materials from storage vessels are rare because storage containers are designed and built specifically to prevent release. Overall, it is unlikely that a spill would occur
Impact Magnitude: Small		
Sensitivity/Vulnerability/Importance of Resource/Receptor – Medium		
Reversibility: Low		
Significance Rating Before Mitigation: MINOR		

Mitigation Measures

A construction environmental management plan (EMP) needs to be in place including, but not limited to:

- Adhere to best practice principles.
- Equipment should be up to industry standard and serviced regularly to prevent oil spills.
- A spill response plan should be in place and construction workers should be trained accordingly.
- 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.

- Hazardous material storage will be constructed on an impermeable surface and the bulk storage facility will be bunded. The Project will restrict storage and handling of hazardous materials and fuels to bunded areas of sufficient capacity to contain a release.
- Refuelling of equipment and vehicles will be carried out in designated areas on hard standing ground to prevent seepage of any spillages into the ground. Collection systems will be installed in these areas to manage any spills, fuels will be collected and either reused, treated by incineration or removed by a local business partner. Drip trays must be used when refuelling and servicing vehicles or equipment, where it is not on a hardstanding surface.
- Leaking equipment must be repaired immediately or be removed from site to facilitate repair.
- The Mine will develop a detailed hazardous material spill response plan, which includes community sensitisation/ notifications when required. The Project will maintain spill clean-up and response capability adequate for addressing spills for all phases of the Expansion. All spills will be immediately contained and cleaned up. Contaminated areas will be remediated and post remediation verification will be carried out.
- Appropriately sized spill kit kept onsite relevant to the scale of the activity taking place must be available.
- Maintain an incidents and complaints register in which all incidents or complaints involving the public are logged.

Residual Impacts

By implementing the above management measures, it is unlikely for an unplanned spill of equipment fuel and oils to negatively impact, soils and groundwater. *Table 7-65* illustrates the residual impacts for each receptor after mitigation measures have been put in place.

Table 7-65 Pre- and Post-Mitigation Impact Rating: Groundwater Quality on the Groundwater Resource during the Construction Phase Post Mitigation

Impacted Media	Project Phase	Pre-mitigation Significance	Potential Impact Residual Significance
Soils	Establishment and Operation	Moderate	Minor
Groundwater	Establishment and Operation	Minor	Negligible

7.13.3 Construction, Operation, and Decommissioning: Vehicle Accidents

Impact Description

The presence of Project vehicles during construction, operations, and decommissioning could increase the risk of accidents along the roads to the Project Site. Degradation and damage to regional and local roads from Project vehicles also has the potential to increase the risk of accidents. The potential impacts of vehicle accidents are discussed in this *Section*.

Traffic volumes will increase during the construction phase of the Project in areas surrounding the Project Site as well as those near existing major transport routes.

Goods including machinery, equipment and building materials will be transported to the Project Site.

The increase in heavy traffic levels on roads will also increase the rate of road wear and could result in damaged road surfaces, breaks in the paved surface (e.g. potholes, damage at the road shoulders) which also increases the risks of road accidents.

There are a number of towns located adjacent to the roads, which will be used for heavy vehicle traffic. There are Heavy Duty Vehicles currently using roads to the Project site. The number of sensitive receptors close to the roads results in risks of vehicle accidents, which could be compounded by the damaged roads such as potholes. The vehicle accidents could be caused by collisions with other vehicles, as well as collisions between vehicles and people.

Impact Assessment

Table 7-66 illustrates describes the impacts of traffic accidents in the Project area.

Table 7-66 Impact Rating: Vehicle Accidents Construction, Operation, Decommissioning Phase before Mitigation

Rating of Impacts Before Mitigation		
Characteristic	**Designation**	**Summary of Reasoning**
Nature	**Direct negative**	Activities could have a negative direct impact on the receiving environment.
Extent	Local/on site	The spatial extent of the increase in traffic, vehicle accidents are considered to be regional, as the impacts are experienced around the Project Site and along the construction routes that extend beyond the Project Site
Duration	Long term	The expected impact will be long term
Scale	Medium	There will be increased traffic related to Project activities
Frequency	NA	NA
Likelihood	Possible	Given the increase in traffic to and from the Project site and the sensitive receptors close to the roads, traffic accidents are considered possible.
Impact Magnitude: Medium		
Sensitivity/Vulnerability/Importance of Resource/Receptor – Medium The N7 and N14 and adjacent road networks are existing important arterial networks and are subject to constant traffic		
Reversibility: Low		
Significance Rating Before Mitigation: Moderate		

Mitigation Measures

The following management measures must be implemented in the Project's management plans:

- All new drivers employed throughout the course of the Mine's operations will be required to undergo Defensive Driver Training.
- Speed limits will be enforced for all vehicles.
- Speed limits of 40kph will be enforced along all internal roads except haul roads where the limit is 80kph.

- The Mine will regularly consult with the relevant local and regional government to ensure the roads used are well maintained, and that potential problems or hazards are communicated to the relevant authority timeously. Expansion planning for construction traffic must be done in consultation with the government.
- The status of the integrity of proposed Project transportation routes with respect to structural properties (load limits, traffic volume limits), functionality (condition of road surface) and safety (signage, markings, and potential public safety hazard areas) must be confirmed. Additional measures required to upgrade transportation routes and minimise traffic congestion must be carried out in consultation with the local authorities.
- The Project will undertake sensitisation in the local communities, including appropriate warning signs and notifications of the risks of traffic accidents.

Residual Impacts

By implementing the above management measures, the likelihood of an unplanned vehicle accident occurring and leading to negative impact is reduced. *Table 7-67* illustrates the residual impact significance after mitigation measures have been put in place.

Table 7-67 Pre- and Post-Mitigation Impact Rating: Vehicle Accidents during the Construction, Operation, and Decommissioning Phase Post Mitigation

Impacted Media	Project Phase	Pre-mitigation Significance	Potential Impact Residual Significance
Unplanned Vehicle Accidents	Establishment and Operation	MODERATE	MINOR

7.14 Cumulative Impacts

7.14.1 Background

The preceding impact assessment assessed the impacts associated with the Project largely in isolation. In an assessment of this nature, it is important to assess cumulative impacts associated with a proposed development and there is a legislated requirement in South Africa to do so. A cumulative impact is one that arises from an impact associated with a proposed Project, that when viewed in isolation may be acceptable, but when combined with multiple developments in the greater area affected by the proposal may not be acceptable.

The DEAT Integrated Environmental Management Information Series (2004) suggest the following principles be applied when undertaking a cumulative assessment:

- Cumulative effects are caused by the aggregate of past, present, and reasonably foreseeable future actions;
- Cumulative effects are the total effect, including both direct and indirect effects, on a given resource, ecosystem, and human community of all actions taken;
- Since it is not practical to analyse the cumulative effects of an action on every environmental receptor, the list of environmental effects must focus on those that are considered meaningful;
- Boundaries must be set so analysts are not attempting to measure effects on everything;

- Cumulative effects analysis on natural systems must use natural ecological boundaries, and analysis of human communities must use actual socio-cultural boundaries to ensure all effects are included;
- Cumulative effects may result from the accumulation of similar effects or the synergistic interaction of different effects;
- Repeated actions may cause effects to build up through simple addition (more and more of the same type of effect), and the same or different actions may produce effects that interact to produce cumulative effects greater than the sum of the effects;
- Cumulative effects may last for years beyond the life of the action that caused the effects; and
- Each affected resource, ecosystem, and human community must be analysed in terms of its capacity to accommodate additional effects, based on its own time and space parameters.

The assessment of cumulative impacts of the Project are presented in this section.

7.14.2 Methodology

The assessment of cumulative impacts requires a holistic and integrated view of the Project and other known projects within a proximity that could feasibly contribute to an accumulated impact.

The current operations at BMM in the Project area are as follows:

- Operations at the Deeps underground mine;
- Operations at the existing underground Swartberg Mine; and
- Existing processing plant and associated infrastructure to process material from Deeps and Swartberg Mines.

Once the planned Swartberg expansion is operational the Deeps mine will have reached its LOM, although the processing plant will continue to operate and process the material from the expanded Swartberg Mine. The processing plant will be upgraded but will remain within current plant footprint at BMM mine.

Other Developments in the beyond the immediate Project area are:

- Gamsberg mine and processing plant (located approximately 28km from the Project site and approximately 11km from Aggeneys).It is noted that any other future proposed developments at the Gamsberg site have not been considered in this assessment, though the same cumulative impact process would be completed for all future developments.
- Phase 2 of the Gamsberg mine (planned construction event) (located approximately 28km from the Project site and approximately 11km from Aggeneys).

The way in which the nature and effect of the impacts are assessed is strongly influenced by the status of the other activities (e.g. already in existence, approved or proposed) and how much data is available to characterise the magnitude of their impacts. Where possible specialists' recommendations and conclusions from similar developments were taken into consideration in the assessment of cumulative impacts, as reflected above and in more detail in each specialist study.

7.14.3 Air Quality

There are no known new Projects in the Project Area that will contribute to air quality emissions. There will be air emissions from the Gamsberg mine and processing plant and Gamsberg Phase 2 construction but it is anticipated that this will not have a cumulative effect. The Gamsberg mine is located approximately 28km from the Swartberg Mine and the prevailing wind direction means that dust

emissions from the Swartberg Mine will not blow towards Gamsberg Mine or Aggeneys town. As a result, the cumulative impact to air quality is considered negligible.

7.14.4 Noise

There are no known new Projects in the Project Area that will contribute to noise emissions. There will be noise emissions from the Gamsberg mine and processing plant, and Gamsberg Phase 2 construction but it is anticipated that this will not have a cumulative effect. The Gamsberg mine is located approximately 28 km from the Swartberg Mine and Aggeneys town therefore it is unlikely that there will be cumulative noise impacts. As a result, the cumulative Impact is considered negligible.

7.14.5 Soils and Geology

The implementation of the Project will result in the removal of soils and excavation across the Project site during the construction phase, resulting changes in drainage regime and increased erosion potential and runoff during establishment, operation and decommissioning. There are no known projects in the Project area which will have a cumulative impact. In addition, it is expected, that re-vegetation will occur on all bare surface in the projects to area on all bare surfaces after construction has been completed. As such, the cumulative impacts on soils and geology are considered negligible.

7.14.6 Terrestrial Flora

Loss of Habitats of Medium-High, High and Very High Sensitivity and Associated Species Post Mitigation

The implementation of the Project will result in the removal of vegetation. In combination with other known contributions in the broader area the most likely cumulative impacts include:

- Increased loss or fragmentation of unique niche habitats and plant species of conservation concern, increasing the impact of existing surrounding anthropogenic activities.
- Possible spread and establishment of alien invasive species.
- Potential for tracts of sensitive habitats adjacent to the mining operations to deteriorate further indefinitely due to the soil-sealing effect of long-term dust deposition.
- Possible change in plant vigour in downstream environments due to changes in surface runoff patterns – most noticeable in riparian vegetation.

The cumulative impacts are considered to be Major.

Loss of Habitats of Medium-Low to Low Sensitivity and Associated Species

The implementation of the Project will result in the removal of vegetation. In combination with other known contributions in the broader area the most likely cumulative impacts include:

- Possible increased loss or fragmentation of unique niche habitats and plant species of conservation concern, increasing the impact of existing surrounding anthropogenic activities.
- Possible spread and establishment of alien invasive species.
- Potential for tracts of sensitive habitats adjacent to the mining operations to deteriorate further indefinitely due to the soil-sealing effect of long-term dust deposition.
- Possible change in plant vigour in downstream environments due to changes in surface runoff patterns – most noticeable in riparian vegetation.

The cumulative impacts are considered to be Moderate.

Loss of Plant Species of Conservation Concern

The implementation of the Project will result in the removal of vegetation. In combination with other known Projects in the broader Project area the most likely cumulative impact of be habitat and potential species loss – or loss of rescued plants - will still occur as a residual impact but could be reduced with effective mitigation as discussed above. Based on the estimated areas of loss, up to 300 ha of natural and partially irreplaceable habitat will be lost to the mine footprint. Even with mitigation, mining will result in a permanent and irreversible loss of habitat that would be suitable for the re-establishment of such species.

The cumulative impacts are considered to be Major.

Reduced Ecological Function and Degradation due to Altered Soil Surfaces

The implementation of the Project will result in the removal of vegetation. In combination with other known contributions in the broader area the most likely cumulative impacts include:

- Increased loss and fragmentation of unique habitats and plant species of conservation concern by reducing natural dispersal corridors, increasing the impact of existing surrounding anthropogenic activities.
- Degradation of downstream habitats such as the Koa River due to potential reduced moisture recharge.
- Possible degradation of on-site and downstream riparian vegetation may also occur due to a potential change in ground-water dynamics caused by the open-cast operations.
- This impact was not further assessed, but will have to be based on a detailed hydrological study, which was not available at the time of writing.
- A gradual but continued expansion of the mining footprint to beyond the area directly impacted – the exact extent of this cannot yet be determined but is also influenced by blasting plumes and wind direction.
- Continued degradation of more sensitive adjacent and possibly downstream habitats such as Koppie Ridges with narrow endemics or the Koa River, due to potential reduced moisture recharge resulting from dust-induces soil surface sealing.

The cumulative impacts are considered to be Major.

Increase in Alien Invasive Vegetation

The implementation of the Project will result in the removal of vegetation. In combination with other known contributions in the broader area the most likely cumulative impacts include:

- Possible increased modification and degradation of natural and unique habitats and continued loss of species unique to the area and affected ecosystems, increasing the impact of existing surrounding anthropogenic activities.
- Possible continued and unabated spread and establishment of alien invasive species.

The cumulative impacts are considered to be Moderate.

7.14.7 Fauna

The Project will contribute to cumulative habitat loss and impact in the broader Project area. The major contributors to habitat loss are mining activities associated with the Gamsberg mine and processing plant and Gamsberg Phase 2 construction. The potential footprint the developments poses a threat to the ecological functioning of the area. Habitat loss and fragmentation are a particular concern and may impact fauna species' ability to respond to environmental fluctuations. The Project will contribute 200 ha

(max) of additional direct and indirect habitat loss to cumulative impact in the area. As this impact is related largely to the presence and operation of the mining activities, it cannot be well mitigated. However, currently, the impacted areas do not appear to be within areas that are likely to be critical for faunal movement in the area. As result the cumulative impact is considered Moderate.

7.14.8 Groundwater

Modelling for the Swartberg Expansion project and modelling undertaken for the Gamsberg Mine project (Helen Seyler, 2013) indicate that the cone of dewater or suppressions will be isolated to each mine area as well as adjacent properties. Therefore it is unlikely that operations of the Projects will result in larger dewatering feature due to the distances between the two operations (22.5 km) as well as the low hydraulic properties of the gneiss plain aquifer. As result the cumulative impacts are considered negligible.

7.14.9 Employment, Skills Enhancement and Local Business Opportunities

The development of the Project will result in increased direct and indirect employment during the construction and operation phases. The nature and extent of the benefits will depend on the extent of local employment.

It is expected that the construction phases of the Gamsberg mine and Swartberg Mine Expansion projects will run consecutively. Therefore, this will result in a significant uplift in local employment directly and indirectly through the procurement of goods and services over continued period of time. Furthermore, both projects are mining projects and therefore there will be continual skills development, which will increase skills level and experience for workers. As such, the potential during construction for cumulative positive benefits associated with economy, employment and skills development is considered to be higher (moderate impact) than for the Project alone.

During operations it is expected that the current workforce of the Deeps mine will be primarily utilised for the Swartberg Expansion and it is not expected that there will be a significant increase in operation employment. Therefore, cumulative impacts of the operational employment will be minor.

7.14.10 Community Health and Safety

It is expected that the construction phases of the Gamsberg mine Phase 2 and Swartberg Mine Expansion projects will run consecutively. In addition, during operations the current workforce of the Deeps mine will be primarily utilised for the Swartberg Expansion and it is not expected that there will be a significant increase in operation employment. Therefore, no major in-migration is expected into the Project area and associated impacts on existing social infrastructure and human health.

As a result the cumulative impacts on Community Health and Safety is expected to be Minor.

7.14.11 Traffic

It is expected that the construction phases of the Gamsberg mine Phase 2 and Swartberg Mine Expansion projects will run consecutively. Therefore, it is anticipated that there will only be minor cumulative impacts during construction

During operations with both Gamsberg and the Swartberg Expansion, operating concurrently as well as existing arterial traffic on the N7 and N14 there is the potential for cumulative impacts. The operations of both Gamsberg and Swartberg Mines will include the transport of processed material. This in combination will existing road traffic along a key transport route may lead to degradation of roads and increased risk of vehicle accidents.

As result the cumulative impacts are expected to be Moderate during operations.

8. ENVIRONMENTAL MANAGEMENT PROGRAMME

8.1 Purpose of this EMPr

The aim of the Environmental Management Programme report (EMPr) is to provide a set of guidelines and actions aimed at addressing potential biophysical and socio-economic impacts associated with the construction, operation and decommissioning phases of the project, and will be included in contract documentation between BMM and its Business partners. The EMPr also provides assurance to regulators and stakeholders that their requirements with respect to biophysical and socio-economic performance will be met, and provides a framework for compliance auditing and inspection programs. It becomes a legally binding document should the Project receive Environmental Authorisation. A standalone EMPr is included in *Annex H*.

8.2 Legal Requirements

In light of the nature of the Project, the following legislation are identified to be applicable:

- National Environmental Management Act (107 of 1998) (NEMA);
- Minerals and Petroleum Resources Development Act (28 of 2002) (MPRDA);
- National Heritage Resources Act (25 of 1999) (NHRA);
- Mine Health and Safety Act (29 of 1996);
- Noise Control Regulations under the Environmental Conservation Act (73 of 1989);
- Major Hazard Installation Regulations (GNR. 692 of 30 July 2001);
- Hazardous Substances Act (56 of 1973);
- Explosives Act (15 of 2003);
- National Environmental Management: Air Quality Act (39 of 2008) (NEM:AQA);
- National Environmental Management Act: Biodiversity Act (10 of 2004) (NEM:BA);
- National Environmental Management: Waste Act (59 of 2008) (NEM:WA); and
- National Water Act (36 of 1998) (NWA).

Despite the applicability of a suite of legislation, the NEMA and MPRDA are the body of legislation that govern the content, structure and approach to this EMPr. However, specific mitigation and management requirements in terms of the remaining aforementioned pieces of legislation will be met in this EMPr as well.

The specific legal requirements for an EMPr, as per the NEMA and MPRDA, are presented below, for ease of reference.

8.2.1 National Environmental Management Act (107 of 1998) (NEMA)

In terms of Section 24 (n) of the NEMA, an EMPr is required. Appendix 4 of the EIA Regulation GNR 326 (2017) outlines specific requirements for the compilation of an EMPr. The specific requirements in terms of the EIA Regulation GNR 326 are included in *Table 8-1.*

Table 8-1 Contents of the EMPr

Legislated Requirements	Section in EMPr
An EMPr must comply with section 24N of the Act and include–	
(a) details of –	
(i) the EAP who prepared the EMPr; and	Section 8.3
(ii) the expertise of that EAP to prepare an EMPr, including a curriculum vitae;	Section 8.3
(b) a detailed description of the aspects of the activity that are covered by the EMPr as identified by the project description;	Section 8.4
(c) a map at an appropriate scale which superimposes the proposed activity, its associated structures, and infrastructure on the environmental sensitivities of the preferred site, indicating any areas that should be avoided, including buffers;	Section 8.2
(d) a description of the impact management outcomes, including management statements, identifying the impacts and risks that need to be avoided, managed and mitigated as identified through the environmental impact assessment process for all phases of the development including—	
(i) planning and design;	Section 8.5
(ii) pre-construction activities	Section 8.5
(iii) construction activities;	Section 8.5
(iv) rehabilitation of the environment after construction and where applicable post closure; and	Section 8.5
(v) where relevant, operation activities;	Section 8.5
(e) a description and identification of impact management outcome required for the aspects contemplated in paragraph (d)	Section 8.5
(f) a description of proposed impact management actions, identifying the manner in which the impact management objectives and outcomes contemplated in paragraph (d) and (e) will be achieved, and must, where applicable, include actions to —	
(i) avoid, modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation;	Section 8.6
(ii) comply with any prescribed environmental management standards or practices;	Section 8.6
(iii) comply with any applicable provisions of the Act regarding closure, where applicable; and	Section 8.6
(iv) comply with any provisions of the Act regarding financial provision for rehabilitation, where applicable;	Section 8.6
(g) the method of monitoring the implementation of the impact management actions contemplated in paragraph (f);	Section 8.6
(h) the frequency of monitoring the implementation of the impact management actions contemplated in paragraph (f);	Section 8.6
(i) an indication of the persons who will be responsible for the implementation of the impact management actions;	Section 8.6
(j) the time periods within which the impact management actions contemplated in paragraph (f) must be implemented;	Section 8.6
(k) the mechanism for monitoring compliance with the impact management actions contemplated in paragraph (f);	Section 8.6
(l) a program for reporting on compliance, taking into account the requirements as prescribed by the Regulations;	Section 8.6
(m) an environmental awareness plan describing the manner in which—	
(i) the applicant intends to inform his or her employees of any environmental risk which may result from their work; and	Section 8.6
(iii) risks must be dealt with in order to avoid pollution or the degradation of the environment; and	Section 8.6
(n) any specific information that may be required by the competent authority.	Section 8.6
(2) Where a government notice gazetted by the Minister provides for a generic EMPr, such generic EMPr as indicated in such notice will apply.	

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

The objectives of the MPRDA, *inter alia*, is to promote equitable access to South Africa's 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 with such activities.

Black Mountain Mining (Pty) Ltd already has an existing mining right and approved EMPr for the mining activities that are currently being undertaken within the Project area. The subject of the present application for Environmental Authorisation is to obtain approval for the proposed Swartberg Mine expansion and amendment of the existing mining right to include the proposed activities covered by this application.

In terms of Section 102 of the MPRDA, amendments to an approved EMPr requires an EIA process to be undertaken in terms of NEMA. In addition, Section 39 of Regulation 527 of the MPRDA outlines specific information requirements for an EMPr, *inter alia*, are as follows:

Table 8-2 EMPr requirements of Section 39 of the MPRDA

Requirements
39 (1) Every person who has applied for a mining right in terms of section 22 must conduct an environmental impact assessment and submit an environmental management programme within 180 days of the date on which he or she is notified by the Regional Manager to do so.
(2) Any person who applies for a reconnaissance permission, prospecting right or mining permit must submit an environmental management plan as prescribed.
(3) An applicant who prepares an environmental management programme or an environmental management plan must-
(a) establish baseline information concerning the affected environment to determine protection, remedial measures and environmental management objectives;
(b) investigate, assess and evaluate the impact of his or her proposed prospecting or mining operations on-
(i) the environment;
(ii) the socio-economic conditions of any person who might be directly affected by the prospecting or mining operation; and
(iii) any national estate referred to in section 3(2) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999), with the exception of the national estate contemplated in section 3(2)(i)(vi) and (vii) of that Act;
(c) develop an environmental awareness plan describing the manner in which the applicant intends to inform his or her employees of any environmental risks which may result from their work and the manner in which the risks must be dealt with in order to avoid pollution or the degradation of the environment; and
(d) describe the manner in which he or she intends to--
(i) modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation;
(ii) contain or remedy the cause of pollution or degradation and migration of pollutants; and
(iii) comply with any prescribed waste standard or management standards or practices.

8.3 Project EAP and Proponent

8.3.1 Expertise of Environmental Assessment Practitioners

The requirement for environmental consultants to act independently and objectively is a well-established principle in South African law. The EIA regulations (GN R.326), specifically state:

"that an EAP (environmental assessment practitioner) (must have) no business, financial, personal or other interest in the activity, application or appeal in respect of which that EAP is appointed in terms of these Regulations other than fair remuneration for work performed in connection with that activity; or that there are no circumstances that may compromise the objectivity of that EAP in performing such work."

ERM is a global environmental consulting organisation employing over 5,000 people in over 150 offices in more than 40 countries. ERM Southern Africa employs over 150 environmental consultants across three offices: Johannesburg, Durban and Cape Town. ERM is a privately owned company registered in South Africa. ERM has no financial ties to, nor is ERM a subsidiary, legally or financially, of BMM. Remuneration for the services by the Proponent in relation to this EIA is not linked to an approval by the decision-making authority. Furthermore, ERM has no secondary or downstream interest in the development.

The role of the environmental consultants is to provide credible, objective and accessible information to government and other stakeholders, so that an informed decision can be made about whether the project should proceed or not. The ERM team selected for this Project possess the relevant expertise and experience to undertake this EIA. As such, ERM has signed the legally required declaration of independence to function as an objective Environmental Assessment Practitioner (EAP). The CVs and details of the Independent Environmental Practitioner are presented in Annex A. The contact details of the EAP for the application are presented in *Box* 1.3 and the core EIA team members involved in this EIA are listed in Table 8-3.

Box 8.1 Contact Details of the EAP

Environmental Resources Management Southern Africa (Pty) Ltd.
Stephanie Gopaul
Address: Postnet Suite 90, Private Bag X12, Tokai, 7966, Cape Town, South Africa
Tel: +27 21 681 5400, Fax: +27 21 686 0736
Email: Stephanie.gopaul@erm.com

Table 8-3 The EIA Team

Name	Role	Qualifications, Experience
Philip Johnson	Partner in Charge	BSc. (Hons), MSc, PIEMA, 14 years
Brendon Solik	Project Manager	B Soc Sci (hons), MSc 5 years
Stephanie Gopaul	Technical Specialist	BSc, MSc, 12 years

8.3.2 Project Proponent

BMM engages in mining operations in South Africa and produces primarily zinc concentrates, as well as lead, copper, and silver concentrates. BMM operates the Gamsberg, Black Mountain Mines consisting of two underground operations namely Swartberg, and Deeps and currently employ more than 1,600 individuals through direct employment and business partners. The contact details for the applicant are presented in *Box 8.2*.

Box 8.2 Contact Details of Project Proponent

Black Mountain Mining Company (Pty) Ltd
Pieter David Venter (Environmental Manager)
Address: Penge Rd, Aggeneys, 8893
Tel: +27 54 983 9802
Email: PVenter@vedantaresources.co.za

8.4 Project Description

8.4.1 Background

BMM is a producer of Copper, Lead and Zinc concentrates in the Northern Cape. BMM currently produce ore from two underground operations; the Deeps and Swartberg (both located on the Black Mountain Mine). Extensive exploration in the vicinity of Swartberg, to determine the extent of the orebody, has opened up the possibility of expanding the existing underground mine and establishing new open pits at Swartberg to levels on par with, or exceeding, the current Deeps mine. A pre-feasibility study completed in April 2017 concluded that the mining of the identified orebody at Swartberg is financially viable.

The bulk of the current ore production, approximately 1.3 million tonnes per annum (Mtpa), is produced from Deeps, and 400 kilo tonnes per annum (ktpa) from the Swartberg operations. The Black Mountain Mine also includes an existing ore processing plant, mine offices, maintenance facilities and other associated services and infrastructure necessary to sustain the existing underground operations. The Deeps Life of Mine (LOM) is scheduled to extend to March 2021. To secure the future of mining at BMM, it is proposed to ramp-up ore production from Swartberg Mine to a minimum of 1.7 Mtpa before Deeps mine is mined out. The expansion will advance the Swartberg LOM within the existing Mining Right Area (MR 517) by at least 19 years.

The expansion of Swartberg Mine will consist of the expansion of the current underground mine and three new open pit mines, and a total of 150,000,000 tons of ore mined from the Swartberg over the 19 year LOM. Of this expected tonnage, approximately 18,000,000 tons of lead and copper concentrate will be extracted. Lead and copper concentrate will be transported via existing rail and/or road networks and exported via the Port of Saldahna in the Western Cape.

BMM has a long-term view to mine additional resources to ensure mining at Black Mountain Mine continues.

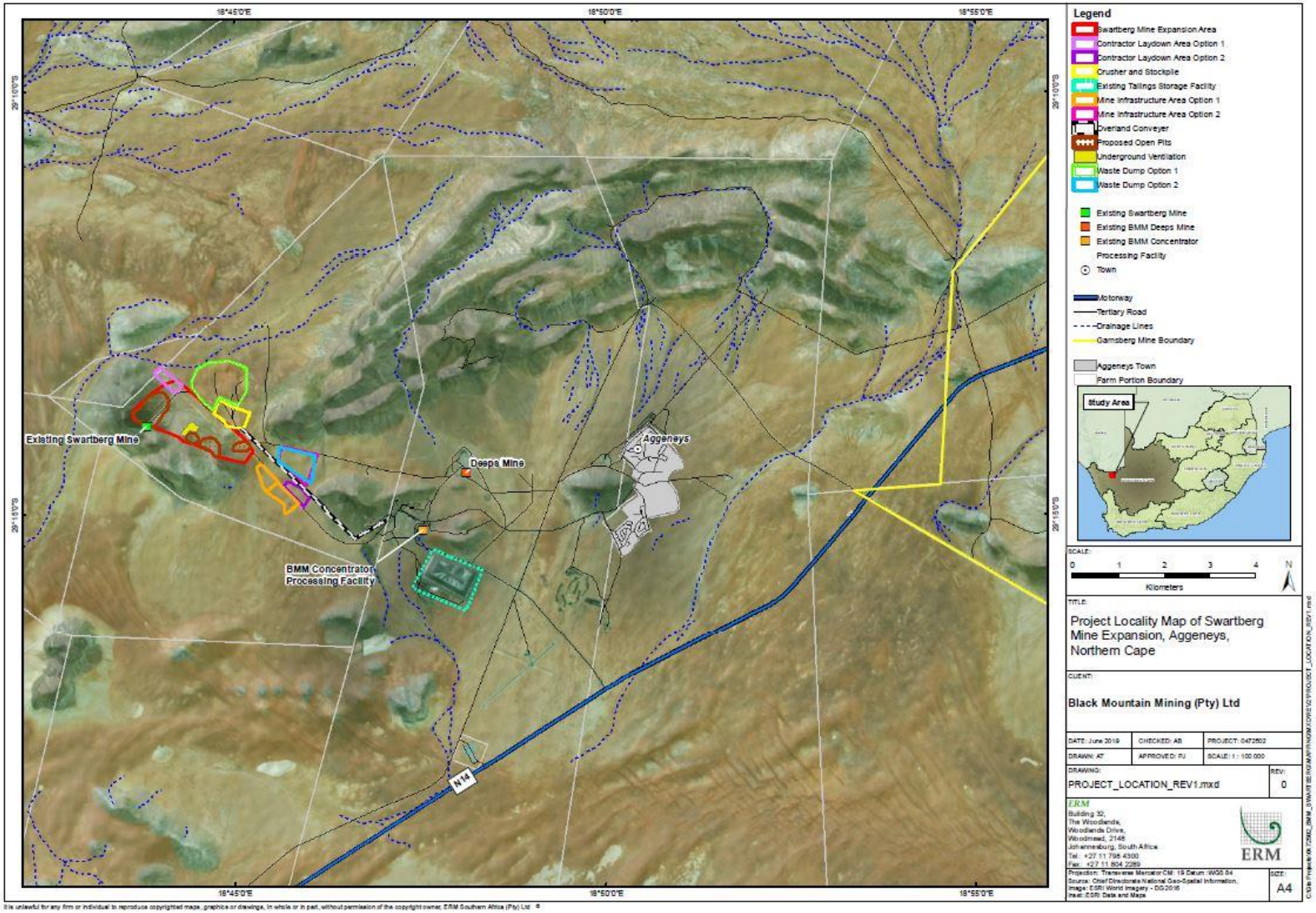
8.4.2 Project Location

The Project site is located in the Northern Cape Province of South Africa, approximately 10 km west of the town of Aggeneys, between the existing towns of Pofadder and Springbok. The Project site falls within the Black Mountain Mine, which is owned by BMM. *Table 8-4* shows the details of the property where the Project will be located and *Figure 8.1* illustrates the Project Location.

Table 8-4 Property Details

Farm Name	Zuurwater 62
Portion Number	Portion 4
SG21 Code	C05300000000006200004
Local Municipality	Khai-Ma Local Municipality
Magisterial District	Namaqualand [C053]
District Municipality	Namakwa District Municipality

Figure 8.1 Project Location Map



8.5 Environmental Management Programme

This section covers the environmental specifications and recommendations required during the following phases of the Project:

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

The EMPr outlines the following:

- Potential impact to the receptor;
- Objective;
- Proposed mitigation / management and monitoring measures;
- Parameters for monitoring;
- Timing/frequency for implementation of mitigation / management and monitoring measures; and
- Responsibility for implementation.

8.5.1 Existing Environmental Management System

BMM has an Environmental Management System (EMS) that is certified to the ISO14001:2015 International Environmental Management Standard. This International Standard, as per *SANAS ISO14001: 2015 Edition, Environmental Management Systems* - Requirements with guidance for use, states that the Standard "*specifies requirements for an environmental management system to enable an organisation to develop and implement a policy and objectives which take into account legal requirements and other requirements to which the organisation subscribes, and information about significant environmental aspects. It applies to those environmental aspects that the organisation identifies as those which it can control and those which it can influence. The system enables an organisation to develop an environmental policy, establish objectives and processes to achieve the policy commitments, take action as needed to improve its performance and demonstrate the conformity of the system to the requirements of the ISO14001 International Standard*".

"*The ISO14001 Standard is based on the methodology known as Plan-Do-Check-Act, which is described as follows:*

- Plan: establish the objectives and processes necessary to deliver results in accordance with the organisation's environmental policy;
- Do: implement the processes;
- Check: monitor and measure processes against environmental policy, objectives, targets, legal and other requirements, and report the results; and
- Act: take actions to continually improve performance of the environmental management system." (SANAS ISO14001: 2004 Edition 2, Environmental Management Systems - Requirements with guidance for use)

The EMS is subjected to annual internal and external audits by competent, independent assessors. External assessors are accredited to the South African National Accreditation System (SANAS) which

is an EMS certification body, and adjudicate whether or not the mine meets the minimum requirements of the ISO14001 Standard.

8.5.2 Management Plans

In addition to this EMPr the following standalone management plans will be developed or existing plans amended for the Project:

- Waste Management Plan (STD040) ;
- Water Management Plan;
- Emergency Response Plan;
- Hazardous Spill Response Plan (STD041);
- Air Quality Management Plan;
- Biodiversity Management Plan;
- Construction Management Plan;
- Traffic and Transportation Management Plan;
- Closure Plan;
- Mine Health and Safety Management Plan;
- Environmental Competence & Awareness (STD026);
- Environmental Aspects (STD027);
- Air Quality Monitoring (STD028);
- Communication & Environmental Reporting (STD031);
- Emergency Preparedness and Response (STD033);
- Environmental Management Systems Manual (STD034);
- Environmental Audits (STD035);
- Environmental Document Control & Record Keeping (STD036);
- Exploration Drilling (STD037);
- Hydrocarbon Management (STD038);
- Handling of Chemical Spillages (STD039);
- Handling, Storage and Disposal of Waste (STD040);
- Environmental Incident & Non-conformance (STD041);
- Legal Register & Compliance (STD042);
- Management of Domestic and Garden Refuse Dumps (STD043);
- Management Review Procedure (STD044);
- Management of Oxidation ponds (STD045);
- Setting of Objectives and Targets (STD046);
- Operating and Managing the Salvage Yard (STD048);
- Correct Storage of Hazardous Material (STD052); and
- Handling, Storage and Disposal of Medical Waste (STD053).

8.5.3 Biodiversity Offset Requirements

Currently, large extents of the study area are delineated as CBA 1, CBA 2 and ESA. However, based on the mostly hexagonal shapes of the CBA areas, it can be assumed that the current classification is based on the extrapolation of information from similar areas and then determined by relevant software, rather than the actual verification of the state and nature of the biodiversity present. In addition, of the vegetation types present as delineated by the latest SANBI Vegmap (available since May 2019), none have been declared as a Listed Threatened Ecosystem up to date.

Looking at the possible contribution that the affected areas may have towards the overall conservation status of the relevant original vegetation types, the following has been evaluation relative to overall and/or nearby comparable habitats where data could be extracted:

- Size of the vegetation type represented in the study area relative to the larger vegetation type;
- Plant species diversity of comparable habitats from the nearby Gamsberg Study (Desmet, 2013); and
- Ecological condition of the defined area.

The results are presented in Table 8-5 and Table 8-6 below.

Table 8-5 Representative areas of vegetation type within the study area

RSA Vegetation Type	Original Extent	Represented by Plant Association	Extent in study area
Aggeneys Gravel Vygieveld	±37,205 ha	Aggeneys Gravel Vygieveld Upper reaches of some Washes	Natural vegetation: ±75 ha (0.20%) Disturbed or modified: ±19 ha (0.05%)
Bushmanland Arid Grassland	±4,125,343 ha	Bushmanland Arid Grassland Washes Modified Plains	Natural vegetation: ±246 ha (0.006%) Disturbed or modified: ±178 ha (0.004%)
Bushmanland Inselberg Shrubland	±81,772 ha	Bushmanland Inselberg Shrubland Mountain Aprons Low Outcrops between Sandy Plains	Natural vegetation: ±118 ha (0.144%) Disturbed or modified: ±40 ha (0.049%)
Bushmanland Sandy Grassland	±267715 ha	Modified Dunes	Natural vegetation: 0 ha (0%) Disturbed or modified: ±134 ha (0.05%)
Namaqualand Klipkoppe Shrubland	±758,222 ha	Arid Inselberg Shrubland	Natural vegetation: ±48 ha (0.006%) Disturbed or modified: ±5 ha (0.0006%)

Table 8-6 Species Diversity

Habitat	Species Counts from Swartberg study	Species Counts from Gamsberg study
1. Aggeneys Gravel Vygieveld	71 Indigenous species	169 Indigenous species
2. Bushmanland Inselberg Shrubland	102 Indigenous species	99 Indigenous species
3. Arid Inselberg Shrubland	35 Indigenous species	150 Indigenous species
4. Mountain Aprons	70 Indigenous species	99 Indigenous species
5. Low Outcrops between Sandy Plains	46 Indigenous species	168 Indigenous species
6. Bushmanland Arid Grassland	64 Indigenous species	99 Indigenous species
7. Modified Dunes	40 Indigenous species	22 Indigenous species
8. Washes	79 Indigenous species	118 Indigenous species

From the above, it can be seen that the extent of the natural, undisturbed vegetation types within the study area are in all cases below to far below 1% of the original extent of the vegetation types. Of these extents, not all will be affected by the mining activities, hence it cannot be argued that the proposed mining activities will have any significant effect on the overall conservation status of the vegetation types at all. Further, when looking at the species diversity of the identified habitats, compared to similar habitats in close vicinity (i.e. Gamsberg prior to mining commencement), it can be seen that the species diversity is less significant, even in entirely undisturbed habitats. It would appear that the extent of the study area (that has not been historically disturbed) lies in a bit of a 'moisture-shadow' area – meaning that precipitation from fog or rainfall (originating mostly from the west/south-west) does not reach that area specifically, but passes over to the next mountain ridge.

From an ecological perspective, the vegetation within the extent of the area investigated does not qualify as CBA Irreplaceable, with only small sections of Bushmanland Inselberg Shrublands that could still qualify as CBA optimal, if at all. Rather, the area should be re-classified as ESA.

Layouts for the proposed mining activities, as far as was feasible, have been adapted to minimise any direct or induced (especially due to dust) impact on sensitive habitats.

Overall, it is considered that the necessity of an offset for the proposed expanded mining footprint cannot be justified on the grounds of flora components.

8.5.4 Mitigation and Monitoring Measures

Mitigation and monitoring measures presented in the tables below have been prescribed by the EIA and specialist studies. The EMPr will require updating with conditions of the Environmental Authorisation and on the basis of the results of any monitoring programmes.

Table 8-7 Construction Environmental Management Measures

Aspect, Potential Impact / Issue	Objective	Mitigation and Enhancement Commitments	Applicable Phase	Monitoring and Indicators	Responsible Party	Implementation Time Frame and Frequency
Air Quality						
Decreased Local Ambient Air Quality due to Dust Emissions	Control and/or avoidance of dust emissions during establishment.	• Take all reasonable measures to minimise the generation of dust as a result of project development activities to the satisfaction of the EO. • As far as practically possible, blasting should only be done under low- or no-wind conditions. • Light Delivery Vehicle speeds must not exceed 40 km/h along dust roads or 20 km/h when traversing unconsolidated and non-vegetated areas; • Haul trucks should not exceed 80km/h on the haul road. • Vehicles must be kept clean to avoid tracking dirt around and off the site. • Vehicles transporting friable materials must be covered. • Where feasible, surface binding agents must be used on exposed open earthworks and roads especially the haul road to the Crusher. • Vegetation clearance must be phased to minimise the area of exposed soil. • Topsoil stockpiles must planted to bind the soil and minimise dust. • The design of stockpiles should be optimised to retain a low profile with no sharp changes in shape. • Drop heights of material must be minimised were possible. • Where possible, wind breaks should be erected around high- dust generating activities. • For significant areas of excavation or exposed ground, dust suppression measures must be used to minimise the spread of dust.	Construction	Visual inspection and photographic record Regular Dust Monitoring South African Emission Standards	Environmental Manager, Environmental Officer	Throughout construction
Noise						
Increased Local Ambient Noise Levels due to Noise Propagation from Establishment Activities	Reduce Project noise levels to acceptable levels.	• Business Partners must keep noise level within acceptable limits, Restrict the use of sound amplification equipment for communication and emergency only. • All diesel-powered construction and earth moving equipment must be well maintained. This must include the regular inspection and, if necessary, replacement of intake and exhaust silencers. Any change in the noise emission characteristics of equipment must serve as trigger for withdrawing it for maintenance. • Vendors must be required to guarantee optimised equipment design noise levels. • A mechanism to monitor noise levels, record and respond to complaints and mitigate impacts should be developed and implemented. • Use of quieter powered mechanical equipment (PME) should be considered, where possible. • Use of noise barriers/enclosures should be considered, where possible. • Vibrating equipment such as crushers must be installed on vibration isolation mountings. • Individual vehicle engine, transmission and body noise/vibration should be minimised through the implementation of an equipment maintenance program. • Maintain road surfaces regularly to avoid corrugations, potholes etc. • Avoid unnecessary idling times. • Minimise the need for trucks/equipment reversing. This will reduce the frequency at which reverse warnings occur. • Any complaints received by Business Partners regarding noise must be recorded and communicated. Where possible or applicable, provide transport to and from the site on a daily basis for construction workers.	Construction	Noise monitoring at any identified sensitive receptors Complaints Register South African Standards	Environmental Manager, Environmental Officer	Throughout construction
Soils						
Loss of soil resources as a result of site clearance and construction activities	Control soil erosion and compaction and promote soil reinstatement.	• Develop and implement a Soil Erosion, Control and Reinstatement Plan. • Restrict extent of disturbance within the Project Site to the extent practicable. • Minimise the period of exposure of the soil surface, including stockpiles, by revegetating temporary-use areas as soon as practicable after construction activities. • Stockpiled soil must not to be compacted. • Stockpiles are to be protected from erosion by keeping the stockpiles as low as possible with gentle gradients, and by planting as soon as possible. • Topsoil stockpiles must not exceed 2 m in height.	Construction	Visual inspection and photographic record	Environmental Manager, Environmental Officer	Throughout construction
Terrestrial Flora						
Loss of habitats of medium and high sensitivity and associated	Minimise the loss of habitats of medium and high sensitivity	• All stockpiled material must be maintained and kept clear of weeds and alien vegetation growth by undertaking regular weeding and control methods.	Construction	Visual inspection and photographic record Biodiversity Action Plan (BAP)	Environmental Manager, Environmental Officer	Throughout construction

Aspect, Potential Impact / Issue	Objective	Mitigation and Enhancement Commitments	Applicable Phase	Monitoring and Indicators	Responsible Party	Implementation Time Frame and Frequency
species due to construction activities		• Where possible, avoid any physical destruction of the Koppies north of the current Swartberg Decline Access Road. • Minimise clearing and operations in habitats with a Very High to Medium-High sensitivity rating. • Avoid any direct activities on any surrounding or adjacent areas with sensitive vegetation or any adjacent or nearby riparian habitats (except the clearing of alien invasive species). • Where clearing for access purposes is essential, the maximum width to be cleared should only be reasonable.. • Avoid blocking and/or destruction of the washes to the south-east of the study area, and those coming off plains and mountains north-east of the study area. • Avoid and where unable to avoid limit placing the waste rock pad within undisturbed natural habitats. • Use existing gravel roads and already disturbed areas to access mining operations as far as possible to avoid the creation of new roads or access routes across natural areas. • No open fires may be lit for cooking or any other purposes, unless in specifically designated and secured areas. • Avoid and/or minimise the loss of species of conservation concern by conducting a thorough pre-construction survey. • Only a registered pest control operator may apply herbicides on a commercial basis and commercial application must be carried out under the supervision of a registered pest control operator. • A daily register must be kept of all relevant details of herbicide usage. • No herbicides must be used in riparian zones. • The pre-construction survey must be followed by implementing the necessary Search and Rescue actions prior to any groundworks taking place, whilst allowing planning that will minimise the destruction of indigenous trees and/or species of conservation concern. • Development and implement a detailed Plant Search- and Rescue, and Monitoring Plan in areas where infrastructure development impact on vegetation before any groundworks taking place. • Delineate all permissible areas so that all movement of vehicles and heavy machinery can be restricted to permissible areas, these being designated access roads, maintenance roads, turning points and parking areas. No off-road driving beyond designated areas will be allowed. • Design and create berms to stop runoff from the mining areas and waste-rock dump during/after periodic/ extreme rainfall events from entering directly into existing washes. • Keep the clearing of natural vegetation to a minimum. • Cleared indigenous shrubs and trees can be shredded and used as mulch on top of topsoil stockpiles or on rehabilitated areas. • Ensure topsoils, where available, are first removed and correctly stored for rehabilitation purposes. • Reduce fragmentation of natural habitat by keeping long-term or permanently impacted areas as close together as possible (but avoiding the blockage of or increased impact on sensitive habitats), e.g. by using waste rock pad Alternative 2, which is closer to the planned open pits, thus also reducing transport requirements. • Parking and operational areas should be regularly inspected for oil spills and covered with an impermeable or absorbent layer (with the necessary storm water control) if oil and fuel spillages are likely to occur. • Reinforce portions of existing access routes that are prone to erosion or seasonal inundation, create structures or low banks to drain the access road rapidly during rainfall events, yet preventing erosion of the track and surrounding areas. • Install adequate drainage structures to ensure that water flows are never concentrated or blocked. • If filling material is to be used, this should be sourced from areas free of invasive species, and alien plant control measures are to be applied to all areas used for sourcing of fill materials. • Areas of high conservation significance in close proximity but outside the physical mining footprint need to be clearly demarcated with appropriate barriers and signage to ensure no further encroachment or disturbance. Any infringements will be reported and appropriate penalties are to be enforced on transgressing staff or Business partners. • - Alien invasive vegetation must be removed according to a plan (in line with relevant municipal and provincial procedures, guidelines and recommendations) and disposed of at a recognised waste disposal facility. • Efforts will be taken to minimise the footprint of short-duration activities and/or linear infrastructure. Efforts to minimise such footprints will include grouping all infrastructure to the same servitude and/or as close as possible to existing and planned long-term physical disturbances. This will also reduce fragmentation due to mining operations.		Rehabilitation Plan Training records		

Aspect, Potential Impact / Issue	Objective	Mitigation and Enhancement Commitments	Applicable Phase	Monitoring and Indicators	Responsible Party	Implementation Time Frame and Frequency
		• Rehabilitate and revegetate all areas that have been disturbed as soon as practically possible. This will be according to a Rehabilitation Plan that needs to be compiled by a suitably qualified specialist and complement the current Biodiversity Management Plan (BMP). It will include the following: ▪ Installation of erosion control structures. ▪ Re-vegetation measures of disturbed/modified areas using indigenous shrubs and grasses only. ▪ Special attention will be paid to ensuring that critical topography is reconstructed as far as practical.				
Loss of habitats of medium to low sensitivity and associated species due to construction activities	Minimise the loss of habitats of medium to low sensitivity	• Minimise clearing and operations in natural habitats. For the location of waste rock pads, clearing of natural vegetation within at least 50 m of adjacent habitats with high sensitivity should be avoided. • Avoid any direct impacts on any surrounding or adjacent area with sensitive vegetation or any adjacent or nearby riparian habitats (except the clearing of alien invasive species). • Avoid blocking and/or destruction of the washes to the south-east of the study area, and those coming off plains and mountains north-east of the study area. • Avoid and where unable to avoid limit placing the waste rock pad within undisturbed natural habitats. • Use existing gravel roads and already disturbed areas to access mining operations as far as possible. • No open fires may be lit for cooking or any other purposes, unless in specifically designated and secured areas. • Conducting a thorough pre-construction survey to avoid and/or minimise the loss of species of conservation concern. • The pre-construction survey must be followed by implementing necessary Search and Rescue actions prior to any groundworks taking place, whilst allowing planning that will minimise the destruction of indigenous trees and/or species of conservation concern. • Delineate all permissible areas so that all movement of vehicles and heavy machinery can be restricted to permissible areas, these being designated access roads, maintenance roads, turning points and parking areas. No off-road driving beyond designated areas will be allowed. • Design and create berms to stop runoff from the mining and waste-rock dump during/after periodic extreme rainfall events from entering directly into existing washes. • Keep the clearing of natural vegetation to a minimum. • Cleared indigenous shrubs and trees can be shredded and used as mulch on top of topsoil stockpiles or on rehabilitated areas. • Ensure topsoils, where available, are first removed and retained for rehabilitation purposes. Topsoils should not be stored in heaps higher than 1 m, may never be compacted and the growth of natural vegetation on such piles during storage should be encouraged. • Wheels of large machinery should be checked prior to entering topsoil storage sites and cleared of seed or any other plant material (especially of species with spiny or bur-like seeds) to reduce the introduction and spread of alien invasive plants. All such plant material removed must be burnt. • Reduce fragmentation of natural habitat by keeping long-term or permanently impacted areas as close as possible together (but avoiding the blockage of or increased impact on sensitive habitats). • Parking and operational areas should be regularly inspected for oil spills and covered with an impermeable or absorbent layer (with the necessary storm water control) if oil and fuel spillages are highly likely to occur. • Reinforce portions of existing access routes that are prone to erosion or seasonal inundation, create structures or low banks to drain the access road rapidly during rainfall events, yet preventing erosion of the track and surrounding areas. • Install adequate drainage structures to ensure that water flows are never concentrated or blocked in any way. • If filling material is to be used, this should be sourced from areas free of invasive species, and alien plant control measures are to be applied to all areas used for sourcing of fill materials. • Areas of high conservation significance in close proximity but outside the physical mining footprint need to be clearly demarcated with appropriate barriers and signage to ensure no further encroachment or disturbance. Any infringements will be reported and appropriate penalties are to be enforced on transgressing staff or Business partners. • Efforts will be taken to minimise the footprint of short-duration activities and/or linear infrastructure. Efforts to minimise such footprints will include grouping all infrastructure to the same servitude and/or as close as possible to existing and planned long-term physical disturbances. • Compilation of a Rehabilitation Plan by a suitably qualified specialist to complement the Biodiversity Management Plan (BMP). It will include the following: ▪ Installation of erosion control structures.	Construction	Monitoring: Visual inspection and photographic record Biodiversity Action Plan (BAP) Rehabilitation Plan Training records	Environmental Manager, Environmental Officer	Throughout construction

Aspect, Potential Impact / Issue	Objective	Mitigation and Enhancement Commitments	Applicable Phase	Monitoring and Indicators	Responsible Party	Implementation Time Frame and Frequency
		▪ Re-vegetation of disturbed/modified areas using indigenous shrubs and grasses only. ▪ Special attention will be paid to ensuring that critical topography is reconstructed as far as practical.				
Loss of plant species of conservation concern due to construction activities	Minimise the loss of plant species of conservation concern	• If possible, avoid any physical destruction of the Koppies north of the current Swartberg Decline Access Road. In general, minimise clearing and operations in habitats with a Very High to Medium-High sensitivity rating. • Avoid and/or minimise the loss of species of conservation concern by conducting a thorough pre-construction survey. • The pre-construction survey must be followed by implementing the necessary Search and Rescue actions prior to any groundworks taking place whilst allowing planning that will minimise the destruction of indigenous trees and/or species of conservation concern. • The following activities will be prohibited for staff and Business Partners or any other person that may be present within or have access to the BMM mining concession area: ▪ Purchase or transport of any wildlife/indigenous plant products from local communities or passing traders who cannot prove that they have valid permits for having such plants in their possession. ▪ Collection of any plants or plant- products for trade, consumption, medicinal use or cultivation, unless such person has the permission of the mine management as well as a valid permit from the responsible authorities. • Plants of conservation concern that will be directly affected by planned mining operations could be used for research purposes, if this will not critically reduce the viability of natural populations, and only with the necessary permits and permissions from the responsible authorities and BMM management. • Any unauthorised driving to areas not directly affected by the mine, but which may contain species of conservation concern and/or natural habitat within the BMM mining concession, will not be allowed. • Rehabilitate and revegetate all areas that have been disturbed as soon as practically possible and continue progressively during all phases of mining. • Where possible, rescued plants can be used as part of the rehabilitation efforts.	Construction,	Visual inspection and photographic record Training records Biodiversity Action Plan (BAP) Plant Search- and Rescue, and Monitoring Plan Rehabilitation Plan	Environmental Manager, Environmental Officer	Throughout construction
Reduced ecological function and degradation due to altered soil surfaces due to construction activities	Minimise impacts to soils to avoid reduced ecological function	• If possible, avoid any physical destruction of the Koppies north of the current Swartberg Decline Access Road. Minimise clearing and operations in habitats with a Very High to Medium-High sensitivity rating. • Avoid any direct impacts on any surrounding or adjacent area with sensitive vegetation or any adjacent or nearby riparian habitats (except the clearing of alien invasive species). • Avoid blocking and/or destruction of the washes to the south-east of the study area, and those coming off plains and mountains north-east of the study area. • Use existing gravel roads and already disturbed areas to access mining operations as far as possible to avoid the creation of new roads or access routes across natural areas. • Keep the clearing of natural vegetation to a minimum. • Indigenous cleared shrubs and trees can be shredded and used as mulch on top of topsoil stockpiles or on rehabilitated areas. • Reinforce portions of existing access routes that are prone to erosion or seasonal inundation, create structures or low banks to drain the access road rapidly during rainfall events, yet preventing erosion of the track and surrounding areas. • Install adequate drainage structures to ensure that water flows are never concentrated or blocked in any way. • Dust levels from blasting and haulage must be controlled and minimised at all times. ▪ As far as practically possible, blasting should only be done under low- or no-wind conditions. ▪ Once the extent of possible dust deposition has been modelled and is known, it will be advisable to search the area affected for plant species of conservation concern. In areas with a high(er) concentration of such species, dust monitoring programmes, coinciding with monitoring programmes of the plants affected should be implemented to advise management if any immediate remedial action will be required, or if possible offset or relocation measures will need to be implemented if affected species start dying off at increased rates due to dust deposition. ▪ Strict speed limits must be set and adhered to in order to reduce dust fall out. • Prior to rehabilitation, landscaping of disturbed areas needs to be undertaken in a way that ensures sufficient surface roughness, but also blends in with natural runoff and drainage patterns, whilst still preventing the start of rill- or gully erosion. • As part of rehabilitation, all compacted soils need to be ripped to a depth of at least 30 cm to prevent soil-surface crusting. • All signs of accelerated erosion after a large rainfall event must be mitigated as soon as possible.	Construction	Monitoring: Visual inspection and photographic record Biodiversity Action Plan (BAP) Rehabilitation Plan Dust monitoring in affected areas	Environmental Manager, Environmental Officer	Throughout construction

Aspect, Potential Impact / Issue	Objective	Mitigation and Enhancement Commitments	Applicable Phase	Monitoring and Indicators	Responsible Party	Implementation Time Frame and Frequency
		• Rehabilitate and revegetate all areas that have been disturbed as soon as practically possible.				
Increase in alien invasive vegetation due to construction activities	Reduce the spread of alien and invasive species below the current rate of infestation. In addition, create awareness about the potential impacts of alien invasive species.	• Wheels of large machinery should be checked prior to entering the site and cleared of seed or any other plant material (especially of species with spiny or bur-like seeds). All such plant material removed must be burnt. • If filling material is to be used, this should be sourced from areas free of invasive species, and alien plant control measures are to be applied to all areas used for sourcing fill materials. • Conduct a detailed Alien Invasive Survey within the BMM concession area, and if possible also along approximately 20 -50 km of all major access routes leading to the mine. From this: ▪ Create and implement a suitable (alien) Invasive Plant Management Plan (following DEA standards for an Alien Management Control Plan). ▪ Destruction of regenerative material of cleared alien species by burning in a protected area is encouraged. ▪ Be aware of alien species that may be newly introduced to the area and act immediately to eradicate once detected. Rehabilitate: • Rehabilitate and revegetate all areas that have been disturbed as soon as practically possible and progressively during all phases of the mine. This will be according to a Rehabilitation Plan to be compiled by a suitably qualified specialist and complement a Biodiversity Action Plan (BAP). It will include the following: ▪ Re-vegetation measures of disturbed/modified areas using indigenous shrubs and grasses only. The selection of species used for rehabilitation may not include any species that are not suitable to the receiving environment (i.e. must occur there naturally), and also no species that are indicative of habitat degradation.	Construction	Visual inspection and photographic record Training records Biodiversity Action Plan (BAP) Invasive Plant Management Plan Rehabilitation Plan	Environmental Manager, Environmental Officer	Throughout construction
Terrestrial Fauna						
Loss of medium, high and very high sensitivity areas of faunal habitat	Minimise impact on faunal habitat due to construction activities	• As far as possible, minimize disturbance and habitat loss within the high and very high sensitivity areas such as drainage lines. • The final design mine footprint areas should be clearly demarcated and all mining activities restricted to these areas. In the event that the final design differs from that presented in this EIA, an additional walkover of the area to confirm conditions. • Any exploration trenches, pits or boreholes that pose a danger to fauna should be filled-in or covered to prevent fauna from falling and becoming trapped. • Use existing gravel roads and already disturbed areas to access mining operations as far as possible to avoid the creation of new roads or access routes across natural habitats. • No open fires may be lit for cooking or any other purposes, unless in specifically designated and secured areas. • There should be waste bins with lids distributed at strategic points across the site to ensure that litter is well-managed. No food waste or other waste that might attract fauna should be left exposed. • There should be a preconstruction search and rescue for fauna prior to vegetation clearing within areas where there are identified fauna resident and which might be killed by construction activities. • Design and create berms to stop runoff from the mining and waste-rock dump during/after periodic extreme rainfall events from entering directly into existing washes. • If the site must be lit at night for security purposes, this should be done with downward-directed low-UV type lights (such as most LEDs), which do not attract insects. • Keep the clearing of natural vegetation to a minimum. • Reduce fragmentation of natural habitat by keeping long-term or permanently impacted areas as close together as possible (but avoiding the blockage of or increased impact on sensitive habitats). • Parking and operational areas should be regularly inspected for oil spills and covered with an impermeable or absorbent layer. • Areas of high faunal significance in close proximity to, but outside the physical mining footprint need to be clearly demarcated with appropriate barriers and signage to ensure no further encroachment or disturbance. Any infringements will be reported and appropriate penalties are to be enforced on transgressing staff or contractors. • Efforts will be taken to minimise the footprint of short-duration activities and/or linear infrastructure. Efforts to minimise such footprints will include grouping all infrastructure to the same servitude and/or as close as possible to existing and planned long-term physical disturbances. This will also reduce fragmentation due to mining operations.	Construction	Visual inspection and photographic record Training records Biodiversity Action Plan (BAP) Rehabilitation Plan	Environmental Manager, Environmental Officer	Throughout construction

Aspect, Potential Impact / Issue	Objective	Mitigation and Enhancement Commitments	Applicable Phase	Monitoring and Indicators	Responsible Party	Implementation Time Frame and Frequency
		• Rehabilitate and revegetate all areas that have been disturbed as soon as practically possible and progressively during all phases of the mine. This will be according to a Rehabilitation Plan to be compiled by a suitably qualified specialist and complement a Biodiversity Action Plan (BAP). • No Threatened or Protected species (ToPs) and/or protected fauna as listed according NEMBA (Act No. 10 of 2004) and relevant provincial ordinances may be removed and/or relocated without appropriate authorisations/permits. • No poaching will be tolerated under any circumstances. • No deliberate or intentional killing of fauna is allowed.				
Loss of fauna due to mining activities	Minimise impacts on fauna during construction activities	• Waste bins with lids should be distributed at strategic points across the site to ensure that litter is well-managed. No food waste should be left exposed. • A preconstruction search and rescue for fauna prior to vegetation clearing must be undertaken within areas where there are identified fauna resident which might be affected by construction activities. • All fauna threatened by mining activities should be removed to safety by an appropriately trained person. • All mine staff and contractors should receive an induction highlighting the need to respect the environment, no littering, no persecution of fauna, no illegal hunting, poaching or harvesting of natural products from the environment. • All construction vehicles should adhere to a low speed limit (30kph for heavy vehicles and 40kph for light vehicles) to avoid collisions with susceptible species such as snakes and tortoises. • All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner. • All open water sources such as reservoirs, waste water, evaporation dams etc should be covered with shade cloth, fine mesh or similar to prevent fauna accessing these areas and from falling into the reservoirs and drowning. • Provide signage to indicate the right of way of fauna such as tortoises. Any roadkill should be recorded and all areas where repeated events occur should be inspected to see if additional mitigation can be applied.	Construction,	Visual inspection and photographic record Training records Biodiversity Action Plan (BAP)	Environmental Manager, ECO	Throughout construction
Groundwater						
Impact of contaminants on the groundwater resource	Minimise degradation of the groundwater resource due to contaminants	• Prior to construction of the WRDs (enlarged foot print area), 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) must be constructed along the base of both WRDs to intercept drainage and convey seepage to a return water dam. • The numerical groundwater flow and transport model should be updated/validated as additional information becomes available (ie SEEP/W model results, geophysics results and hydraulic conductivity of WRDs material) prior to construction to ensure assumptions made during the development of the model remain valid.	Construction	Monitoring: Groundwater quality monitoring must be undertaken in the vicinity of contamination sources and in radially increasing distance from them. The monitoring data should be stored in an appropriate data management tool/database. It is recommended that additional groundwater monitoring boreholes be constructed for the planned WRDs. Effluent quality meeting DWS requirements	Environmental Manager, Environmental Officer	Throughout construction
Socio-Economic						
Employment, skills enhancement and local business opportunities	To build local capacity in the Project-affected communities to enable local recruitment and contracting to be realised and successful.	• The Mine will establish a Recruitment Policy which prioritises the employment of South African and local residents (originating from the Local Municipality) over foreigners. All contractors will be required to recruit in terms of the Project's Recruitment Policy, where practical. • The Khâi-Ma Local Economic Development (LED) Forum should be consulted in the process of unlocking opportunities for local businesses. • The Project will advertise job opportunities and criteria for skills and experience needed through local media, at least three months ahead of recruitment. This information should also be provided to all relevant authorities, community representatives and organisations on the interested and affected party database. • The Recruitment Policy and Procedure should promote the employment of women as a means of ensuring that gender equality is attained. • No employment will take place at the entrance to the site. Only formal channels for employment will be used.	Construction	Recruitment Policy Social and Labour Plan Grievance mechanism records	Environmental Manager, Community Relations Officer	Prior to and during construction

Aspect, Potential Impact / Issue	Objective	Mitigation and Enhancement Commitments	Applicable Phase	Monitoring and Indicators	Responsible Party	Implementation Time Frame and Frequency
Presence of the workforce and jobseekers	Minimise impacts on the local population due to the presence of the work force and job seekers	• BMM will ensure that their security personnel work in close collaboration with the police to monitor any illegal activity. • BMM and its appointed business partners will conform on the current induction programme and Code of Conduct for all workers directly or indirectly employed by the Mine. 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 all communities and traditions; ▪ 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 consumption 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 ▪ Description of disciplinary measures for infringement of the Code of Conduct and company rules. • The Mine will follow the current grievance procedure that is easily accessible to the local community, through which complaints related to business partner or employee behaviour can be lodged and responded to. The Mine will respond in a serious manner to any such complaints. • The BMM HIV/AIDS Policy and information document for all workers directly related to the Project will apply. The information document will address factual health issues as well as behaviour change issues around the transmission and infection of HIV/AIDS.	Construction	Code of Conduct HIV/AIDS Policy Stakeholder Engagement Records Training records Grievance mechanism records	Environmental Manager, Community Relations Officer	Prior to construction and to be implemented throughout construction, operations and decommissioning
Pressure on Social Infrastructure and Services	To ensure pressure is not exerted on the local social amenities which will reduce the availability and access of services to the local community.	The Project will implement a grievance procedure that is easily accessible to the local community, through which complaints related to business partner or employee behaviour can be lodged and responded to. The Project will respond in a serious manner to any such complaints. Key steps include: • Development of an Employment Management Plan. • Regular Engagement with Khai Ma Municipality to understand impact to the social infrastructure. • Circulation of contact details of 'grievance officer' or other key Project contact. • Awareness raising among the local community regarding the grievance procedure and how it works. • Establishment of a grievance register to be updated and maintained by the Project.	Construction	Employment Management Plan Stakeholder Engagement Records Training records Grievance mechanism records	Environmental Manager, Community Relations Officer	Prior to construction and to be implemented throughout construction, operations and decommissioning
Impact on human health due to air emissions and dust generation	To reduce the health impact on Project-affected communities to the lowest possible level.	• The Mine will develop and implement a Grievance Mechanism to address stakeholder concerns related to the Project in a timely manner.	Construction	Grievance mechanism records	Environmental Manager, Community Relations Officer, Environmental Officer	Prior to construction and to be implemented throughout construction, operations and decommissioning
Risk to workers' health and safety due to hazardous construction activities	To reduce the risk associated with occupational health and safety.	• The Mine will implement a rigorous induction programme for all employees outlining health and safety risks. • The Project will comply with all applicable South African legislation in terms of health and safety, and worker rights, which will include access to workman's compensation for loss of income resulting from an onsite incident. • As part of the business partner and supplier selection process, the Project will take into consideration performance with regard to worker management, worker rights, health and safety as outlined in South African law and the Project's policies. • The Mine will provide support to business partners and sub-business partners to ensure that labour and working conditions are in line with South African law through capacity building. • Workers will be provided with primary health care and basic first aid at construction camps /worksites. • Facilities and operations will be developed, planned and maintained such that robust barriers are in place to prevent accidents. All employees have the duty to stop any works if adequate systems to control risks are not in place. • In line with the worker code of conduct, employees should not be under the influence of intoxicants which could adversely affect the ability of that employee to perform the work or adversely affect the health and safety of other employees, other persons or the environment. • The Project will provide of Personal Protective Equipment (PPE), training and monitoring as well as ongoing safety checks and safety audits. • The Project will implement the current BMM Grievance Mechanism to address employee concerns related to the Project in a timely manner.	Construction	Induction records Training records Grievance mechanism records	Project Manager, Environmental Manager, Community Relations Officer	Prior to construction and to be implemented throughout construction, operations and decommissioning

Aspect, Potential Impact / Issue	Objective	Mitigation and Enhancement Commitments	Applicable Phase	Monitoring and Indicators	Responsible Party	Implementation Time Frame and Frequency
Increase in traffic volumes	Minimise the impact of the quality of local roads as well as other road users	• All vehicles will be regularly checked and maintained, including tyre wear. • Contact details will be displayed on vehicles to allow other road users to report bad driving at any time. • All drivers will be sensitised about potential accident risks to local users and will be periodically checked for alcohol consumption. • All driver will be appropriately licensed. • 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. • The Mine will develop and implement a Grievance Mechanism to address employee concerns related to the Project in a timely manner.	Construction	Traffic Management Plan License record Training records Vehicle maintenance records Grievance mechanism	Environmental Manager, Environmental Officer	Prior to construction and to be implemented throughout construction
Archaeology and Cultural Heritage						
Impacts on local archaeology and cultural heritage due to construction activities	To avoid, minimise, manage and mitigate the impact on local archaeology and cultural heritage resources	• Development of a facility Environmental Management Programme (EMPr) that takes cognizance of heritage resources in the event of any future extensions of roads or other infrastructure. • Provision for on-going heritage monitoring in a facility EMPr which also provides guidelines on what to do in the event of any major heritage feature being encountered during any phase of construction/maintenance. • A Chance Finds Procedure must be developed to ensure that any heritage resource finds are recorded and reported to the appropriate authorities, and if necessary, all work is stopped until the find can be assessed by a relevant specialist. In addition the relevant Heritage Authority should be contacted by the client. • Should the ESA site be threatened it may be recommended that a surface collection be made to preserve a representative sample. • Officials from relevant heritage authorities (National and Provincial) must be permitted to inspect the operation at any time in relation to the heritage component of the EMPr. • All work must cease immediately, if any human remains and/or other archaeological, palaeontological and historical material are uncovered. Such material, if exposed, must be reported to the nearest museum, archaeologist/ palaeontologist (or the South African Police Services), so that a systematic and professional investigation can be undertaken. Sufficient time must be allowed to remove/collect such material before development recommences.	Construction	Chance Find Procedure Grievance mechanism records	Environmental Manager, Community Relations Officer, Environmental Officer	Throughout construction, operations and decommissioning
Unplanned Events						
Occupational Health and Safety	To reduce the risk associated with occupational health and safety.	• Development of an Occupational Health and Safety Management Plan (OHSMP). Inductions, training, H&S records and remediating actions, risk assessments of all activities and provision of PPE. • The OHSMP should cover all workers on site, including temporary workers and Business partners. • Carry out regular monitoring and audits of the OHSMP and update as required.	Construction	Occupational Health and Safety Management Plan Training records H&S audit records	Environmental Manager, Community Relations Officer	Throughout construction, operations and decommissioning
Accidental spills of equipment fuel, oils, and chemicals	Reduce the risk of accidental spills of equipment fuels and oils.	• Adhere to best practice principles. • Construction equipment should be up to industry standard and serviced regularly to prevent oil spills. • A spill response plan should be in place and construction workers should be trained accordingly. • 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. • Hazardous material storage will be constructed on an impermeable surface and the bulk storage facility will be bunded. The Project will restrict storage and handling of hazardous materials and fuels to bunded areas of sufficient capacity to contain a release. • Refuelling of equipment and vehicles will be carried out in designated areas on hard standing ground to prevent seepage of any spillages into the ground. Collection systems will be installed in these areas to manage any spills, fuels will be collected and either reused, treated by incineration or removed by a local business partner. Drip trays must be used when refuelling and servicing vehicles or equipment, where it is not on a hardstanding surface. • Leaking equipment must be repaired immediately or be removed from site to facilitate repair. • The Mine will develop a detailed hazardous material spill response plan, which includes community sensitisation/ notifications when required. The Project will maintain spill clean-up and response capability adequate for addressing spills for all phases of the Expansion. All spills will be immediately contained and cleaned up. Contaminated areas will be remediated and post remediation verification will be carried out. • Appropriately sized spill kit kept onsite relevant to the scale of the activity taking place must be available.	Construction	Spill Response Plan Training records Equipment maintenance records Incident register	Environmental Manager, Environmental Officer	Throughout construction, operations and decommissioning

Aspect, Potential Impact / Issue	Objective	Mitigation and Enhancement Commitments	Applicable Phase	Monitoring and Indicators	Responsible Party	Implementation Time Frame and Frequency
		• Maintain an incidents and complaints register in which all incidents or complaints involving the public are logged.				
Vehicle Accidents	Reduce the risk and potential impact of vehicle accidents on site and for all Project related activities. .	• All new drivers employed throughout the course of the Mine's operations will be required to undergo Defensive Driver Training. • Speed limits will be enforced for all vehicles. • Speed limits of 40kph will be enforced along all internal roads except haul roads where the limit is 80kph. • The Mine will regularly consult with the relevant local and regional government to ensure the roads used are well maintained, and that potential problems or hazards are communicated to the relevant authority timeously. Expansion planning for construction traffic must be done in consultation with the government. • The status of the integrity of proposed Project transportation routes with respect to structural properties (load limits, traffic volume limits), functionality (condition of road surface) and safety (signage, markings, and potential public safety hazard areas) must be confirmed. Additional measures required to upgrade transportation routes and minimise traffic congestion must be carried out in consultation with the local authorities. • The Project will undertake sensitisation in the local communities, including appropriate warning signs and notifications of the risks of traffic accidents.	Construction,	Training records Grievance mechanism	Project Manager, Environmental Manager, Environmental Officer	Throughout construction, operations and decommissioning

Table 8-8 Operational Environmental Management Measures

Aspect, Potential Impact / Issue	Objective	Mitigation and Enhancement Commitments	Applicable Phase	Monitoring and Indicators	Responsible Party	Implementation Time Frame and Frequency
Air Quality						
Decreased Local Ambient Air Quality due to Dust Emissions	Control and/or avoidance of dust emissions during operations.	• Take all reasonable measures to minimise the generation of dust as a result of project development activities to the satisfaction of the EO. • As far as practically possible, blasting should only be done under low- or no-wind conditions. • Vehicle speeds must not exceed 40 km/h along dust roads or 20 km/h when traversing unconsolidated and non-vegetated areas; • Haul truck speeds on haul roads should not exceed 80km/h • Vehicles must be kept clean to avoid tracking dirt around and off the site. • Vehicles transporting friable materials must be covered. • Where feasible, surface binding agents must be used on exposed open earthworks and roads especially haul roads. • Vegetation clearance must be phased to minimise the area of exposed soil. • Topsoil stockpiles must planted to bind the soil and minimise dust. • The design of stockpiles should be optimised to retain a low profile with no sharp changes in shape. • Drop heights of material must be minimised were possible. • Where possible, wind breaks should be erected around high- dust generating activities. • For significant areas of excavation or exposed ground, dust suppression measures must be used to minimise the spread of dust.	Operations	Visual inspection and photographic record South African Emission Standards	Environmental Manager, Environmental Officer	Throughout operations
Noise						
Increased local ambient noise levels due to noise propagation from operational activities	Reduce Project noise to acceptable levels.	• Business Partners must keep noise level within acceptable limits, Restrict the use of sound amplification equipment for communication and emergency only. • All diesel-powered construction and earth moving equipment must be well maintained. This must include the regular inspection and, if necessary, replacement of intake and exhaust silencers. Any change in the noise emission characteristics of equipment must serve as trigger for withdrawing it for maintenance. • Vendors must be required to guarantee optimised equipment design noise levels. • A mechanism to monitor noise levels, record and respond to complaints and mitigate impacts should be developed and implemented. • Use of quieter powered mechanical equipment (PME) should be considered, where possible. • Use of noise barriers/enclosures should be considered, where possible. • Vibrating equipment such as crushers must be installed on vibration isolation mountings. • Individual vehicle engine, transmission and body noise/vibration should be minimised through the implementation of an equipment maintenance program. • Maintain road surfaces regularly to avoid corrugations, potholes etc. • Avoid unnecessary idling times. • Minimise the need for trucks/equipment reversing. This will reduce the frequency at which reverse warnings occur. • Any complaints received by Business Partners regarding noise must be recorded and communicated. Where possible or applicable, provide transport to and from the site on a daily basis for construction workers.	Operations	Noise monitoring at any identified sensitive receptors	Environmental Manager, Environmental Officer	Throughout operations
Terrestrial Flora						
Loss of habitats of medium and high sensitivity and associated species due to construction activities	Minimise the loss of habitats of medium and high sensitivity	• Where possible, avoid any physical destruction of the Koppies north of the current Swartberg Decline Access Road. • Avoid any direct activities on any surrounding or adjacent areas with sensitive vegetation or any adjacent or nearby riparian habitats (except the clearing of alien invasive species). • No open fires may be lit for cooking or any other purposes, unless in specifically designated and secured areas. • Pits should be backfilled as soon as possible (if possible). • Rehabilitate and revegetate all areas that have been disturbed as soon as practically possible according to the Rehabilitation Plan	Operations	Visual inspection and photographic record Biodiversity Action Plan (BAP) Rehabilitation Plan Training records	Environmental Manager, Environmental Officer	Throughout operations
Loss of habitats of medium to low sensitivity and associated	Minimise the loss of habitats of medium to low sensitivity	• Minimise clearing and operations in natural habitats. • Avoid any direct impacts on any surrounding or adjacent area with sensitive vegetation or any adjacent or nearby riparian habitats (except the clearing of alien invasive species).	Operations	Visual inspection and photographic record Biodiversity Action Plan (BAP)	Environmental Manager, Environmental Officer	Throughout operations

Aspect, Potential Impact / Issue	Objective	Mitigation and Enhancement Commitments	Applicable Phase	Monitoring and Indicators	Responsible Party	Implementation Time Frame and Frequency
species due to operational activities		• No open fires may be lit for cooking or any other purposes, unless in specifically designated and secured areas. • Delineate all permissible areas so that all movement of vehicles and heavy machinery can be restricted to permissible areas, these being designated access roads, maintenance roads, turning points and parking areas. No off-road driving beyond designated areas will be allowed. • Wheels of large machinery should be checked prior to entering topsoil storage sites and cleared of seed or any other plant material (especially of species with spiny or bur-like seeds) to reduce the introduction and spread of alien invasive plants. All such plant material removed must be burnt. • Parking and operational areas should be regularly inspected for oil spills and covered with an impermeable or absorbent layer (with the necessary storm water control) if oil and fuel spillages are highly likely to occur. • Maintenance of access routes that are prone to erosion or seasonal inundation. • If filling material is to be used, this should be sourced from areas free of invasive species, and alien plant control measures are to be applied to all areas used for sourcing of fill materials. • Areas of high conservation significance in close proximity but outside the physical mining footprint need to be clearly demarcated with appropriate barriers and signage to ensure no further encroachment or disturbance. Any infringements will be reported and appropriate penalties are to be enforced on transgressing staff or contractors. • Rehabilitate and revegetate all areas that have been disturbed as soon as practically possible according to the Rehabilitation Plan		Rehabilitation Plan Training records		
Loss of plant species of conservation concern due to operational activities	Minimise the loss of plant species of conservation concern	• If possible, avoid any physical destruction of the Koppies north of the current Swartberg Decline Access Road. In general, minimise clearing and operations in habitats with a Very High to Medium-High sensitivity rating. • The following activities will be prohibited for staff and contractors or any other person that may be present within or have access to the BMM mining concession area: ▪ Purchase or transport of any wildlife/indigenous plant products from local communities or passing traders who cannot prove that they have valid permits for having such plants in their possession. ▪ Collection of any plants or plant- products for trade, consumption, medicinal use or cultivation, unless such person has the permission of the mine management as well as a valid permit from the responsible authorities. • Any unauthorised driving to areas not directly affected by the mine, but which may contain species of conservation concern and/or natural habitat within the BMM mining concession, will not be allowed. • Rehabilitate and revegetate all areas that have been disturbed as soon as practically possible according to the Rehabilitation Plan	Operations	Visual inspection and photographic record Training records Biodiversity Action Plan (BAP) Rehabilitation Plan	Environmental Manager, Environmental Officer	Throughout operations
Reduced ecological function and degradation due to altered soil surfaces due to operational activities	Minimise impacts to soils to avoid reduced ecological function	• If possible, avoid any physical destruction of the Koppies north of the current Swartberg Decline Access Road. Minimise clearing and operations in habitats with a Very High to Medium-High sensitivity rating. • Avoid any direct impacts on any surrounding or adjacent area with sensitive vegetation or any adjacent or nearby riparian habitats (except the clearing of alien invasive species). • Maintain existing access routes that are prone to erosion or seasonal inundation. • Dust levels from blasting and haulage must be controlled and minimised at all times. ▪ As far as practically possible, blasting should only be done under low- or no-wind conditions. ▪ Speed limits (40kph) must be adhered to in order to reduce dust fall out. ▪ Haul truck on haul road must adhere to 80km/h speed limit • All signs of accelerated erosion after a large rainfall event must be mitigated as soon as possible. • Rehabilitate and revegetate all areas that have been disturbed as soon as practically possible.	Operations	Visual inspection and photographic record Biodiversity Action Plan (BAP) Rehabilitation Plan Dust monitoring in affected areas	Environmental Manager, Environmental Officer	Throughout operations
Increase in alien invasive vegetation due to operational activities	Reduce the spread of alien and invasive species below the current rate of infestation. In addition, create awareness about the potential impacts of alien invasive species.	• Wheels of large machinery should be checked prior to entering the site and cleared of seed or any other plant material (especially of species with spiny or bur-like seeds). All such plant material removed must be burnt. • If filling material is to be used, this should be sourced from areas free of invasive species, and alien plant control measures are to be applied to all areas used for sourcing fill materials. • Destruction of regenerative material of cleared alien species by burning in a protected area is encouraged. • Be aware of alien species that may be newly introduced to the area and act immediately to eradicate once detected. • Rehabilitate and revegetate all areas that have been disturbed as soon as practically possible according to the Rehabilitation Plan.	Operations	Visual inspection and photographic record Training records Biodiversity Action Plan (BAP) Rehabilitation Plan	Environmental Manager, Environmental Officer	Throughout operations
Terrestrial Fauna						

Aspect, Potential Impact / Issue	Objective	Mitigation and Enhancement Commitments	Applicable Phase	Monitoring and Indicators	Responsible Party	Implementation Time Frame and Frequency
Loss of medium, high and very high sensitivity areas of faunal habitat	Minimise impact on faunal habitat due to operational activities	• The mine footprint areas should be clearly demarcated and all mining activities restricted to these areas. • Any exploration trenches, pits or boreholes that pose a danger to fauna should be filled-in or covered to prevent fauna from falling and becoming trapped. • No open fires may be lit for cooking or any other purposes, unless in specifically designated and secured areas. • There should be waste bins with lids distributed at strategic points across the site to ensure that litter is well-managed. No food waste or other waste that might attract fauna should be left exposed. • If the site must be lit at night for security purposes, this should be done with downward-directed low-UV type lights (such as most LEDs), which do not attract insects. • Parking and operational areas should be regularly inspected for oil spills and covered with an impermeable or absorbent layer. • Areas of high faunal significance in close proximity to, but outside the physical mining footprint need to be clearly demarcated with appropriate barriers and signage to ensure no further encroachment or disturbance. Any infringements will be reported and appropriate penalties are to be enforced on transgressing staff or contractors. • Pits should be backfilled as soon as possible, all stockpiles must be, as far as possible, obliterated and/or landscaped to merge into the surroundings. • Rehabilitate and revegetate all areas that have been disturbed as soon as practically possible and progressively during all phases of the mine. This will be according to a Rehabilitation Plan to be compiled by a suitably qualified specialist and complement a Biodiversity Action Plan (BAP).	Operations	Monitoring: Visual inspection and photographic record Training records Biodiversity Action Plan (BAP) Rehabilitation Plan	Environmental Manager, Environmental Officer	Throughout operations
Loss of fauna due to mining activities	Minimise impacts on fauna during operational activities	• Waste bins with lids should be distributed at strategic points across the site to ensure that litter is well-managed. No food waste should be left exposed. • All mine staff and contractors should receive an induction highlighting the need to respect the environment, no littering, no persecution of fauna, no illegal hunting, poaching or harvesting of natural products from the environment. • All vehicles on-site should adhere to a low speed limit (40km/h for heavy vehicles and 40km/h for light vehicles) to avoid collisions with susceptible species such as snakes and tortoises. • Haul truck on haul road must adhere to 80km/h speed limit • All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner. • All open water sources such as reservoirs, waste water, evaporation dams etc should be covered with shade cloth, fine mesh or similar to prevent fauna accessing these areas and from falling into the reservoirs and drowning. • Provide signage to indicate the right of way of fauna such as tortoises. Any roadkill should be recorded and all areas where repeated events occur should be inspected to see if additional mitigation can be applied.	Operations	Visual inspection and photographic record Training records Biodiversity Action Plan (BAP) Rehabilitation Plan	Environmental Manager, Environmental Officer	Throughout operations
Groundwater						
Impact of contaminants on the groundwater resource	Minimise degradation of the groundwater resource due to contaminants	• Toe seepage from the WRD's 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 that as much water as possible should be recycled and re-used. • The numerical groundwater flow and transport model should be updated/validated as additional information becomes available (ie SEEP/W model results, geophysics results and hydraulic conductivity of WRDs 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 (WUL) requirements.	Operations	Groundwater quality monitoring in the vicinity of contamination sources and in radially increasing distance from them. The monitoring data should be stored in an appropriate data management tool/database. Effluent quality meeting DWS requirements	Environmental Manager, Environmental Officer	Throughout operations
Impact of contaminants on groundwater users	Minimise the impact on groundwater users due to contamination of the groundwater resource	• Should monitoring data confirm an impact on private users, the client will compensate affected famers for their loss or replace the lost water supply source.	Operations	Groundwater quality should be monitored at the existing (known) private boreholes at regular intervals to confirm modelling results. Effluent quality meeting DWS requirements	Environmental Manager, Environmental Officer	Throughout operations
Impact of drawdown or	Minimise impacts to the groundwater	• The monitoring data should be stored in an appropriate data management tool/database.	Operations	Groundwater levels in the vicinity of the pits as well as in	Environmental Manager,	Throughout operations

Aspect, Potential Impact / Issue	Objective	Mitigation and Enhancement Commitments	Applicable Phase	Monitoring and Indicators	Responsible Party	Implementation Time Frame and Frequency
dewatering on the groundwater resource	resource due to drawdown or dewatering	• Groundwater models should 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.		each of the known farm boreholes (Witputs BH, Koeris 54BH1 and Koeris 54BH2), must be monitored on a regular basis.	Environmental Officer	
Impact of drawdown or dewatering on groundwater users	Minimise the impact on groundwater users due to drawdown or dewatering of the groundwater resource	• Should monitoring confirm that any of the private boreholes are affected by lowering of the groundwater table, rendering boreholes unusable (ie loss of water supply source), the client will compensate affected famers for their loss, or replace the lost water supply source. • This can be achieved 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.	Operations	Groundwater levels in each of the known farm boreholes must be monitored.	Environmental Manager, Environmental Officer	Throughout operations
Socio-economic						
Employment, skills enhancement and local business opportunities	To build local capacity in the Project-affected communities to enable local recruitment and contracting to be realised and successful.	• The Mine will establish a Recruitment Policy which prioritises the employment of South African and local residents (originating from the Local Municipality) over foreigners. All contractors will be required to recruit in terms of the Project's Recruitment Policy, where practical. • The Khâi-Ma Local Economic Development (LED) Forum should be consulted in the process of unlocking opportunities for local businesses. • The Project will advertise job opportunities and criteria for skills and experience needed through local media, at least three months ahead of recruitment. This information should also be provided to all relevant authorities, community representatives and organisations on the interested and affected party database. • The Recruitment Policy and Procedure should promote the employment of women as a means of ensuring that gender equality is attained. • No employment will take place at the entrance to the site. Only formal channels for employment will be used.	Operations	Recruitment Policy and Procurement Policy Grievance mechanism records	Environmental Manager, Community Relations Officer	Throughout operations
Presence of the workforce and jobseekers	Minimise impacts on the local population due to the presence of the work force and job seekers	• BMM will ensure that their security personnel work in close collaboration with the police to monitor any illegal activity. • All new employees directly or indirectly employed by the Project to go through the induction programme and a Code of Conduct. 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. • Grievance procedure to be in place that is easily accessible to the local community, through which complaints related to contractor or employee behaviour can be lodged and responded to. The Project will respond in a serious manner to any such complaints.	Operations	Stakeholder Engagement Records Training records Grievance mechanism records	Environmental Manager, Community Relations Officer	Prior to construction and to be implemented throughout construction, operations and decommissioning
Pressure on Social Infrastructure and Services	To ensure pressure is not exerted on the local social amenities which will reduce the availability and access of services to the local community.	• Implementation of the Grievance Mechanism	Construction, operations and decommissioning	Stakeholder Engagement Records Training records Grievance mechanism records	Environmental Manager, Community Relations Officer	Prior to construction and to be implemented throughout construction, operations and decommissioning
Impact on human health due to air emissions	To reduce the health impact on Expansion - affected communities to the lowest possible level.	• The Project will develop and implement a Grievance Mechanism to address stakeholder concerns related to the Project in a timely manner.	Operations	Grievance mechanism records	Environmental Manager, Community Relations Officer	Prior to construction and to be implemented throughout construction, operations and decommissioning
Risk to workers' health and safety due to hazardous operation activities	To reduce the risk associated with occupational health and safety.	• The Mine must comply with all applicable South African legislation in terms of health and safety, and worker rights, which will include access to workman's compensation for loss of income resulting from an onsite incident. • As part of the contractor and supplier selection process the Mine will take into consideration performance with regard to worker management, worker rights, health and safety as outlined in South African law and the Project's policies.	Operations	Training records Grievance mechanism records H&S Audits	Project Manager, Environmental Manager, Community Relations Officer	Prior to construction and to be implemented throughout construction, operations and decommissioning

Aspect, Potential Impact / Issue	Objective	Mitigation and Enhancement Commitments	Applicable Phase	Monitoring and Indicators	Responsible Party	Implementation Time Frame and Frequency
		• The Project will provide support to contractors and subcontractors to ensure that labour and working conditions are in line with South African law through capacity building. • Workers will be provided with primary health care and basic first aid at construction camps /worksites. • Facilities and operations will be developed, planned and maintained such that robust barriers are in place to prevent accidents. All employees have the duty to stop any works if adequate systems to control risks are not in place. • In line with the worker code of conduct employees should not be under the influence of intoxicants which could adversely affect the ability of that employee to perform the work or adversely affect the health and safety of other employees, other persons or the environment. • The Mine will provide Personal Protective Equipment (PPE), training and monitoring as well as ongoing safety checks and safety audits. • The Mine will develop and implement a Grievance Mechanism to address employee concerns in a timely manner.				
Increase in traffic volumes	Minimise the impact of traffic on the quality of local roads as well as other road users	• 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. • 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. • The Mine will develop and implement a Grievance Mechanism to address employee concerns related to the Project in a timely manner.	Operations, decommissioning	Traffic Management Plan Training records Vehicle maintenance records Grievance mechanism	Environmental Manager, Environmental Officer	Throughout operations and decommissioning
Unplanned Events						
Occupational Health and Safety	To reduce the risk associated with occupational health and safety.	• Development or upgrade of an Occupational Health and Safety Management Plan (OHSMP). Inductions, training, H&S records and remediating actions, risk assessments of all activities and provision of PPE. • The OHSMP should cover all workers on site, including temporary workers and contractors. • Carry out regular monitoring and audits of the OHSMP and update as required.	Construction, operations and decommissioning	Occupational Health and Safety Management Plan Training records H&S records	Environmental Manager, Community Relations Officer	Throughout construction, operations and decommissioning
Accidental spills of equipment fuel, oils, and chemicals	Reduce the risk of accidental spills of equipment fuels and oils.	• Adhere to best practice principles. • 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. • 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. • Hazardous material storage will be constructed on an impermeable surface and the bulk storage facility will be bunded. The Project will restrict storage and handling of hazardous materials and fuels to bunded areas of sufficient capacity to contain a release. • Refuelling of equipment and vehicles will be carried out in designated areas on hard standing ground to prevent seepage of any spillages into the ground. Collection systems will be installed in these areas to manage any spills, fuels will be collected and either reused, treated by incineration or removed by a local contractor. • Drip trays must be used when refuelling and servicing vehicles or equipment, where it is not on a hardstanding surface. • Implement the detailed hazardous material spill response plan, which includes community sensitisation/ notifications when required. The Project will maintain spill clean-up and response capability adequate for addressing spills for all phases of the Project. All spills will be immediately contained and cleaned up. Contaminated areas will be remediated and post remediation verification will be carried out.	Construction, operations and decommissioning	Spill Response Plan Training records Records of spill clean up and post remediation verification	Environmental Manager, Environmental Officer	Throughout construction, operations and decommissioning
Vehicle Accidents	Reduce the risk and potential impact of vehicle accidents on site and for all Project related activities. .	• All new drivers employed throughout the course of the Project's operations will be required to undergo training. • Speed limits will be enforced for all Project vehicles. • Speed limits of 40km/h for light vehicles and 80km/h for haul trucks on the haul road will be enforced along all internal roads.	Construction, operations and decommissioning	Training records Grievance mechanism	Project Manager, Environmental Manager	Throughout construction, operations and decommissioning

Aspect, Potential Impact / Issue	Objective	Mitigation and Enhancement Commitments	Applicable Phase	Monitoring and Indicators	Responsible Party	Implementation Time Frame and Frequency
		• The Project will work with the relevant local and regional government to ensure the roads used by Project vehicles are well maintained, and that potential problems or hazards are communicated to the relevant authority timeously.				

Table 8-9 Decommissioning Environmental Management Measures

Aspect, Potential Impact / Issue	Objective	Mitigation and Enhancement Commitments	Applicable Phase	Monitoring and Indicators	Responsible Party	Implementation Time Frame and Frequency
Air Quality						
Decreased local ambient air quality due to dust emissions	Control and/or avoidance of dust emissions during decommissioning.	• Take all reasonable measures to minimise the generation of dust as a result of project development activities to the satisfaction of the EO. • As far as practically possible, blasting should only be done under low- or no-wind conditions. • Vehicle speeds must not exceed 40 km/h along dust roads or 20 km/h when traversing unconsolidated and non-vegetated areas; • Vehicles must be kept clean to avoid tracking dirt around and off the site. • Vehicles transporting friable materials must be covered. • Where feasible, surface binding agents must be used on exposed open earthworks and roads. • Vegetation clearance must be phased to minimise the area of exposed soil. • Topsoil stockpiles must planted to bind the soil and minimise dust. • The design of stockpiles should be optimised to retain a low profile with no sharp changes in shape. • Drop heights of material must be minimised were possible. • Where possible, wind breaks should be erected around high- dust generating activities. • For significant areas of excavation or exposed ground, dust suppression measures must be used to minimise the spread of dust.	Decommissioning	Visual inspection and photographic record South African Emission Standards	Environmental Manager, Environmental Officer	Throughout decommissioning
Noise						
Increased Local Ambient Noise Levels due to Noise Propagation from Decommissioning Activities	Reduce noise levels to acceptable levels.	• Business Partners must keep noise level within acceptable limits, Restrict the use of sound amplification equipment for communication and emergency only. • All diesel-powered construction and earth moving equipment must be well maintained. This must include the regular inspection and, if necessary, replacement of intake and exhaust silencers. Any change in the noise emission characteristics of equipment must serve as trigger for withdrawing it for maintenance. • Vendors must be required to guarantee optimised equipment design noise levels. • A mechanism to monitor noise levels, record and respond to complaints and mitigate impacts should be developed and implemented. • Use of quieter powered mechanical equipment (PME) should be considered, where possible. • Use of noise barriers/enclosures should be considered, where possible. • Vibrating equipment such as crushers must be installed on vibration isolation mountings. • Individual vehicle engine, transmission and body noise/vibration should be minimised through the implementation of an equipment maintenance program. • Maintain road surfaces regularly to avoid corrugations, potholes etc. • Avoid unnecessary idling times. • Minimise the need for trucks/equipment reversing. This will reduce the frequency at which reverse warnings occur. Any complaints received by Business Partners regarding noise must be recorded and communicated. Where possible or applicable, provide transport to and from the site on a daily basis for construction workers.	Decommissioning	Noise monitoring at/ near identified sensitive receptors Complaints register	Environmental Manager, Environmental Officer	Throughout decommissioning
Terrestrial Flora						
Increase in alien invasive vegetation due to decommissioning activities	Minimise the spread of alien and invasive species post decommissioning and closure	• Wheels of large machinery should be checked prior to entering the site and cleared of seed or any other plant material (especially of species with spiny or bur-like seeds). All such plant material removed must be burnt. • If filling material is to be used, this should be sourced from areas free of invasive species, and alien plant control measures are to be applied to all areas used for sourcing fill materials.	Decommissioning, post closure	Visual inspection and photographic record Training records Rehabilitation Plan	Environmental Manager, Environmental Officer	Throughout decommissioning

Aspect, Potential Impact / Issue	Objective	Mitigation and Enhancement Commitments	Applicable Phase	Monitoring and Indicators	Responsible Party	Implementation Time Frame and Frequency
		Rehabilitate: • Rehabilitate and revegetate all areas that have been disturbed. This will be according to a Rehabilitation Plan to be compiled by a suitably qualified specialist and complement a Biodiversity Action Plan (BAP). It will include the following: ▪ As part of rehabilitation, all compacted soils need to be ripped to a depth of at least 30 cm to prevent soil-surface crusting. ▪ Re-vegetation measures of disturbed/modified areas using indigenous shrubs and grasses only. The selection of species used for rehabilitation may not include any species that are not suitable to the receiving environment (i.e. must occur there naturally), and also no species that are indicative of habitat degradation. • After decommissioning, if access roads or portions thereof will not be of further use to the landowner(s), remove all foreign material and rip area to a depth of at least 30 cm to facilitate the establishment of vegetation, followed by a suitable revegetation program.				
Groundwater						
Impact on groundwater quality of the groundwater resource	Minimise degradation of the groundwater resource due to contaminants	• Operational mitigation measures have to be maintained post closure. • Final profiling of the 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.	Decommissioning, post closure	It is expected that the DWS Water Use Licence requirements will indicate that the mining site and regionally identified boreholes that are off-site of the project area should be monitored (groundwater levels and water quality) for at least 10 years after mine closure. Indicators: Effluent quality meeting DWS requirements	Environmental Manager; Environmental Officer	Throughout decommissioning and post closure
Impact of contaminants on groundwater users	Minimise the impact on groundwater users due to contamination of the groundwater resource	• Should monitoring data confirm impact on private users, the client will compensate affected famers for their loss, or replace the lost water supply source. • The numerical groundwater flow and transport model which must have been updated at regular intervals becomes available to ensure assumptions made during the development of the model remain valid and that model predictions remain current.	Decommissioning, post closure	It is expected that the DWS Water Use Licence requirements will indicate that the mining site and regionally identified boreholes that are off-site of the project area should be monitored (groundwater levels and water quality) for at least 10 years after mine closure. Indicators: Effluent quality meeting DWS requirements	Environmental Manager, Environmental Officer	Throughout decommissioning and post closure
Impact of drawdown or dewatering on the groundwater resource	Minimise impacts to the groundwater resource due to drawdown or dewatering	• 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.	Decommissioning, post closure	It is expected that the DWS Water Use Licence requirements will indicate that the mining site and regionally identified boreholes that are off-site of the project area should be monitored (groundwater levels and water quality) for at least 10 years after mine closure.	Environmental Manager, Environmental Officer	Throughout decommissioning and post closure
Impact of drawdown or dewatering on groundwater users	Minimise the impact on groundwater users due to drawdown or dewatering of the groundwater resource	• 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. • 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.	Decommissioning, post closure	It is expected that the DWS Water Use Licence requirements will indicate that the mining site and regionally identified boreholes that are off-site should be monitored for at least 10 years after mine closure.	Environmental Manager, Environmental Officer	Throughout decommissioning and post closure
Socio-economic						
Loss of Employment and Contract Opportunities	To minimise the negative impact of the loss of jobs and termination of contracts due to the decommissioning	• The company should develop a Decommissioning Plan for the ultimate closure of the mine to ensure that all social aspects are considered, including human resource management, retrenchment packages, retraining and transferable skills.	Decommissioning	Decommissioning Plan Grievance mechanism records	Project Manager, Community Relations Officer	Prior to decommissioning

Aspect, Potential Impact / Issue	Objective	Mitigation and Enhancement Commitments	Applicable Phase	Monitoring and Indicators	Responsible Party	Implementation Time Frame and Frequency
	and closure of the mine.					
Presence of the workforce and jobseekers	Minimise impacts on the local population due to the presence of the work force and job seekers	• BMM will ensure that their security personnel work in close collaboration with the police to monitor any illegal activity. • All new employees directly or indirectly employed by the Project to go through the induction programme and a Code of Conduct. 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. • Grievance procedure to be in place that is easily accessible to the local community, through which complaints related to contractor or employee behaviour can be lodged and responded to. The Project will respond in a serious manner to any such complaints.	Decommissioning	Stakeholder Engagement Records Training records Grievance mechanism records	Environmental Manager, Community Relations Officer	Prior to construction and to be implemented throughout construction, operations and decommissioning
Pressure on Social Infrastructure and Services	To ensure pressure is not exerted on the local social amenities which will reduce the availability and access of services to the local community.	• Implementation of the Grievance Mechanism.	Construction, operations and decommissioning	Stakeholder Engagement Records Training records Grievance mechanism records	Project Manager, Environmental Manager, Community Relations Officer	Throughout Project life
Impact on human health due to air emissions and dust generation	To reduce the health impact on Project-affected communities to the lowest possible level.	• The Mine will develop and implement a Grievance Mechanism to address stakeholder concerns related to the Project in a timely manner.	Construction, operations and decommissioning	Grievance mechanism records	Environmental Manager, Community Relations Officer	Throughout Project life
Risk to workers' health and safety due to hazardous Decommissioning activities	To reduce the risk associated with occupational health and safety.	• The Mine will implement a rigorous induction programme for all employees outlining health and safety risks. • The Project will comply with all applicable South African legislation in terms of health and safety, and worker rights, which will include access to workman's compensation for loss of income resulting from an onsite incident. • As part of the contractor and supplier selection process the Project will take into consideration performance with regard to worker management, worker rights, health and safety as outlined in South African law, international standards and the Project's policies. • The Project will provide support to contractors and subcontractors to ensure that labour and working conditions are in line with South African law through capacity building. • Workers will be provided with primary health care and basic first aid at construction camps /worksites. • Facilities and operations will be developed, planned and maintained such that robust barriers are in place to prevent accidents. All employees have the duty to stop any works if adequate systems to control risks are not in place. • In line with the worker code of conduct, employees should not be under the influence of intoxicants which could adversely affect the ability of that employee to perform the work or adversely affect the health and safety of other employees, other persons or the environment. • The Project will provide of Personal Protective Equipment (PPE), training and monitoring as well as ongoing safety checks and safety audits. • The Project will develop and implement a Grievance Mechanism to address employee concerns related to the Project in a timely manner.	Decommissioning	Training records Grievance mechanism records H&S Audits	Project Manager, Environmental Manager, Community Relations Officer	Throughout Project life
Unplanned Events						
Occupational Health and Safety	To reduce the risk associated with occupational health and safety.	• Development or upgrade of an Occupational Health and Safety Management Plan (OHSMP). Inductions, training, H&S records and remediating actions, risk assessments of all activities and provision of PPE.	Construction, operations and decommissioning	Occupational Health and Safety Management Plan Training records	Environmental Manager, Community Relations Officer	Throughout construction, operations and decommissioning

Aspect, Potential Impact / Issue	Objective	Mitigation and Enhancement Commitments	Applicable Phase	Monitoring and Indicators	Responsible Party	Implementation Time Frame and Frequency
		• The OHSMP should cover all workers on site, including temporary workers and contractors. • Carry out regular monitoring and audits of the OHSMP and update as required.		H&S Audits		
Accidental spills of equipment fuel, oils, and chemicals	Reduce the risk of accidental spills of equipment fuels and oils.	• Adhere to industry best practice principles. • 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. • 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. • Hazardous material storage will be constructed on an impermeable surface and the bulk storage facility will be bunded. The Project will restrict storage and handling of hazardous materials and fuels to bunded areas of sufficient capacity to contain a release. • Refuelling of equipment and vehicles will be carried out in designated areas on hard standing ground to prevent seepage of any spillages into the ground. Collection systems will be installed in these areas to manage any spills, fuels will be collected and either reused, treated by incineration or removed by a local contractor. Drip trays must be used when refuelling and servicing vehicles or equipment, where it is not on a hardstanding surface. • Implement the detailed hazardous material spill response plan, which includes community sensitisation/ notifications when required. The Project will maintain spill clean-up and response capability adequate for addressing spills for all phases of the Project. All spills will be immediately contained and cleaned up. Contaminated areas will be remediated and post remediation verification will be carried out.	Construction, operations and decommissioning	Spill Response Plan Training records Records of spill clean-up and post remediation verification	Environmental Manager, Environmental Officer	Throughout construction, operations and decommissioning
Vehicle Accidents	Reduce the risk and potential impact of vehicle accidents on site and for all Project related activities. .	• All new drivers employed throughout the course of the Project's operations will be required to undergo appropriate levels of training. • Speed limits will be enforced for all Project vehicles. • Speed limits of 40km/h for light vehicles and 80km/h for haul trucks on the haul road will be enforced along all internal roads. • The Mine will work with the relevant local and regional government to ensure the roads used by Project vehicles are well maintained, and that potential problems or hazards are communicated to the relevant authority timeously.	Construction, operations and decommissioning	Training records Grievance mechanism	Project Manager, Environmental Manager	Throughout construction, operations and decommissioning

8.6 Implementation of the EMPr

8.6.1 Proponent Roles and Responsibilities

BMM is committed to provide resources essential to the implementation and control of the EMPr. Resources include the appropriate human resources with the necessary skills. BMM has and will have dedicated personnel judged to be competent on the basis of appropriate education, training, and experience to manage and oversee the environmental and social aspects of project operations.

Specific roles and responsibilities of the Proponents key positions are provided in *Table 8-10*.

Table 8-10 BMM Role and Responsibilities

Position	Responsibility
Project Manager	• Oversee the project team and coordinate all activities pertaining to the Project.
Environmental Manager	• Ensure that the Project and all its Business partners operate in accordance with applicable regulatory requirements and the Project EMPr; • Liaise with regulators on the Project's behalf; and • Oversee programs associated with environmental management.
Site Manager	• Manage, and ensure the efficient functioning of all site activities by the Project staff and by engineering, procurement, and Business partners and Business partners; • Support the HSE Manager with matters related to HSE compliance and enforcement including implementation of EMPr.
Community Relations Manager	• Liaise with the communities on the Project's behalf, including in relation to works being carried out by Business partners and Business partners; • Oversee programs associated with local employment and social and community development initiatives; • Maintain the Project's grievance procedure.
Environmental Officer [1]	• BMM will utilise the current permanent environmental officers for construction and operational phase; • The officers will advise BMM to manage on third party specialist's appointment to undertake monitoring as stipulated in the EMPr. The officers will be responsible to oversee the specialist during their period on site; • The officers will also manage third party services to undertake audits as per the EMPr; • The officers must: • Be fully knowledgeable with the contents and the conditions of the Environmental Authorisation (s) including all subsequent amendments; • Be fully knowledgeable with the contents of the EMPr(s). • Be fully knowledgeable of all the Project licences and permits issued to the site and ensure communication to the relevant personnel on the conditions contained therein; • Be fully knowledgeable with the contents of all relevant environmental legislation, and ensure compliance with them; • Ensure that the contents of this document are communicated to the Business partner site staff and that the Site Manager and Business partner are constantly made aware of the contents through regular discussion; • Ensure that the compliance of the EMPr (s), EA(s) and legislation is monitored through regular and comprehensive inspection of the site and surrounding areas;

[1] BMM has indicated that the role typically referred to as ECO is currently fulfilled by the title of Environmental officer at the project site

Position	Responsibility
	• Ensure that the Site Manager has input into the review and acceptance of construction methods and method statements; • Ensure that activities on site comply with all relevant environmental legislation; • Keep record of all environmental activities on site, problems identified, transgressions noted and a task schedule of tasks undertaken; • Ensure that the compilation of progress reports for submission to the Project Company, with input from the Site Manager, takes place on a regular basis, Weekly, Monthly Reports including the Final Post-Construction Audit Report. • Monitor and report on the compliance and performance of the Project with respect to the execution of the EMPr; • Carry out regular on-site inspection; • Monitor and enforce compliance and performance of Business partners and any Business partners;

As a general mitigation strategy, the Environmental officers should be present at the onset, for the site preparation to ensure the correct demarcation of no-go areas, and facilitate environmental induction with construction staff and supervise any flora relocation and faunal rescue activities that may need to take place during the site clearing (i.e. during site establishment).

Thereafter monthly site compliance inspections would probably be sufficient, provided that compliance with the requirements of the EA, EMPr and environmental legislation is maintained. Any Ad-hoc environmental issues which may arse after that will also be dealt with by the site Environmental Officer and Business partners.

In addition, the appointed Business partner will be required to establish and maintain a similar HSE organization.

Business partners are responsible for the overall execution of the activities envisioned in the construction phase including the implementation and compliance with recommendations and conditions of the EMPr and all project permits as stipulated by BMM. It is important that the Business partner is fully aware of the responsibilities in terms of the relevant environmental legislation and the contents of this EMPr. The Business partner is responsible for informing employees and sub-Business partners of their environmental obligations in terms of the environmental specifications, and for ensuring that employees are adequately experienced and properly trained in order to execute the works in a manner that will minimise environmental impacts.

Table 8-11 Business partner Roles and Responsibilities

Position	Responsibility
Business Partner Project Manager	• Oversee and coordinate all activities; ultimately responsible for HSE compliance of the Business partner; • Be fully knowledgeable with the contents of the EIA Reports and risk management; • Be fully knowledgeable with the contents and conditions of the Environmental Authorisations and related amendments; • Be fully knowledgeable with the contents of the EMPr; • Be fully knowledgeable with the contents of all relevant environmental legislation, and ensure compliance with these; • Have overall responsibility of the EMPr and its implementation; • Ensure that audits are conducted to ensure compliance to the EMPr; • Ensure there is communication with the Project Manager, the ECO, the EO/ Environmental Representative, and relevant discipline engineers on matters concerning environmental compliance; • Be fully knowledgeable with the contents of all Project licences and permits; • Ensure that no actions are taken which will harm or may indirectly cause harm to the environment, and take steps to prevent pollution on the site.
Business Partner Site Manager	• Ensure that all work by the Business partner and by all Business partners is done in compliance with applicable regulatory environmental requirements and the Project HSE plans. Responsible for coordination with project Community Relations Manager for all community relations issues including upcoming works. • The Site Manager has the same responsibilities as the Project Manager and is more responsible for the day to day of the EMPr.
Business partner HSE Manager	• Ensure that the Business partner organization operates in accordance with applicable regulatory environmental requirements and the Project HSE plans.
Business partner Environmental Officer (if appointed)	• The Business partner's EO/ Environmental Representative, employed by the Business partner on a fulltime basis. The EO will be responsible for full day-to-day implementation of this EMPr and should be appointed prior to any commencement of the activities. The Business partner's EO/ Environmental Representative should: • Understand the relevant environmental legislation and processes and the implementation thereof; • Understand the hierarchy of Environmental Compliance Reporting, and the implications of Non-Compliance; • Keep accurate and detailed records of all EMPr-related activities on site. The EO shall keep a daily diary for monitoring the site-specific activities as per project schedule; • The EO is responsible for managing the day-to-day on-site implementation of this EMPr and other Project Permits/ Authorisations; • Train and induct all Business partners employees prior to commencement of any works; • Compilation of Weekly and Monthly Monitoring Reports to be submitted to BMM, and Site Manager; • In addition, the EO/ Environmental Representative must act as project liaison and advisor on all environmental and related issues and ensure that any complaints received from the public are duly recorded and forwarded to the Site Manager, and Business partner.

It is important to note that it is the responsibility of the Business partner (and delegated sub-Business partners) to enforce the day-to-day implementation of the enhancement and mitigation measures for

the construction phase specified in this EMPr. The Business partner must be contractually required to perform all work in compliance with relevant national HSE legislation and regulations, and the EMPr.

8.6.2 Training and Environmental Awareness on Site

BMM will identify, plan, monitor, and record training needs for personnel whose work may have a significant adverse impact upon the environment or social conditions. BMM recognises that it is important that employees at each relevant function and level are aware of the Project's environmental and social management measures; potential impacts of their activities; and roles and responsibilities in achieving conformance with the commitments and procedures. Training and awareness-raising therefore forms a key element of the EMPr.

Key staff will, therefore, be appropriately trained in key areas of environmental and social management and operational control with core skills and competencies being validated on an on-going basis. The identification of training and awareness requirements and expediting of the identified training/awareness events will be the responsibility of the Safety Manager, Environmental Manager and EO.

This will be achieved through a formal training process. Employee training will include awareness and competency with respect to:

- Environmental and social impacts that could potentially arise from their activities;
- Key sensitive no-go areas as identified in the EMPs;
- Legal requirements in relation to environmental and social performance;
- Necessity of conforming to the requirements of the EIA and EMPr, in order to avoid or reduce those impacts;
- Activity-specific training on waste management practices, documentation systems and community interactions; and
- Roles and responsibilities to achieve that conformity, including those in respect of change management and emergency response.

The Safety Manager and the Environmental manager for BMM have a responsibility to ensure that their personnel are adequately trained. The BMM training Manager is be responsible for coordinating the training, maintaining employee training records, and ensuring that these are monitored and reviewed on a regular basis. The Safety Manager and the Environmental manager for BMM will also periodically verify through discussion and observations that staff are performing competently.

The BMM Training Manager is responsible for coordinating training, maintaining employee-training records, and ensuring that these are monitored and reviewed on a regular basis. The BMM Training Manager will also periodically verify that staff is performing competently through discussion and observation.

The EO is responsible for site environmental awareness training for personnel working on the job sites. The Business partners are also responsible for identification of any additional training requirements to maintain required competency levels.

8.6.3 Record Keeping

BMM will control HSE documentation, including management plans; associated procedures; and checklists, forms and reports, through a formal procedure. All records will be kept on site and kept in both hard copy and soft copy formats. The Environmental Manager and Safety Manager is responsible for maintaining a master list of applicable HSE documents.

8.6.4 Grievance Mechanism

The management of grievances is a vital component of stakeholder management and an important aspect of risk management for the project, since grievances can be an indication of growing stakeholder concerns (real and perceived). Grievances may be verbal or written and are usually either specific claims for damages/injury or complaints or suggestions about construction or operational activities.

When a grievance has been brought to the attention of BMM it will be logged and evaluated. The person or group with the grievance is required to present grounds for making a complaint or claiming loss so that a proper and informed evaluation can be made. Where a complaint or claim is considered to be valid then steps are require to be undertaken to rectify the issue. Where there remains disagreement on the outcome then an arbitration procedure may be required to be overseen by a third party (e.g. government official). Stakeholders will be informed of the grievance procedure.

An existing six-step grievance procedure will be used for the project. These are as follows:

- Step 1: Receive and Log Grievance;
- Step 2: Acknowledge Grievance;
- Step 3: Assess and Prioritise Grievance and Forward to Relevant Department;
- Step 4: Investigate and Resolve Grievance;
- Step 5: Sign-off on Grievance; and
- Step 6: Monitor.

8.6.5 Monitoring Programme

Monitoring will be conducted to ensure compliance with regulatory requirements as well as to evaluate the effectiveness of operational controls and other measures intended to mitigate potential impacts. Monitoring parameters are included in the EMPr.

8.6.6 Auditing

Beyond the routine inspection and monitoring activities conducted, audits will be carried out internally by BMM to ensure compliance with regulatory requirements. The audit shall be performed by qualified staff and the results shall be reported to the Site management to be addressed.

The audit will include a review of compliance with the requirements of the EMPr and include, at a minimum, the following:

- Completeness of HSE documentation, including planning documents and inspection records;
- Conformance with monitoring requirements;
- Efficacy of activities to address any non-conformance with monitoring requirements; and
- Training activities and record keeping.

8.6.7 Corrective Action

Potential impacts and associated risks should be identified. Investigating a ‘near miss’ or actual incident after it occurs can be used to obtain valuable lessons and information that can be used to prevent similar or more serious occurrences in the future.

BMM will implement a formal non-compliance and corrective action tracking procedure for investigating the causes of, and identifying corrective actions to, accidents or environmental or social non-compliances. This ensures coordinated action between the Site and its Business partners. The BMM Environmental manager is responsible for keeping records of corrective actions and for overseeing the

modification of environmental or social protection procedures and/or training programs to avoid repetition of non-conformances and non-compliances.

8.6.8 Reporting

BMM will provide appropriate documentation of EHS related activities, including internal inspection records, training records, and reports to the DMR as required.

9. CONCLUSION

9.1 Introduction

The aim of the Environmental Impact Assessment (EIA) for the proposed Project is to provide information to inform decision-making that will contribute to sound decision making and environmental and social sustainable development. This report is to be submitted to the DMR to provide an independent assessment of the proposed Project, thus enabling the DMR to make an accountable and informed decision regarding the environmental authorisation for the proposed development in terms of NEMA.

In considering a development of this type, it is inevitable that there will be a degree of environmental impact. However, details provided in this Report indicate how these have been mitigated where possible, and should be viewed along with Black Mountain Mining's plan to continue and develop mineral resources contributing to economic stability in the Northern Cape.

Through the EIA process, which included stakeholder and specialist input, ERM has identified and assessed a number of potential impacts relating to the development. A brief overview of the EIA findings and key mitigation measures are presented in this chapter.

The preferred layout of the waste rock dump has been designed based on the sensitivity constraints of the site, as established during the EIA process, including ecological sensitivities, as identified during the initial screening process.

9.2 Summary of Impacts Identified and Assessed

A summary of the bio-physical and socio-economic impacts, including their pre-mitigation and residual impacts post-mitigation, is given in *Table 9-1.*

Table 9-1 Summary of the significance of identified impacts in the construction phase of the proposed Project

Impact	Phase	Significance Pre Mitigation	Residual Impact Significance
Air Quality: Decreased Local Ambient Air Quality due to Dust Emissions	Construction, Operations, Decommissioning	Moderate (receptors within 200m of the Project site)	Minor (receptors within 200m of the Project site)
Ambient Noise and Vibration: Increase in the Ambient Noise Levels	Construction, Operations, Decommissioning	Minor	Minor
Soils and Geology: Loss of Soil Resources as a result of Site Clearance and Construction Activities	Construction	Moderate	Minor
Terrestrial Flora: Loss of Medium and High Sensitivity Habitats and Associated Species	Construction, Operations	Major	Moderate
Terrestrial Flora: Loss of Medium and Low Sensitivity Habitats and Associated Species	Construction, Operations	Moderate	Minor
Terrestrial Flora: Loss of Plant Species of Conservation Concern	Construction, Operations	Major	Minor
Terrestrial Flora: Reduced Ecological Function and Degradation due to Altered Soil Surfaces	Construction, Operations	Major	Major
Terrestrial Flora: Increase in Alien Invasive Vegetation	Construction, Operations	Moderate	Minor
Terrestrial Fauna: Faunal Habitat Loss of Medium, High Sensitivity areas	Construction, Operations	Moderate	Moderate
Terrestrial Fauna: Loss of Individuals of Fauna due to mining activities.	Construction, Operations	Moderate	Minor
Groundwater: Impact of Contaminants on the Groundwater Resource	Operations	Moderate	Minor
Groundwater: Impact of Contaminants on the Groundwater Resource	Decommissioning	Moderate	Moderate
Groundwater: Impact of Contaminants on Groundwater Users	Operations, Decommissioning	Negligible	Negligible
Groundwater: : Impact of Drawdown or Dewatering on the Groundwater Resource	Operations, Decommissioning	Moderate	Moderate
Groundwater: : Impact of Drawdown or Dewatering on Groundwater Users	Operations, Decommissioning	Negligible	Negligible
Employment, Skills Enhancement and Local Business Opportunities	Construction, Operations, Decommissioning	Positive	Positive
Loss of Employment, Skills Enhancement and Local Business Opportunities	Decommissioning	Major	Moderate
Community Health and Safety: Impacts Associated with the Presence of the Workforce and Jobseekers	Construction, Operations, Decommissioning	Moderate	Minor
Community Health and Safety: Pressure on Social Infrastructure and Services	Construction, Operations, Decommissioning	Minor	Negligible
Community Health and Safety: Impact on Human Health due to Air Emissions	Construction, Decommissioning	Minor	Negligible
Community Health and Safety: Impact on Human Health due to Air Emissions	Operations	Minor	Minor

Impact	Phase	Significance Pre Mitigation	Residual Impact Significance
Worker Health and Safety and Rights: Risk to Workers' Health and Safety due to Hazardous Activities	Construction, Operations, Decommissioning	Moderate	Minor
Traffic: Increase in Traffic Volumes	Construction, Operations	Moderate	Minor
Archaeology and Cultural Heritage	Construction, Operations, Decommissioning	Minor	Minor
Unplanned Events: Occupational Health and Safety Hazards	Construction, Operations, Decommissioning	Major	Moderate
Unplanned Events: Accidental Spills of Equipment Fuel, Oils, and Chemicals on Soils	Construction, Operations, Decommissioning	Moderate	Minor
Unplanned Events: Accidental Spills of Equipment Fuel, Oils, and Chemicals on Groundwater	Construction, Operations, Decommissioning	Minor	Negligible
Unplanned Events: Vehicle Accidents	Construction, Operations, Decommissioning	Moderate	Minor

9.2.1 Significance Impact Summary

It is considered that the majority of the potential impacts which have been identified in this assessment, associated with the proposed development, can be mitigated to a level which is deemed appropriate for the construction phase to proceed; assuming that the mitigation measures identified in the EMPr are adequately implemented.

The significance of impact on terrestrial flora has been assessed to be Major both pre- and post-mitigation, as the Project will result in loss of highly sensitive habitats and species. An extensive list of mitigation measures has been proposed to minimise the loss, however the location of the proposed mine expansion suggests there will a degree of habitat loss. Another major impact relates to Occupational Health and Safety should an unplanned event occur, however this can be mitigated to Moderate with strict operational controls.

9.2.2 Recommendations

It is considered that an appropriate level of effort has been made by the Project proponent to accommodate the mitigation measures recommended during this EIA process, to the extent that is practically possible. The implementation of the mitigation measures detailed in Chapter 8 and listed in the EMPr, including monitoring, will provide a basis for ensuring that the potential positive and negative impacts associated with the establishment of the Project are respectively enhanced and mitigated to a level which is deemed adequate for the Project to proceed.

In summary, based on the findings of this assessment, ERM is of the opinion that the Swartberg Mine Expansion should be authorised, contingent on the recommended mitigation and monitoring measures being implemented, for potential environmental and socio-economic impacts, as outlined in the EIA Report and EMPr.

10. REFERENCES

AMC Consultants. 2017. Draft Report, Swartberg Underground Project Pre-feasibility Study. AMC Project 117020.

Anthing, L. 1863. Letter to the Cape Parliament. Cape Blue Book.

Assouline, S. 2004. Rainfall-Induced Soil Surface Sealing Contribution of the Agricultural Research Organization, Institute of Soil, Water and Environmental Sciences, Bet Dagan, Israel, No. 617/03. Vadose Zone Journal. 3:570-591.

Beaumont, P. B. Smith, A.B., and Vogel, J.C. 1995. Before the Einiqua: the archaeology of the frontier zone. In A. B. Smith. Einiqualand: studies of the Orange River frontier, Cape Town: UCT Press.

Beaumont, P.B. and Morris, D. 1990. Guide to archaeological sites in the Northern Cape. Kimberley: McGregor Museum.

Bisigato, A.J., Villagra, P.E., Ares, J.O. and Rossi, B.E. 2009. Vegetation heterogeneity in Monte Desert ecosystems: A multi-scale approach linking pattern and process. Journal of Arid Environments. 73:182-191.

Bromilow, C. 2010. Problem plants and alien weeds of South Africa. Briza Publications, Pretoria, RSA.

Burghardt, W. 2006. Soil sealing and soil properties related to sealing. Geological Society, London, Special Publications. 266:117-124.

Burnett, M.R., August, P.V., Brown, J.H. and Killingbeck, K.T. 1998. The influence of geomorphological heterogeneity on biodiversity. A patch-scale perspective. Conservation Biology. 12: 363-370.

Carrick, P.J. and Krüger, R. 2007. Restoring degraded landscapes in lowland Namaqualand: Lessons from the mining experience and from regional ecological dynamics. Journal of Arid Environments. 20:767-781.

Chapin, F.S., Zavaleta, E.S., Eviner, V.T., Naylor, R.L., Vitousek, P.M., Reynolds, H.L., Hooper, D.U., Lavorel, S., Sala, O.E., Hobbie, S.E., Mack, M.C. and Díaz, S. 2000. Consequences of changing biodiversity. Nature. 405:234-242.

Chong, G.W. and Stohlgren, T.J. 2007. Species-area curves indicate the importance of habitats' contributions to regional biodiversity. Ecological Indicators. 7:387-395.

De Ridder, N.A. and Kruseman, G.P 1990. Analysis and Evaluation of Pumping Test Data.
Deacon, J. nd. Archaeological Impact Assessment - specialist input to planning and design. Unpublished notes compiled for the National Monuments Council.

Dekker, S.C., Rietkerk, M. and Bierkens, M.F.P. 2007. Coupling microscale vegetation soil-water and macroscale vegetation-precipitation feedbacks in semiarid ecosystems. Global Change Biology. 13:671-678.

Department of Environmental Affairs. 2011. National Environmental Management: Biodiversity Act, 2004: National list of ecosystems that are threatened and in need of protection, Government Gazette Number 34809, Notice 1002, 9 December 2011, Pretoria: DEA.

Department of Environmental Affairs and Tourism, 2007. NEMBA 2004 (Act No. 10 of 2004): Critically Endangered, Endangered, Vulnerable and Protected Species, Regulation No. 151, Government Gazette No. 29657, 23 February 2007, Pretoria: DEAT.

Department of Water Affairs and Forestry. 1993. South African Water Quality Guidelines (first edition). Volume 1: Domestic Use.

Department of Water Affairs and Forestry. 1996. South African Water Quality Guidelines (second edition). Volume 1: Domestic Use.

Department of Water Affairs and Forestry. 1998. Quality of Domestic Water Supply, Volume 1: Assessment Guide. WRC Report Nr. TT101/98.

Desmet, P. 2010. Gamsberg Zinc Project. Vegetation Baseline Report. Report for SRK Consulting on behalf of Anglo Operations Limited, Cape Town.

Desmet, P.G., Yates, M. and Botha, M. 2005. Bushmanland Conservation Initiative Spatial Data Report. Botanical Society of South Africa, Kirstenbosch, South Africa.

Díaz, S., Tilman, D. and Fargione, J. 2005. Biodiversity regulation of ecosystem services. In: Ecosystems and human well-being: Current state and trends. Millennium Ecosystem Assessment Series Vol 1, Island Press, Washington, Covelo, London. 297-329.

Dirnböck, T., Hobbs, R.J., Lambeck, R.J. and Caccetta, P.A. 2002. Vegetation distribution in relation to topographically driven processes in southwestern Australia. Applied Vegetation Science. 5:147-158.

Dunn, E.J. 1931. The Bushmen. London: Charles Griffin and Co.

Ehrlén, J. and Van Groenendael, J.M. 1998. The trade-off between and longevity - an important aspect of plant species diversity. Applied Vegetation Science. 1:29-36.

Endemic Vision Environmental Services, 2017. Basic Assessment Report and Environmental Management Plan. Swartberg Decline. DMR Ref: NC-00066-MR/102.

Environmental Resources Management, 2013. Environmental and Social Impact Assessment Report for the Gamsberg Zinc Mine and Associated Infrastructure in the Northern Cape.

Environmental Resources Management, 2017. Review of the Black Mountain Mine Biodiversity Management and Monitoring. Final Front Report.

Eriksson, B. K., Rubach, A. and Hillebrand, H. 2006. Biotic habitat complexity controls species diversity and nutrient effects on net biomass production. Ecology. 87:246–254.

Fitzsimmons, J.A. and Michael, D.R. 2016. Rocky outcrops: A hard road in the conservation of critical habitats. Biological Conservation. 211:36-44

Foden, W., Midgley, G.F., Hughes, G., Bond, W.J., Thuiller, W., Hoffman, M.T., Kaleme, P., Underhill, L.G., Rebelo, A. and Hannah, L. 2007. A changing climate is eroding the geographical range of the Namib Desert tree Aloe through population declines and dispersal lags. Diversity and Distributions 13:645-653.

Germishuizen, G. and Meyer, N.L. 2003. Plants of southern Africa: an annotated checklist. Strelitzia 14. South African National Biodiversity Institute, Pretoria.

Henderson, L. 2001. Alien weeds and invasive plants: A complete guide to declared weeds and invaders in South Africa. Agricultural Research Council, Paarl Printer, Cape Town.

Hill, D. and R. Arnold. 2012. Building the evidence base for ecological impact assessment and mitigation, Journal of Applied Ecology. 49(1): 6-9.

Hooper, D.U., Chapin, F.S., Ewel, J.J., Hector, A., Inchausti, P., Lavorel, S., Lawton, J.H., Lodge, D.M., Loreau, M., Naeem, S., Schmid, B., Setälä, H., Symstad, A.J., Vandermeer, J. and Wardle, D.A. 2005. Effects of biodiversity on ecosystem functioning: A consensus of current knowledge. Ecological Monographs. 75(1): 3-35.

Hough, J.J.H. and Rudolph, D.C. 2018. Black Mountain Mining: Aquifer Test Pumping, Falling Head Testing and Slug Testing of Selected Groundwater Monitoring Boreholes, RVN818.1/1842.

Hough, J.J.H. and Rudolph, D.C. 2019. Black Mountain Mining: Quarterly Groundwater monitoring Report, Phase 2: 1st Quarter 2019, RVN831.1/1908.

Hough, J.J.H and Rudolph, D.C. 2019. Gamsberg Mine: Quarterly Groundwater monitoring Report, Phase 5: 1st Quarter 2019, RVN814.5/1907.

IDP, 2012-2017. Khai-Ma Municipality Integrated Development Plan.

Keith, D.A. 1998. An evaluation and modification of World Conservation Union Red List Criteria for classification of extinction risk in vascular plants. Conservation Biology. 12(5):1076-1090.

Kremen, C. 2005. Managing ecosystem services: what do we need to know about their ecology? Ecology Letters. 8:468-479.

Le Houérou, H.N. 2000. Restoration and rehabilitation of arid and semiarid Mediterranean ecosystems in North Africa and west Asia: A review. Arid Soil Research and Rehabilitation. 14:3-14.

Lloyd, J.W. and Heathcote, J.A. 1985. Natural inorganic Hydro-Chemistry in relation to groundwater. Clarendon Press, Oxford.

Lukas E, 2002. Windows interpretation system for hydrogeologists (WISH) Software developed by Institute for Groundwater Studies (IGS).

Morris, D. and Beaumont, P.B. 1991. !Nawabdanas: archaeological sites at Renosterkop, Kakamas District, Northern Cape. South African Archaeological Bulletin. 46:115-124.

Morris, D. and Beaumont, P.B. 2004. Archaeology in the Northern Cape: some key sites. Kimberley: McGregor Museum.

Morris, D. 1999a. Archaeological impact assessment, ‘Southern Option’, powerline ‘Schuitdrift’ to ‘Paulputs’, Pofadder District, Northern Cape. Unpublished Report to Eskom.

Morris, D. 1999b. Archaeological impact assessment, Skuitklipkop Microwave Tower, Kenhardt District, Northern Cape. Unpublished Report to Eskom.

Morris, D. 2000a. Gamsberg Zinc Project environmental impact assessment specialist report: archaeology.

Morris, D. 2000b. Archaeological impact assessment, Black Mountain Mine, Aggeneys, Northern Cape. Unpublished report to Walmsley Environmental Consultants.

Morris, D. 2000c. Archaeological specialist report: desktop assessment of possible archaeological resources along the proposed route, Helios to Aggeneis, Northern Cape. Appendix G in Eyethu Engineers CC: Scoping report: environmental impact assessment for the proposed Aggeneis to Helios 400 kV transmission line. Eskom Transmission Group.

Morris, D. 2001. Gamsberg Zinc: supplementary report on archaeological resources at Gamsberg. Unpublished report for Gamsberg Zinc Project.

Morris, D. 2010. Cultural Heritage Assessment: Gamsberg. Supplementary observations to a previous specialist report on archaeological resources. Unpublished report to SRK Consulting.

Morris, D. 2011. Black Mountain Concentrated Solar Power Facility development at Aggeneys, Northern Cape. Heritage Impact Assessment.

Morris, D. 2012. Pofadder Solar Thermal Facility KaXu Solar One: specialist input for the Environmental Impact Assessment Phase and Environmental Management Plan: Archaeology.

Morris, D. 2013. Environmental Management Plan Report for Black Mountain Mine, Aggeneys, Northern Cape: Input with respect to Heritage Resources.

Morris, D. 2016. Paulputs CSP Project and Road Realignment of the MN73 near Pofadder, Northern Cape.

Morris, D. 2018. Before the Anthropocene: human pasts in Karoo landscapes. African Journal of Range and Forest Science. 35:179-190.

Mucina, L. and Rutherford, M.C. 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria

Münzbergova, Z. and Herben, T. 2005. Seed, dispersal, microsite, habitat and recruitment limitation: identification of terms and concepts in studies of limitation. Oecologia. 145:1-8.

Nciizah, A.D and Wakindiki, I.C. 2016. Physical crust formation and steady-state infiltration rate in soils dominated by primary minerals in some South African ecotopes. South African Journal of Plant and Soil. 33:1, 43-50.

Northern Cape Department of Environment and Nature Conservation. 2016. Northern Cape Critical Biodiversity Areas [Vector] 0. Available from the Biodiversity GIS website.

Orton, J. 2016. Heritage Impact Assessment for the proposed Sol Invictus 3 PV facility, Namakwa Magisterial District, Northern Cape.

Penn, N. 2005. The Forgotten Frontier: Colonist and Khoisan on the Cape's Northern Frontier in the 18th Century. Athens, Ohio and Cape Town: Ohio University Press and Double Storey Books.

Perlman, D.L. and Milder, J.C. 2005. Practical ecology for planners, developers and citizens. Island Press, Washington.

Pether, J. 2012. Proposed Orlight SA Development of a solar photovoltaic power plant near Aggeneys, Northern Cape Province, Portion 1 of Farm Aoams 57 RD.

Prinsloo, H.P. 1998. Argeologiese omgewingsverslag: Pofadder en Aggeneys omgewing. For Klopfer Environmental Consultants.

Raimondo, D., Von Staden, L., Foden, W., Victor, J.E., Helme, N.A., Turner, R.C. Kamundi, D.A. and Manyama, P.A. 2009. Red list of South African plants 2009. Strelitzia. 25: 1-668. Updated Online: http://redlist.sanbi.org/.

Robinson, A.M.L. 1978. Selected articles from the Cape Monthly Magazine NS, 1870-1876. Cape Town: Van Riebeeck Series Second Series No 9.

Sampson, C.G. 1974. The Stone Age archaeology of South Africa. New York: Academic Press.

SANBI. 2016a. Lexicon of Biodiversity Planning in South Africa. Beta Version, June 2016. South African National Biodiversity Institute, Pretoria. 72.

SANBI. 2016b. Botanical Database of Southern Africa (BODATSA) [dataset]. http://newposa.sanbi.org/

SANBI. 2017. Technical guidelines for CBA Maps: Guidelines for developing a map of Critical Biodiversity Areas and Ecological Support Areas using systematic biodiversity planning. First Edition (Beta Version), June 2017. Compiled by Driver, A., Holness, S. and Daniels, F. South African National Biodiversity Institute, Pretoria.

Smith, A.B. 1995. Archaeological observations along the Orange River and its hinterland. In A. B. Smith. Einiqualand: studies of the Orange River frontier, Cape Town: UCT Press.

South African National Standard, SANS241:2006. 2006. Drinking Water, Edition 6.1, ISBN 0-626-18876-8.

South African National Standard, SANS241-1:2011. 2011. Drinking Water - Part 1: Microbiological, physical, aesthetic and chemical determinants, Edition 1, ISBN 978-0-626-26115-3.

South African National Standard, SANS241-1:2015. 2015. Drinking Water - Part 1: Microbiological, physical, aesthetic and chemical determinants, Edition 2, ISBN 978-0-626-29841-8.

South African National Standard, SANS241-2:2011. 2011. Drinking Water - Part 2: Application of SANS241-1, Edition 1, ISBN 978-0-626-26116-0.

South African National Standard, SANS241-2:2015. 2015. Drinking Water - Part 2: Application of SANS241-1, Edition 2, ISBN 978-0-626-31245-9.

Texo-Faber Consultants, 2015. Biodiversity Action Plan 2015, Black Mountain Mining Pty (Ltd).

Thompson, G. 1827. Travels and adventures in Southern Africa. Reprint, Cape Town: Africana Connoisseurs Press, 1962.

U.S. Environmental Protection Agency (EPA). 2003. List of Drinking Water Contaminants and their Maximum Contaminant Levels.

uMoya-Lilu Consulting (Pty) Ltd. 2018. Air Quality Management Plan for the Northern Cape. Report: uMN016-18.

Van Ryneveld, K. 2017. Koa Valley prospecting right application (without bulk sampling, portions of farms Haramoep 53, Oonab-Noord 609, Amam 46 and Nooisabes 51, near Springbok/Aggneys, Namakwa District Municipality, Northern Cape.

Van Tonder, G., Bardenhagen, I., Riemann, K., Van Bosch, J., Dzanga, P. and Xu, Y. 2002. Manual on Pump Test Analysis in Fractured-Rock Aquifers. Water Research Commission. WRC Report No.: 1116/1/02.

Van Tonder, G., Kunstmann, H., Xu., Y and Zhang Jin-Hui. 2001. FC-Method, Version 3.0.

Webley, L. and Halkett, D. 2012. Heritage Impact Assessment; proposed Aggeneys photovoltaic solar plant on Portion 1 of the farm Aroams 57, Northern Cape Province.

Webley, L. and Halkett, D. 2016. Scoping Heritage Assessment; proposed construction of CS and PV facilities on the Remaining Extent of the farm Hartbeest Vlei 86 near Aggeneys, Northern Cape.

Whitelaw, G. 1997. Archaeological monuments in KwaZulu-Natal: a procedure for the identification of value. Natal Museum Journal of Humanities. 9:99-109.

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ERM Cape Town
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Great Westerford Building
240 Main Road
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7700
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South Africa
T +27 21 681 5400
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