APPENDIX M

Carbon Footprint Assessment Report

REPORT

Carbon Footprint Report for the Gamsberg Expansion Project

Black Mountain Mining (Pty) Ltd

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Executive Summary

Black Mountain Mining (Pty) Ltd. (BMM), a subsidiary of Vedanta Zinc International (VZI), operates the Black Mountain Complex cluster consisting of the underground Black Mountain Mine operations, Deeps and Swartberg, and the opencast Gamsberg Mine. The Black Mountain Mine complex mines zinc, lead, silver and copper and hoists 1.7 million tonnes (mt) of ore a year with a current production capacity of 90 000 tonnes per annum (tpa) metal-in-concentrate. The Gamsberg Mine came into operation in June 2016 and mines approximately 4 million tonnes per annum (mta) and produces 250-300 tpa of zinc concentrate per annum.

Gamsberg Mine is located over three properties, which are owned by BMM. The mine is situated in the Namakwa District, Northern Cape and is approximately 120 km east of Springbok and approximately 270 km from Upington, between the towns of Aggeneys and Pofadder.

A number of existing environmental related authorisations are in place for the Gamsberg Mine. Furthermore, a permitting process was recently completed for the Gamsberg Smelter. The mine currently requires further environmental related applications to authorise additional infrastructure and activities that are required for ongoing operations and were not included in the previous authorisations.

These proposed activities require regulatory approval prior to commencement. Gamsberg Mine has therefore requested that Golder Associates Africa (Pty) Ltd (Golder), a member of WSP Group Africa (Pty) Ltd (WSP), to undertake the required regulatory approval process. As part of this process, a Carbon Footprint (Greenhouse Gas (GHG)) Assessment Report (this report), for the proposed activity changes, is required.

In line with the National Environmental Management: Air Quality Act 39 of 2004 (NEM:AQA), Government Notice of 275 of 2017 (Government Gazette 40762), the National Greenhouse Gas Emission Reporting Regulations promulgated on 3 April 2017 requires all qualifying process activities in Annexure 1 to be quantified and submitted. Activities undertaken for Gamsberg Mine fall within the *Energy Sector* under Annexure 1 of the National Greenhouse Gas Reporting Regulations and as such, must quantify such information. Under Section 29 of the NEM:AQA 39 of 2004, Government Notice 710 of 2017 (Government Gazette 40996), the GHGs (carbon dioxide, (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6)) have been declared as priority pollutants. The key GHG emissions associated with activities for Gamsberg Mine will only include CO_2 for their operations. Further, persons falling within the list of production processes, specified in Annexure A, which involves emission of GHGs in excess of 0.1 Mt annually are required to prepare and submit to the Minister pollution prevention plans for approval. It is understood that operations for the Gamsberg Mine operations do not trigger any processes outlined in Annexure A, that will result in an excess of 0.1 Mt GHG annually. As such, a pollution prevention plan will not be required.

The total GHG emissions for Gamsberg Mine was estimated to be 513 961 t CO_{2eq} in 2023 but will decrease to 68 626 t CO_{2eq} by 2030. The decrease in emissions by 2030 is a result of the renewable's energy implementation and displacement of diesel fuel.

The mining surface fleet which currently uses diesel will be replaced with fuel cell technology and have fleet effectively on fuel cells. This technology is based on current development of the technology by Anglo Platinum in conjunction with Engie Africa (which operates in the fields of energy transition, electricity generation and distribution, natural gas, nuclear, renewable energy and petroleum). Additionally, current projections for Gamsberg Mine include replacement of light duty vehicles (LDVs) with battery electric vehicles (BEVs) by 2025. Currently only Ford and Rivian have BEVs on market but Toyota have indicated that they will have BEV Hilux LDVs on market by 2025.

By August 2023, Gamsberg will have 77 MW of renewables in place (currently without storage) and is likely to result in a 40% reduction in emissions. Gamsberg Mine is currently in negotiations with Independent Power

Producers (IPPs) to bring storage into their generation plans which will reduce ESKOM electricity influence to 20% of supply. However, given the ongoing negotiations, the ESKOM transition has not been reflected in the calculations and will need to be updated once this agreement has been finalised.

Table of Contents

TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION

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Gamsberg Mine is located over three properties, which are owned by BMM. The mine is situated in the Namakwa District, Northern Cape and is approximately 120 km east of Springbok and approximately 270 km from Upington, between the towns of Aggeneys and Pofadder.

A number of existing environmental related authorisations are in place for the Gamsberg Mine. Furthermore, a permitting process was recently completed for the Gamsberg Smelter. The mine currently requires further environmental related applications to authorise additional infrastructure and activities that are required for ongoing operations and were not included in the previous authorisations.

These proposed activities require regulatory approval prior to commencement. Gamsberg Mine has therefore requested that Golder Associates Africa (Pty) Ltd (Golder), a member of WSP Group Africa (Pty) Ltd (WSP), to undertake the required regulatory approval process. As part of this process, a Carbon Footprint (Greenhouse Gas (GHG)) Assessment Report (this report), for the proposed activity changes, is required.

2.0 PROCESS DESCRIPTION

2.1 Current operations

BMM plans to mine a total of 150 000 000 tonnes of ore from the Gamsberg Zinc Mine over a 19-year Life of Mine (LoM). Of this expected LoM tonnage, approximately 18 000 000 tonnes of zinc concentrate will be extracted.

Based on the relatively low grade of the zinc deposit, the treatment process will generate approximately 132 000 000 tonnes of tailings and approximately 1.5 billion tonnes of waste rock over the LoM.

The Gamsberg zinc deposit is a tabular relatively thin mineralised lens dipping to the southeast. The South Pit was developed to initially extract the ore reserve found closest to surface. Following this, a process of sequentially excavating push backs were undertaken to gain depth and access to deeper reserves. The final open pit is expected to cover an area of 600 ha, with a final depth of 650 m, and a width and length of 2 220 m and 2 700 m respectively.

Loading and hauling of ore and overburden is performed in the pit using a fleet of large capacity shovels, loaders, excavators, haul trucks and other service equipment. The ore is hauled to the primary crusher and overburden to the waste rock dump using large capacity haul trucks (typically between 220 tonne (t) and 300 t capacity). The primary crusher is located adjacent to the open pit on a flat point of the V-cut access road along the northern slope of the inselberg. The crushed ore is transported from the primary crusher and the Run of Mine (ROM) stockpile to the processing plant via a conveyor system.

An estimated 1.5 billion tonnes of waste rock will be generated during the LoM. The haul trucks transport the waste material to the edge of the inselberg where it is tipped over the edge to form a waste rock dump expected to cover 490 hectares.

The processing plant is currently located between the N14 national road and the Gamsberg inselberg and consists of the following components:

- Milling circuit;
- ROM stockpiles;
- Flotation circuit;
- Dewatering, filtration and zinc concentrate handling circuits;
- Tailings circuit;
- Material lay down and storage areas;
- Equipment wash areas; and
- Bulk fuel storage facilities.

The treatment of ROM ore at a current rate of 4.5 Mt per annum with plans to increase to the planned 10 Mt per annum at the processing plant yields about 9 Mt per annum of tailings material which is disposed at a tailings storage facility (TSF) located north of the N14 national road. The tailings are sent to a thickener to reduce the water content before being pumped to the TSF. The percolated water from the TSF is collected and returned to the return water dam where it is pumped and reused in the concentrating process.

2.2 Future infrastructure requirements

A number of existing environmental related authorisations are in place for the Gamsberg Mine. Furthermore, a permitting process was recently completed for the Gamsberg Smelter in 2020.

The mine currently requires further environmental related applications to authorise additional activities that are required for ongoing operations and which were not included in the previous authorisations, and authorise changes required in infrastructure layout as a result of optimised planning. These activities require an Environmental Authorisation (EA) as contemplated under Section 24 of the National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA) (as amended).Proposed infrastructure developments

2.2.1.1 New potable water pipeline

A new above-ground potable water pipeline is proposed to run from the Horseshoe dam to the processing plant. This pipeline will be developed in an existing servitude already use for pipelines transporting water from Sedibeng Water to the mine. The location where the pipeline is proposed to be developed has already been cleared of vegetation as it is within a road reserve. The proposed pipeline will be installed above-ground and will have an inside diameter of 400 mm, an outside diameter of 460 mm, a throughput of 460 m_3/hour and will be approximately 7 km in length. The entire pipeline will belong to Gamsberg Mine.

2.2.1.2 Expansion of dangerous goods storage facilities

To support the ongoing operations at Gamsberg Mine, an increase in storage capacity will be required for the following dangerous goods storage facilities:

- Fuel storage capacity which is proposed to increase from 600 m^3 to 1 200 m^3; and
- Emulsion storage is proposed to be increased from 2 x 85t silos and 2 x 50t silos to 2 x 100t and 2 x 200t silos respectively.

2.2.1.3 River diversion

To minimise pollution from the waste rock dump, ROM pad and crushers and conveyer infrastructure associated with the phase 1 and 2 plant infrastructure, it is proposed that the ephemeral riverbed that passes between the processing plant and the mining operations, be altered.

The diversion will include the construction of an attenuation weir, diversion berms, two above-ground pipelines for conveying any upstream runoff past the impacted area (processing plant and the mining operations) and an energy dispersion outlet structure. The altered section will be approximately 1.5 km in length.

The alteration will be in place for the duration of the operational phase of the mine and will be rehabilitated during the decommissioning and closure phase.

2.2.1.4 Refined layout for the waste rock dump and quartzite rock dump/berm

A waste rock dump facility, with a capacity to store 1.5 billion tonnes of waste rock on an area of 490 ha, is approved in the *Environmental and Social Impact Assessment Report for the Gamsberg Zinc Mine and Associated Infrastructure in the Northern Cape* (June 2013).

In addition to the main waste rock dump facility and in order to mitigate the impacts on biodiversity as a result of the basin/crater mining activities, it was recommended that a rock dump / berm, comprising only quartzite rock, be designed and constructed to shield the remainder of the basin / crater from mining activities. It is detailed in the *Environmental Management Programme for the Gamsberg Zinc Mine and Associated Infrastructure in the Northern Cape* (May 2013), that the berm should be constructed to the same elevation as the plateau comprising a non-acid leaching rock core and a quartzite rock outer layer. It is further stated that the placement of the barrier must be defined with input from a qualified botanist and the engineering team prior to the placement of the rock.

The Gamsberg Mine engineering team has refined the layout of the current waste rock to optimise the placement of waste rock and to avoid current mine infrastructure and to ensure safe operation of the facility. The updated waste rock dump layout is based on the storage capacity and footprint as approved in the 2013 Environmental Impact Assessment (EIA) and Environmental Management Programme (EMPr).

The 2013 EMPr does not include a final position and layout of the biodiversity protection rock dump / berm. The engineering team, in consultation with the biodiversity specialist has defined the final layout and position.

The updated waste rock dump layout and layout and position of the biodiversity rock dump / berm will be included in the Basic Assessment Report.

2.2.1.5 Defined layout of the crusher and Coarse Ore Stockpile for Plant Phase 2

The 2013 EIA states that the full production capacity of the mine will be 10 Mtpa ore. This capacity will be reached in a modular approach following the mine ramp up plan as described in the report. It is stated that the current concentrator plant will be ramped up in three modules to full capacity. It is indicated that the three phases of the concentrator plant will each consist of a concentrator stream with supporting utility and supporting infrastructure.

An amended concentrator plant boundary and shortened conveyor route was approved in the *Gamsberg Mine Environmental Management Programme Amendment* (December 2016). The information was presented at a high level and did not differentiate between the infrastructure components required for the three plant modules.

The Gamsberg Mine engineering team has defined the phase 2 plant components in preparation for construction. The updated conveyor and phase 2 concentrator plant layout will be included in the Basic Assessment Report.

The layout of the Gamsberg Mine additional infrastructure and activities are illustrated in Figure 1.

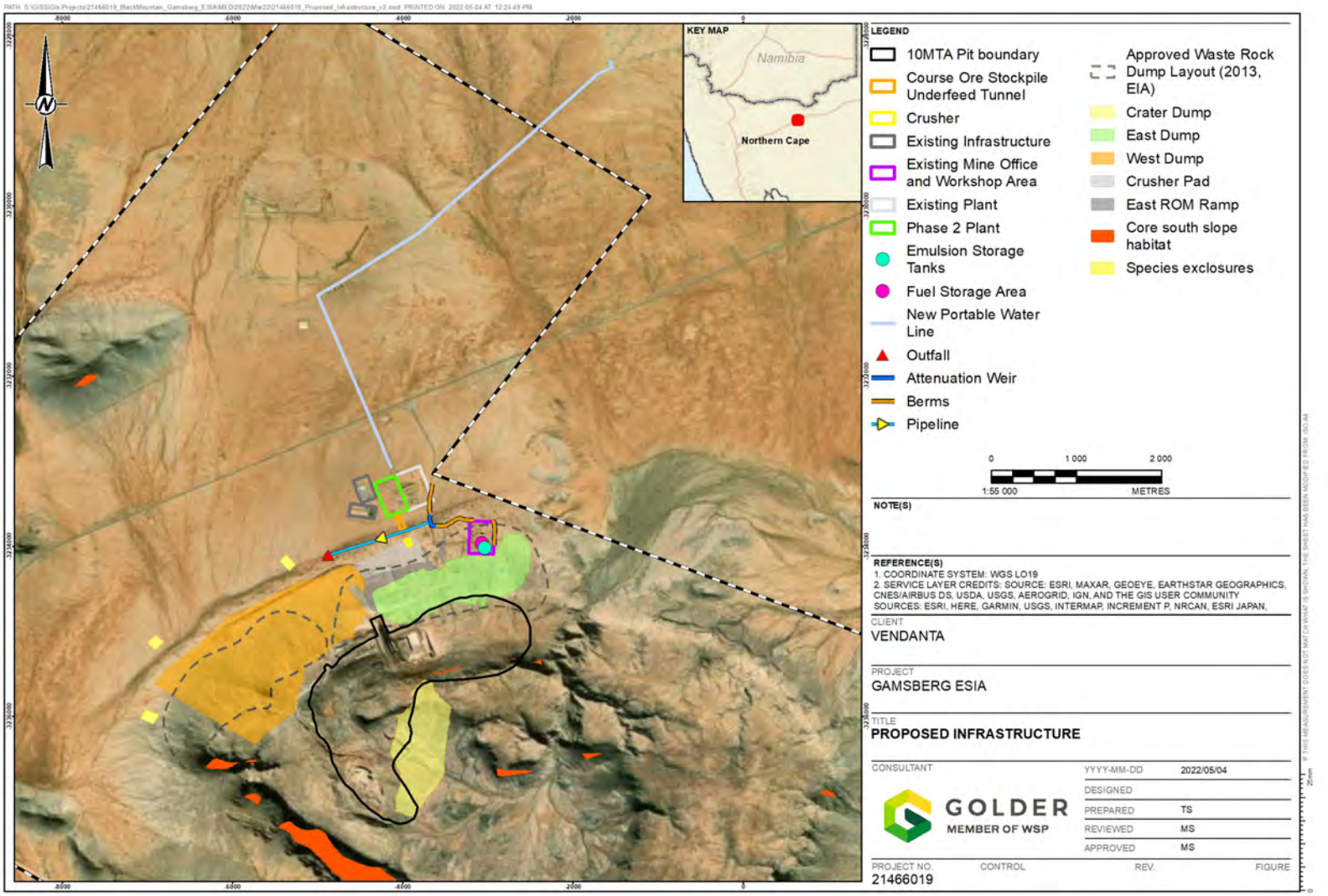

Figure 1: Proposed infrastructure layout of the Gamsberg Mine additional infrastructure and activities

3.0 APPLICABLE LEGISLATION

3.1 National Greenhouse Gas Emission Reporting Regulations

The National Greenhouse Gas Emission Reporting Regulations were published on 3 April 2017 as General Notice 275 of 2017 (Government Gazette 40762). Amendments to these regulations were published on 11 September 2020 as General Notice 994 of 2020 (Government Gazette 43712). These regulations include a list of activities for which GHG emissions must be reported, which include:

- Energy
- Industrial Processes and Product Use.
- Agriculture, Forestry and Other Land Use.
- Waste Sector.

These Regulations apply to the categories of emission sources listed in Annexure 1 to these Regulations and a corresponding data provider as classified in regulation 4 of these Regulations.

The purpose of these Regulations is to introduce a single national reporting system for the transparent reporting of GHG emissions, which will be used:

- To update and maintain a National Greenhouse Gas Inventory.
- For the Republic of South Africa to meet its reporting obligations under the United Nations Framework Convention on Climate Change (UNFCCC) and instrument treaties to which it is signatory.
- To inform the formulation and implementation of legislation and policy.

For purposes of these Regulations, a data provider is classified as follows:

- Category A: any person in control of or conducting an activity marked in the Category A column above the capacity given in the threshold column of the table in Annexure 1 to these Regulations.
- Category B: any organ of state, research institution or academic institution, which holds GHG emission data or activity data relevant for calculating GHG emissions relating to a category identified in table in Annexure 1 to these Regulations.

Notwithstanding Category A, the Minister may identify additional GHGs, sources and associated data providers by following the consultative process set out in sections 56 and 57 of the Act and, in writing, require such data providers to register and to submit data for their emissions within a specified period to the competent authority.

A person classified as a Category A data provider in terms of regulation 4(1)(a) of these Regulations must register all facilities where activities exceed the thresholds listed in Annexure 1 by providing the relevant information as listed in Annexure 2 to these Regulations, within 30 days after the commencement of these Regulations or within 30 days after commencing such an activity after the commencement of these Regulations. A data provider must ensure that the registration details are complete and are an accurate reflection of the Intergovernmental Panel on Climate Change (IPCC) emission sources at each facility. The registration contemplated in sub-regulation (1) must be done as follows:

- On the National Atmospheric Emissions Inventory System (NAEIS); and
- In cases where the NAEIS is unable to meet the registration requirements, the registration must be done by submitting the information specified in Annexure 2 in an electronic format to the competent authority.

A Category A data provider must submit the GHG emissions and activity data as set out in the Technical Guidelines for Monitoring, Reporting and Verification of Greenhouse Gas Emissions by Industry for each of the

relevant GHGs and IPCC emission sources specified in Annexure 1 to these Regulations for all of its facilities and in accordance with the data and format requirements specified in Annexure 3 to these Regulations for the preceding calendar year, to the competent authority by 31 March of each year.

3.2 Declaration of Priority Pollutants and Pollution Prevention Plans

Under Section 29 of the National Environmental Management: Air Quality Act (NEM:AQA 39 of 2004), Government Notice 710 of 2017 (Government Gazette 40996), GHGs (carbon dioxide, (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6)) have been declared as priority pollutants. Further, persons falling within the list of production processes, specified in Annexure A, which involves emission of GHGs in excess of 0.1 Mt annually are required to prepare and submit to the Minister pollution prevention plans for approval in line with NEM:AQA, Government Notice 712 of 2017 (Government gazette 40996). On 22 May 2018, in Government Notice 513 in Government Gazette 41642, the Minster of Environmental Affairs amended the National Pollution Prevention Plan Regulations (published in Notice 712 on 21 July 2017). In terms of this amendment, the first pollution prevention plan was due on or before 21 June 2018.

A pollution and prevention plan must include:

- Details of the person submitting the plan, including company name and company registration number in terms of the Companies Act, name and contact details of person responsible for submitting the pollution prevention plan on behalf of the company.
- Description of production processes as listed in Annexure A to these Regulations.
- Greenhouse gases generated from the production processes listed in Annexure A to these Regulations and their activities reported in accordance with the National Greenhouse Gas Emission Reporting Regulations.
- Total GHG emissions from the production process for the calendar preceding the submission of pollution prevention plan.
- Details of the methodology that is to be used by the person to monitor annual GHG emissions and evaluate progress towards meeting GHG emission reductions must be in line with the National Greenhouse Gas Emission Reporting Regulations.
- Description of mitigation measures, based on the best information available at time, that will be implemented and result in deviation from the GHG emissions baseline over the pollution prevention plan's period, and the projected emissions reductions that will be achieved.

A first pollution prevention plan must cover a period from the date of promulgation of these Regulations up to 31 December 2020 and the subsequent pollution prevention plans must cover periods of five calendar years each.

4.0 BASELINE ASSESSMENT

4.1 South Africa's Greenhouse Gas Emissions

South Africa is the world's 14th largest emitter of GHGs. Its CO_2 emissions are principally due to a heavy reliance on coal. Furthermore, South Africa has the world's fifth largest mining sector, which contributed 8% of its gross domestic product (GDP) in 2017.

However, a recently released draft electricity plan proposes a significant shift away from the fuel, towards gas and renewables. While coal would continue to play a role for decades, the plan would see no new plants built after 2030 and four-fifths of capacity closed by 2050.

South Africa has pledged to peak its emissions between 2020 and 2025, allowing them to plateau for roughly a decade before they start to fall (Carbon Brief Profile: South Africa, 2018).

5.0 METHODOLOGY

5.1 Gamsberg's Greenhouse Gas Emissions

This assessment has been undertaken in accordance with the National Greenhouse Gas Emission Reporting Regulations promulgated on 3 April 2017 which requires all qualifying process activities in Annexure 1 to be quantified and submitted. Activities undertaken for Gamsberg fall within the ***Energy Sector*** under Annexure 1 of the National Greenhouse Gas Reporting Regulations and as such, must quantify such information. Under Section 29 of the NEM:AQA 39 of 2004, Government Notice 710 of 2017 (Government Gazette 40996), the GHGs have been declared as priority pollutants. The key GHG emissions associated with the additional infrastructure and activities proposed for the Gamsberg Mine operations will only include CO_2. Further, persons falling within the list of production processes, specified in Annexure A, which involves emission of GHGs in excess of 0.1 Mt annually are required to prepare and submit to the Minister pollution prevention plans for approval. It is understood that operations for the Gamsberg operations do not trigger any processes outlined in Annexure A, that will result in an excess of 0.1 Mt GHG annually. As such, a pollution prevention plan will not be required.

5.1.1 Project Boundaries

In determining the GHG emissions inventory for the Gamsberg Mine additional infrastructure and activities, it is necessary to firstly define the organisational and operational boundaries of the assessment.

5.1.1.1 Organisational Boundaries

Organisations vary in their legal and organisational structures and, like financial accounting, reporting on the GHG emissions of operations is dependent on the structure of the organisation, and whether the operations are wholly owned, joint ventures or subsidiaries (WBCSD and WRI, 2004). It is expected that the organisation boundaries will state the makeup of the company, and the operations that the organisation owns or controls.

In defining the organisational boundaries, there are generally two distinct approaches. These are equity share and control. With the equity share approach, the organisation accounts for GHG emissions from operations according to its share of equity in the operation. Typically, the equity share is equivalent to the organisation's percentage ownership. With the control approach, the organisation accounts for 100% of the GHG emissions from operations over which it has control. In terms of this approach, an organisation is not accountable for operations in which it owns a percentage but has no control. Control can be in the form of either financial control, in which the organisation directs the financial and operational policies of the operation, or operational control, where the organisation has the full authority to introduce and implement operational policies.

This assessment reports on the GHG emissions for Gamsberg Mine, in terms of the control approach, where Gamsberg Mine accounts for 100% of the estimated GHG emissions.

5.1.1.2 Operational Boundaries

In defining the operational boundaries, the GHG emissions associated with the organisation's operations are identified and characterised as either direct or indirect emissions.

In order to help with the characterisation of direct and indirect emission sources, three 'scopes' within the Greenhouse Gas Protocol Corporate Accounting and Reporting Standard, are defined. The use of scopes not only improves transparency and consistency in reporting, but also ensures that organisations do not account for different emissions in the same scope (i.e. double counting). A brief description of the three scopes is provided below:

- **Scope 1**: Direct emissions arise from activities owned or controlled by an organisation, such as emissions from combustion in boilers, furnaces, and vehicles operating onsite. In the case of Gamsberg Mine, this refers to emissions associated with the usage of diesel and explosives.
- **Scope 2**: Indirect emissions released into the atmosphere associated with the consumption of purchased electricity, heat, steam and cooling; these emissions occur at a distance from the site. In the case of Gamsberg, this refers to emissions associated with electricity consumption.
- **Scope 3**: Other indirect emissions, other than those associated with energy usage, including business travel by means not owned or controlled by the entity, waste disposal by means not owned or controlled by the entity, and extraction/production and transport of purchased materials or fuels. In the case of Gamsberg, this refers to emissions associated with purchased goods and services and fuel and energy related activities.

Figure 2 presents an overview of Scope 1, Scope 2, and Scope 3 emissions across the value chain of an organisation.

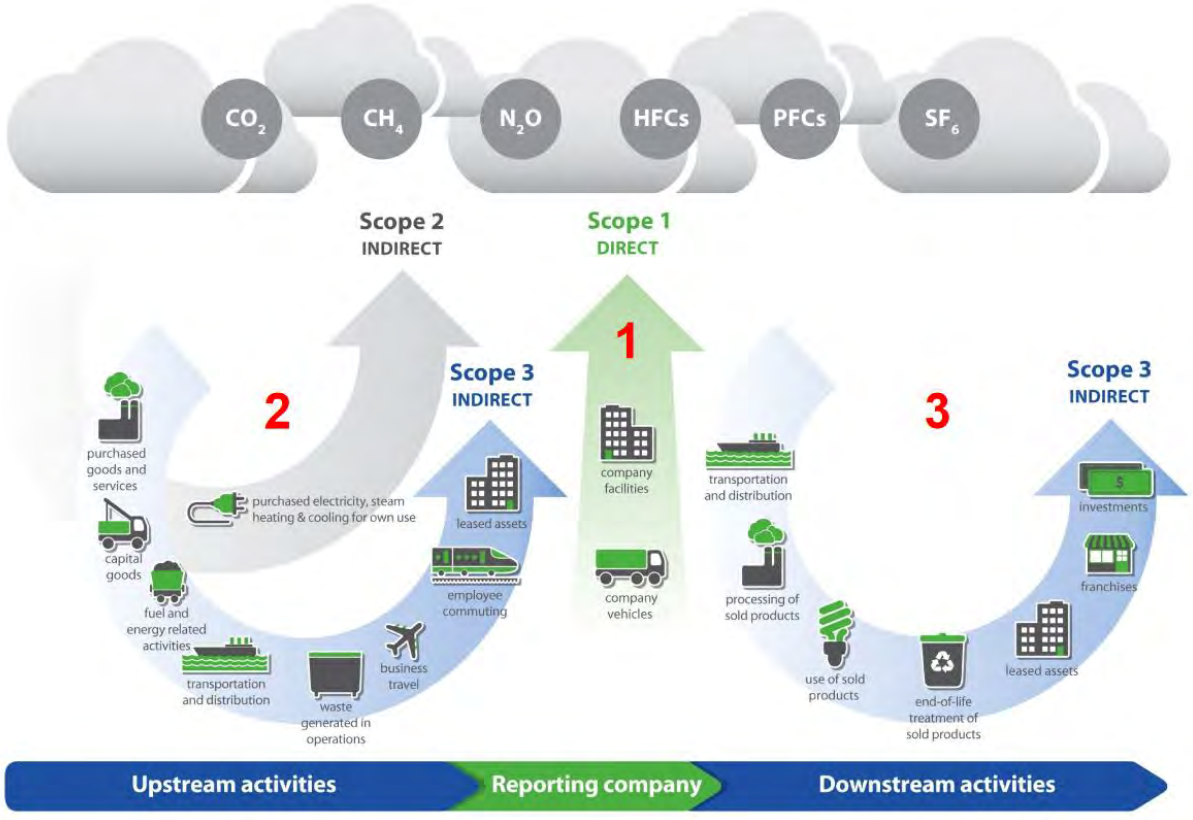

Figure 2: Overview of Scope 1, Scope 2 and Scope 3 emissions across the value chain (WBCSD & WRI, 2004)

5.1.2 Emission Tier Approach

Activities undertaken for Gamsberg Mine fall within the ***Energy Sector*** under Annexure 1 of the National Greenhouse Gas Reporting Regulations. These regulations include a tiered approach to determining GHG emissions, as follows:

- **Tier 1**: Default IPCC emission factors available in the 2006 IPCC Guidelines are used to calculate emissions from activity data.

- **Tier 2**: Country specific emission factors published in the Technical Guidelines for Monitoring, Reporting and Verification of Greenhouse Gas Emissions by industry are used to calculate emissions from activity data.
- **Tier 3**: Emission models, material carbon balances and continuous emission measurements in the Technical Guidelines for Monitoring, Reporting and Verification of Greenhouse Gas Emissions by industry available on the DEA website (www.environment.gov.za) are utilized.

6.0 GREENHOUSE GAS EMISSION ASSESSMENT

6.1 Gamsberg GHG Emissions

A GHG, as defined by the IPCC, is a compound which has the ability to trap heat over a certain lifetime in the atmosphere. The six priority pollutant GHGs, as listed within the Notice to declare GHG as Priority Air Pollutants (Government Notice 710 of 2017), are CO_2, CH_4; N_2O; HFCs; PFCs; and SF_6. The key GHG emissions associated with activities for Gamsberg will include CO_2 as a result of the diesel combustion, explosives used, electricity consumption, purchased water and fuel and energy related activities on site.

The impact of these GHGs are quantified using their Global Warming Potential (GWP), which is a measure of their heat trapping effect relative to the effects of the same weight of CO_2 released over the same period of time. It is important to consider the GWP of GHG's, given that minor emissions of a high GWP gas could make a significant contribution to a carbon footprint. GHG emissions are therefore usually expressed in CO_2 equivalent terms (CO_{2eq}) to reflect the contribution of the various GHG emissions. The heat trapping ability for CO_2 after 100 years will remain as 1. The emission factors for the project are presented in Table 1, whilst the consumption data is presented in Table 2.

Table 1: Greenhouse gas emission factors

Scope	Source	Activity Use	Emission Factor Unit	CO_2	Tier Approach
Scope 1	Diesel mobile combustion	Gamsberg openpit, plant vehicles and concentrate plant	Tonne/litre	0.0031	2
	Explosives	Gamsberg	Tonne/tonne	0.17	1
Scope 2	Electricity	Gamsberg openpit and plant	Tonne/MWh	0.932	3
Scope 3	Purchased water	Gasmberg plant	Tonne/million litres	1.4	2
	Diesel production	Gamsberg openpit, plant vehicles and concentrate plant	Tonne/litre	0.00063	2
	Transmission and distribution losses	Gamsberg openpit and plant	Tonne/MWh	0.10523	3
	Explosives	Gamsberg	Tonne/Tonne	2.63	3

Table 2: Consumption data for Gamsberg Mine

Scope	Source	Unit	Quantity/Annum					
			2023	2024	2025	2026	2027	2030 to 2060
Scope 1	Diesel mobile combustion	Kilolitres	93 117	71 513	70 793	69 376	36 544	-
	Explosives	Tonnes	13 924	17 589	17 589	17 589	14 657	17 589
Scope 2	Electricity	MWh	114 020	68 412	45 607	13 680	11 400	13 680
Scope 3	Purchased water	Kilolitres	3 710 160	3 710 160	3 710 160	3 710 160	3 091 800	3710 160
	Diesel production	Kilolitres	93 117	71 513	70 793	69 376	36 544	-
	Transmission and distribution losses	MWh	114 020	68 412	45 607	13 680	11 400	13 680
	Explosives	Tonnes	13 924	17 589	17 589	17 589	14 657	17 589

Using the greenhouse emission factors, consumption data and GWP, the total GHG emissions for Gamsberg Mine was estimated to be 513 961 tCO_{2eq} in 2023 but will decrease to 68 626 tCO_{2eq} by 2030.

The decrease in emissions by 2030 is a result of the renewable's energy implementation and displacement of diesel fuel. The mining surface fleet which currently uses diesel will be replaced with fuel cell technology and have fleet effectively on fuel cells. This technology is based on current development of the technology by Anglo Platinum in conjunction with Engie. Additionally, current projections for Gamsberg Mine include replacement of light duty vehicles (LDVs) with battery electric vehicles (BEVs) by 2025. Currently only Ford and Rivian have BEVs on market but Toyota have indicated that they will have BEV Hilux LDVs on market by 2025.

By August 2023, Gamsberg Mine will have 77 MW of renewables in place (currently without storage) and is likely to result in a 40% reduction in emissions. Gamsberg Mine is currently in negotiations with Independent Power Producers (IPPs) to bring storage into their generation plans which will reduce ESKOM electricity influence to 20% of supply. However, given the ongoing negotiations the ESKOM transition has not been reflected in the calculations and will need to be updated once this agreement has been finalised.

Table 3: Source specific greenhouse gas emissions for Gamsberg Mine

Scope	Source	Total CO_2e (tonnes/year)					
		2023	2024	2025	2026	2027	2030 to 2060
Scope 1	Diesel mobile combustion	293 262	225 223	222 955	218 491	115 091	-
	Explosives	2 367	2 990	2 990	2 990	2 492	2 990
Scope 2	Electricity	106 216	63 729	42 485	12 744	10 620	12 744
Scope 3	Purchased water	5 194	5 194	5 194	5 194	4 329	5 194
	Diesel production	58 302	44 775	44 324	43 437	22 881	-
	Transmission and distribution losses	11 999	7 199	4 799	1 440	1 200	1 440
	Explosives	36 621	46 258	46 258	46 258	38 549	46 258
Total Carbon Footprint		**513 961**	**395 368**	**369 005**	**330 554**	**195 162**	**68 626**

6.2 Contribution of Gamsberg Mine to South Africa's GHG Emissions

According to the most recent national GHG inventory, South Africa's total GHG emissions were estimated to be 513 $MtCO_2e$ in 2017 (excluding forestry and other land use). The energy sector was the main contributor (80.1%), followed by agriculture, forestry and land use change (9.5%), industrial processes and product use (6.3%), and waste (4.1%).

The estimated contribution of Gamsberg to the total annual GHG emissions of South Africa is expected to be 0.1% in 2023 and will further decrease to 0.01% by 2030. Such emissions are considered extremely low in relation to the total contribution.

7.0 CONCLUSION AND RECOMMENDATIONS

Gamsberg Mine appointed Golder to undertake a carbon footprint for the additional infrastructure and activities located in the Northern Cape. The total GHG emissions for Gamsberg Mine was estimated to be 513 961 tCO_{2eq} in 2023 but will decrease to 68 626 tCO_{2eq} by 2030.

The strategy for Gamsberg Mine is to attain carbon neutral by 2050 and is focussed on the renewable's energy implementation and displacement of diesel fuel.

The decrease in emissions by 2030 is a result of this approach. The mining surface fleet which currently uses diesel will be replaced with fuel cell technology and have fleet effectively on fuel cells. This technology is based on current development of the technology by Anglo Platinum in conjunction with Engie Africa (which operates in the fields of energy transition, electricity generation and distribution, natural gas, nuclear, renewable energy and petroleum). Additionally, current projections for Gamsberg Mine include replacement of light duty vehicles

(LDVs) with battery electric vehicles (BEVs) by 2025. Currently only Ford and Rivian have BEVs on market but Toyota have indicated that they will have BEV Hilux LDVs on market by 2025.

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https://golderassociates.sharepoint.com/sites/145886/project files/6 deliverables/drafts/specialist studies/aqia and carbon footprint/21466019-351701-3 gamsberg draft carbon footprint_12apr22.docx

APPENDIX A

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GOLDER ASSOCIATES AFRICA (PTY) LTD

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DETAILS OF THE SPECIALIST

Table 1: Details of specialist

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Declaration of Independence by Specialist

I, Novania Reddy, declare that I –

- Act as the independent specialist for the undertaking of a specialist section for the proposed project.
- Do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed;
- Do not have nor will have a vested interest in the proposed activity proceeding;
- Have no, and will not engage in, conflicting interests in the undertaking of the activity;
- Undertake to disclose, to the competent authority, any information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan, or document.

Novania Reddy

APPENDIX N

Closure Planning and Costing Report

GOLDER
MEMBER OF WSP

REPORT

Regulatory Process for Additional Infrastructure for the Gamsberg Zinc Mine - Closure Planning and Costing aligned to the NEMA Financial Provisioning Regulations (GN.R. 1147)

Black Mountain Mining (Pty) Ltd

Submitted to:

Gamsberg Zinc Mine
Black Mountain Mining (Pty) Ltd
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21466019-352023-5

May 2022

Distribution List

1 x eCopy Gamsberg Zinc Mine

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Declaration of Independence by Specialist

We, Deshree Pillay and Johan Bothma, declare that we –

- Act as the independent specialists for the undertaking of a specialist section for the proposed Gamsberg Basic Assessment regulatory process for additional infrastructure
- Do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed
- Do not have nor will have a vested interest in the proposed activity proceeding
- Have no, and will not engage in, conflicting interests in the undertaking of the activity and
- Undertake to disclose, to the competent authority, any information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan, or document

ACRONYMS AND ABBREVIATIONS

Abbreviation	Explanation
AP	Acid Potential
BIR	Bushmanland Inselberg Region
BMM	Black Mountain Mining (Pty) Ltd
DMRE	Department of Mineral Resources and Energy
EA	Environmental Authorisation
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme Report
EMS	Environmental Management System
GDP	Gross Domestic Product
Gamsberg	Gamsberg Zinc Mine
IDP	Integrated Development Plan
LFA	Landscape Function Analyses
LoM	Life of Mine
MRA	Mining Rights Area
NAG	Net-Acid Generating Capacity
NEMA	National Environmental Management Act
NP	Neutralising Potential
NNP	Net Neutralising Potential
NPR	Neutralising Potential Ratio
ROM	Run of Mine
SLF	Secured Landfill Facility
TSF	Tailings Storage Facility
VZI	Vedanta Zinc International
WHO	World Health Organisation
WRD	Waste Rock Dump

UNITS OF MEASUREMENT

Abbreviation	Explanation
km	Kilometre
ha	Hectare
m	Metre
mbgl	Metres below ground level
m^3	Cubic metres
mm	Millimetre
mamsl	Metres above mean sea level
mt	million tonnes
mta	million tonnes per annum
t	ton
tpa	tonnes per annum

Table of Contents

TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION

Black Mountain Mining (Pty) Ltd. (BMM), a subsidiary of Vedanta Zinc International (VZI), operates the Black Mountain Complex cluster consisting of the underground Black Mountain Mine operations, Deeps and Swartberg, and the opencast Gamsberg Zinc Mine (Gamsberg). The Black Mountain Mine complex mines zinc, lead, silver and copper and hoists 1.7 million tonnes (mt) of ore a year with a current production capacity of 90 000 tonnes per annum (tpa) metal-in-concentrate.

The Gamsberg Zinc Mine came into operation in June 2016 and mines approximately 4 million tonnes per annum (mta) and produces 250-300 tpa of zinc concentrate per annum.

BMM plans to mine a total of 150 000 000 tons of ore from the Gamsberg Zinc Mine over a 19-year Life of Mine (LoM). Of this expected LoM tonnage, approximately 18 000 000 tons of zinc concentrate will be extracted. Based on the relatively low grade of the zinc deposit, the treatment process will generate approximately 132 000 000 tons of tailings and approximately 1.5 billion tons of waste rock over the LoM.

The Gamsberg zinc deposit is a tabular, relatively thin mineralised lens dipping to the southeast. The South Pit was developed to initially extract the ore reserve found closest to surface. Following this, a process of sequentially excavating push backs were undertaken to gain depth and access to deeper reserves. The final open pit is expected to cover an area of 600 ha, with a final depth of 650 m, and a width and length of 2 220 m and 2 700 m respectively.

Loading and hauling of ore and overburden is performed in the pit using a fleet of large capacity shovels, loaders, excavators, haul trucks and other service equipment. The ore is hauled to the primary crusher and overburden to the waste rock dump using large capacity haul trucks (typically between 220 ton (t) and 300 t capacity). The primary crusher is located adjacent to the open pit on a flat point of the V-cut access road along the northern slope of the inselberg. The crushed ore is transported from the primary crusher and the Run of Mine (ROM) stockpile to the processing plant via a conveyor system.

An estimated 1.5 billion tons of waste rock will be generated during the LoM. The haul trucks transport the waste material to the edge of the inselberg where it is tipped over the edge to form a waste rock dump expected to cover 490 hectares.

The processing plant is currently located between the N14 national road and the Gamsberg inselberg and consists of the following components:

- Milling circuit
- ROM stockpiles
- Flotation circuit
- Dewatering, filtration, and zinc concentrate handling circuits
- Tailings circuit
- Material lay down and storage areas
- Equipment wash areas
- Bulk fuel storage facilities

The treatment of ROM ore at a current rate of 4.5 Mt per annum with plans to increase to the planned 10 Mt per annum at the processing plant yields about 9 Mt per annum of tailings material which is disposed at a tailings storage facility (TSF) located north of the N14 national road. The tailings are sent to a thickener to reduce the

water content before being pumped to the TSF. The percolated water from the TSF is collected and returned to the return water dam where it is pumped and reused in the concentrating process.

A number of existing environmental related authorisations are in place for the Gamsberg Mine. Furthermore, a permitting process was recently completed for the Gamsberg Smelter in 2020.

The mine currently requires further environmental related applications to authorise additional activities that are required for ongoing operations, and which were not included in the previous authorisations, and authorise changes required in infrastructure layout as a result of optimised planning. These activities require an Environmental Authorisation (EA) as contemplated under Section 24 of the National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA) (as amended).

This report presents the **closure input** to the Basic Assessment process for Gamsberg. It is noted that this report must be read in conjunction with the overarching Rehabilitation, Decommissioning and Closure Plan (SRK Consulting, 2021) in terms of:

- The National Environmental Management Act (NEMA, Act 107 of 1998)
- Specifically, the Financial Provisioning Regulations (GN.R. 1147 - as amended), gazetted on 20 November 2015, and due to commence in June 2022

This report only summarises information that is pertinent to the authorisation process and does not replace the on-going closure planning processes. This report is focused on the scheduled closure situation.

2.0 PROJECT LOCATION AND EXTENT

The Gamsberg Mine is located in the Northern Cape Province of South Africa, approximately 14 km east of the town of Aggenys and 120 km east of Springbok along the N14 (see Figure 1 below).

The mine is situated in the Namakwa District, Northern Cape and is approximately 120 km east of Springbok and approximately 270 km from Upington, between the towns of Aggeneys and Pofadder. The Gamsberg Zinc Mine is located over three properties namely, Portion 1 of the farm Bloemhoek 61, Portion 1 of the farm Gams 60 and the remainder of farm Aroams 57.

Gamsberg is located in the Lower Orange River Water Management Area (WMA), and specifically in the D81G (predominant) and D82C (minor) Quaternary Catchments. The following farm portions have been included in the application process as seen in Figure 2:

- Farm Aroams No. 57, portions 0, 2, 7
- Farm Gams No. 60, portions 1 and 4
- Farm Bloemhoek No. 61, portion 1

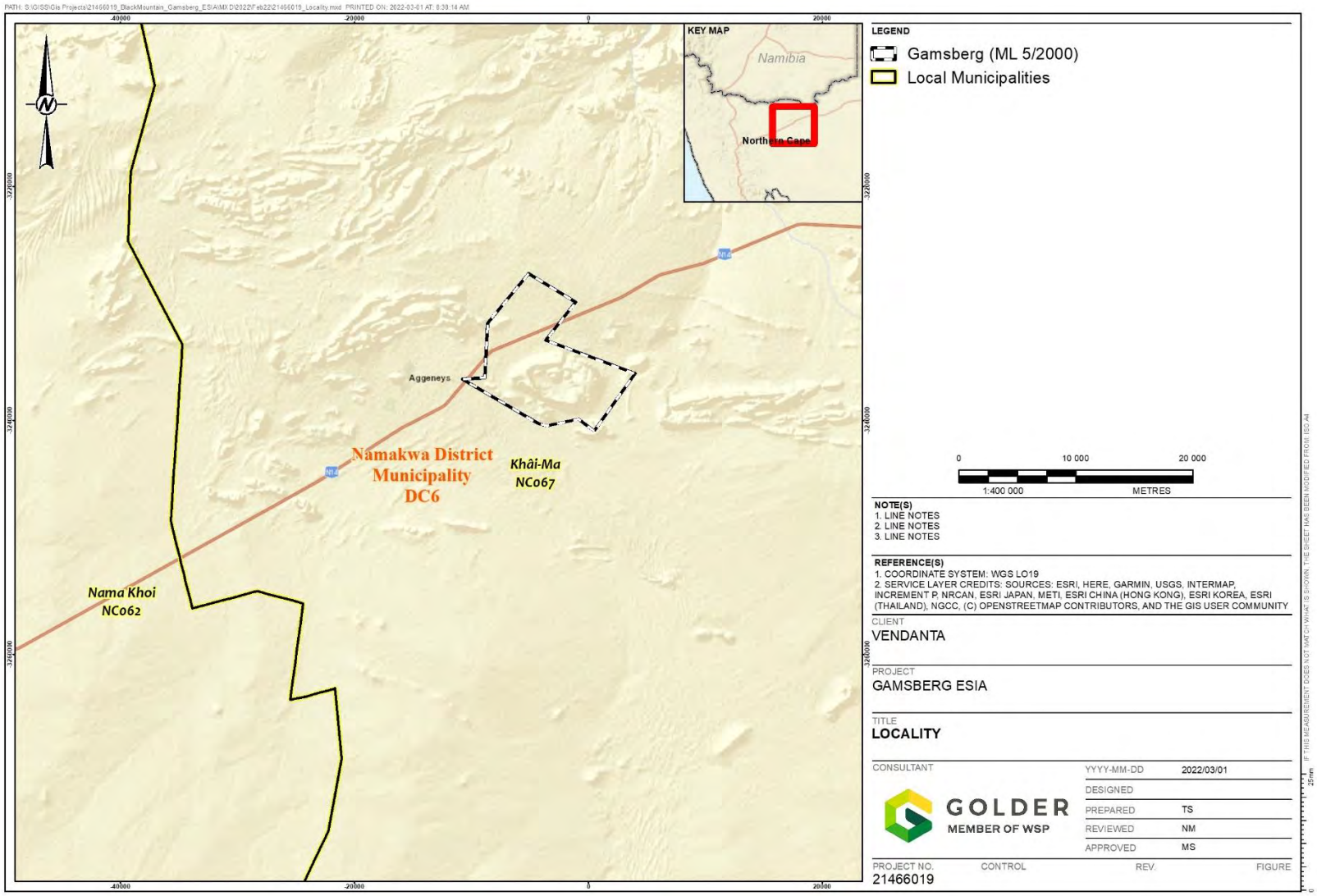

Figure 1: Gamsberg regional locality map *(Golder 2022a)*

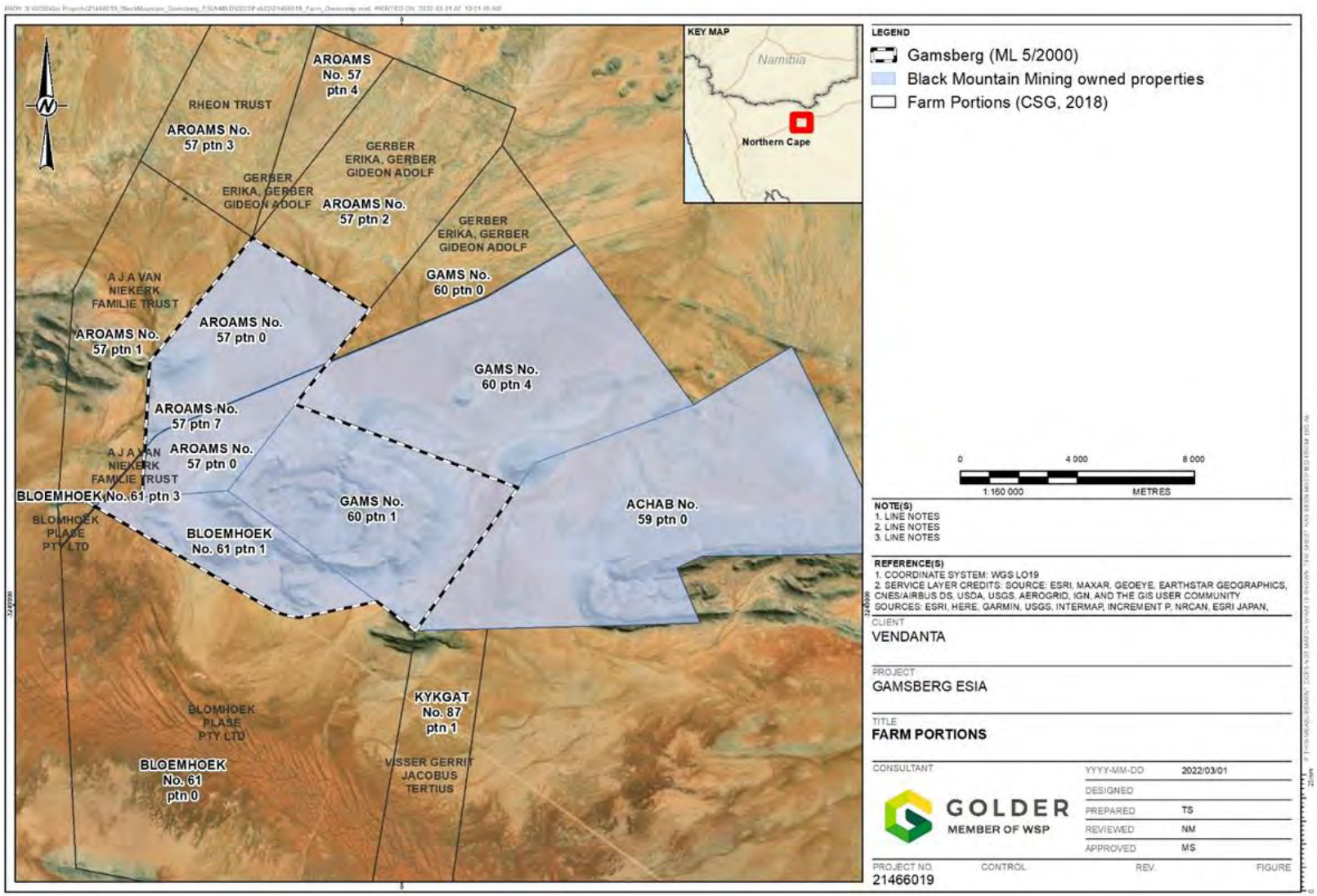

Figure 2: Property map for Gamsberg *(Golder, 2022b)*

3.0 KEY CHANGES FROM EXISTING AUTHORISED PROJECT

The following key changes and additions, and which are addressed by this closure framework, are noted:

Proposed infrastructure developments:

- River diversion
- New potable water pipeline
- Expansion of dangerous goods storage facilities

Layout changes to approved infrastructure

- Refined layout for the waste rock dump and quartzite rock dump/berm
- Crusher and coarse ore stockpile for plant phase 2

4.0 PROJECT DESCRIPTION

Proposed infrastructure developments:

To commence with the implementation of phase 2 of the mine development, that will bring Gamsberg Mine closer to the approved 10 million ton per annum production, Gamsberg Mine requires additional infrastructure not approved under previously issued environmental authorisations (EAs). Gamsberg Mine is proposing to construct the following additional infrastructure:

- ***New potable water pipeline:*** A new above-ground potable water pipeline is proposed to run from the Horseshoe dam to the processing plant. This pipeline will be developed in an existing servitude already use for pipelines transporting water from Sedibeng Water to the mine. The location where the pipeline is proposed to be developed has already been cleared of vegetation as it is within a road reserve. The proposed pipeline will be installed above-ground and will have an inside diameter of 400 mm, an outside diameter of 460 mm, a throughput of 460 m^3/hour and will be approximately 7 km in length. The entire pipeline will belong to Gamsberg Mine.
- ***Expansion of dangerous goods storage facilities:*** An increase in storage capacity will be required for the following dangerous goods storage facilities:
  - Fuel storage capacity which is proposed to increase from 600 m^3 to 1 200 m^3.
  - Emulsion storage is proposed to be increased from two 85 t silos and two 50 t silos to two 100 t and two 200 t silos respectively.
- ***River diversion:*** To minimise pollution from the waste rock dump, ROM pad and crushers and conveyer infrastructure associated with the phase 1 and 2 plant infrastructure, it is proposed that the ephemeral riverbed that passes between the processing plant and the mining operations, be altered. The diversion will include the construction of an attenuation weir, diversion berms, two above-ground pipelines for conveying any upstream runoff past the impacted area (processing plant and the mining operations) and an energy dispersion outlet structure. The altered section will be approximately 1.5 km in length. The alteration will be in place for the duration of the operational phase of the mine and will be rehabilitated during the decommissioning and closure phase.

Layout changes to approved infrastructure

- ***Refined layout for the waste rock dump and quartzite rock dump/berm[1]:***
  - A waste rock dump facility, with a capacity to store 1.5 billion tons of waste rock on an area of 490 ha, is approved in the Environmental and Social Impact Assessment Report for the Gamsberg Zinc Mine and Associated Infrastructure in the Northern Cape (June 2013).
  - In addition to the main waste rock dump facility and in order to mitigate the impacts on biodiversity as a result of the basin/crater mining activities, it was recommended that a rock dump / berm, comprising only quartzite rock, be designed, and constructed to shield the remainder of the basin / crater from mining activities. It is detailed in the Environmental Management Programme for the Gamsberg Zinc Mine and Associated Infrastructure in the Northern Cape (May 2013), that the berm should be constructed to the same elevation as the plateau comprising a non-acid leaching rock core and a quartzite rock outer layer. It is further stated that the placement of the barrier must be defined with input from a qualified botanist and the engineering team prior to the placement of the rock.
  - The Gamsberg Mine engineering team has refined the layout of the current waste rock to optimise the placement of waste rock and to avoid current mine infrastructure and to ensure safe operation of the facility. The updated waste rock dump layout is based on the storage capacity and footprint as approved in the 2013 EIA and EMPr.
  - The 2013 EMPr does not include a final position and layout of the biodiversity protection rock dump / berm. The engineering team, in consultation with the biodiversity specialist has defined the final layout and position.
- ***Crusher and coarse ore stockpile for plant Phase 2:*** The 2013 EIA states that the full production capacity of the mine will be 10 Mtpa ore. This capacity will be reached in a modular approach following the mine ramp up plan. It is stated that the current concentrator plant will be ramped up in three modules to full capacity. It is indicated that the three phases of the concentrator plant will each consist of a concentrator stream with supporting utility and supporting infrastructure.
- An amended concentrator plant boundary and shortened conveyor route was approved in the Gamsberg Mine Environmental Management Programme Amendment (December 2016). The information was presented at a high level and did not differentiate between the infrastructure components required for the three plant modules.
- The Gamsberg Mine engineering team has now defined the phase 2 plant components in preparation for construction of the phase 2 infrastructure.

5.0 APPROACH

The approach followed with the update of closure input to inform the Basic Assessment (BA) process was as follows:

- Assessment of relevant available background information regarding Gamsberg Mine, and specifically the additional infrastructure that will be built.
- Establishment of a preliminary understanding of the baseline legal and environmental context.

[1] The approved waste rock dump and quartzite rock dump/berm is deemed to already be included in the existing mine-wide closure plan and associated costs. Given that the proposed changes will not materially change the closure requirements for this feature and that any rehabilitation requirements will be implemented during operations, no additional closure cost allowance has been made for this purpose

- Formulation of the foundational aspects that guide closure planning, including the closure vision and the envisaged next land use.
- Identification of closure-related risks associated with the amendment project to be included in the next annual update of the GN.R. 1147 closure plans.
- Establishment of the closure scenario that provides the closure planning battery limits and the key assumptions related to the remaining operational period, until cessation of operations, and the closure period and beyond.
- Formulation of the closure objectives and closure measures to be implemented to achieve the closure vision, the next land use and to mitigate the potential closure risks identified.
- Development of appropriate monitoring and maintenance guidelines
- Estimating the cost to implement the closure measures as devised.
- Recommendation of several key principles and activities to be undertaken to ensure quality concurrent rehabilitation and the achievement of the closure vision, next land use and necessary risk mitigation.
- Compilation of a succinct report that documents the approach followed in developing the closure input for the BA process.

6.0 REGULATORY COMMITMENTS INFORMING THE CLOSURE INPUT

The current EMPr conditions dealing specifically with rehabilitation, and that are also relevant to the construction of additional infrastructure project, are summarised below. The following information has been included from the approved EMPr submitted to the Department of Mineral Resources and Energy (DMRE) for the proposed Smelter Plant (SLR Consulting (Pty) Ltd , 2020).

- The potential post mining land uses will continue to be discussed with the DMRE. However, the most suitable post closure land use identified is the establishment of a nature reserve on suitable areas, use functional infrastructure for alternative uses where possible and demolish the rest. The remaining infrastructure could be used for accommodation and facilities for eco-tourism (viz. battlefield tours, special species, flowers, and game viewing trails).
- All plant infrastructure not required to support post-closure land use(s) should be demolished and removed.
- The potable water pipeline from the Horseshoe water reservoir to the smelter complex should be dismantled and removed (for recycling / scrap).
- Areas where surface infrastructure has been removed should be levelled and restored in terms of soil horizons, vegetation, and drainage (as far as practical).

The LOM rehabilitation plan involves the following:

- Decommissioned infrastructure areas should be landscaped and levelled so that the areas are free draining and that there is no ponding of water.
- Any remaining slopes should be modified to at least 1V:3H (or flatter) to minimise erosion, and long slopes may require energy/flow breakers to curb the velocity of storm water runoff.
- Decommissioned infrastructure areas should be deep ripped and revegetated with indigenous species to align to the surrounding natural environment as far as practical.
- Topsoil that was stripped and stockpiled as part of construction works, should be replaced (presumably 375 mm – similar to existing mining areas).

- Planting with a mix of indigenous grasses (dry seeding), shallow rooted pioneer species and deep-rooted species, where appropriate, such as trees/shrubs (hand planting of seedlings). Deep rooted species are typically not suitable for areas that have covers (e.g. secured landfill facility).

7.0 ENVIRONMENTAL CONTEXT

Table 1 provides a brief overview of the environmental setting of the overall mine site, and where applicable that of the specific additional infrastructure area, providing the preliminary context required to inform the rehabilitation and closure inputs for the BA process. The information included within this section was sourced from the proposed Smelter Project EMPr (SLR Consulting (Pty) Ltd , 2020)

Table 1: Overview of environmental context

Environmental category	Description
Infrastructural components	
Climate	The following information was obtained from the Specialist Climate Change Impact Assessment Report (Promethium Carbon , 2020): ■ The Khâi-Ma Municipality experiences very low mean annual precipitation of approximately 92 mm. The majority of the rainfall occurs in the summer months from January to June. ■ Due to the low annual rainfall, flooding is rare. However, due to the arid nature of the area, flash floods occur easily if there is a large downpour as the ground is hard and water rushes off along preferential pathways. The only areas susceptible to flooding occur along the Orange River approximately 33 km north of the site. ■ Drought, on the other hand, is more common particularly in the eastern areas of the Khâi-Ma Municipality which is more drought-prone. ■ Maximum temperatures range from 35˚C to 39˚C with minimum temperatures of -1˚C to 13˚C and a mean annual temperature of approximately 20˚C. The area experiences between 30 and 45 very hot days (temperate exceeds 35˚C) and is characterised as a hyper-arid environment with potential. ■ Prevailing winds in the region are mainly experienced during the night in a southerly direction with Westerly winds being experienced in the daytime. Wind speeds are generally low, with monthly average wind speeds ranging from 3.3 m/s to 4.3 m/s. During the dry period, dust concentration levels increase due to drier conditions and are dispersed by the prevailing winds.
Topography	■ The local topography is characterised with undulating plains, containing low growing shrubby vegetation and grasses. The surrounding plains are approximately 750 – 900 metres above mean sea level (mamsl), with the highest areas of the Gamsberg inselberg varying between 1 100 – 1 150 mamsl. The Gamsberg inselberg is approximately 7.2 km east – west and approximately 4.6 km north – south. Erosion along the top of the inselberg has resulted in the creation of a basin within the feature, which subsequently varies between 60 – 70 m below the rim of the inselberg (ERM , 2013).
Geology	The following information was obtained from the Gamsberg Smelter Project EIA (SLR Consulting (Pty) Ltd , 2020):

Environmental category	Description
	■ Gamsberg forms part of the Bushmanland Group and comprises basal leucocratic gneiss of the Gladkop Group and is overlain by quartzite and mica-sillimanite schist of the Aggeneys Subgroup. ■ The interpreted structural features were determined to be predominantly oriented in a north to northwest direction with a few lineaments oriented in east to west and southeast directions. Large lineaments occur east and west of the existing TSF, and a small lineament occurs west of the TSF. No lineaments are evident within the proposed infrastructure locations for the smelter complex, TSF and Secured Landfill Facility (SLF).
Land use, land capability and soils	The following information was obtained from the Gamsberg Smelter Project EIA (SLR Consulting (Pty) Ltd , 2020): ■ The Gamsberg area is characterised by an extensive peneplain, and the soils present in the peneplain are predominantly shallow and stony. The soils present on the peneplain are generally characterised by reddish sandy topsoil that is shallow in nature. However, a 10 cm thick red sandy surface layer is present along the northern section of the site. The western and southern part of the site is characterised with deeper red soils, varying in depth from 30 cm to 60 cm. Along the southwestern portion of the site, deeper red soils occur. ■ Land capability in the study area (assessed using the System of Land Capability Classification for Agriculture in South Africa) ranged from low (Class VI) to very low (Class VIII), largely because of the arid climate of the area and the sandy nature of soils found there. According to the Chamber of Mines land capability classification system, the affected area may only be used as a 'wilderness' area, i.e. it cannot be used for any alternative agricultural purpose.
Biodiversity	The following information was obtained from the Gamsberg Mine Environmental Management Programme Amendment (SRK Consulting (Pty) Ltd , 2016): ■ The Gamsberg inselberg sits within the Bushmanland Inselberg Region (BIR). The vegetation found on the plains and along the warmer north-facing slopes is characteristic of the Nama Karoo Biome, whereas the vegetation of cooler higher-elevation plains and south-facing slopes is characteristic of the Succulent Karoo Biome. ■ The vegetation found on the Bushmanland inselbergs forms a distinct centre of plant endemism located within the larger Eastern Gariep Centre of Endemism. As there are a number of species identified that are considered to be endemic to the Bushmanland inselbergs and the BIR itself, the region has been termed "*Bushmanland Inselberg Centre of Endemism*". ■ The Gamsberg inselberg is the most regionally important inselberg in the BIR in terms of its biodiversity and composition. A total of 397 plant species were identified and recorded in the area. These species are found within six vegetation types – Aggeneys Gravel Vygieveld, Bushmanland Inselberg Shrubland, Bushmanland Arid Grassland, Bushmanland Sandy Grassland, Azonal and Bushmanland Inselberg Succulent Shrubland. ■ Based on the species of conservation concern identified on site, together with habitat rarity, ecosystem functioning and status, 11 habitats of special concern were

Environmental category	Description
	identified – kloofs, springs, headwater seeps, headwater catchments, temporary rock pools, plateau quartz gravel patches, plains quartz gravel patches, calcrete gravel patches, south slopes, and washes.
Surface water	The following information was obtained from Surface Water Assessment (SLR Consulting (Pty) Ltd , 2020): Water Management Area: ■ The Gamsberg Zinc Mine Mining Right Area (MRA) is influenced by four quaternary catchments D81G, D82A, B82B and B82C. The D81G catchment drains into the Orange River and the D82C catchment is an interior drainage basin that does not drain into the sea. Most of the water courses in the area are transient but the small catchment area on top of the Gamsberg Mine contains a spring and can experience seasonal flows. ■ Most of the water courses in the area are transient but the small catchment area on top of the Gamsberg Mine contains a spring and can experience seasonal flows. The most significant watercourse considered is a drainage line running parallel to the N14 at the base of the northern side of the Gamsberg. Quaternary catchment D82C is an endoreic catchment, which implies only that it is an interior drainage basin that does not drain to the sea. ■ Water is currently supplied to the mine by Sedibeng Water via two existing pipelines from the Orange River. Water is required at the mine for the process plant, drinking, sanitation and other miscellaneous uses like canteen, safety shower, etc.
	Surface water quality (SLR Consulting (Pty) Ltd , 2020): ■ All parameters were within the limits of the SANS241: 2006. The SANS241 Guidelines showed exceedances in Barium noted at the monitoring points GAMS 1SW and GAMS 3SW. The excedences in Barium can be attributed to historic barite mining activities undertaken on the north-eastern side of Gamsberg Mine. ■ It is evident that the water emerging as springs from the Gamsberg Inselberg was fit for domestic use and livestock watering. However, it must be noted that although the barium values comply on average over the monitoring period there were instances where certain samples did not comply with the World Health Organisation (WHO) guideline concentration level for drinking water. ■ Some seasonal variation during the higher rainfall months of February and March may be anticipated with an initial peak in concentrations due to constituents that have built up on surfaces being washed into runoff or infiltrating into the groundwater, followed by dilution effects once these first flush constituents have been removed. These effects are likely to be less evident in the natural springs due to the filtering effects of the soil and the time lag for recharge to groundwater.
Groundwater	The following information was obtained from the Hydrogeological Study (SLR Consulting (Pty) Ltd , 2020): ■ The groundwater contour map indicates that groundwater flow is radially to the northeast and southwest away from the Gamsberg Inselberg. ■ The average groundwater levels measured during the Golder (2007), SRK (2010), and ERM (2013a) hydrocensus investigations were 31.7 mbgl, 28.1 mbgl, and 29.4

Environmental category	Description
	mbgl, respectively. The groundwater levels ranged between artesian conditions and 178.8 mbgl. ■ Regional monitoring boreholes had an average groundwater level of 30.8 mbgl and ranged between 8.6 mbgl and 78.9 mbgl for the April 2019 monitoring round. The mine monitoring boreholes had an average groundwater level of 30.6 mbgl and ranged between 11.6 mbgl and 52.3 mbgl for the April 2019 monitoring round. Groundwater levels of the monitoring network boreholes were quasi-stable and there were no adverse effects due to the pit dewatering affecting mine and regional groundwater levels. ■ No regional aquifers are developed in the area and groundwater occurs mainly in secondary fractured-rock aquifers. Primary weathered zone aquifers are rare and localised because soils are thinly developed. Based on the aquifer classification map (Parsons and Conrad, 1998), the aquifer system underlying the site is regarded mainly as a poor groundwater region. A poor groundwater region consists of a low to negligible yielding aquifer system of moderate to poor water quality. ■ A detailed hydrocensus was conducted within the Gamsberg area in 2012 which has since then been updated in 2018, however it mainly focused on the Swartberg Operations associated with BMC. In total, 42 hydrocensus sites were identified, 38 boreholes of which 18 were privately owned by farmers and 20 were existing Vedanta-owned monitoring boreholes and four natural springs of which two were located on privately owned land and two springs were located on land owned by Vedanta (Golder Associates , 2019). ■ Geochemical tests and analysis indicate that the amount of sulphur present in Jarosite is sufficient to potentially generate acidity, but this is largely balanced by the presence of calcite and lime in the Jarofix, which can neutralise the acidity. The calculated neutralising potential ratio (NPR) and net neutralising potential (NNP) values for Jarofix are within the ranges for which there is uncertainty as to whether acid would be produced. This is because of how close the acid potential (AP) and neutralising potential (NP) values are, meaning that the potential for acid generation of Jarofix would depend on the relative rates at which the Jarosite, lime and calcite react during the formation of Jarofix. The paste pH and net-acid generating capacity (NAG) pH do provide some confidence that the initial pH of leachate from Jarofix would be near neutral to slightly alkaline (SLR Consulting (Pty) Ltd , 2020). ■ Elevated concentrations of iron, manganese, lead, and uranium above the guideline values were noticed in several samples. (ERM , 2013) concluded that elevated EC, TDS, chloride, sulphate, calcium, magnesium, sodium, and zinc were likely to affect the palatability of the groundwater, while nitrate, fluoride, potassium, iron, manganese, lead and uranium presented potential health risks.
Socio-economic	The following information was obtained from the Social Impact Assessment Report (Boersema, 2020) ■ The Project is located within the Khâi-Ma Local Municipality situated in the Namakwa District Municipality of the Northern Cape Province. The Gamsberg Zinc Mine is located at the Gamsberg Inselberg, approximately 14 km east of the town of Aggeneys and 120 km east of Springbok along the N14. Other settlements include Pofadder (57 km) and Pella (60 km).

Environmental category	Description
	■ The Khâi-Ma Municipality had a population of 12 333 people in 2016. Population density is around one person per square kilometre, with the majority of the population living in the rural areas (4 035 people). Aggeneys has a population of 2 053 people (845 households) and Pofadder 2 919 people (733 households). ■ The major contributions to the economy from the district are agriculture, community services and mining. The Gross Domestic Product (GDP) growth rate for the Namakwa District was 3.7% in 2016. The Nama Khoi Municipality was the biggest contributor to the District's GDP (41%) in 2013 while Khâi-Ma municipality contributed 7% (note that this was prior to the establishment of the Gamsberg Zinc Mine). Renewable energy is increasing its contribution to the economy of the district, while tourism is also a relatively large contributor. ■ About 90% of households have piped water and 84% have flush or chemical toilets. Weekly refuse removal is available to 94% of households, and 87.6% have electricity. In 2016, the Khâi-Ma Local Municipality was the local municipality within its district, which had the most access to basic services. However, the Municipality still has problems in delivering satisfactory services to its communities due to lack of capacity and influx of people. The high levels of water consumption are also a big concern. ■ Provincial hospitals are located in Springbok and Upington. The various towns in the municipal areas have functional government primary health care clinics. Serious cases are referred to the Springbok hospital. The District Municipality Integrated Development Plan (IDP) lists the following main objectives: ■ Ensuring the delivery of basic services which include water, sanitation, electricity, and waste management. ■ Creation of job opportunities through the community public works programme. ■ Building municipal capacity to enable municipalities to collect their revenue. ■ Ensuring sustainable economic and social transformation in the district. ■ Promote a society with a renewed sense of identity and confident in their skills and knowledge. ■ Bridging the digital divide.

8.0 CLOSURE VISION

The overarching closure vision proposed for BMM, as adopted in the 2020 mine closure update, is as follows (SLR Consulting (Pty) Ltd , 2020).

The primary objective is to strive towards achieving closure that would be widely accepted and cost-effective for the Gamsberg Zinc Mine. The BMM/Gamsberg Zinc Mine Closure Vision aims to make sure the BMM/Gamsberg Zinc Mine zone of influence is a safe, stable, non-polluting and healthy environment with predominantly grazing potential supporting local biodiversity and small-scale, socio-economic enterprises

The above closure vision will be used to guide future conceptualisation of appropriate closure objectives and associated closure measures for the additional infrastructure and the total mining operation towards ensuring that the closure planning is practical, achievable, and implementable.

9.0 ENVISAGED NEXT LAND USES

Possible options identified for post closure land-use at BMM (including the Gamsberg Zinc Mine) from all the data collected include five options ranked from most suitable to least suitable (EVES, 2018).

1. Establish a nature reserve on suitable areas, use functional infrastructure for alternative uses where possible and demolish the rest. The remaining infrastructure could be used for accommodation and facilities for eco-tourism (viz. battlefield tours, special species, flowers, and game viewing trails).
2. Leasing all land on a permanent basis.
3. Possible multiple closure enterprises/land use:
    - Sell some property and/or infrastructure for industrial purposes.
    - Sell some houses to employees or other willing buyers.
    - Establish Aggeneys as a functional town run by Khâi-Ma Local Municipality.
    - Outsource all other services (waste management, sewage, water etc.).
    - Establish parts of Aggeneys as a Retirement Village.
    - Transfer ownership of contracting companies, township and other workshops, training centre and general use facilities to highest bidder.
    - Investigate alternative industries (e.g. algae farming at sewage farms; reprocessing of tailings).
    - Maximise local conditions for solar energy plants.
4. Agricultural development (specialist farming/small farming projects).
5. Demolish town and mining infrastructure and rehabilitate for grazing by game and livestock (in the event that the municipality decides not to assume responsibility for the town after a thorough consultation process).

The public participation process of 2010 indicated the following post closure land use options as appropriate:

- Game ranching (or farming)
- Agricultural projects mixed with conservation and eco-tourism activities.

Note: With the introduction of the additional infrastructure, the most suitable post closure land use is still considered wilderness/nature reserve and the promotion of eco-tourism in the area.

10.0 CLOSURE-RELATED RISKS

A preliminary screening level risk assessment was conducted to initiate alignment to GN.R. 1147 requirements. The methodology adopted is summarised as follows:

Eight categories are considered to describe the nature of the risk, with the primary category being the one that the assessors determine is impacted most significantly should the risk be manifest. The nature of the risk is assessed to fall into one of the following categories:

- Schedule
- Cost
- Safety
- Occupational health
- Environment
- Legal and regulatory
- Social / communities
- Reputation

Once the risks were captured, the probability of the risk occurring, as well as the consequence of the risk occurring (i.e., high, significant, medium, or low) were rated according to the criteria presented in Figure 3, thus determining the pre-mitigation risk level. Measures were then devised to mitigate the risk, followed by a re-assessment of the post mitigation risk level, again according to Figure 3.

The risks identified are provided in Table 2 according to:

- Aspect/activity, within the following categories:
  - River diversion
  - Topsoil resources
  - Access roads, potential hardstands
  - Socio-economic (internal and external) and
  - Residual risks
- Risk driver/causes
- Consequence/unwanted event
- Risk rating pre-mitigation
- Risk rating post mitigation

The full screening level risk assessment, including the proposed mitigation measures, is provided in APPENDIX A.

Projects / Mine Closure Risk Matrix

Risk Matrix		CONSEQUENCE				
Consequence Type		**1 - Insignificant**	**2 - Minor**	**3 - Moderate**	**4 - High**	**5 - Major**
Schedule		Less than 1% impact on overall project timeline	May result in overall project timeline overrun equal to or more than 1% and less than 3%	May result in overall project timeline overrun of equal to or more than 3% and less than 10%	May result in overall project timeline overrun of equal to or more than 10% and less than 30%	May result in overall project timeline overrun of 30% or more
Cost		Less than 1% impact on the overall budget of the project	May result in overall project budget overrun equal to or more than 1% and less than 3%	May result in overall project budget overrun of equal to or more than 3% and less than 10%	May result in overall project budget overrun of equal to or more than 10% and less than 30%	May result in overall project budget overrun of 30% or more
Safety		First aid case	Medical treatment case	Lost time injury	Permanent disability or single fatality	Numerous permanent disabilities or multiple fatalities
Occupational Health		Exposure to health hazard resulting in temporary discomfort	Exposure to health hazard resulting in symptoms requiring medical intervention and full recovery (no lost time)	Exposure to health hazards/ agents (over the OEL) resulting in reversible impact on health (with lost time) or permanent change with no disability or loss of quality of life	Exposure to health hazards/ agents (significantly over the OEL) resulting in irreversible impact on health with loss of quality of life or single fatality	Exposure to health hazards/ agents (significantly over the OEL) resulting in irreversible impact on health with loss of quality of life of a numerous group/population or multiple fatalities
Environment		Lasting days or less; affecting small area (metres); receiving environment highly altered with no sensitive habitats and no biodiversity value (e.g. urban / industrial areas).	Lasting weeks; affecting limited area (hundreds of metres); receiving environment altered with little natural habitat and low biodiversity value	Lasting months; affected extended area (kilometres); receiving environment comprising largely natural habitat and moderate biodiversity value	Lasting years; affecting area on sub-basin scale; receiving environment classified as having sensitive natural habitat with high biodiversity value	Permanent impact; affecting area on a whole basin or regional scale; receiving environment classified as highly sensitive natural habitat with very high biodiversity value
Legal & Regulatory		Technical non-compliance. No warning received; no regulatory reporting required	Breach of regulatory requirements; report/involvement of authority. Attracts administrative fine	Minor breach of law; report/investigation by authority. Attracts compensation/ penalties/ enforcement action	Breach of the law; may attract criminal prosecution, penalties/ enforcement action. Individual licence temporarily revoked	Significant breach of the law. Individual or company law suits; permit to operate substantially modified or withdrawn
Social / Communities		Minor disturbance of culture/ social structures	Some impacts on local population, mostly repairable. Single stakeholder complaint in reporting period	On going social issues. Isolated complaints from community members/ stakeholders	Significant social impacts. Organized community protests threatening continuity of operations	Major widespread social impacts. Community reaction affecting business continuity. "License to operate" under jeopardy
Reputation		Minor impact; awareness/ concern from specific individuals	Limited impact; concern/ complaints from certain groups/ organizations (e.g. NGOs) period	Local impact; public concern/ adverse publicity localised within neighbouring communities	Suspected reputational damage; local/ regional public concern and reactions	Noticeable reputational damage; national/ international public attention and repercussions
PROBABILITY		**RISK RATING**				
5 - Almost Certain Once a year	The unwanted event has occurred frequently; occurs in order of one or more times per year & is likely to reoccur within 1 year *	**11 (Medium)**	**16 (Significant)**	**20 (Significant)**	**23 (High)**	**25 (High)**
4 - Likely Once every 3 years	The unwanted event has occurred infrequently; occurs in order of less than once per year & is likely to reoccur within 3 years *	**7 (Medium)**	**12 (Medium)**	**17 (Significant)**	**21 (High)**	**24 (High)**
3 - Possible Once every 10 years	The unwanted event has happened at some time; or could happen within 10 years*	**4 (Low)**	**8 (Medium)**	**13 (Significant)**	**18 (Significant)**	**22 (High)**
2 - Unlikely Once every 30 years	The unwanted event has happened at some time; or could happen within 30 years *	**2 (Low)**	**5 (Low)**	**9 (Medium)**	**14 (Significant)**	**19 (Significant)**
1 - Rare > Once every 30 years	The unwanted event has never been known to occur; or it is highly unlikely that it will occur within 30 years *	**1 (Low)**	**3 (Low)**	**6 (Medium)**	**10 (Medium)**	**15 (Significant)**

* The unwanted event can refer to events that have occurred in Vametco's business, the mining industry or other sectors

Risk Rating	Risk Level	Guidelines for Risk Matrix
21 to 25	High	A high risk exists that management's objectives may not be achieved. Appropriate mitigation strategy to be devised immediately.
13 to 20	Significant	A significant risk exists that management's objectives may not be achieved. Appropriate mitigation strategy to be devised as soon as possible.
6 to 12	Medium	A moderate risk exists that management's objectives may not be achieved. Appropriate mitigation strategy to be devised as part of the normal management process.
1 to5	Low	A low risk exists that management's objectives may not be achieved. Monitor risk, no further mitigation required.

Figure 3: Risk matrix

Table 2: Screening level risk assessment

Aspect / Activity	Risk driver / causes	Consequence / unwanted event	Risk pre-mitigation	Risk post mitigation
River diversion, additional pipelines, and expansion of dangerous goods storage				
Runoff diversion furrows	Furrows become blocked or overtop	Accelerated recharge to final voids, loss of catchment yield and costly post-closure (residual) maintenance costs	13 (S)	9 (M)
Topsoil resource	Lack of available topsoil	Lack of topsoil to rehabilitate disturbed areas at closure in order to meet EMPr commitments, resulting in shallow compacted soils and a permanent loss of land capability and not achieving next land use commitments	23 (H)	18 (S)
Rehabilitation - backfilled areas	Rehabilitated backfilled areas are not free draining to the environment, resulting in ponding of runoff water and reduced clean water runoff	Waterlogging results in failure of rehabilitated grasslands and loss of land capability, as well as decreased runoff that reduces catchment yield	17 (S)	9 (M)
Access roads and dangerous goods storage				
Hydrocarbon spillages	Leakage and/or spillage of hydrocarbons (diesel, oil, etc.) from earth moving equipment or fuel storage	Hydrocarbon contamination of surface and ground water, and of soils, resulting in reduced fertility and land capability with poor rehabilitation success	17 (S)	9 (M)
Socio-economic – internal & external				
**Please note that the in the context of the permitting project there will be no social impact at closure. The social impact of closure is detailed in the mine wide closure plan*				
Residual				
Post-closure maintenance	Inadequate maintenance of stormwater management structures and rehabilitated land by next land user over the long term	Failure of storm water management structures and rehabilitated land through mismanagement (e.g., overgrazing), could be blamed on inadequate closure measures for which Black Mountain Mining (Pty) Ltd may be held responsible This situation could potentially have both cost and reputational consequences	18 (S)	10 (M)
Climate	Failure to consider climate change impacts in closure designs and models	Climatic changes could impact stability or cover integrity of mine residue deposits	14 (S)	10 (M)

11.0 CLOSURE SCENARIO

To guide the determination of scheduled closure costs, the likely closure scenario has been defined in terms of the following:

- **Remaining operational period until cessation of operations** that allows for the execution of routine closure-related work as part of operations, as far as possible, to limit the remaining closure costs at LoM.
- **Closure period and beyond** that allows for the mine site to be handed over to the closure contractor(s), if the mine does not do the closure work, once most operational personnel have left the site, to implement the closure measures and related engineering in terms of the final closure plan.

The closure scenario, as seen in Table 3 below, is based on the LoM, mining planning and the battery limits for closure, focusing specifically on the following key aspects:

- River diversion
- New potable water pipeline
- Expansion of dangerous goods storage facilities
- Water management

Table 3: Closure scenario for BMM additional infrastructure

Remaining operational period until cessation of operations	Closure and beyond
Infrastructure	
■ Surface infrastructure considered redundant / defunct during operations (i.e. obsolete mining business partner, roads no longer needed to support operations and redundant buildings) would have been appropriately decommissioned and footprint areas rehabilitated ■ Suitable transfer agreements would be in place for infrastructure identified for third party beneficial reuse (e.g. offices, access roads, etc.)	■ Final dismantling, removal and demolition would be undertaken with scrap steel prepared for salvage. Excess material with no further beneficial reuse will be safely disposed of ■ Surface contamination due to the removal of surface infrastructure will be collected and removed for safe disposal ■ Disturbed footprint areas will be suitably rehabilitated and vegetated to achieve a succession trajectory that will eventually result in the agreed end land use and desired ecological state
Water/runoff management	
■ Operational water management will continue for the remaining life of facility	■ Site drainage lines will be reinstated / developed on the rehabilitated surface areas ■ Surface water and groundwater monitoring will continue to be conducted for five years post closure to demonstrate success of implemented closure measures

12.0 CLOSURE OBJECTIVES

The initial closure philosophy and objectives below have been developed to guide the closure measures to be implemented on site towards achieving the above closure vision.

- **Physical stability:** to remove and/or stabilise/rehabilitate surface infrastructure and related disturbance, unavoidable mining residue and open pits that are present on the mine, to facilitate the implementation of the planned next land use, by ensuring that:
  - All rehabilitated disturbed areas that have the potential for wind and/or water erosion will be provided with a suitable vegetation cover to combat these aspects/forces.
  - Monitoring is undertaken to demonstrate the success of the closure and rehabilitation measures implemented.
- **Environmental quality:** to ensure that local environmental quality is not adversely affected by possible physical impacts and chemical contamination arising from the rehabilitated areas and that catchment yield is sustained as far as possible, by ensuring that:
  - Rehabilitated mining areas do not present any unacceptable environmental risks.
  - Environmental impacts will be investigated and addressed at source. If not possible, the required intervention / mitigation measures will be implemented, and preferably during operations to limit the intervention required at closure.
  - Ongoing monitoring will be undertaken to ensure the quality of the surface and groundwater, specifically in terms of acidity and salinity, remains within acceptable threshold levels.
- **Health and safety:** to limit the possible health and safety threats to humans and animals using the rehabilitated mine site as it becomes available, by ensuring that:
  - Health and safety threats are prevented as far as possible. If not, to limit these to acceptable risks that can be reasonably/realistically achieved.
- **Land capability / land-use:** to re-instate suitable land capabilities over the rehabilitated portions of the mine site, by ensuring that:
  - Land capability will be reinstated to match the pre-mining land capabilities as far as possible. If not, effort will be put into achieving the next best land capability.
- **Aesthetic quality:** to leave behind a rehabilitated mine site that, in general, is not only neat and tidy with an acceptable overall aesthetic appearance, but which is also aligned to the respective land uses, by ensuring that:
  - Recognition is given to the local/natural landscape forms, and these be repeated as far as practically possible.
  - Rehabilitation measures that appear unnatural/visually intrusive will be avoided as far as possible.
- **Biodiversity:** to encourage, where appropriate the re-establishment of native vegetation on the rehabilitated mine sites, such that the terrestrial biodiversity is largely re-instated over time, by ensuring that
  - Viable self-sustaining vegetation communities are established.

- Invasive species that could threaten the reinstatement of the desired vegetation communities are actively eradicated.

- **Social:** to ensure that the measures and/or contributions made by the mine towards the long-term socio-economic benefit of the local communities are sustainable, and aligned to the detailed socio-economic mine closure plan, by ensuring that:
  - Local communities are adequately informed about mine closure (next land use planning, scheduled closure and reskilling initiatives linked to the next land use, where possible).

13.0 CLOSURE MEASURES

The closure actions / measures are largely informed by the devised closure objectives and outcomes of the ERA. The closure actions, detailed in Table 4, are developed to implement the next land use, while mitigating environmental risks identified for the mine.

Table 4: Closure measures developed for each closure aspect of BMM Gamsberg Zinc Mine project

Aspect	Closure measures
Infrastructural components	
Steel structures, reinforced concrete structures, offices, workshops, residential buildings and related structures and infrastructure	■ Identify structures that could be beneficially re-used and establish agreements for transfer/handover ■ Demolish all remaining surface infrastructure with no beneficial post-closure re-use ■ Conduct shaping and/or replace topsoil so that all concrete foundations are at least 1 m below surface and place topsoil aligned with the envisaged land capability of each area (but to a minimum of 350mm) ■ Rip to alleviate compaction ■ Ameliorate soils based on dedicated soil fertility sampling ■ Establish vegetation by applying suitable seed mix
Pipelines	■ Dismantle / demolish all pipelines ■ Transport to an existing mine scrapyard or material storage area for future re-use
Water / runoff management	
Reinstatement of drainage lines	■ Reinstate site drainage lines over rehabilitated areas
Post closure aspects	
Surface water and groundwater monitoring	■ Continue with annual groundwater monitoring for a period of at least five years post-closure (or until site relinquishment criteria have been met) ■ Continue with annual surface water monitoring for a period of at least five years post-closure (or until site relinquishment criteria have been met)
Rehabilitation monitoring	■ Conduct rehabilitation monitoring for a period of 10 years post-closure (or until site relinquishment criteria have been met)
Care and maintenance	■ Conduct care and maintenance over rehabilitated areas for a period of 10 years post-closure (or until site relinquishment criteria have been met)

Aspect	Closure measures
Preliminary and general / contingencies	■ P&Gs were applied at 25% and contingencies were applied at 10%
Residual closure aspects	
Water treatment	■ Not applicable, it is assumed that further required water management / treatment would be a mine wide concern and not occur in isolation

14.0 MONITORING AND MAINTENANCE

14.1 Audit and reporting requirements for the closure plan

Table 5 outlines the schedule of internal, external, and legislated audits of the closure plan for a year (in isolated cases every 2nd year) and includes the required reporting that is to be undertaken to ensure that this closure plan is implemented, as required, on an annual basis.

Table 5: Schedule outlining internal, external, and legislated audits and reporting of the closure plan

Type of audit	Name of audits	Responsibility	Frequency of audits	Approximate schedule	Approach taken to address and close out audit findings
Internal	Water Use Licence audit	Site environmental coordinators	Annual	Q1	Internal audit findings are captured in the site Environmental Management System (EMS) as actions for implementation and close-out. Resources (people and funds), and timeframes, are assigned to all audit findings, and progress is tracked on an EMS platform.
	Legal compliance audit	Permitting specialist	Every 2nd year	Q1	
	Environmental Performance Audit	Site environmental coordinators	Annual	Q2	
	ISO14001 EMS audit	EMS specialist	Annual	Q2	
	GN704 water audit	Water specialist	Annual or every 2nd year	Q3	
	Closure knowledge gap audit	Site environmental coordinators	Annually	Throughout the year	
External	Closure cost and closure plan update	External closure and rehabilitation specialist	Annually	As per financial year end	Closure costing report and closure plan to be submitted to external auditors.
	Water Use License audit	External water consultant	Annual	Q3	Capture external audit findings in the site Environmental Management System (EMS) as actions for implementation and close out. Resources (people and funds), and timeframes, are assigned to all audit findings, and progress
	Legal compliance audit	External legal compliance consultant	Every 2nd year	Q2	
	Environmental audits	External environmental consultant	Annually (comprises of old EMPr PAR and audit of environmental authorizations)	Q4	

Type of audit	Name of audits	Responsibility	Frequency of audits	Approximate schedule	Approach taken to address and close out audit findings
	ISO14001 EMS audit	External EMS consultant	Annual	Q3	is tracked on an EMS platform.
	GN704 water audit	Appointed water consultant	Annual or every 2nd year	Q4	

14.2 Monitoring programme and site relinquishment criteria

The rehabilitation performance of all areas rehabilitated after decommissioning and closure, but prior to site relinquishment (i.e., the pre-site relinquishment monitoring period), must be documented in a dedicated biannual rehabilitation performance report until site relinquishment criteria are met. The report should reflect on the findings of the monitoring undertaken, rehabilitation performance and whether corrective action is required.

The rehabilitation monitoring programme and preliminary site relinquishment criteria (including required analysis criteria for surface rehabilitation, surface water and groundwater) are presented Table 6.

The monitoring programme and site relinquishment criteria were developed for the following purposes:

- To establish and create a post-closure knowledge base, that is comparable to the operational phase knowledge base.
- To demonstrate compliance with regulatory requirements (such as instream water quality as per the water use licence).

To demonstrate success/performance of the implemented closure measures (i.e., to demonstrate that the site relinquishment criteria have been achieved) in support of a final closure certificate.

Table 6: Preliminary monitoring programme and site relinquishment criteria for BMM[2]

Monitoring				Site relinquishment criteria		Reporting and corrective action	
Component/aspect	**Monitoring objective**	**Monitoring network**	**Monitoring method and frequency**	**Metrics/target**	**Initial criteria (performance success)**	**Reporting**	**Recommended corrective action**
Surface water							
In-stream surface water quality	To monitor changes (improvement) in surface water quality following final rehabilitation at closure (to determine when water quality objectives and targets are met).	Review operational surface water monitoring and sampling network, to ensure monitoring points are appropriate for the post-closure situation.	Collect surface water samples monthly for chemical analysis by an accredited laboratory (monitor parameters stated in WUL). Sample monthly for one year after the final rehabilitation activities, then revaluate frequency of sampling. Conduct in-field measurements for pH and EC (as a minimum) when samples are collected – to allow for immediate corrective action if non-compliances are detected. Monitoring will continue for at least 5 years post-closure (or until a closure certificate is issued).	In-stream water quality targets set in WUL for samples collected from the monitoring points at the mine site as stipulated in the WUL.	Surface water quality has improved to meet the WUL water quality thresholds. Or Surface water quality has improved to comply with the Water Quality Management Objectives (WQMO) as defined as the Reserve for the area in the WUL.	Surface water monitoring reports and data will be submitted to the DWS as per the WUL (but amend to six-monthly frequency on closure).	Investigate the cause of any non-compliance in surface water quality leaving the site (using the source – pathway – receptor model) and address the contaminant source with improved rehabilitation and / or appropriate mitigation measures.
Groundwater							
Groundwater quality	To monitor ground water quality in both natural aquifers and mine workings, to track water quality changes (improvements) over time as a result of closure rehabilitation activities.	Review operational groundwater monitoring and sampling network and revise as advised by a specialist.	Review the operational groundwater monitoring plan and program, and revise to meet post-mining monitoring needs by: Ensuring that key borehole sampling sites are retained (or new ones introduced as required) to monitor groundwater quality at key points in the mining rights area. Continuing to monitor the comprehensive suite of water quality parameters that allow an ion balance to be calculated (same as those analysed during operations) - provides assurance on accuracy of lab results and ensure that all potentially harmful cations and anions are analysed. Groundwater samples will be collected quarterly for chemical analysis by an accredited water laboratory.	Water quality analyses show that groundwater at and beyond the mine boundary meets the National Water Quality Standards for potable water at 95th percentile (or as a minimum have a chemistry typical of baseline groundwater quality of the area). The groundwater monitoring plan can demonstrate the movement and extent of any contaminated groundwater plumes. Offsite borehole water qualities are not impacted by the closed mine, and do not impact neighbours.	Groundwater samples show improving water qualities trending towards background levels.	Results and findings will be compiled into a quarterly water report, with attached laboratory results. An annual compliance report will be compiled and submitted to the authorities for evaluation and comment.	Investigate the cause of any non-compliance in borehole water qualities (using the source – pathway – receptor model) and develop appropriate mitigation measures to reduce the generation of contamination at source where possible, or to contain or intercept polluted groundwater movement towards sensitive receptors where this is necessary.

[2] This monitoring programme and associated relinquishment criteria only relate to the project being permitted, the mine wide closure plan will include additional requirements i.e surface and groundwater. Only applicable monitoring requirements have been included.

Monitoring				Site relinquishment criteria		Reporting and corrective action	
Component/aspect	**Monitoring objective**	**Monitoring network**	**Monitoring method and frequency**	**Metrics/target**	**Initial criteria (performance success)**	**Reporting**	**Recommended corrective action**
			Monitoring of boreholes will continue for at least 5 years post-closure (or until a closure certificate is issued).	The calculated ion balance for each water sample does not exceed a 5% imbalance (sanity check on lab results).			
Surface rehabilitation							
Land capability	To continuously measure rehabilitation performance against the land capability objectives committed to as part of next land use planning.	All areas disturbed by mining activities and land reinstated by rehabilitation activities.	Regularly conduct post-mining land capability assessments of rehabilitated areas that include: An assessment of soil depth and soil bulk density on a 100 x 100 m grid. Digging of a soil test pit every 9 ha, to: Collect soil samples for lab analysis of soil properties (bulk density & soil texture), record rooting depth, root density, and bio-perturbation, collect soil samples for lab analysis of soil (pH, resistance, organic carbon, major cations and anions). Create land capability map for rehabilitated sites according to the Chamber of Mines' Rehabilitation Guidelines (2018). Land capability assessment is typically a once-off exercise on rehabilitated units within 3 years of completion of the rehabilitation work.	Land capability commitments are achieved.	Site has an accurate post-mining land capability map based on ongoing. assessment according to site-wide land capability commitments, so that an understanding of how the mine is tracking against its targets is continuously refined. The areas rehabilitated to different land capability classes in the post-mining landscape do not vary by more than 10% from defined land capability targets.		Consult with DMRE on any land capability shortfalls that cannot be addressed with available topsoil resources and agree new post-mining land capability targets that will determine the scope of post-mining land uses, that can then be communicated with key stakeholders as part of the mine closure process. Use topsoil stockpile reserves, if available, to improve land capability, where possible. In-fill areas where differential settling has occurred, and re-shape to be free draining (towards maintaining prescribed land capability depths).
Soil fertility	To achieve basal soil fertility levels that will support a self-sustaining vegetation cover (within 5 – 10 years of completion of rehabilitation).	All areas disturbed by mining activities and land reinstated by rehabilitation activities.	Sample rehabilitated soils annually for the first 5 years, and every 3 years thereafter until fertility targets met or a closure certificate is issued. Analyse samples at a certificated soils laboratory.	Soil fertility meets the minimum requirements for maintenance of grassland/pastures. Soil analyses indicated: ■ pH in range of 5.0 to 8.5 ■ Resistance is >300 Ω, ■ P is >20mg/kg, and ■ K is >100mg/	Soil analyses indicate that soils on rehabilitated areas are not salinized, have the correct pH, and have sufficient levels of fertility to support a sustainable vegetation cover.	Findings will be reported in a soil fertility report, after each assessment.	Where soil is deficient, ameliorate sufficiently to address the deficiency and to provide a sustainable vegetation cover in support of the next land use.

Monitoring				Site relinquishment criteria		Reporting and corrective action	
Component/aspect	**Monitoring objective**	**Monitoring network**	**Monitoring method and frequency**	**Metrics/target**	**Initial criteria (performance success)**	**Reporting**	**Recommended corrective action**
				■ N is in adequate supply so as not to induce yellowing of vegetation			
Surface erosion	To monitor rehabilitated areas for soil erosion to ensure that a self-sustaining vegetation cover is established that will minimise soil loss through raindrop impact and rainfall runoff erosion.	All areas disturbed by mining activities and land reinstated by rehabilitation activities.	Conduct visual inspections for erosion (sheet, rill, and gulley erosion) on an annual basis for the first 5 years (end of wet season), and every 3 years thereafter until landform equilibrium is met.	Visual inspections of rehabilitated areas indicate that erosion has been stabilised by rehabilitation activities and is not significantly higher than surrounding natural areas.	No new erosion seen on rehabilitated land after 5 years.	Findings will be reported in an internal rehabilitation report after each assessment.	Eroded areas will be stabilised by infilling and reshaping, and by establishing vegetation on the repaired areas/ bare patches, as required.
Vegetation establishment	To ensure the successful establishment of suitable perennial grass species on rehabilitated areas, and that these perennial species persist in the rehabilitated landscape.	All areas disturbed by mining activities and land reinstated by rehabilitation activities.	Monitor the establishment and persistence of vegetation on rehabilitated areas (species composition and basal cover), using standard pasture assessment methods. To be undertaken by a suitably qualified specialist. Monitor annually for 5 years, then every 3 years until a sustainable vegetation cover has been established.	The vegetation established on the rehabilitated areas should be cluster vegetation that mimics the current vegetation occurring naturally on the rocky slopes of hills.	Vegetation on rehabilitated areas comprises at least 4 perennial grass species, one of which has a creeping habit, and that these species provide a basal cover of at least 15% after 3 years.	Findings will be reported in an annual rehabilitation report.	Where the rehabilitation targets for vegetation establishment are not met, re-seed and apply appropriate adaptive management strategies to correct any deterioration in the species composition and cover (e.g., review defoliation/ fertilisation practices and modify accordingly).
Invasive alien species	To eradicate or control declared Category 1, 2 and 3 invader species on both rehabilitated land and on unmined areas within the mining rights area. To minimise the threat posed by invasive species to reinstated natural ecosystems and habitats, and biodiversity.	All areas disturbed by mining activities and land reinstated by rehabilitation activities.	Conduct a visual inspection for invasive species over the site on an annual basis, focussing on rehabilitated and previously disturbed areas, and on areas where invasive species have been eradicated. Inspect annually for the first 3 years after closure, and then every 3 years, at least, until closure.	The site is free of declared alien invasive plant species (Cat 1 – 3 invader species as per CARA, 1983 & Cat 1a, 1b and 2 as per NEM:BA, 2004).	The site is free of declared alien invasive species (CARA Cat 1 – 3 & NEMBA 1a, 1b and 2) invader species), and if not compliant the control programmes in place are effective and are eradicating alien invasive plant species.	Findings will be reported in a rehabilitation report after each assessment.	Where measures do not effectively control/eradicate alien invasive plant species, review control measures and modify to improve effectiveness.

15.0 CLOSURE COSTS

15.1 Assumptions and qualifications

This section describes the key assumptions made and the implications for the EMPr.

15.1.1 General costing assumptions

- The unit rates are third-party contractors' rates. The March 2022 base rates were applied and reflected as at March 2022.
- The closure costs for the site could comprise several cost components. This report only addresses the decommissioning and rehabilitation costs, equating to an outside (third party) contractor establishing on-site and conducting the outstanding rehabilitation-related work.
- Based on the above, dedicated contractors would be commissioned to conduct the demolition and rehabilitation work on the site. This would inter alia require establishment costs for the contractors and hence, the allowance for preliminary and general (P&Gs) in the cost estimate.
- No allowance was made to offset the salvage value of the scrap against the demolition costs.
- Allowance has been made for third party contractors and consultants to conduct compliance monitoring and the required care and maintenance work following the rehabilitation of outstanding items.
- The closure costs were only computed for the scheduled closure situation.

15.1.2 Infrastructure

- Costs associated with the removal of infrastructure that falls within the mine path will be included within the mine's operational budget.
- Once the infrastructure has been removed, the remaining footprint areas will be shaped to be free draining to avoid ponding.
- It is assumed that the footprint for the relocated infrastructure will be the same as the current infrastructure; however, the relocation costs are assumed for the operational budget and will not be directly associated to the project.

15.1.3 Water management

- An allowance for the reinstatement of drainage lines at the river diversion

15.2 Closure and pre-site relinquishment costs

The unscheduled and scheduled closure costs for the Gamsberg Zinc Mine phase 2 project additional infrastructure, as at March 2022, are summarised in Table 7.

Table 7: Scheduled closure costs for the Gamsberg Zinc Mine, as at March 2022

	Closure Components	Scheduled Closure (2039)	
1	Infrastructural aspects	R	1,455,554.72
2	Mining aspects	R	-
3	General surface rehabilitation	R	-
4	Water / runoff Management	R	-
	Sub-Total 1	**R**	**1,455,554.72**
5	**P&Gs, Contingencies and Additional Allowances**		
5.1	Preliminaries and general	R	363,888.68
5.2	Contingencies	R	145,555.47
5.3	Additional studies	R	-
	Sub-Total 2	**R**	**509,444.15**
6	**Pre-site Relinquishment Monitoring and Aftercare**		
6.1	Surface water monitoring	R	17,957.80
6.2	Groundwater monitoring	R	53,873.35
6.3	Rehabilitation monitoring	R	-
6.4	Care and maintenance (High Intensity)	R	-
6.5	Care and maintenance (Low Intensity)	R	-
	Sub-Total 3	**R**	**71,831.15**
	Closure Total Excl. VAT. (Sub-total 1 +2 +3)	**R**	**2,036,830.02**
7	**Residual Closure Costs**		
7.1	Water treatment	R	-
	Sub-Total 4	**R**	**-**
	Residual Closure Total Excl. VAT. (Sub-total 4)	**R**	**-**
	Total including residual closure costs Excl. VAT. (Sub-total 1 +2 +3+4)	**R**	**2,036,830.02**
	Grand Total (Incl. P&Gs) Excl. VAT.	**R**	**2,036,830.02**
	Grand Total Incl. VAT @ 15% (Sub-total 1 +2 +3+4)	**R**	**2,342,354.53**

16.0 REHABILITATION PLANNING

The way soils are managed during the mining operations dictates, to a large extent, the post mining land capability and thus the end land use potential that can be achieved. It also has a significant impact on the groundwater infiltration and the overall water make of the entire mining area and will affect the quantity and quality of water make at the mine, not only during the life of the mine, but for many years post closure.

This section provides a summary of pertinent information and principles related to the rehabilitation and closure of the operation additional infrastructure to be incorporated into the EMPr, including additional information to guide topsoil stripping and placement.

16.1.1 Topsoil management

Restoring land capabilities and land uses post closure will require operational accuracy in constructing the post mining landform and managing topsoil resources throughout the LoM. Stripping and storing different soil types separately and ensuring that usable topsoil is not over stripped and mixed with subsoils is a key component of effective rehabilitation.

16.1.1.1 Soil stockpiling

Only stockpile soils when necessary and maximise opportunities for live placement of stripped soils to their final destination (direct placement) aligned with the topsoil placement plan to be developed. The following management measures should be implemented to manage stockpiling activities:

- Develop and implement innovative soil stockpiling methodologies and explore possible equipment modifications to limit compaction of soils during stripping and stockpiling related to the box-cut development.
- Develop stockpiling procedures that will limit the heavy traffic across stockpiled soils and train operators and supervisors.
- Tip and level soil heaps as tightly (close together) as possible to maximum lift depths to limit compaction during stockpile development. Graders should not be used to level or shape placed topsoil as it will cause irreversible soil compaction.
- Locate soil stockpiles where they do not interfere with current and future mining operations and with final replacement of topsoil on either subsoil or reshaped spoils in mind.
- The stockpiles should be placed in a free draining location to minimize soil erosion and possible water logging.
- Provide adequate drainage on and around stockpiles to control erosion from wind and water. Provide berms and trenches or suitable alternative control measures as required.
- Store the soil derived from surface infrastructure areas as close as possible to where they will be required for rehabilitation purposes.
- Subsoil is to be used for cladding safety berms on highwalls and ramps where applicable, while topsoil should be used exclusively for rehabilitation and closure purposes.

16.1.1.2 Soil placement

Soil placement from stockpiles or as part of the concurrent rehabilitation process (live placement) requires the following management measures:

- Develop a detailed soil placement plan based on the post mining landform design and desired land use capability.

- Arable soil thickness groupings should be grouped together in economically viable plot sizes.
- Develop soil placement procedures and traffic management plans to limit any heavy traffic across placed soils.
- Tip soil heaps at appropriate spacing to limit dozing distances to achieve the prescribed depth.
- Only utilise the mid-sized dozers and equipment with low ground pressure to level placed topsoil (graders should not be used for this purpose as it causes irreversible compaction).
- Rip all placed topsoil to alleviate compaction and ensure disturbance of the soil / spoil interface.

16.1.2 Topsoil stripping and post mining land capability planning

It is recommended that the available baseline soil assessments and the pre-mining capacity classes that were identified as part of the original development be used to develop dedicated topsoil stripping and topsoil placement plans that are aligned with the drainage requirements of the post mining topography.

16.1.3 Integration with mine planning

Both the topsoil stripping and topsoil placement layers should be submitted to the mining planners for inclusion in future scenarios and detailed planning for implementation.

The topsoil placement plans should be reviewed/updated as needed to address the following:

- Developed in conjunction with the stripping plan and aligned with the drainage framework and topography provided by post mining landform design.
- Refine and align the placement plan as the post mining landform design is developed in more detail for construction and to account for possible mine plan changes.
- Incorporate the outcomes of specialist end land use studies as this aspect is developed and refined over the LoM.
- Incorporate the placement planning into the mine planning and scheduling to ensure integration with mining activities.

16.1.4 Stormwater management

The following actions are required to address risks related to storm water management:

- Identify and address the areas with a potential high drainage density and storm water velocity through an iterative process of testing and adjusting/refining the post mining landform design with storm water and erosion modelling.
- Construct additional storm water measures where required based on detailed hydrological calculations and engineering designs.
- Design the post mining landform based on sound geomorphological principles to limit the requirement for constructed measures that could fail or might require ongoing maintenance.
- Provide clean and dirty water separation measures during operations to limit soil loses due to erosion and contamination.
- Re-vegetate all rehabilitated areas as soon as practically possible.

16.1.5 Vegetation establishment

The following measures are required:

- Site specific rehabilitation methodologies and strategies should be developed that are aligned with the desired end land capability (leverage learnings from other operations).
- Develop operational procedures and train operators and supervisors.
- Define soil amelioration specifications based on dedicated fertility monitoring and keep records of specialist recommendations and fertiliser applications.
- Source fertiliser and seed mixtures from reputable companies to ensure quality and rehabilitation success.
- Implement revegetation measures on all rehabilitated areas as soon as possible, typically including (but not limited to) the following:
  - Deep ripping of all placed soils for effective compaction alleviation.
  - Disc and scarify the ripped area to prepare the seedbed.
  - Apply a suitable seed mixture and soil amelioration based on dedicated fertility sampling and analysis.
  - Seeding should be done between November and mid-January taking cognisance of rainfall (early season seeding results in more successful rehabilitation outcomes).
- Apply follow up seeding and soil amelioration based on monitoring results.
- Implement land management measures based on the land capability and intended land use.

16.1.6 Monitoring and maintenance

The following monitoring is required during the operational phase to ensure appropriate rehabilitation implementation and to ensure that objectives set out in the Closure Plan are systematically achieved over the LoM:

- Develop sign-off criteria for levelled/backfilled areas that must include comparing the monthly survey data (as-built surfaces) to the post mining landform design elevations.
- Monitor all aspects of topsoil stripping, stockpiling and placement to ensure procedures are followed and soils are placed to prescribed areas and depths.
- Annually conduct land capability assessments of newly rehabilitated areas to determine and map the actual soil depths towards incrementally developing a post mining land capability plan.
- Rehabilitation performance monitoring (including vegetation and soil fertility monitoring and carrying capacity assessments) of all rehabilitated areas for a period of five years following revegetation.
- Maintenance and after care of rehabilitated areas will continue for a minimum period of five years after revegetation to confirm that relinquishment criteria have been achieved.
- On-going maintenance including defoliation and maintenance to maintain grass cover vitality so that all rehabilitated areas are maintained at the envisaged carrying capacity.
- Maintain the LoM topsoil balance based on monthly survey data and amend as required to ensure efficient use of topsoil resources for rehabilitation and closure purposes.

17.0 CONCLUSIONS AND RECOMMENDATIONS

This closure framework underpins the BA process for the planned BMM Gamsberg Zinc Mine. The closure framework draws from the available knowledge base, including the most recent GN.R. 1147 closure plan and supporting documents that were compiled for greater mine site in 2021-2022.

It is envisaged that the outcome of this closure framework be consolidated with the annual update of the site wide GN.R. 1147 closure plan (planned for 2023).

Key components of integrated rehabilitation planning have been addressed and include the development of a predictive post mining landform design, pre-stripping and topsoil stripping integrated with the LoM scheduling. Areas that require further attention include the following:

- Dedicated topsoil management plans are required. The topsoil placement plan must be developed and integrated with the post mining landform design, stripping plan and LoM schedule. The placement plan must be based on accurate materials balance data.
- Drainage densities and storm water velocities should be determined by hydrological calculations based on the post mining landform design, the design should be refined as required and additional storm water measures devised for areas of high risk to erosion and scouring.
- Specialist studies are required to develop a comprehensive next land use plan to ensure that the end land use aligns with surrounding land uses and broader strategic land use planning for the region.
- Rehabilitation and closure objectives must be refined and included in the annual rehabilitation plan to ensure that the objectives are systematically addressed as part of the concurrent rehabilitation during the LoM.

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19.0 AUTHORSHIP & DOCUMENT REVIEW

This report has been compiled by Deshree Pillay and reviewed by Johan Bothma. Golder Integrated Management Systems (GAIMS) review done by Johan Bothma. All technical comments and queries can be directed to the Golder Project Manager.

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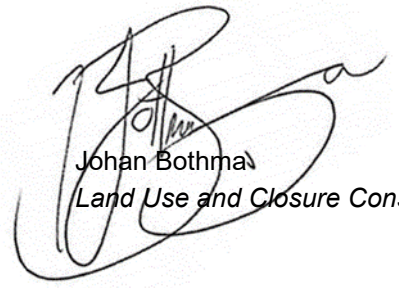

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APPENDIX A

Closure Environmental Risk Assessment

Projects / Mine Closure Risk Matrix

Risk Matrix		CONSEQUENCE				
Consequence Type		**1 - Insignificant**	**2 - Minor**	**3 - Moderate**	**4 - High**	**5 - Major**
Schedule		Less than 1% impact on overall project timeline	May result in overall project timeline overrun equal to or more than 1% and less than 3%	May result in overall project timeline overrun of equal to or more than 3% and less than 10%	May result in overall project timeline overrun of equal to or more than 10% and less than 30%	May result in overall project timeline overrun of 30% or more
Cost		Less than 1% impact on the overall budget of the project	May result in overall project budget overrun equal to or more than 1% and less than 3%	May result in overall project budget overrun of equal to or more than 3% and less than 10%	May result in overall project budget overrun of equal to or more than 10% and less than 30%	May result in overall project budget overrun of 30% or more
Safety		First aid case	Medical treatment case	Lost time injury	Permanent disability or single fatality	Numerous permanent disabilities or multiple fatalities
Occupational Health		Exposure to health hazard resulting in temporary discomfort	Exposure to health hazard resulting in symptoms requiring medical intervention and full recovery (no lost time)	Exposure to health hazards/ agents (over the OEL) resulting in reversible impact on health (with lost time) or permanent change with no disability or loss of quality of life	Exposure to health hazards/ agents (significantly over the OEL) resulting in irreversible impact on health with loss of quality of life or single fatality	Exposure to health hazards/ agents (significantly over the OEL) resulting in irreversible impact on health with loss of quality of life of a numerous group/population or multiple fatalities
Environment		Lasting days or less; affecting small area (metres); receiving environment highly altered with no sensitive habitats and no biodiversity value (e.g. urban / industrial areas).	Lasting weeks; affecting limited area (hundreds of metres); receiving environment altered with little natural habitat and low biodiversity value	Lasting months; affected extended area (kilometres); receiving environment comprising largely natural habitat and moderate biodiversity value	Lasting years; affecting area on sub-basin scale; receiving environment classified as having sensitive natural habitat with high biodiversity value	Permanent impact; affecting area on a whole basin or regional scale; receiving environment classified as highly sensitive natural habitat with very high biodiversity value
Legal & Regulatory		Technical non-compliance. No warning received; no regulatory reporting required	Breach of regulatory requirements; report/involvement of authority. Attracts administrative fine	Minor breach of law; report/investigation by authority. Attracts compensation/ penalties/ enforcement action	Breach of the law; may attract criminal prosecution, penalties/ enforcement action. Individual licence temporarily revoked	Significant breach of the law. Individual or company law suits; permit to operate substantially modified or withdrawn
Social / Communities		Minor disturbance of culture/ social structures	Some impacts on local population, mostly repairable. Single stakeholder complaint in reporting period	On going social issues. Isolated complaints from community members/ stakeholders	Significant social impacts. Organized community protests threatening continuity of operations	Major widespread social impacts. Community reaction affecting business continuity. "License to operate" under jeopardy
Reputation		Minor impact; awareness/ concern from specific individuals	Limited impact; concern/ complaints from certain groups/ organizations (e.g. NGOs) period	Local impact; public concern/ adverse publicity localised within neighbouring communities	Suspected reputational damage; local/ regional public concern and reactions	Noticeable reputational damage; national/ international public attention and repercussions
PROBABILITY		**RISK RATING**				
5 - Almost Certain **Once a year**	The unwanted event has occurred frequently; occurs in order of one or more times per year & is likely to reoccur within 1 year *	**11 (Medium)**	**16 (Significant)**	**20 (Significant)**	**23 (High)**	**25 (High)**
4 - Likely **Once every 3 years**	The unwanted event has occurred infrequently; occurs in order of less than once per year & is likely to reoccur within 3 years *	**7 (Medium)**	**12 (Medium)**	**17 (Significant)**	**21 (High)**	**24 (High)**
3 - Possible **Once every 10 years**	The unwanted event has happened at some time; or could happen within 10 years*	**4 (Low)**	**8 (Medium)**	**13 (Significant)**	**18 (Significant)**	**22 (High)**
2 - Unlikely **Once every 30 years**	The unwanted event has happened at some time; or could happen within 30 years *	**2 (Low)**	**5 (Low)**	**9 (Medium)**	**14 (Significant)**	**19 (Significant)**
1 - Rare **> Once every 30 years**	The unwanted event has never been known to occur; or it is highly unlikely that it will occur within 30 years *	**1 (Low)**	**3 (Low)**	**6 (Medium)**	**10 (Medium)**	**15 (Significant)**

* The unwanted event can refer to events that have occurred in Vametco's business, the mining industry or other sectors

Risk Rating	Risk Level	Guidelines for Risk Matrix
21 to 25	High	A high risk exists that management's objectives may not be achieved. Appropriate mitigation strategy to be devised immediately.
13 to 20	Significant	A significant risk exists that management's objectives may not be achieved. Appropriate mitigation strategy to be devised as soon as possible.
6 to 12	Medium	A moderate risk exists that management's objectives may not be achieved. Appropriate mitigation strategy to be devised as part of the normal management process.
1 to5	Low	A low risk exists that management's objectives may not be achieved. Monitor risk, no further mitigation required.

	Aspect/Activity	Risk driver (Causes)	Consequence/unwanted event	Consequence type	Probability	Consequence rating	Risk level (pre-mitigation)	Closure action/measure	Probability	Consequence rating	Risk level (post-mitigation)
1	**River diversion**										
	Runoff diversion furrows	Furrows become blocked or overtop	Accelerated recharge to final voids, loss of catchment yield and costly post-closure (residual) maintenance costs	Cost	3	3	13 (S)	Provide for the ongoing maintenance of the diversion furrows after site relinquishment, or design furrows so as not to require long term maintenance	2	3	9 (M)
	Topsoil resource	Lack of available topsoil	Lack of topsoil to rehabilitate disturbed areas at closure in order to meet EMPr commitments, resulting in shallow compacted soils and a permanent loss of land capability and not achieving next land use commitments	Environment	5	4	23 (H)	Undertake a topsoil inventory and develop a running LoM topsoil balance In the absence of sufficient topsoil, undertake trials to test alternative strategies to replace soil as a growth medium (e.g. amelioration / fertilisation strategies) Demonstrate during the operational phase that planned land capability on rehabilitated pit areas have been met (especially for areas designated as arable land)	3	4	18 (S)
	Rehabilitation - backfilled areas	Rehabilitated backfilled areas are not free draining to the environment, resulting in ponding of runoff water and reduced clean water runoff	Waterlogging results in failure of rehabilitated grasslands and loss of land capability, as well as decreased runoff that reduces catchment yield	Environment	4	3	17 (S)	Develop and implement an appropriate post-mining landform design / dedicated surface profile plan to ensure free drainage of clean runoff water directly to the catchment	2	3	9 (M)
2	**Access roads, potential hardstands**										
	Hydrocarbon spillages	Leakage and/or spillage of hydrocarbons (diesel, oil, etc.) from earth moving equipment or fuel storage	Hydrocarbon contamination of surface and ground water, and of soils, resulting in reduced fertility and land capability with poor rehabilitation success	Environment	4	3	17 (S)	Undertake a contaminated land assessment to determine the extent of contamination Conduct soil remediation and/or remove contaminated soil for appropriate disposal based on the findings of the assessment	2	3	9 (M)
3	**RESIDUAL RISKS (Residual risks are defined as post site relinquishment risks)**										
3,1	**Residual risks**										
	Post-closure maintenance	Inadequate maintenance of stormwater management structures and rehabilitated land by next land user over the long term	Failure of storm water management structures and rehabilitated land through mismanagement (e.g. overgrazing), could be blamed on inadequate closure measures for which the mine may be held responsible. This situation could potentially have both cost and reputational consequences	Reputation	3	4	18 (S)	Land transfer agreements must include clear instruction for maintenance of stormwater structures and management of sensitive rehabilitated areas as part of the title deed It should be stated that failure on the part of the next land owner to adhere to the management practices stipulated in the agreement, absolves mine from liabilities associated with such failures resulting from post closure mismanagement	1	4	10 (M)
	Climate	Failure to consider climate change impacts in closure designs and models	Climatic changes could impact stability or cover integrity of mine residue deposits	Cost	2	4	14 (S)	Final rehabilitation designs should cater for predicted climate change impacts on rehabilitated facilities/areas. A climate change model for the area needs to be developed to ensure that closure designs will be appropriate in the long term	1	4	10 (M)

APPENDIX B

Closure Costing Spreadsheets

UNIT RATES FOR DEMOLITION, EARTHWORKS, REHABILITATION AND RELATED WORK							March 2022
Ref nr		Currency	Unit Rate	Unit	Comment	Base rate	1,0468
A	**Concrete**					2021/03/30	Applied unit rate
A1	**Demolition of concrete structures**						
A1.1	Very heavy concrete with thickness greater than 750 mm	Rands	1 613,00	/m^3	Demolition cost of reinforeced concredte, excluding screening & sorting and disposal of waste	R 1 613,00	R 1 688,53
A1.2	Heavy concrete with thickness 500 - 750 mm	Rands	1 207,00	/m^3	Demolition cost, excluding screening & sorting and disposal of waste	R 1 207,00	R 1 263,52
A1.3	Medium concrete with thickness between 250 and 500 mm	Rands	810,00	/m^3	Demolition cost, excluding screening & sorting and disposal of waste	R 810,00	R 847,93
A1.4	Light concrete thickness less than 250 mm	Rands	490,00	/m^3	Demolition cost, excluding screening & sorting and disposal of waste	R 490,00	R 512,94
A2	**Demolition of concrete floors, bases and foundations**				Based on unit rates A1		
A2.1	Strip foundation	Rands	170,10	/m	Reinforced (0.35 m x 0.6m x 1 m x Medium concrete unit rate)	R 170,10	R 178,07
A2.2	Column footing	Rands	1 366,88	/unit	(1.5 m x 1.5 m x 0.75 m) x (Medium concrete unit rate)	R 1 366,88	R 1 430,88
A2.3	Bases and floors after removal of super structures	Rands	283,50	/m^2	Reinforced (0.35 m x 1 m^2 x Medium concrete unit rate)	R 283,50	R 296,78
A2.4	Heavy duty floors and bases after removal of super structure	Rands	405,00	/m^2	0.5 m x 1 m^2 x Medium concrete unit rate	R 405,00	R 423,96
A2.5	Concrete slabs < 200 mm thick , no reinforcement	Rands	98,00	/m^2	Excludes disposal (Light concrete unit rate x 0.20 m)	R 98,00	R 102,59
A2.6	Concrete slabs < 250 mm, no reinforcement	Rands	122,50	/m^2	Excludes disposal (Light concrete unit rate x 0.25 m)	R 122,50	R 128,24
A2.7	Dam concrete liner 150 mm thickness	Rands	73,50	/m^2	Removal of 150 mm thick concrete liner, excluding disposal. [0.150 m x Light concrete unit rate]	R 73,50	R 76,94
A3	**Concrete crushing**						
A3.1	Crush concrete to aggregate	Rands	227,00	/m^3	Crushing concrete to 75 mm aggregate.	R 227,00	R 237,63
B	**Steel structures and equipment**						
B1	**Demolition of steel buildings and related infrastructure (Including Sheeting)**				Based on unit rated of B2		
B1.1	Light plant or structures	Rands	319,59	/m²	Up to 300 kg of steel per square metre. Includes sheeting	R 319,59	R 334,56
B1.2	Light/medium plant or structures	Rands	718,00	/m²	Up to 500 kg of steel per square metre. Includes sheeting	R 718,00	R 751,62
B1.3	Medium plant or structures	Rands	1 288,96	/m²	Up to 800 kg of steel per square metre. Includes sheeting	R 1 288,96	R 1 349,32
B1.4	Medium/heavy plant or structures	Rands	2 409,60	/m²	Up to 1200 kg of steel per square metre. Includes sheeting	R 2 409,60	R 2 522,43
B1.5	Heavy plant structures	Rands	3 307,50	/m²	Up to 1500 kg of steel per square metre. Includes sheeting	R 3 307,50	R 3 462,38
B1.6	Very heavy plant structures	Rands	3 969,00	/m^2	Up to 1750 kg of steel per square metre. Includes sheeting	R 3 969,00	R 4 154,85
B2	**Demolition of steel structures**						
B2.1	Steel structures: light	Rands	1 065,00	/t	As per Jet demolition	R 1 065,00	R 1 114,87
B2.2	Steel structures: medium	Rands	1 611,20	/t	As per Jet demolition	R 1 611,20	R 1 686,65
B2.3	Steel structures: medium/heavy	Rands	2 008,00	/t	As per Jet demolition	R 2 008,00	R 2 102,03
B2.4	Steel structures: heavy	Rands	2 205,00	/t	As per Jet demolition	R 2 205,00	R 2 308,25
B3	**Demolition of permanent shed type structures**						
B3.1	0m – 5m high	Rands	75,02	/m^2	Includes sheeting. Cost based on unit rate B1.1, light steel 80 kg/m2	R 75,02	R 78,54
B3.2	5m – 10m high	Rands	146,88	/m^2	Includes sheeting. Cost based on unit rate B1.1, light steel 80 kg/m2	R 146,88	R 153,76
B3.3	10m – 15m high	Rands	234,24	/m^2	Includes sheeting. Cost based on unit rate B1.1, light steel 80 kg/m2	R 234,24	R 245,20
B3.4	15m – 20m high	Rands	331,14	/m^2	Includes sheeting. Cost based on unit rate B1.1, light steel 80 kg/m2	R 331,14	R 346,65
B4	**Crane hire and use**						
B4.1	120 ton Crane hire	:	42 208,32	/d	Rate per 10 h/day, Include site establishment and personnel accommodation, assuming a minimum of 10 days on site. As per Johnson Crane hire	R 42 208,32	R 44 184,78
B4.2	220 ton Crane hire	:	65 072,16	/d	Rate per 10 h/day, Include site establishment and personnel accommodation, assuming a minimum of 10 days on site. As per Johnson Crane hire	R 65 072,16	R 68 119,24
B5	**Demolition of steel tanks and dams with rubber lining**						
B5.1	≤5m diameter	Rands	6 795,94	/tank	Cost includes an allowance for removal of liner, and excludes demolition of support structure and concrete base	R 6 795,94	R 7 114,17
B5.2	5m - 10m diameter	Rands	22 411,50	/tank	Cost includes an allowance for removal of liner, and excludes demolition of support structure and concrete base	R 22 411,50	R 23 460,94
B5.3	10 - 15m diameter	Rands	48 930,76	/tank	Cost includes an allowance for removal of liner, and excludes demolition of support structure and concrete base	R 48 930,76	R 51 222,01
B5.4	15 - 20m diameter	Rands	89 162,72	/tank	Cost includes an allowance for removal of liner, and excludes demolition of support structure and concrete base	R 89 162,72	R 93 337,88
B5.5	20 - 30m diameter	Rands	221 275,79	/tank	Cost includes an allowance for removal of liner, and excludes demolition of support structure and concrete base	R 221 275,79	R 231 637,30
B5.6	30 - 45m diameter	Rands	595 596,13	/tank	Cost includes an allowance for removal of liner, and excludes demolition of support structure and concrete base	R 595 596,13	R 623 485,64
B5.7	Unlined steel tanks - 5m dia	Rands	5 909,51	/tank		R 5 909,51	R 6 186,23
B6	**Dismantling of cable racks**						
B6.1	Cable rack - general	Rands	31,95	/m	Light steel structure of 30 kg/m	R 31,95	R 33,45
B7	**General steel aspects**						
B7.1	Cladding and sheeting	Rands	27,00	/m^2	Steel sheeting	R 27,00	R 28,26
B7.2	Car ports (IBR roof)	Rands	51,80	/m^2	Excluding paving	R 51,80	R 54,22
B7.3	Car ports (shade net)	Rands	30,36	/m^2	Excluding paving	R 30,36	R 31,78
B7.4	Substations	Rands	400,00	/m^2	Soft strip substation infrastructure before demolition, excludes brick building and disposal of waste	R 400,00	R 418,73
C	**Demolition of buildings and structures**						
C1	Normal one storey brick buildings	Rands	415,00	/m^2	Soft strip before demolition, excludes disposal of waste. As per Jet Demolition (0.8m3m2 of light concrete)	R 415,00	R 434,43
C2	Normal double storey brick buildings	Rands	747,00	/m^2	Soft strip before demolition, excludes disposal of waste As per Jet Demolition	R 747,00	R 781,98
C3	Single brick wall (110mm)	Rands	16,00	/m	Free standing single brick wall 110 mm thick x 2000 mm high x per running meter	R 16,00	R 16,75
C4	Double brick wall (220mm)	Rands	23,00	/m	Free standing double brick wall 220 mm thick x 2000 mm high x per running meter	R 23,00	R 24,08
C5	Prefabricated Buildings	Rands	103,75	/m^2	As per Jet Demolition (factor of 0.25 of brick buildings)	R 103,75	R 108,61
C6	Fibre reinforced walls	Rands	192,00	/m	As per Jet Demolition (half the cost of single brick wall)	R 192,00	R 200,99
C7	Removal of timber structures	Rands	207,50	/m^2	As per Jet Demolition (half the cost of brick building)	R 207,50	R 217,22
	Asbestos						
C8	Upfront preperation for asbestos removal	Rands	120 000,00	sum	Preparing area for removal of asbestos material	R 120 000,00	R 125 619,15
C9	Dismantling of asbestos	Rands	192,00	/m^2	Removal of asbestos material, excluding disposal (note: apply applicable hazardous waste disposal cost)	R 192,00	R 200,99
D	**Linear infrastructure**						
D1	**Conveyors**						
D1.1	**Demolition of overland conveyors**						
D1.1.1	Overland conveyors - light, without cladding	Rands	417,41	/m	Single conveyor including dismantling of steel and demolition of concrete footings, excludes disposal of waste. Assumes 180kg / m	R 417,41	R 436,95
D1.1.2	Overland conveyors - light, with cladding	Rands	480,02	/m	Single conveyor including dismantling of steel and demolition of concrete footings, excludes disposal of waste. Assumes 180kg / m and 15% for cladding	R 480,02	R 502,49
D1.1.3	Overland conveyors - medium, without cladding	Rands	470,66	/m	Single conveyor including dismantling of steel and demolition of concrete footings, excludes disposal of waste. Assumes 230kg / m	R 470,66	R 492,69
D1.1.4	Overland conveyors - medium, with cladding	Rands	541,25	/m	Single conveyor including dismantling of steel and demolition of concrete footings, excludes disposal of waste. Assumes 230kg / m and 15% for cladding	R 541,25	R 566,60
D1.1.5	Overland conveyors - heavy, without cladding	Rands	545,21	/m	Single conveyor including dismantling of steel and demolition of concrete footings, excludes disposal of waste. Assumes 300kg / m	R 545,21	R 570,73
D1.1.6	Overland conveyors - heavy, with cladding	Rands	626,99	/m	Single conveyor including dismantling of steel and demolition of concrete footings, excludes disposal of waste. Assumes 300kg / m and 15% for cladding	R 626,99	R 656,35
D1.2	**Demolition of suspended conveyors**						
D1.2.1	Suspended conveyors - light, without cladding	Rands	521,76	/m	Single conveyor including dismantling of steel, support structures and demolition of concrete footings, excludes disposal of waste. Included a 25% premium on overland conveyors	R 521,76	R 546,19
D1.2.2	Suspended conveyors - light, with cladding	Rands	600,02	/m	Single conveyor including dismantling of steel, support structures and demolition of concrete footings, excludes disposal of waste. Included a 25% premium on overland conveyors	R 600,02	R 628,12
D1.2.3	Suspended conveyors - medium	Rands	676,57	/m	Single conveyor including dismantling of steel, support structures and demolition of concrete footings, excludes disposal of waste. Included a 25% premium on overland conveyors	R 676,57	R 708,25
D1.2.4	Suspended conveyors - heavy, without cladding	Rands	681,51	/m	Single conveyor including dismantling of steel, support structures and demolition of concrete footings, excludes disposal of waste. Included a 25% premium on overland conveyors	R 681,51	R 713,42
D1.2.5	Suspended conveyors - heavy, with cladding	Rands	783,73	/m	Single conveyor including dismantling of steel, support structures and demolition of concrete footings, excludes disposal of waste. Included a 25% premium on overland conveyors	R 783,73	R 820,43

UNIT RATES FOR DEMOLITION, EARTHWORKS, REHABILITATION AND RELATED WORK							March 2022
Ref nr		Currency	Unit Rate	Unit	Comment	Base rate	1,0468
D2	**Demolition of overland power lines**						
D2.1	Minor power lines	Rands	27,00	/m	< 11 kV (local lines, usually wooden poles). Assume 1 km / day, therefore approximately 20 poles demolished per day	R 27,00	R 28,26
D2.2	Major power lines	Rands	72,00	/m	> 11 kV (not usually used because transferred to service provider). Assume 500 m per day, 25% added premium for additional steel handling at a cost of R25 000 / day	R 72,00	R 75,37
D3	**Demolition of pipelines**						
D3.1	Overland steel pipeline on plinths (< 200 mm)	Rands	52,40	/m	5m plinths spacing, includes disposal of waste @ 10 km	R 52,40	R 54,85
D3.2	Overland steel pipeline on plinths (200-350mm)	Rands	91,68	/m	5m plinths spacing, includes disposal of waste @ 10 km	R 91,68	R 95,98
D3.3	Overland steel pipeline on plinths (350-500mm)	Rands	150,24	/m	5m plinths spacing, includes disposal of waste @ 10 km	R 150,24	R 157,27
D3.4	Overland steel pipeline on plinths (500-1000mm)	Rands	231,10	/m	5m plinths spacing, includes disposal of waste @ 10 km	R 231,10	R 241,92
D3.5	Suspended steel pipeline	Rands	191,23	/m	Includes removal of support structures	R 191,23	R 200,19
D3.6	HDPE pipelines (< 350mm)	Rands	19,10	/m	Assume 1.5 km a day at R15 000 labour plus R10000 cutting cost	R 19,10	R 19,99
D3.7	HDPE pipelines (350mm - 500mm)	Rands	28,36	/m	Assume 1 km a day at R15 000 labour plus R10000 cutting cost	R 28,36	R 29,68
D4	**Demolition of cabling**						
D4.1	Copper cables	Rands	1 032,00	/t	Removal and dismantling of copper cables	R 1 032,00	R 1 080,32
D5	**Railway lines**						
D5.1	Demolition of electrified medium gauge railway line	Rands	246,00	/m	Demolish rail tracks, sleepers and collect ballast for local stockpiling for re-use. Assumed removal of overhead powerlines at 0.75 of overhead powerlines	R 246,00	R 257,52
D5.2	Demolition of non-electrified medium gauge railway line	Rands	191,32	/m	Demolish rail tracks, sleepers and collect ballast for local stockpiling for re-use.	R 191,32	R 200,28
E	**Removal of roads, paving and walkways**						
E1	Tar roads with 500 - 600mm layerworks	Rands	79,13	/m^2	Layerworks buried in trench next to road , but excludes the disposal of tar as this will be stockpiled for beneficial re-use by local Municipalities. Assume asphalt thickness of 750 mm	R 79,13	R 82,84
E2	Haul roads	Rands	29,36	/m^2	Include ripping, dozing (D9), shaping/level and vegetation of road, excludes veneer clean-up at a road width of 45 m	R 29,36	R 30,73
E3	Gravel road with engineered surface	Rands	73,95	/m^2	Roads where layerworks is stabilised with cement. ripping, profiled and vegetated	R 73,95	R 77,41
E4	Normal gravel roads	Rands	11,93	/m^2	Gravel roads without layerworks or stabilisation of layerworks - ripping, profiled and vegetated	R 11,93	R 12,49
E5	Two track gravel road	Rands	6,39	/m		R 6,39	R 6,69
E6	Hard stand	Rands	60,00	/m^2	Assumed at minimal thickness < 100mm. Excluding disposal	R 60,00	R 62,81
E7	Brick paving	Rands	28,00	/m^2	Excluding disposal (note: included in demolition waste calculator, disposal costs to be assigned)	R 28,00	R 29,31
F	**Shafts, inclines and dam impoundments**						
F1	**Plugging/sealing of shafts**						
F1.1	Sealing of vertical shaft of 2 m diameter	Rands	1 452 932,00	sum	Refer to shaft calculator	R 1 452 932,00	R 1 520 967,32
F1.2	Sealing of vertical shaft of 2.5 m diameter	Rands	1 709 553,04	sum		R 1 709 553,04	R 1 789 604,95
F1.3	Sealing of vertical shaft of 3.5 m diameter	Rands	2 288 070,72	sum		R 2 288 070,72	R 2 395 212,43
F1.4	Sealing of vertical shaft of 5 m diameter	Rands	3 268 182,32	sum		R 3 268 182,32	R 3 421 218,95
F1.5	Sealing of vertical shaft of 5.5 m diameter	Rands	3 574 588,16	sum		R 3 574 588,16	R 3 741 972,62
F1.6	Sealing of vertical shaft of 7 m diameter	Rands	4 694 150,24	sum		R 4 694 150,24	R 4 913 959,56
F1.7	Sealing of vertical shaft of 8 m diameter	Rands	5 471 875,76	sum		R 5 471 875,76	R 5 728 103,03
F1.8	Sealing of vertical shaft of 10 m diameter	Rands	7 156 805,76	sum		R 7 156 805,76	R 7 491 931,94
F1.9	Sealing of vertical shaft of 12.5 m diameter	Rands	9 436 946,48			R 9 436 946,48	R 9 878 843,04
F1.10	Incline shaft reinforced plug (3.5mx5m dimension)	Rands	298 578,89	sum	For 3.5x5m dimension, includes venting, excludes portal filling	R 298 578,89	R 312 560,21
F1.11	Incline shaft reinforced plug (3.5mx8m dimension)	Rands	477 726,24	sum	For 3.5x8m dimension, includes venting, excludes portal filling	R 477 726,24	R 500 096,35
F1.12	Adits (1.5x1.5)	Rands	38 388,71	sum	Routine adits of 1.5mx1.5m derived from incline shaft plug rate	R 38 388,71	R 40 186,31
F2	**Removal of dam liners and plugging and sealing of penstock**						
F2.1	Single HDPE liner	Rands	5,38	/m^2	Removal and disposal of single HDPE liner	R 5,38	R 5,63
F2.2	Three HDPE liners	Rands	8,07	/m^2	Removal and disposal of three HDPE liners	R 8,07	R 8,45
F2.3	Plug outlet and seal penstock of tailings dam	Rands	82 938,05	sum		R 82 938,05	R 86 821,72
G	**Rehabiliation of disturbed areas**						
G1	**Profiling**						
G1.1	Shaping/levelling of infrastructural footprint areas (500 mm)	Rands	87 590,82	/ha	Includes stockpiling of material, backfilling of excavations in cut to fill operation and final profiling, at an average depth of 500 mm over footprint area. Included an allowance of 25% extra over for negotiating remaining foundations, Excavations etc. Flat dozing for profiling rate (per m3) (H4.3), multiplied by depth of 500 mm and converted to per hectare rate, with 25% extra over	R 87 590,82	R 91 692,37
G1.2	Shaping/levelling of infrastructural footprint areas (750 mm)	Rands	131 386,22	/ha	Includes stockpiling of material, backfilling of excavations in cut to fill operation and final profiling, at an average depth of 750 mm over footprint area. Included an allowance of 25% extra over for negotiating remaining foundations, Excavations etc. Flat dozing for profiling rate (per m3) (H4.3), multiplied by depth of 750 mm and converted to per hectare rate, with 25% extra over	R 131 386,22	R 137 538,54
G1.3	Reshaping / profiling of dumps (general)	Rands	205 260,72	/ha		R 205 260,72	R 214 872,30
G1.4	Import cover material and spread (300 mm)	Rands	137 873,24	/ha	3000 m3 over 2 km average @ R Rands/m3	R 137 873,24	R 144 329,32
G1.5	Import cover material and spread (500 mm)	Rands	229 788,73	/ha	5000 m3 over 2 km average @ R Rands/m3	R 229 788,73	R 240 548,87
G1.6	Shaping and levelling of cover material **(Doze over)**	Rands	9,85	/m^3	Including quality control in terms of leveling (60% of routine dozing rate)	R 9,85	R 10,31
G1.7	Profiling of general disturbed areas (excluding infratructural footprint areas)	Rands	1 642,09	/ha	Minimal dozing to enhance site drainage - no backfilling of excavations etc.	R 1 642,09	R 1 718,98
G1.8	Breach dam wall and reshape to 1:5	Rands	787,74	/m	Dam wall of approx. 5 m high with existing side slopes 1:3. Flat dozing rate	R 787,74	R 824,63
G2	**Vegetation**						
G2.1	Establishment of vegetation (general) flat areas and slopes of less than 1:5	Rands	31 052,45	/ha	Grasses on flat areas - hand seeding Refer to sheet G2 for assumptions and detailed costing 5 x costing options available, depending on total extent; for G2.1 the"> 50 ha" option has been assumed The costing in G2.1.1 - G2.1.5 assumes the reduced cost of fertilizer, i.e. assumed that organic material will be sourced	R 31 052,45	R 32 506,52
G2.1.1	< 10 ha	Rands	40 858,49	/ha	Refer to G2 tab for further information, assumed "with organic material" option	R 40 858,49	R 42 771,74
G2.1.2	10 - 25 ha	Rands	37 589,81	/ha	Refer to G2 tab for further information, assumed "with organic material" option	R 37 589,81	R 39 350,00
G2.1.3	25 - 40 ha	Rands	34 321,13	/ha	Refer to G2 tab for further information, assumed "with organic material" option	R 34 321,13	R 35 928,26
G2.1.4	40 - 50 ha	Rands	32 686,79	/ha	Refer to G2 tab for further information, assumed "with organic material" option	R 32 686,79	R 34 217,39
G2.1.5	> 50 ha	Rands	31 052,45	/ha	Refer to G2 tab for further information, assumed "with organic material" option	R 31 052,45	R 32 506,52
G2.2	Establishment of vegetation on dumps	Rands	50 262,30	/ha	Grasses on slopes and upper surfaces - hand seeding	R 50 262,30	R 52 615,89
	Slopes between 1:5 & 1:4	Rands					
G2.2.1	< 10 ha	Rands	46 987,26	/ha	Refer to G2 tab for further information, assumed "with organic material" option	R 46 987,26	R 49 187,50
G2.2.2	10 - 25 ha	Rands	43 228,28	/ha	Refer to G2 tab for further information, assumed "with organic material" option	R 43 228,28	R 45 252,50
G2.2.3	25 - 40 ha	Rands	39 469,30	/ha	Refer to G2 tab for further information, assumed "with organic material" option	R 39 469,30	R 41 317,50
G2.2.4	40 - 50 ha	Rands	37 589,81	/ha	Refer to G2 tab for further information, assumed "with organic material" option	R 37 589,81	R 39 350,00
G2.2.5	> 50 ha	Rands	35 710,32	/ha	Refer to G2 tab for further information, assumed "with organic material" option	R 35 710,32	R 37 382,50
	Slopes > 1:3	Rands			With organic material		
G2.2.6	< 10 ha	Rands	66 134,61	/ha	Refer to G2 tab for further information, assumed "with organic material" option	R 66 134,61	R 69 231,44
G2.2.7	10 - 25 ha	Rands	60 843,84	/ha	Refer to G2 tab for further information, assumed "with organic material" option	R 60 843,84	R 63 692,93
G2.2.8	25 - 40 ha	Rands	55 553,07	/ha	Refer to G2 tab for further information, assumed "with organic material" option	R 55 553,07	R 58 154,41
G2.2.9	40 - 50 ha	Rands	52 907,68	/ha	Refer to G2 tab for further information, assumed "with organic material" option	R 52 907,68	R 55 385,15
G2.2.10	> 50 ha	Rands	50 262,30	/ha	Refer to G2 tab for further information, assumed "with organic material" option	R 50 262,30	R 52 615,89
G2.3	Establishment of vegetation (Natural grassland)	Rands	9 451,80	/ha	Vegetation established from the seedbed harvested from the surrounding undisturbed grasslands areas. Include auger harvesting, seeding and labour. Excluding any fertilisation and soil amelioration	R 9 451,80	R 9 894,39
G2.4	Establishment of woody / thorny species	Rands	18 073,27	/ha	100 trees per ha @ R80 per tree X2 for labour and establishment	R 18 073,27	R 18 919,57
G2.5	Establishment of wetland vegetation (vegetation plugs)	Rands	196 975,93	/ha	Establish vegetation plugs with hydroscopic gel along scarified strips 500 mm apart in organic silt trap cells. @ R 36 /m2	R 196 975,93	R 206 199,57

UNIT RATES FOR DEMOLITION, EARTHWORKS, REHABILITATION AND RELATED WORK							March 2022
Ref nr		Currency	Unit Rate	Unit	Comment	Base rate	1,0468
	Control of declared invasive alien plants	Rands			Control of IAS plants (exotics) is not a once off operation. Firstly, an IAS Control Plan should be in place and should be adhered too until the desired level of control is achieved. Control is in the form of initial control (cut and treat stem or foliar application if young plants), follow up treatment approximately 8 weeks thereafter and then bi-annual maintenance applications reduced to annual control until no new or regrowth is occurring. Total control period will depend on species being targeted and can vary from 2 to 5 years. Exotics with a commercial value (eucalyptus/wattles) can be removed at no cost depending on maturity and quality of trees, proximity to saw mills/charcoal factories, accessibility and size of woodlot. When exotics are removed for commercial value, felling contractors generally do not treat the cut stumps or stems and herbicide applications to control new and regrowth post removal should be budgeted for.		
G2.6	Removal of exotic/alien vegetation/small trees (<10ha)	Rands		/ha	For small areas <10 ha; assuming saplings less than 3 m in height; includes initial cut and treat and follow up foliar spray; excludes yearly maintenance control		
G2.6.1	Low infestation density	Rands	4 750,69	/ha	<20%	R 4 750,69	R 4 973,15
G2.6.2	Medium infestation density	Rands	12 083,27	/ha	50%	R 12 083,27	R 12 649,08
G2.6.3	Dense infestation density	Rands	20 138,79	/ha	>75%	R 20 138,79	R 21 081,81
G2.7	Removal of exotic/alien vegetation/small trees (>100ha)	Rands		/ha	For substantial areas >100ha; assuming saplings less than 3m in height; includes initial cut and treat and folow up foliar spray; excludes maintenance control		
G2.7.1	Low infestation density	Rands	3 924,48	/ha	<20%	R 3 924,48	R 4 108,25
G2.7.2	Medium infestation density	Rands	9 398,10	/ha	50%	R 9 398,10	R 9 838,18
G2.7.3	Dense infestation density	Rands	15 491,38	/ha	>75%	R 15 491,38	R 16 216,78
G2.8	Removal of individual trees	Rands		/no	Includes cut and treat stump, cross cutting and removal, chipping brush wood in situ; excludes de-stumping		
G2.8.1	Small tree diameter (< 300mm)	Rands	516,38	/tree	Minimum 50 trees	R 516,38	R 540,56
G2.8.2	Small - medium tree diameter (300mm to 600mm)	Rands	1 549,14	/tree	Minimum 20 trees	R 1 549,14	R 1 621,68
G2.8.3	Medium tree diameter (600mm to 1000mm)	Rands	3 614,65	/tree	Minimum 10 trees	R 3 614,65	R 3 783,91
G2.8.4	Medium - large tree diameter (> 1000mm not exceeding 1500mm)	Rands	5 576,90	/tree	Minimum 10 trees	R 5 576,90	R 5 838,05
G2.9	Hydroseeding	Rands	24 615,79	/ha	Seeding slurry (artificial seed and compost mix) is transported in a tank, either truck mounted and sprayed over prepared surface. @ R 3.70 /m2	R 24 615,79	R 25 768,45
G2.10	Stabilize pH levels of soil with good quality lime	Rands	9 480,72	/ha	4ton/ha. Includes purchase, transport, handling and spreading. R250/t (purchase price) X 35ton truck (R35/km = R1/ton transport costs) X 250km = R8 750 (transportation costs). R250/t + transport costs (Rate confirmed with Randolf - March 2019)	R 9 480,72	R 9 924,67
G2.11	Stabilize pH levels of soil with industrial lime	Rands	11 850,90	/ha	35ton/ha. Includes purchase, transport, handling and spreading.	R 11 850,90	R 12 405,83
G2.12	Establish tree stations	Rands		/ha	Includes land preparation, planting at a planting density of 1111 trees per hectare, cost of plants and materials, watering and maintenance for 1 season		
G2.12.1	Planting inserts	Rands	51 121,54	/ha		R 51 121,54	R 53 515,37
G2.12.2	Planting trees	Rands	61 965,50	/ha	2 litre bag size	R 61 965,50	R 64 867,11
G2.12.3	Planting trees	Rands	79 522,39	/ha	5 litre bag size	R 79 522,39	R 83 246,12
G3	**Water management (pans, riparian areas, re-instatement of drainage lines)**						
G3.1	Reinstatement of drainage lines	Rands	6 569,31	/ha	Using a drainage density of 0.2 on average (Pittman et al.), average drainage corridor depth of 250 mm, general shaping and levelling rate but excludes 25% extra over	R 6 569,31	R 6 876,93
G3.2	Routing of storm water along dump toe	Rands	271,10	/m		R 271,10	R 283,79
G3.3	Reinstatement of wetlands	Rands	878 969,34	/ha	Please refer to wetland calculator	R 878 969,34	R 920 128,15
G3.4	**Boreholes**						
G3.4.1	Drilling of general boreholes (< 35m)	Rands	62 221,11	/unit	The rate includes site establishment and related costs, labour and PVC casing	R 62 221,11	R 65 134,69
G3.5	Equipping of scavanger borehole (Pump, electrical and piping)	Rands	38 165,79	/unit	Nominal allowance	R 38 165,79	R 39 952,95
G3.6	**Plug and seal of boreholes**						
G3.6.1	Surface plug (5m)	Rands	8 556,40	sum	The rate includes site establishment and related costs, all plug material and labour.	R 8 556,40	R 8 957,06
G3.6.2	Full depth plug (35m)	Rands	17 334,85	sum	The rate includes site establishment and related costs, all plug material and labour.	R 17 334,85	R 18 146,58
G4	**Surface subsidence**						
G4.1	Placement of composite rock grid with geotextile	Rands	59,22	/m^2	10% added for stitching of overlaps	R 59,22	R 61,99
G4.2	Rehabilitation of sinkholes and subsided areas	Rands	485 489,26	/ha	Infilling and stabilisation of cracks. Assumed double rate of rip, general shaping & levelling, and vegetation. Assume 1 m3 of infill material would be required for every 100 m2 (3km haul distance)	R 485 489,26	R 508 222,89
G4.3	Placement of geotextile over surface	Rands	47,24	/m^2	A8 bidim material	R 47,24	R 49,45
G5	**Demolition waste handling and disposal**						
G5.1	**General waste**						
G5.1.1	Builder's rubble / inert demolition waste		161,07	/m^3	Disposal rate only, excludes transport to waste facility	R 161,07	R 168,61
G5.1.2	General waste / industrial waste		398,66	/m^3	Disposal rate only, excludes transport to waste facility	R 398,66	R 417,33
G5.2	**Hazardous waste**						
G5.2.1	Hydrocarbon waste (dry waste only)		503,47	/m^3	Disposal rate only, excludes transport to waste facility	R 503,47	R 527,05
G5.2.2	Asbestos		852,03	/m^3	Disposal rate only, excludes transport to waste facility	R 852,03	R 891,93
G5.2.3	Brine		1 533,65	/m^3	Disposal rate only, excludes transport to waste facility	R 1 533,65	R 1 605,47
G5.2.4	Sediment / sludges		1 079,23	/m^3	Disposal rate only, excludes transport to waste facility	R 1 079,23	R 1 129,77
H	**Earthworks**						
H1	**Excavation**						
H1.1	Minor excavation	Rands	36,15	/m^3	Small volumes: < 10 000 m3	R 36,15	R 37,84
H1.2	Bulk excavation	Rands	31,98	/m^3	(> 100 000 m3)	R 31,98	R 33,48
H1.3	Trench excavation	Rands	50,61	/m^3	Continuous trench excavation	R 50,61	R 52,98
H1.4	Removal of gunited embankments	Rands	105,79	/m^2	Excludes disposal. As per Fraser Alexander	R 105,79	R 110,74
H1.5	Clean-up of contaminated materials/soils	Rands	51,17	/m^3	Excavation only, load and haul and disposal to be determined separately. Excavate to stockpile	R 51,17	R 53,57
H1.6	Dragline	Rands	6,97	/m^3	Based on Kriel March 2019	R 6,97	R 7,30
H1.7	Excavation and centralised stockpiling of material for later disposal		29,79		Bulk excavation rate including 25% extra over for centralised stockpiling	R 29,79	R 31,18
H2	**Materials transport**						
H2.1	**General load and haul**						
H2.1.1	Load and haul (1km haul)	Rands	36,15	/m^3	Small volumes on site (< 10 000 m3)	R 36,15	R 37,84
H2.1.2	Load and haul (2 km haul)	Rands	42,34	/m^3	Small volumes on site (< 10 000 m3)	R 42,34	R 44,32
H2.1.3	Load, haul (1- 2 km free haul) and spread over	Rands	47,51	/m^3	Including flattening / dozing of material	R 47,51	R 49,73
H2.1.4	Extra over rates for overhaul beyond free haul distance	Rands	7,00	/m^3	Small volumes on site (< 10 000 m3)	R 7,00	R 7,33
H2.1.5	Load and haul (1km haul) - large volumes		36,15	/m^3	Large volumes on site (> 50 000 m3)	R 36,15	R 37,84
H2.1.6	Load and haul (2 km haul) - large volumes		42,34	/m^3	Large volumes on site (> 50 000 m3)	R 42,34	R 44,32
H2.1.7	Load, haul (1- 2 km free haul) and spread over (large volumes)		46,47	/m^3	Including flattening / dozing of material	R 46,47	R 48,65
H2.1.8	Extra over rates for overhaul beyond free haul distance (large volumes)		8,23	/m^3	Large volumes on site (> 50 000 m3)	R 8,23	R 8,62
H2.2	**Bulk load and haul (restricted to 5km)**						
H2.2.1	0 - 1km (CAT 777)	Rands	29,97	/m^3	Bulk volumes (> 100 000 m3). Assume 100ton and more than 1000 loads.	R 29,97	R 31,37
H2.2.2	1 - 2km (CAT 777)	Rands	31,58	/m^3	Bulk volumes (> 100 000 m3)	R 31,58	R 33,06
H2.2.3	2 - 3km (CAT 777)	Rands	37,33	/m^3	Bulk volumes (> 100 000 m3)	R 37,33	R 39,08
H2.2.4	3 - 4km (CAT 777)	Rands	43,08	/m^3	Bulk volumes (> 100 000 m3)	R 43,08	R 45,10
H2.2.5	4 - 5km (CAT 777)	Rands	48,83	/m^3	Bulk volumes (> 100 000 m3)	R 48,83	R 51,12
H3	**Ripping**						
H3.1	General ripping	Rands	30 423,09	/ha	D 7 dozer - 3 ripper tines to depth of 500 mm. As per Fraser Alexander	R 30 423,09	R 31 847,69
H3.2	Deep ripping (heavy)	Rands	75 186,88	/ha	D 9 dozer - 1 ripper tine to depth of 1 m. As per Fraser Alexander	R 75 186,88	R 78 707,60
H3.3	Ripping for alleviation of compaction	Rands	26 036,22	/ha	D 6 dozer - 3 ripper tines to depth of 500 mm. As per Fraser Alexander	R 26 036,22	R 27 255,40
H3.4	Scarify upper surface of dumps	Rands	3 201,55	/ha	4X4 Tractor for vegetation preparation . As per Fraser Alexander	R 3 201,55	R 3 351,47
H3.5	Ripping to alleviate compaction BBT grader	Rands	7 952,24	/ha	For areas > 50 ha using a grader, Quotation received from BBT	R 7 952,24	R 8 324,61
H3.6	Ripping to alleviate compaction BBT dozer	Rands	19 622,41	/ha	For areas > 50 ha using a D6 dozer, Quotation received from BBT	R 19 622,41	R 20 541,25

UNIT RATES FOR DEMOLITION, EARTHWORKS, REHABILITATION AND RELATED WORK							March 2022
Ref nr		Currency	Unit Rate	Unit	Comment	Base rate	1,0468
H4	**Dozing rates**						
H4.1	Flat dozing for profiling	Rands	16,42	/m^3	Small volumes, cut to fill including final profiling- Dozing of loose material D6/7. As per Fraser Alexande	R 16,42	R 17,19
H4.2	Down dozing of material	Rands	11,36	/m^3	Small volumes - no profiling – Dozing of loose material D6/7. As per Fraser Alexander	R 11,36	R 11,89
H4.3	Flat dozing for profiling	Rands	14,01	/m^3	Large volumes - levelling and dozing of loose material / D10/D11. As per Kotze Construction	R 14,01	R 14,67
H4.4	Down dozing of material	Rands	10,70	/m^3	Large volumes - levelling and dozing of loose material	R 10,70	R 11,20
H5	**General earthworks**						
H5.1	Compaction	Rands	28,73	/m^3	Compaction in layers of 250 mm thickness. As per Fraser Alexander	R 28,73	R 30,08
H5.3	Blasting	Rands	20,63	/m^3		R 20,63	R 21,60
I	**Fencing**						
I1	**Erect fence**						
I1.1	Security fencing	Rands	186,84	/m		R 186,84	R 195,59
I1.1.1	Diamond mesh	Rands	206,35	/m	1.8 m high	R 206,35	R 199,80
I1.1.2	Razor mesh	Rands	273,27	/m	1.8 m high	R 273,27	R 264,60
I1.2	Stock fencing	Rands	61,35	/m		R 61,35	R 64,22
I1.3	Concrete palisade	Rands	1 321,72	/m	1.8 m high	R 1 321,72	R 1 383,61
I1.4	Steel palisade	Rands	1 098,65	/m	40 x 40 x 7 spike; 1.8 m high	R 1 098,65	R 1 063,80
I2	**Dismantle fence**						
I2.1	Security fencing	Rands	43,79	/m	Include in inert demolition	R 43,79	R 45,84
I2.2	Stock fencing	Rands	13,84	/m	Include in inert demolition	R 13,84	R 14,49
I2.3	Concrete palisade	Rands	152,23	/m	Include in inert demolition	R 152,23	R 159,36
I2.4	Clear-vu fence	Rands	46,47	/m	Include in inert demolition	R 46,47	R 48,65
J	**Post-closure aspects**						
J1	Rehabilitation monitoring	Rands	2 612,47	/10yr	Per hectare for a duration of 10 years	R 5 224,94	R 5 469,60
J2	Care and maintenance - high intensity	Rands	37 644,04	/10yr	Per hectare for a duration of 10 years	R 75 288,08	R 78 813,54
J3	Care and maintenance - low intensity	Rands	14 639,35	/10yr	Per hectare for a duration of 10 years	R 29 278,70	R 30 649,71
J4	Care and maintenance - to sustain grass cover vitality	Rands	7 580,45	/10yr	Cutting @ R680/ha, baling@ R600/ha, plus transport by tractor average 5 km@R21/km. (note: rate to be applied @ 3 year intervals).	R 15 160,90	R 15 870,83
K	**Post-closure monitoring (Site Specific)**				**Refer to project information tab for calculation**		
K1	Surface water	Rands	3 430,90	/yr	Duration and intervals are indicated as per calculation and line item discription	R 3 430,90	R 3 591,56
K2	Groundwater	Rands	10 292,70	/yr	Duration and intervals are indicated as per calculation and line item discription	R 10 292,70	R 10 774,67
L	**Other**						
L1	Not applicable	Rands	-	N/A		R 0,00	R 0,00
L2	Sum allowance	Rands	-	/sum	Only to be used for post-closure aspects and additional allowances	R 0,00	R 0,00
M	**Site Specific**				**Refer to project information tab for calculation**		
M1	Load and Haul - 3 km	Rands	55,08	/m^3	Site specific Small Volume load and haul distance 1 km, Refer to project information tab for the calculation	R 55,08	R 57,66
M2	Load and Haul - 5 km	Rands	67,16	/m^3	Site specific Small Volume load and haul distance 5 km, Refer to project information tab for the calculation.	R 67,16	R 70,30
M3	Load and Haul - 8 km	Rands	89,15	/m^3	Site specific Small Volume load and haul distance 10 km, Refer to project information tab for the calculation	R 89,15	R 93,32
M4	Load and Haul - 15 km	Rands	140,46	/m^3	Site specific Small Volume load and haul distance 15 km, Refer to project information tab for the calculation	R 140,46	R 147,04
M5	Load and Haul - 55 km	Rands	433,66	/m^3	Obtained from quotation to suupply topsoil to Krondraai (114/m3 over 30 km). Applied 60% of R114/m3 for 14 km	R 433,66	R 453,97

21466019 BMM- Gamsberg Zinc Mine Closure Costs, as at March 2022									
Gamsberg EIA									
Closure Component	Select	Scheduled Closure (2039)							
		Applicable	Quantity	Unit	Unit rate code	Unit rate	Total cost		Notes
1	**Infrastructural Areas**								
1,1	**Dismantling of processing plant and related structures**								
1.1.1	Not applicable								
	Sub-total for Dismantling of processing plant and related structures						**R**	**-**	
1,2	**Demolition of steel buildings**								
1.2.1	Fuel storage tank	Yes	1	/tank	B5.1	R 7 114,17	R	7 114,17	Fuel storage capacity of 1 200 m3. Assume storage in tank
	Concrete bunding of fuel storage tanks	Yes	247,5	/m3	A1.4	R 512,94	R	126 952,65	Assume concrete bunding of less than 250mm thickness
1.2.2	100t emulsion storage silos	Yes	2	/tank	B5.2	R 23 460,94	R	46 921,88	Assume steel tank of 5m - 10m diameter of 100t
1.2.3	200t emulsion storage silos	Yes	2	/tank	B5.3	R 51 222,01	R	102 444,02	Assume steel tank of 10m - 15m diameter of 200t
	Sub-total for Demolition of steel buildings						**R**	**283 432,72**	
1,3	**Demolition of other buildings and structures**								
1.3.1	Not applicable								
	Sub-total for Demolition of other buildings and structures						**R**	**-**	
1,4	**Rehabilitation of roads and paved surfaces**								
1.4.1	Not applicable	No	0	N/A	L1	R 0,00	R	-	
	Sub-total for Rehabilitation of roads and paved surfaces						**R**	**-**	
1,5	**Demolition and rehabilitation of railway lines**								
1.5.1	Not applicable	No	0	N/A	L1	R 0,00	R	-	
	Sub-total for Demolition and rehabilitation of railway lines						**R**	**-**	
1,6	**Other linear Infrastructure**								
1.6.1	New potable water pipeline	Yes	7000	/m	D3.3	R 157,27	R	1 100 890,00	Pipeline of 7km (7000m) to run from the Horseshoe dam to the processing plant. The proposed pipeline will be installed above-ground and will have an inside diameter of 400 mm, an outside diameter of 460 mm, a throughput of 460 m3/hour.
1.6.2	River diversion pipeline 1	Yes	1200	/m	D3.7	R 29,68	R	35 616,00	Proposed pipeline to convey water from the attenuation weir to the trapezoidal channels. The pipelines will both be operational and will be laid above ground. Pipeline is 1.2km (1200m) with an inside diameter of 0.75 (Hydrology and conceptual design of the Gamsberg River Diversion, Golder Member of WSP, 2022)
1.6.3	River diversion pipeline 2	Yes	1200	/m	D3.7	R 29,68	R	35 616,00	Proposed pipeline to convey water from the attenuation weir to the trapezoidal channels. The pipelines will both be operational and will be laid above ground. Pipeline is 1.2km (1200m) with an inside diameter of 0.75 (Hydrology and conceptual design of the Gamsberg River Diversion, Golder Member of WSP, 2022)
	Sub-total for Other linear Infrastructure						**R**	**1 172 122,00**	
1,7	**Disposal of demolition waste**								
1.7.1	Establish salvage yard								
	Not applicable	No	0	N/A	L1	R 0,00	R	-	
1.7.2	Construct decontamination bay								
	Not applicable	No	0	N/A	L1	R 0,00	R	-	
1.7.3	Sorting and screening of demolition waste								
	Not applicable	No	0	N/A	L1	R 0,00	R	-	
1.7.4	Inert building rubble / concrete demolition waste (subject to waste classification)								
	Crushing of concrete demolition waste	No	247,5	/m3	A3.1	R 237,63	R	-	
	Transport of concrete demolition waste to mine	No	247,5	/m3	M3	R 93,32	R	-	

21466019 BMM- Gamsberg Zinc Mine Closure Costs, as at March 2022									
Gamsberg EIA									
Closure Component	Select	Scheduled Closure (2039)							
		Applicable	Quantity	Unit	Unit rate code	Unit rate	Total cost		Notes
1.7.5	Steel demolition waste								
	Transport of steel demolition waste	Yes	0,0	N/A	L1	R 0,00	R	-	
1.7.6	General demolition waste								
	Transport of general demolition waste to mine	Yes	0,0	/m3	M3	R 93,32	R	-	
1.7.7	Hazardous waste								
	Not applicable	No	0	N/A	L1	R 0,00	R	-	
	Sub-total for Disposal of demolition waste						**R**	**-**	
1,8	**Making good of infrastructure**								
1.8.1	Not applicable	No	0	N/A	L1	R 0,00	R	-	
	Sub-total for Making good of infrastructure						**R**	**-**	
	Sub-total for Infrastructural Areas						**R**	**1 455 554,72**	
2	**Mining Areas**								
2,1	**Open pit rehabilitation including final voids and ramps**								
2.1.1	Not applicable	No	0	N/A	L1	R 0,00	R	-	
	Sub-total for Open pit rehabilitation including final voids and ramps						**R**	**-**	
2,2	**Sealing of shafts, adits and inclines**								
2.2.1	Not applicable								
	Sub-total for Sealing of shafts, adits and inclines						**R**	**-**	
2,3	**Rehabilitation of stockpiles and processing residues**								
2.3.1	Not applicable								
	Sub-total for Rehabilitation of stockpiles and processing residues						**R**	**-**	
2,4	**Rehabilitation of clean water impoundments**								
2.4.1	Not applicable	No	0	N/A	L1	R 0,00	R	-	
	Sub-total for Rehabilitation of clean water impoundments						**R**	**-**	
2,5	**Rehabilitation of dirty water impoundments**								
2.5.1	Not applicable	No	0	N/A	L1	R 0,00	R	-	
	Sub-total for Rehabilitation of dirty water impoundments						**R**	**-**	
2,6	**Rehabilitation of subsided areas**								
2.6.1	Not applicable	No	0	N/A	L1	R 0,00	R	-	
	Sub-total for Rehabilitation of subsided areas						**R**	**-**	
	Sub-total for Mining Areas						**R**	**-**	
3	**General Surface Rehabilitation**								
3,1	Not applicable	No	0	N/A	L1	R 0,00	R	-	
	Sub-total for General Surface Rehabilitation						**R**	**-**	
3,2	**Other surface disturbances**								
3.2.1	Not applicable	No	0	N/A	L1	R 0,00	R	-	
	Sub-total for Other surface disturbances						**R**	**-**	
	Sub-total for General Surface Rehabilitation						**R**	**-**	
4	**Water / Runoff Management**								
4,1	**River diversions and watercourse reinstatement**								
4.1.1	River diversion								Detailed design includes a pipeline and an energy dispersion structure. Refer above to cost of pipeline
	Not applicable	No	0	N/A	L1	R 0,00	R	-	

21466019 BMM- Gamsberg Zinc Mine Closure Costs, as at March 2022									
Gamsberg EIA									
Closure Component	Select	Scheduled Closure (2039)							
		Applicable	Quantity	Unit	Unit rate code	Unit rate	Total cost		Notes
	Sub-total for River diversions and watercourse reinstatement						**R**	**-**	
4,2	**Reinstatement of drainage lines**								
4.2.1	Not applicable	No	0	N/A	L1	R 0,00	R	-	
	Sub-total for Sub-total for River diversions and watercourse reinstatement						**R**	**-**	
	Sub-total for Water / Runoff Management							**R 0,00**	
	Sub-Total 1 (for infrastructure and related aspects)						**R**	**1 455 554,72**	
5	**P&Gs, Contingencies and Additional Allowances**								
5,1	Preliminaries and general	Yes	25	/sum	L2	R 363 888,68	R	363 888,68	25% P&Gs applied. In line with the assumed Ps&Gs for the mine wide closure works
5,2	Contingencies	Yes	10	/sum	L2	R 145 555,47	R	145 555,47	10% Contingencies applied
5,3	Additional studies	No	0	N/A	L1	R 0,00	R	-	Assumed that all studies undertaken during operational period
	Sub-Total 2 (for Additional Allowances)						**R**	**509 444,15**	
6	**Pre-site Relinquishment Monitoring and Aftercare**								
6,1	Surface water quality monitoring	Yes	5	/yr	K1	R 3 591,56	R	17 957,80	Allowance for 5 years, 1 monitoring point, yearly downstream of channel
6,2	Groundwater quality monitoring	Yes	5	/yr	K2	R 10 774,67	R	53 873,35	Allowance for 5 years, 3 monitoring points, yearly at expansion areas
6,3	Rehabilitation monitoring of rehabilitated areas	No	0	/10yr	J1	R 5 469,60	R	-	
6,4	Care and maintenance of rehabilitated areas (high intensity)	No	0	/10yr	J2	R 78 813,54	R	-	
6,5	Care and maintenance of rehabilitated areas (low intensity)	No	0	/10yr	J3	R 30 649,71	R	-	
	Sub-Total 3 (for Post-Closure aspects)						**R**	**71 831,15**	
	Total Excl. VAT. (for Sub-total 1 +2 +3)						**R**	**2 036 830,02**	
7	**Post-site Relinquishment Monitoring and Aftercare (Residual)**								
7,1	Not applicable	No	0	N/A	L1	R 0,00	R	-	
	Sub-Total 4 (for Post-Closure aspects)						**R**	**-**	
	Grand Total Excl. VAT. (for Sub-total 1 +2 +3+4)						**R**	**2 036 830,02**	

APPENDIX C

Document Limitations

DOCUMENT LIMITATIONS

This document has been provided by Golder Associates Africa Pty Ltd ("Golder") subject to the following limitations:

i) This Document has been prepared for the particular purpose outlined in Golder's proposal and no responsibility is accepted for the use of this Document, in whole or in part, in other contexts or for any other purpose.

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APPENDIX O

Environmental Screening Report and Land Claim Report

SCREENING REPORT FOR AN ENVIRONMENTAL AUTHORIZATION AS REQUIRED BY THE 2014 EIA REGULATIONS – PROPOSED SITE ENVIRONMENTAL SENSITIVITY

EIA Reference number:

Project name: Gamsberg Zinc Mine

Project title: Integrated Regulatory Process for the Gamsberg 10 Million Ton Operation

Date screening report generated: 30/03/2022 18:13:54

Applicant: Black Mountain Mining (Pty) Ltd

Compiler: Golder Associates Africa (Pty) Ltd, a member of WSP

Compiler signature: .....

Application Category: Any activities within or close to a watercourse

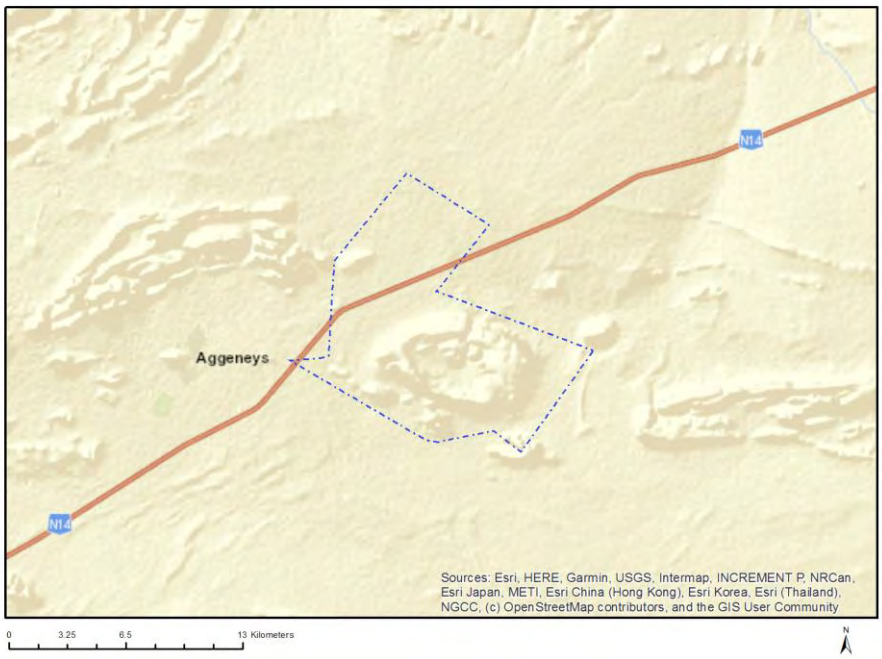
Table of Contents

Proposed Project Location

Orientation map 1: General location

General Orientation: Gamsberg Zinc Mine

Map of proposed site and relevant area(s)



Cadastral details of the proposed site

Property details:

No	Farm Name	Farm/ Erf No	Portion	Latitude	Longitude	Property Type
1	AROAMS	57	0	29°10'2.03S	18°56'49.07E	Farm
2	BLOEMHOEK	61	0	29°18'33.15S	18°56'12.63E	Farm
3	GAMS	60	0	29°12'48.97S	19°1'5.14E	Farm
4	ACHAB	59	0	29°14'54.16S	19°5'33.92E	Farm
5	KYKGAT	87	0	29°21'1.58S	19°2'18.92E	Farm
6	GAMS	60	1	29°14'51.32S	18°59'20.48E	Farm Portion
7	BLOEMHOEK	61	2	29°15'0.39S	18°53'17.71E	Farm Portion
8	AROAMS	57	0	29°13'53.2S	18°55'43.23E	Farm Portion
9	GAMS	60	0	29°10'9.27S	19°1'21.57E	Farm Portion
10	ACHAB	59	0	29°14'56.01S	19°5'32.3E	Farm Portion
11	KYKGAT	87	1	29°19'54.54S	19°0'33.26E	Farm Portion
12	AROAMS	57	1	29°11'32.78S	18°54'17.67E	Farm Portion
13	BLOEMHOEK	61	1	29°15'40.95S	18°56'32.76E	Farm Portion
14	AROAMS	57	6	29°14'13.53S	18°54'5.42E	Farm Portion
15	AROAMS	57	0	29°12'18.36S	18°56'30.97E	Farm Portion
16	AROAMS	57	1	29°14'26.26S	18°54'13.67E	Farm Portion
17	BLOEMHOEK	61	0	29°14'58.9S	18°52'57.03E	Farm Portion
18	BLOEMHOEK	61	0	29°18'59.66S	18°56'11.81E	Farm Portion
19	AROAMS	57	7	29°12'53.22S	18°56'22.86E	Farm Portion
20	GAMS	60	4	29°12'25.29S	19°2'10.5E	Farm Portion
21	BLOEMHOEK	61	3	29°14'47.11S	18°53'32.9E	Farm Portion
22	BLOEMHOEK	61	1	29°14'45.2S	18°53'27.71E	Farm Portion

Development footprint[1] vertices:
No development footprint(s) specified.

Wind and Solar developments with an approved Environmental Authorisation or applications under consideration within 30 km of the proposed area

No	EIA Reference No	Classification	Status of application	Distance from proposed area (km)
1	14/12/16/3/3/2/448/13	Solar PV	Approved	0
2	14/12/16/3/3/2/448/6	Solar PV	Approved	0
3	14/12/16/3/3/2/448/7	Solar PV	Approved	0
4	14/12/16/3/3/2/970	Solar PV	Approved	11.4
5	14/12/16/3/3/2/448/14	Solar PV	Approved	0
6	14/12/16/3/3/2/965	Solar PV	Approved	11.4
7	14/12/16/3/3/2/448/3	Solar PV	Approved	0
8	14/12/16/3/3/2/448/16	Solar PV	Approved	0
9	14/12/16/3/3/1/2103	Solar PV	Approved	13.7
10	14/12/16/3/3/2/971	Solar PV	Approved	11.4
11	14/12/16/3/3/2/872	Solar PV	Approved	28.6
12	14/12/16/3/3/2/448/10	Solar PV	Approved	0
13	14/12/16/3/3/2/964	Solar PV	Approved	11.4
14	14/12/16/3/3/2/873	Solar PV	Approved	28.6
15	14/12/16/3/3/2/871	Solar PV	Approved	28.6
16	12/12/20/2151	Solar PV	Approved	6.4
17	14/12/16/3/3/2/968	Solar PV	Approved	11.4
18	12/12/20/2630/AM3	Solar PV	Approved	0
19	14/12/16/3/3/2/448/1	Solar PV	Approved	0
20	12/12/20/2334/5	Solar PV	Approved	13.2
21	14/12/16/3/3/2/448/1	Solar PV	Approved	0
22	14/12/16/3/3/2/448/12	Solar PV	Approved	0
23	14/12/16/3/3/2/448/5	Solar PV	Approved	0
24	12/12/20/2602	Solar PV	Approved	12.2
25	14/12/16/3/3/1/2221	Solar PV	Approved	0
26	14/12/16/3/3/2/969	Solar PV	Approved	11.4
27	14/12/16/3/3/2/448/10	Solar PV	Approved	0
28	14/12/16/3/3/2/869	Solar PV	Approved	28.6
29	14/12/16/3/3/2/972	Solar PV	Approved	11.4
30	14/12/16/3/3/2/448/2	Solar PV	Approved	0
31	14/12/16/3/3/1/2102	Solar PV	Approved	13.7
32	14/12/16/3/3/2/448/11	Solar PV	Approved	0
33	12/12/20/2334/4	Solar PV	Approved	13.2
34	14/12/16/3/3/2/448/8	Solar PV	Approved	0
35	14/12/16/3/3/2/222	Solar PV	Approved	12.2
36	14/12/16/3/3/2/448/15	Solar PV	Approved	0
37	14/12/16/3/3/2/448/9	Solar PV	Approved	0
38	14/12/16/3/3/1/2222	Solar PV	Approved	0
39	12/12/20/2630	Solar PV	Approved	0
40	14/12/16/3/3/2/448/4	Solar PV	Approved	0

[1] "development footprint", means the area within the site on which the development will take place and incudes all ancillary developments for example roads, power lines, boundary walls, paving etc. which require vegetation clearance or which will be disturbed and for which the application has been submitted.

Environmental Management Frameworks relevant to the application

No intersections with EMF areas found.

Environmental screening results and assessment outcomes

The following sections contain a summary of any development incentives, restrictions, exclusions or prohibitions that apply to the proposed development site as well as the most environmental sensitive features on the site based on the site sensitivity screening results for the application classification that was selected. The application classification selected for this report is:
Any activities within or close to a watercourse.

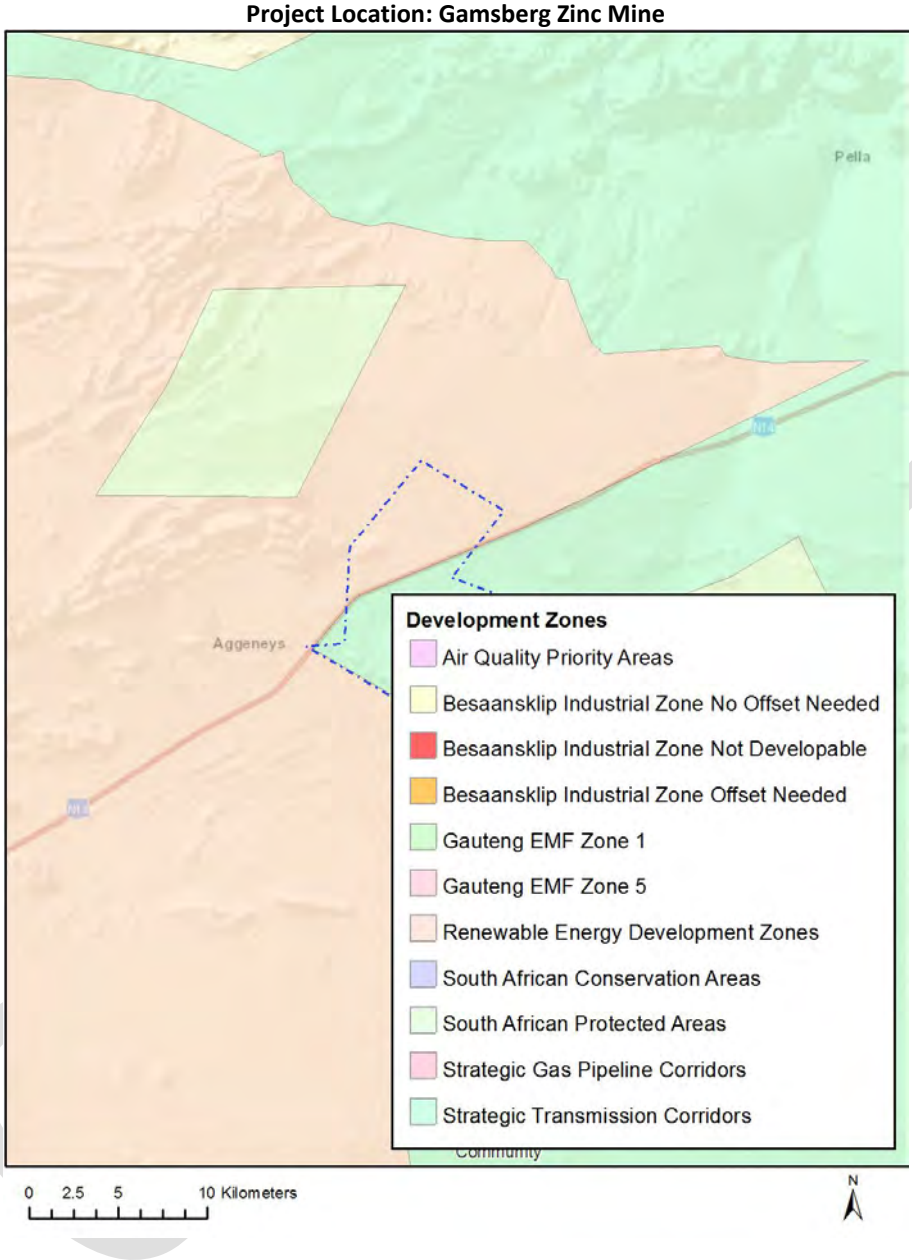
Relevant development incentives, restrictions, exclusions or prohibitions

The following development incentives, restrictions, exclusions or prohibitions and their implications that apply to this site are indicated below.

Incentive, restriction or prohibition	Implication
Strategic Transmission Corridor-Northern corridor	https://screening.environment.gov.za/ScreeningDownloads/DevelopmentZones/Combined_EGI.pdf
Renewable energy development zones 8-Springbok	https://screening.environment.gov.za/ScreeningDownloads/DevelopmentZones/Combined_REDZ.pdf
South African Protected Areas	https://screening.environment.gov.za/ScreeningDownloads/DevelopmentZones/SAPAD_OR_2021_Q3_Metadata.pdf

Map indicating proposed development footprint within applicable development incentive, restriction, exclusion or prohibition zones

Project Location: Gamsberg Zinc Mine



Proposed Development Area Environmental Sensitivity

The following summary of the development site environmental sensitivities is identified. Only the highest environmental sensitivity is indicated. The footprint environmental sensitivities for the proposed development footprint as identified, are indicative only and must be verified on site by a suitably qualified person before the specialist assessments identified below can be confirmed.

Theme	Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
Agriculture Theme				X
Animal Species Theme		X		

Aquatic Biodiversity Theme	X			
Archaeological and Cultural Heritage Theme	X			
Civil Aviation Theme		X		
Defence Theme	X			
Paleontology Theme			X	
Plant Species Theme	X			
Terrestrial Biodiversity Theme	X			

Specialist assessments identified

Based on the selected classification, and the environmental sensitivities of the proposed development footprint, the following list of specialist assessments have been identified for inclusion in the assessment report. It is the responsibility of the EAP to confirm this list and to motivate in the assessment report, the reason for not including any of the identified specialist study including the provision of photographic evidence of the site situation.

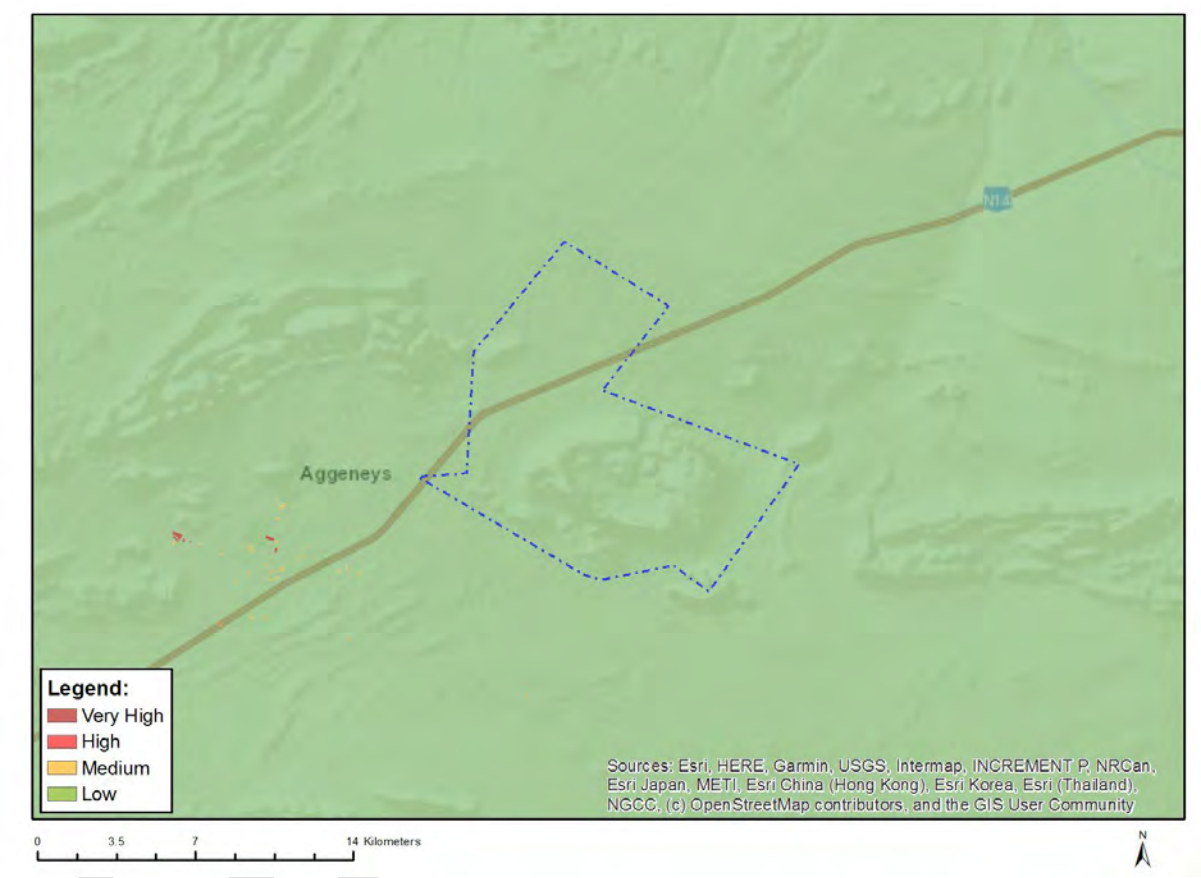
No	Specialist assessment	Assessment Protocol
1	Landscape/Visual Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
2	Archaeological and Cultural Heritage Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
3	Palaeontology Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
4	Terrestrial Biodiversity Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Terrestrial_Biodiversity_Assessment_Protocols.pdf
5	Aquatic Biodiversity Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Aquatic_Biodiversity_Assessment_Protocols.pdf
6	Hydrology Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
7	Socio-Economic	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf

	Assessment	
8	Plant Species Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Plant_Species_Assessment_Protocols.pdf
9	Animal Species Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Animal_Species_Assessment_Protocols.pdf

Results of the environmental sensitivity of the proposed area.

The following section represents the results of the screening for environmental sensitivity of the proposed site for relevant environmental themes associated with the project classification. It is the duty of the EAP to ensure that the environmental themes provided by the screening tool are comprehensive and complete for the project. Refer to the disclaimer.

MAP OF RELATIVE AGRICULTURE THEME SENSITIVITY

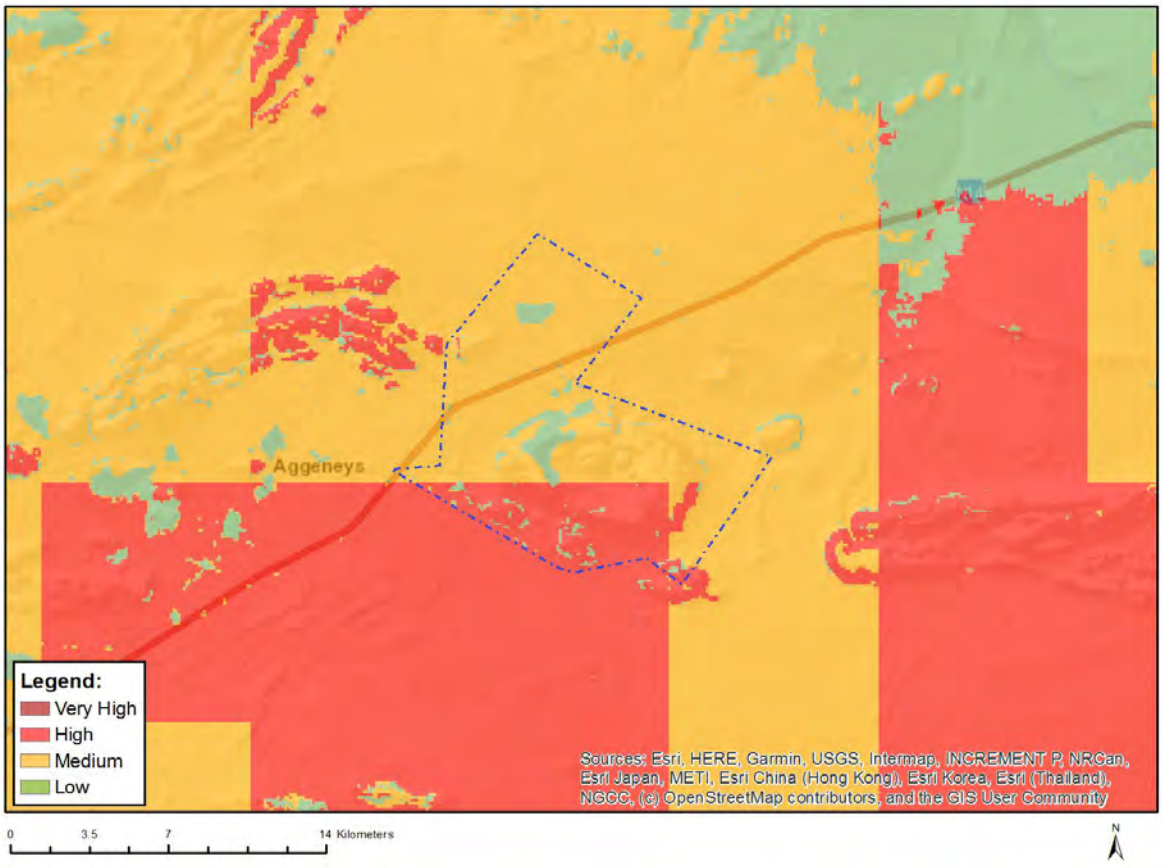


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

Sensitivity Features:

Sensitivity	Feature(s)
Low	Land capability;01. Very low/02. Very low/03. Low-Very low/04. Low-Very low/05. Low

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



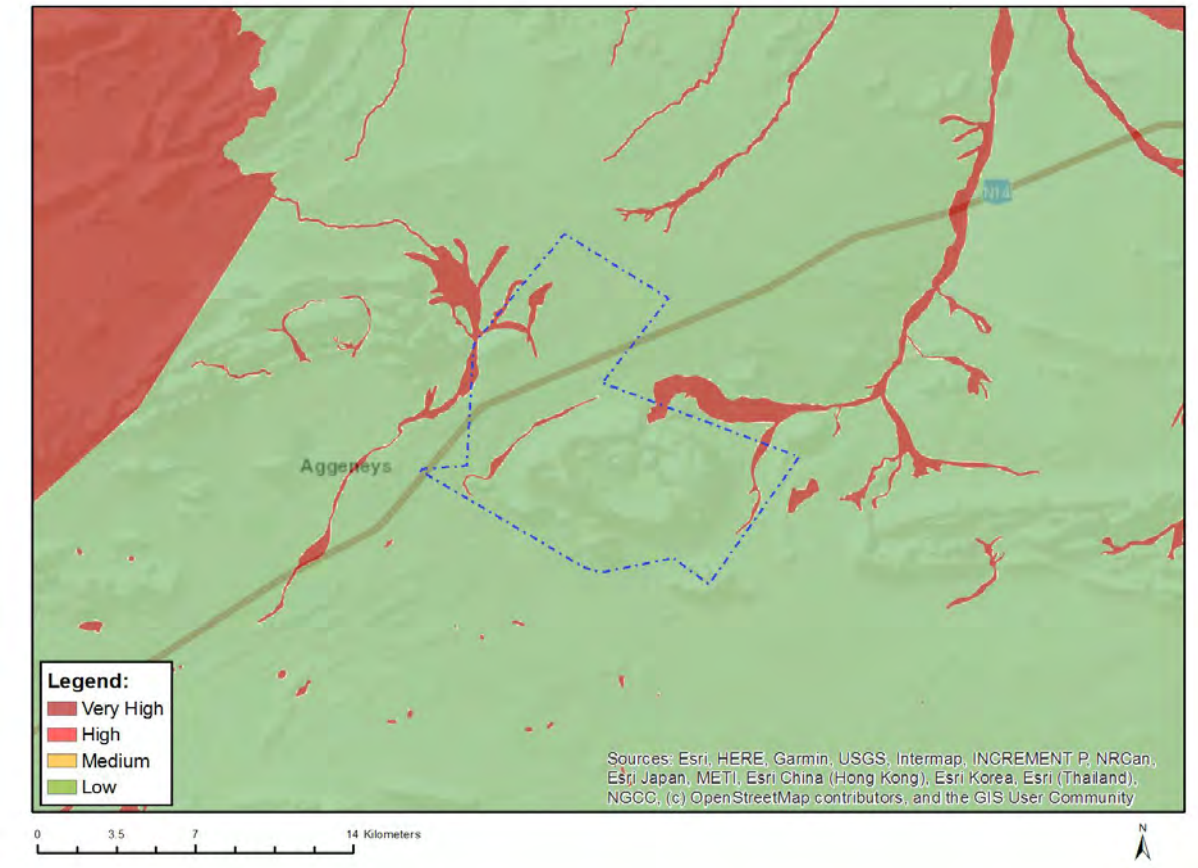
Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Aves-Neotis ludwigii
High	Aves-Aquila verreauxii
High	Aves-Calendulauda burra
Low	Low sensitivity
Medium	Aves-Neotis ludwigii
Medium	Aves-Calendulauda burra
Medium	Aves-Sagittarius serpentarius
Medium	Aves-Aquila verreauxii

MAP OF RELATIVE AQUATIC BIODIVERSITY THEME SENSITIVITY

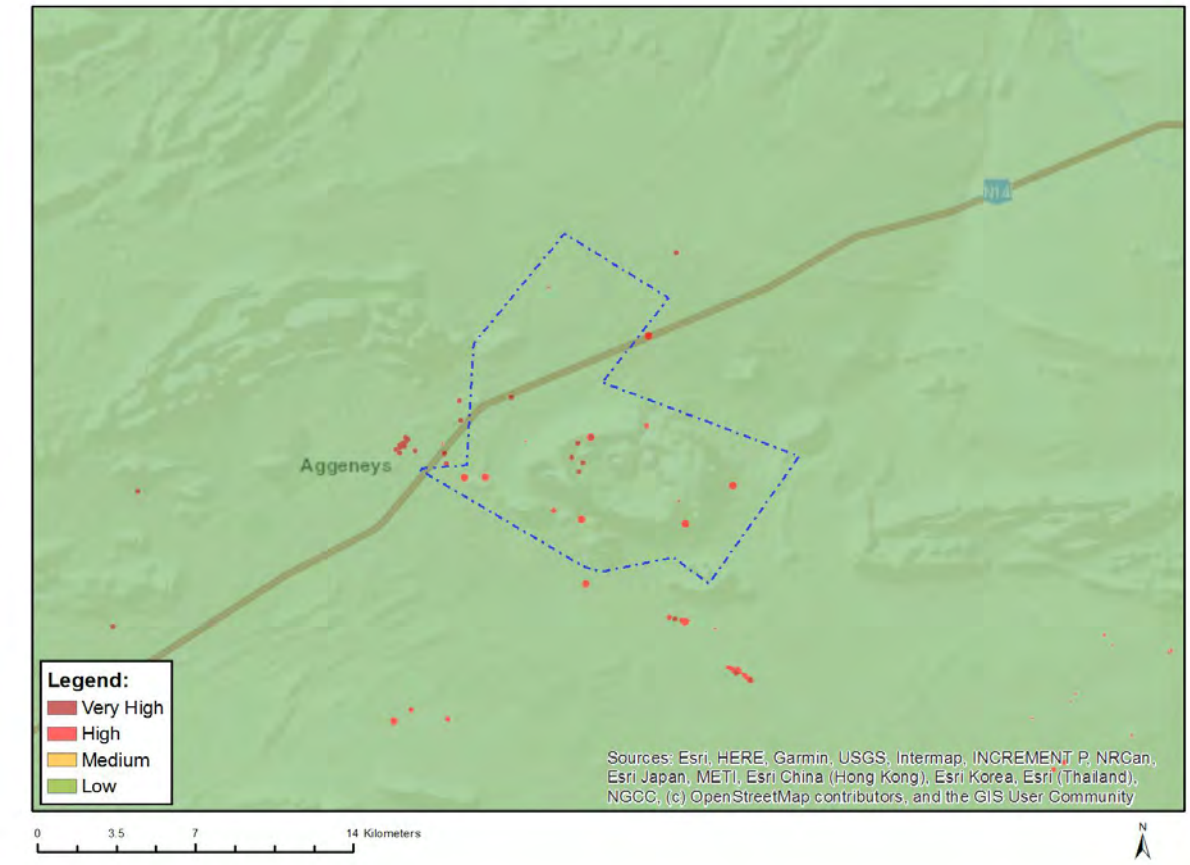


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity
Very High	Rivers
Very High	Wetlands and Estuaries

MAP OF RELATIVE ARCHAEOLOGICAL AND CULTURAL HERITAGE THEME SENSITIVITY

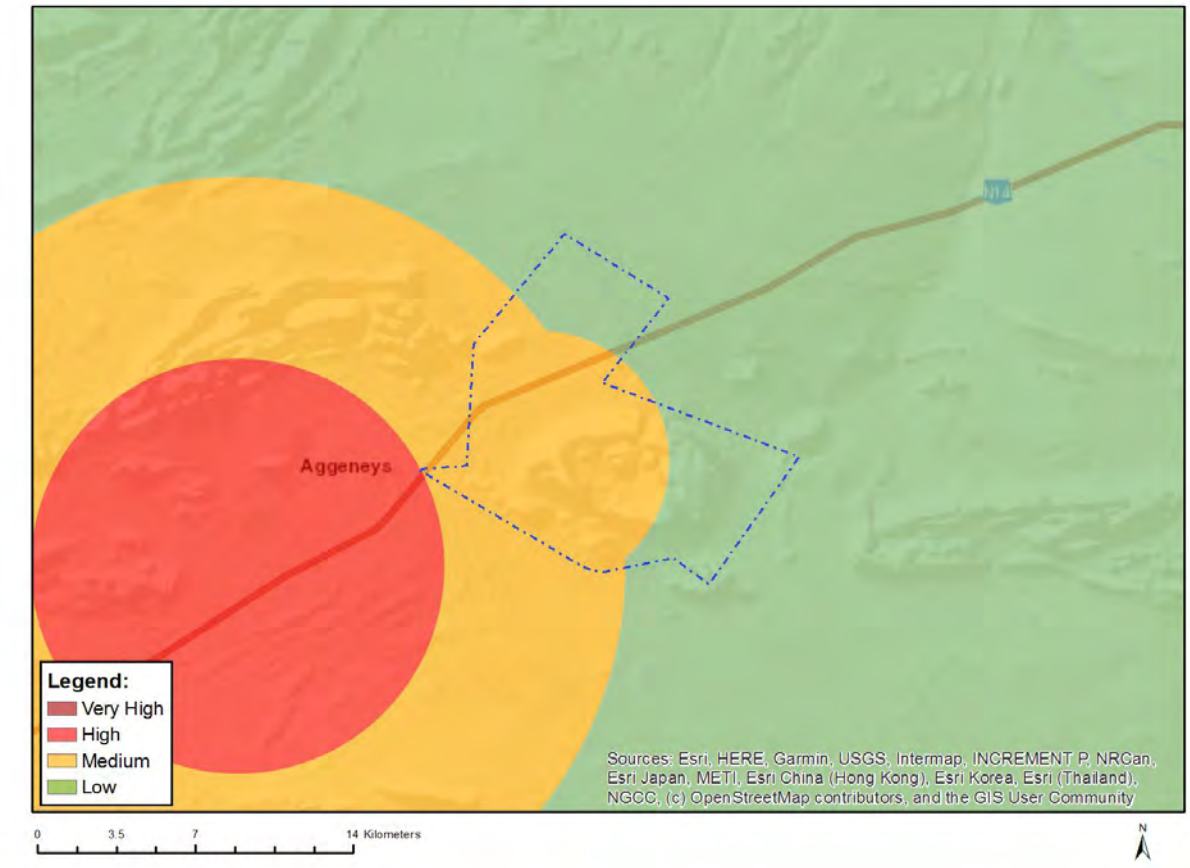


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
High	Within 150m of a Grade IIIa Heritage site
High	Within 100m of a Grade IIIb Heritage site
High	Within 50m of a Grade IIIc Heritage site
Low	Low sensitivity
Very High	Within 100m of an Ungraded Heritage site

MAP OF RELATIVE CIVIL AVIATION THEME SENSITIVITY

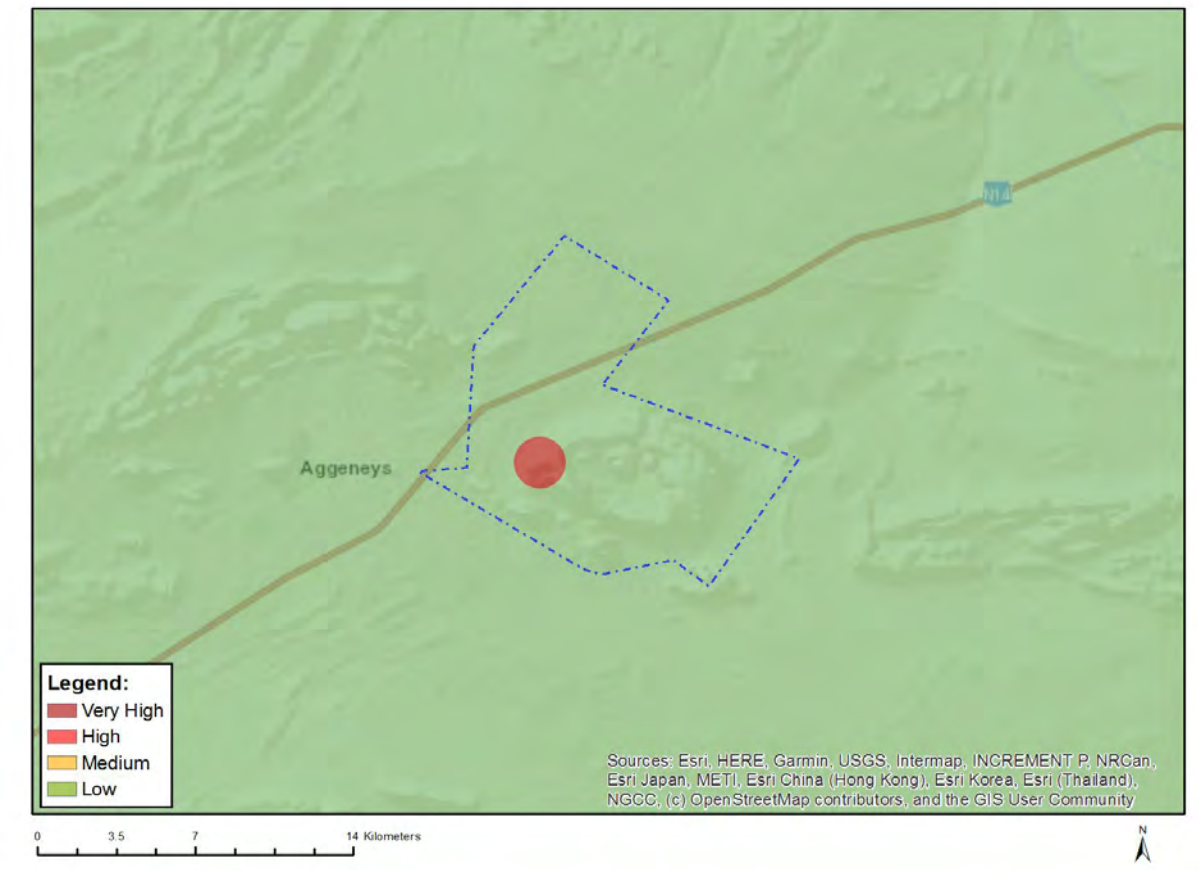


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Within 8 km of other civil aviation aerodrome
Low	Low sensitivity
Medium	Within 5 km of an air traffic control or navigation site
Medium	Between 8 and 15 km of other civil aviation aerodrome

MAP OF RELATIVE DEFENCE THEME SENSITIVITY

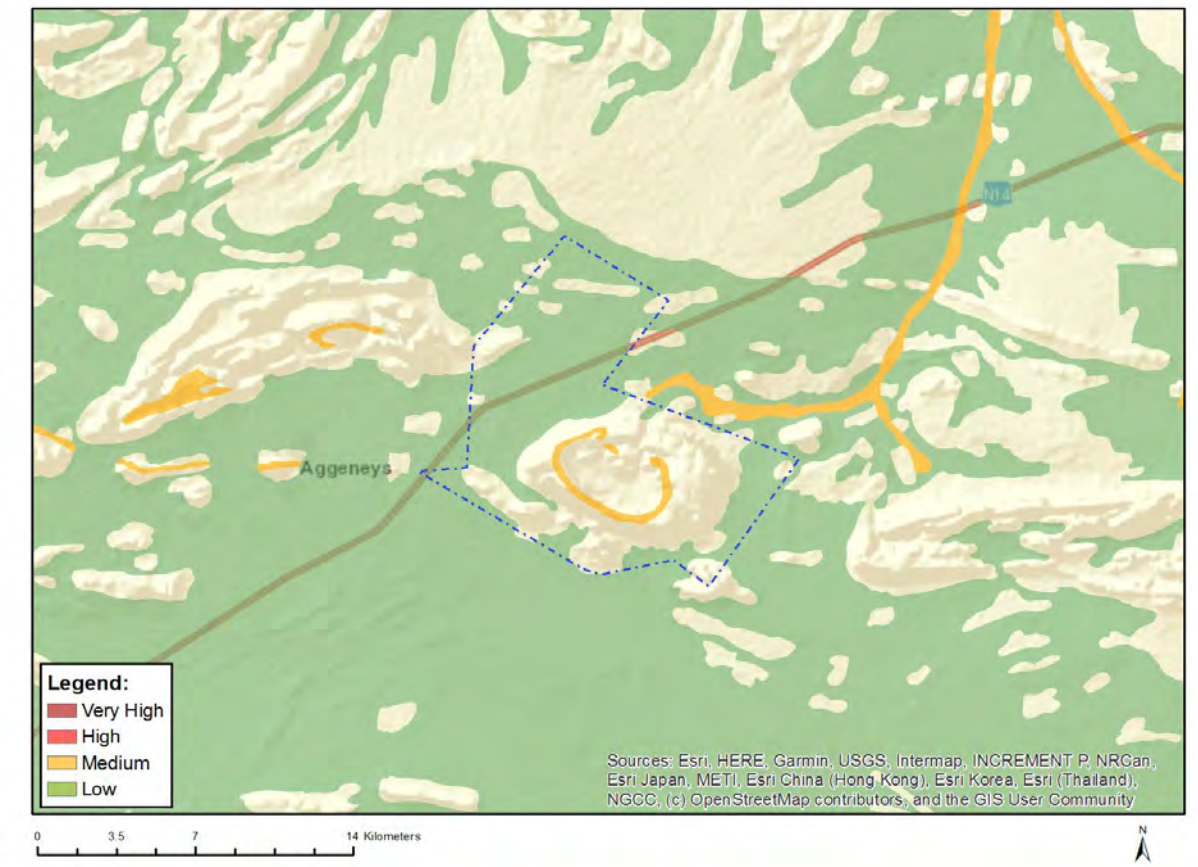


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity
Very High	Military and Defence Site

MAP OF RELATIVE PALEONTOLOGY THEME SENSITIVITY

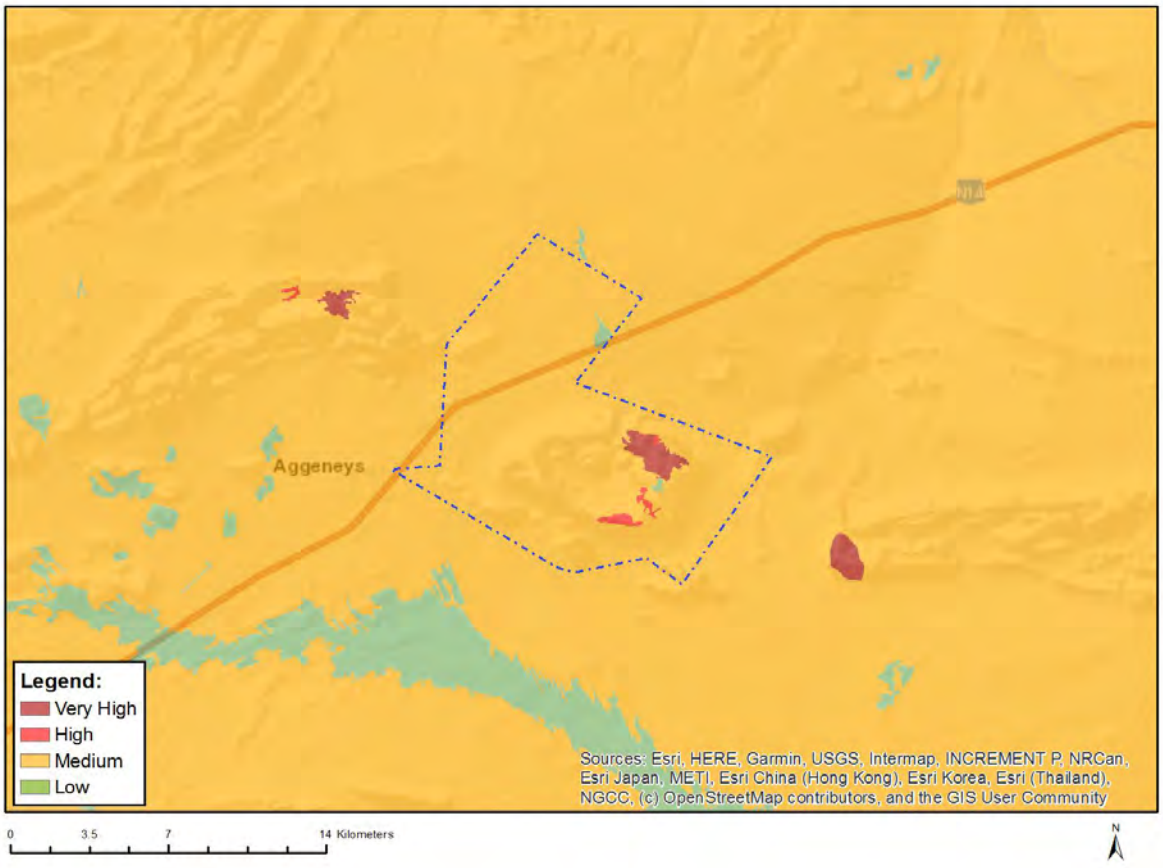


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Low	Features with a Low paleontological sensitivity
Medium	Features with a Medium paleontological sensitivity

MAP OF RELATIVE PLANT SPECIES THEME SENSITIVITY



Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

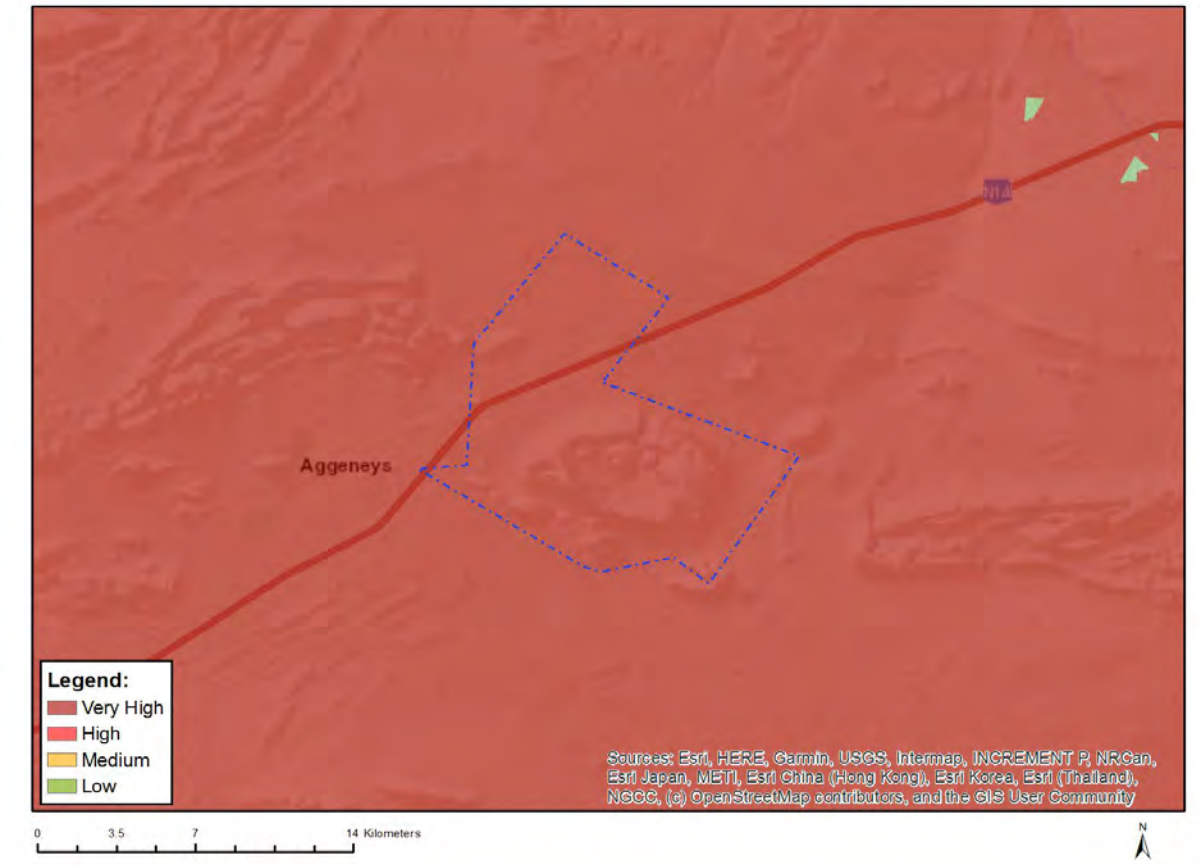
Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
High	Sensitive species 425
High	Cephalophyllum fulleri
High	Sensitive species 854
Low	Low Sensitivity
Medium	Sensitive species 425
Medium	Sensitive species 1157
Medium	Cephalophyllum fulleri
Medium	Sensitive species 119
Medium	Sensitive species 901
Medium	Sensitive species 12
Medium	Sensitive species 854
Medium	Crotalaria pearsonii
Medium	Sensitive species 122

Medium	Sensitive species 144
Very High	Sensitive species 134

MAP OF RELATIVE TERRESTRIAL BIODIVERSITY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Very High	Critical biodiveristy area 1
Very High	Critical biodiveristy area 2
Very High	Ecological support area
Very High	Protected Areas Expansion Strategy

COMMISSION ON RESTITUTION OF LAND RIGHTS

OFFICE OF THE REGIONAL LAND CLAIMS COMMISSIONER: NORTHERN CAPE
Hyesco Arcade, 4-8 Old Main Road, Kimberley, 8300 | PO Box 2458, Kimberley, 8300
Tel: (053) 807 5700 | Fax: (053) 831 6501

Enquiries: **Natashia Romain**

WSP GOLDER
E-mail: QMonareng@golder.co.za

Dear Mr / Ms

VERIFICATION OF LAND CLAIMS:

1. **PORTION 1 OF THE FARM BLOEMHOEK 61**
2. **PORTION 1 OF THE FARM GAMS 60**
3. **PORTION 0 OF THE FARM AROAMS 57**

SITUATE IN THE KHAI MA MUNICIPALITY
NORTHERN CAPE PROVINCE

We refer to your letter received: **22 April 2022**.

We confirm that as at the date of this letter no land claims appear on our database in respect of the Properties. This includes the database for claims lodged by 31 December 1998; and those lodged between 1 July 2014 and 27 July 2016 in terms of the Restitution of Land Rights Amendment Act, 2014.

Whilst the Commission takes reasonable care to ensure the accuracy of the information it provides, there are various factors that are beyond the Commission's control, particularly relating to claims that have lodged but not yet been gazetted such as:

1.Some Claimants referred to properties they claim dispossession of rights in land against using historical property descriptions which may not match the current property description; and
2.Some Claimants provided the geographic descriptions of the land they claim without mentioning the particular actual property description they claim dispossession of rights in land against.

The Commission therefore does not accept any liability whatsoever if through the process of further investigation of claims it is found that there is in fact a land claim in

respect of the above property.

If you are aware of any change in the description of the above property after 19 June 1913 kindly supply us with such description so as to enable us to do a further search.

Yours faithfully

p.p. RSMashitisho
Ms. M. Du Toit
Chief Director: Land Restitution Support-Northern Cape
Date: 22/04/2022

APPENDIX P

Impact Assessment Table

EMPr Ref. Nr	ACTIVITY *whether listed or not listed.*	POTENTIAL IMPACT	ASPECTS AFFECTED	PHASE In which impact is anticipated	Size and Scale of Disturbance	Magnitude	Duration	Scale	Probability	Significance	Significance without Mitigation	Magnitude	Duration	Scale	Probability	Significance	Significance with Mitigation	Detailed Mitigation Measures	Mitigation Type	Time period for implementation	Standards to be Achieved	Compliance with Standards	Responsible person
Construction Phase																							
Air Quality																							
1.1	Emissions from the construction activities.	Impact on surrounding sensitive receptors due to increased dust and particulate matter.	Ambient air quality	Construction Phase	17 ha	6	2	2	3	**30**	**Moderate**	4	2	1	2	**14**	**Low**	■ Modifying or ceasing loading activities during dry and high wind conditions. ■ Avoid double handling of material, where possible. ■ Minimising the drop height of the material from truck loads/transfer points. A drop height policy should be maintained on-site and all equipment operators should be trained in the policy such that drop height reduction is implemented during materials handling activities. ■ Using water carts with boom sprayers or wet suppression systems. ■ The height of existing berms at soil stockpiles must be increased, reducing the impact of winds on the stockpiles. ■ Maintaining stockpile moisture levels to avoid further entrainment of particles.	Minimise and control through impact management and monitoring.	Duration of construction phase	Compliance with NAAQA at the mine boundary.	By implementing dust control measures at significant emission sources, the cumulative ambient particulate load will be reduced.	Gamsberg Zinc Mine Environmental Manager, ECO, appointed business partners
Surface Water																							
2.1	Soil Stripping and stockpiling	Loss of soils through erosion, particularly for topsoil stockpiles with unvegetated steep slopes, resulting in increased sedimentation to water resources.	Downstream water resources	Construction phase	17 ha	8	3	2	4	52	**Moderate**	4	3	1	3	**24**	**Low**		Minimise and control through impact management and monitoring.	Duration of construction phase	Impact avoided Regulation GN 704 for storm water management at mines.	Compliance with GN 704 Implement the proposed mitigation measures to ensure compliance to the WUL conditions.	Gamsberg Zinc Mine Environmental Manager, ECO, appointed business partners

EMPr Ref. Nr	ACTIVITY *whether listed or not listed.*	POTENTIAL IMPACT	ASPECTS AFFECTED	PHASE In which impact is anticipated	Size and Scale of Disturbance	Magnitude	Duration	Scale	Probability	Significance	Significance without Mitigation	Magnitude	Duration	Scale	Probability	Significance	Significance with Mitigation	Detailed Mitigation Measures	Mitigation Type	Time period for implementation	Standards to be Achieved	Compliance with Standards	Responsible person
2.2	Construction of attenuation weir	Increased runoff and erosion in compacted areas and modification of natural infiltration. Soil contamination from chemical spills including sterilisation by cement pollutants.	Downstream water resources	Construction phase		8	3	2	4	52	Moderate	4	3	1	3	**24**	Low	■ Avoid clearing during the wet season when short heavy downpours can be expected. This should help to limit erosion. ■ Re-use stockpiled soil within as short a period as possible. ■ Ensure adequately designed berms and stormwater collection facilities to capture sediment before water is released into the environment. All stormwater management systems should be compliant with Regulation GN 704; and ■ Ensure clean-up of hydrocarbon spills from machinery is done immediately, and contaminated soils disposed of to a permitted site. ■ After construction, the land must be cleared of debris, surplus materials, and equipment. All parts of the land must be left in a condition as close as possible to that prior to construction.	Minimise and control through impact management and monitoring.	Duration of construction phase	Impact avoided Regulation GN 704 for storm water management at mines.	Compliance with GN 704 Implement the proposed mitigation measures to ensure compliance to the WUL conditions.	Gamsberg Zinc Mine Environmental Manager, ECO, appointed business partners
2.3	Layout of pipeline system	Loss of soils through erosion, particularly when excavating pipeline trenches.	Downstream water resources	Construction phase		8	3	2	4	52	Moderate	4	3	1	3	**24**	Low		Minimise and control through impact management and monitoring.	Duration of construction phase	Impact avoided Regulation GN 704 for storm water management at mines.	Compliance with GN 704 Implement the proposed mitigation measures to ensure compliance to the WUL conditions.	Gamsberg Zinc Mine Environmental Manager, ECO, appointed business partners
2.4	Vehicles and use of equipment/ machinery	Contamination of soils and downstream water resources by chemical pollutants.	Downstream water resources	Construction phase	17 ha	8	3	2	4	52	Moderate	4	3	1	3	**24**	Low		Minimise and control through impact management and monitoring.	Duration of construction phase	Impact avoided Regulation GN 704 for storm water management at mines.	Compliance with GN 704 Implement the proposed mitigation measures to ensure compliance to the WUL conditions.	Gamsberg Zinc Mine Environmental Manager, ECO, appointed business partners
Soil, land use and land capability																							
3.1	Vegetation clearance, soil stripping and stockpiling during construction of additional infrastructure	Change in surface profile	Soils, land use and land capability	Construction phase	17 ha	6	5	1	3	**36**	Moderate	6	5	1	3	**36**	Moderate	No mitigation possible.	N/A	N/A	N/A	N/A	N/A

EMPr Ref. Nr	ACTIVITY *whether listed or not listed.*	POTENTIAL IMPACT	ASPECTS AFFECTED	PHASE In which impact is anticipated	Size and Scale of Disturb ance	Magnitude	Duration	Scale	Probability	Significance	Significance without Mitigation	Magnitude	Duration	Scale	Probability	Significance	Significance with Mitigation	Detailed Mitigation Measures	Mitigation Type	Time period for implementati on	Standards to be Achieved	Compliance with Standards	Responsible person
3.2	Vegetation clearance, soil stripping and stockpiling during construction of additional infrastructure	Change in land capability	Soils, land use and land capability	Construction phase	17 ha	6	5	1	3	**36**	**Moderate**	6	5	1	3	**36**	**Moderate**	■ Minimise the infrastructure footprint and therefore disturbance to the minimum area necessary by forward planning (clearing land during the dry season rather than wet season) and clear demarcation of the areas to be disturbed. ■ Avoid permanently impacting topsoil and subsoil but salvaging the maximum depth of these when clearing areas for infrastructure. ■ Avoid mixing topsoil (A-horizon) with subsoil (B-horizon) during stripping and storing of soil (where applicable). ■ Ensuring that the overall thickness of the soils utilised for rehabilitation is consistent with surrounding undisturbed areas and future land use (at least grazing land use).	Minimise and control through impact management and monitoring.	Duration of construction phase	Impact avoided	Conduct land clearance, soil stripping and stockpiling in accordance with the Gamsberg Zinc Mine procedures to reduce the impact on soils in the immediate area.	Gamsberg Zinc Mine Environmental Manager, ECO, appointed business partners

EMPr Ref. Nr	ACTIVITY *whether listed or not listed.*	POTENTIAL IMPACT	ASPECTS AFFECTED	PHASE In which impact is anticipated	Size and Scale of Disturbance	Magnitude	Duration	Scale	Probability	Significance	Significance without Mitigation	Magnitude	Duration	Scale	Probability	Significance	Significance with Mitigation	Detailed Mitigation Measures	Mitigation Type	Time period for implementation	Standards to be Achieved	Compliance with Standards	Responsible person
3.3	Vegetation clearance, soil stripping and stockpiling during construction of additional infrastructure	Erosion and sedimentation	Soils, land use and land capability	Construction phase	17 ha	2	2	1	3	**15**	**Low**	2	2	1	2	**10**	**Low**	■ Implement an effective system of run-off control, where it is required, that collects and safely disseminates run-off water from all hardened surfaces and prevents potential down slope erosion. ■ Periodic erosion monitoring to be undertaken in cleared areas. ■ Any occurrence of erosion must be attended to immediately and the integrity of the erosion control system at that point must be amended to prevent further erosion form occurring there. ■ Retain as much vegetation cover over as much of the site as possible to protect soil from water and wind erosion. Work should be stopped in land clearance areas during heavy rainfall periods.	Minimise and control through impact management and monitoring.	Duration of construction phase	Impact avoided	Conduct land clearance, soil stripping and stockpiling in accordance with the Gamsberg Zinc Mine procedures to reduce the impact on soils in the immediate area.	Gamsberg Zinc Mine Environmental Manager, ECO, appointed business partners

3.4	Vegetation clearance, soil stripping and stockpiling during construction of additional infrastructure	Loss of topsoil	Soils, land use and land capability	Construction phase	17 ha	4	4	1	3	**27**	**Low**	2	4	1	2	**14**	**Low**	■ Any available topsoil should first be stripped from the entire surface to be disturbed and stockpiled for re-spreading during rehabilitation. The depth of topsoil stripping will be dependent on the specific field conditions. ■ It is only in areas where topsoil cannot be retained on the surface during the operational phase, and where the area will be rehabilitated back to veld after decommissioning, that it should be stripped and stockpiled for the duration of the operational phase for re-spreading during de-commissioning. ■ Topsoil stockpiles must be conserved against losses through erosion by establishing vegetation cover on them. ■ During rehabilitation, the stockpiled topsoil must be evenly spread over the entire disturbed surface. ■ If there is compaction, either in re-spread topsoil or in areas where topsoil was retained during the operational phase, it must be loosened using appropriate decompaction (ripping) equipment. ■ If topsoil has been stockpiled for the duration of the operational phase, re-vegetation is likely to require seeding and / or planting. Erosion must be carefully controlled where necessary on topsoiled areas.	Minimise and control through impact management and monitoring.	Duration of construction phase	Impact avoided	Conduct land clearance, soil stripping and stockpiling in accordance with the Gamsberg Zinc Mine procedures to reduce the impact on soils in the immediate area.	Gamsberg Zinc Mine Environmental Manager, ECO, appointed business partners

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3.5	Vehicles and use of equipment/ machinery	Soil compaction	Soils, land use and land capability	Construction phase	17 ha	6	5	1	3	**36**	**Moderate**	4	5	1	3	**30**	**Moderate**	■ Soil compaction during construction and decommissioning phases cannot be avoided as heavy machinery will be operational in all areas where disturbance is anticipated. ■ Business partners (in particular heavy machinery) will be restricted to designated areas as defined by the Environmental Department. ■ Tracked vehicles will be utilised in soil clearance activities as per soil stripping and handling procedures. ■ Limit traffic to designated roads.	Minimise and control through impact management and monitoring.	Duration of construction phase	Impact avoided	Implementing the requirements of GNR. 331. Norms and Standards for Remediation of Contaminated Land & Soil Quality will reduce the impact on soils in the immediate area.	Gamsberg Zinc Mine Environmental Manager, ECO, appointed business partners

3.6	Vehicles and use of equipment/ machinery	Soil contamination	Soils, land use and land capability	Construction phase	17 ha	4	4	1	3	**27**	Low	4	2	1	2	**14**	Low	■ All vehicles and machinery shall be kept in good working order and inspected on a regular basis for possible leaks and shall be repaired as soon as possible if required. ■ Repairs shall be carried out in a dedicated repair area only, unless in-situ repair is necessary as a result of a breakdown. ■ Drip trays shall at all times be placed under vehicles that require in-situ repairs. ■ Drip trays shall be emptied into designated containers only and the contents disposed of at a licenced hazardous material disposal facility. ■ Ensure proper handling of hazardous chemicals and materials (e.g., fuel, oil, cement, concrete, reagents, emulsion etc.) as per their corresponding Safety Data Sheets (SDS) and the Gamsberg Zinc Mine spill response procedures. ■ Accidental spills (concrete, chemicals, process water, hydrocarbons, ore, waste) need to be reported immediately so that effective remediation and clean-up strategies and procedures can be implemented. Soil that is contaminated by fuel, chemical or oil spills, for example, from vehicles, or ore spillage at the crusher and coarse ore stockpile area will either be collected to be treated at a	Minimise and control through impact management and monitoring.	Duration of construction phase	Impact avoided	Implementing the requirements of GNR. 331. Norms and Standards for Remediation of Contaminated Land & Soil Quality will reduce the impact on soils in the immediate area.	Gamsberg Zinc Mine Environmental Manager, ECO, appointed business partners

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																		pre-determined and dedicated location, or will be cleaned up and treated in situ, using sand, soil or a suitable absorption medium.					
Biodiversity																							

4.1	Vegetation clearance, soil stripping and stockpiling during construction of additional infrastructure	Direct loss and disturbance of natural habitat and associated flora SCC	Biodiversity	Construction phase	17 ha	8	5	1	5	70	High	4	5	1	2	20	Low	■ To prevent loss of flora of conservation concern beyond the direct disturbance footprint, prior to any vegetation clearing, the development footprints should be clearly marked out with flagging tape/posts in the field. Vegetation clearing should be restricted to the proposed project footprints only, with no clearing permitted outside of these areas. ■ A search and rescue survey for all flora SCC should then be conducted within these marked footprints prior to the commencement of construction to determine the number of potentially impacted plant species of conservation concern. Based on the findings of the survey, clearing and/or relocation permits should be obtained from the relevant authority to clear or rescue and relocate potentially impacted plant SCC. ■ Rescued plants should be relocated to an adjacent area of natural habitat. ■ It is recommended that no large plant specimens should be translocated prior to mining/developing new areas. This has been highly unsuccessful to date with virtually zero survival in transplanted Aloidendron dichotomoa and Boscia albitrunca trees observed (Desmet, 2022). As an alternative mitigation	Minimise and control through impact management and monitoring.	Duration of operational phase	Impact avoided	Implementing the proposed mitigation measures to reduce the impact on flora.	Gamsberg Zinc Mine Environmental Manager, ECO, appointed business partners

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																		measure, the budget that would have been allocated to translocation of large plant specimens should instead be allocated to the purchase of more conservation land as part of the offset so that these species can be conserved in-situ.					
4.2	Vegetation clearance, soil stripping and stockpiling during construction of additional infrastructure	Establishment and spread of alien and invasive species	Biodiversity	Construction phase	17 ha	8	5	1	3	42	Moderate	4	5	1	2	20	Low	An alien and invasive species management plan should be developed for the Gamsberg Zinc Mine, which includes details of strategies and procedures that must be implemented on site to control the spread of alien and invasive species, particularly Prosopis sp. A combined approach using both chemical and mechanical control methods, with periodic follow-up treatments informed by regular monitoring, is recommended.	Minimise and control through impact management and monitoring.	Duration of operational phase	Impact avoided	Implementing the proposed mitigation measures to reduce the impact on flora.	Gamsberg Zinc Mine Environmental Manager, ECO, appointed business partners

EMPr Ref. Nr	ACTIVITY *whether listed or not listed.*	POTENTIAL IMPACT	ASPECTS AFFECTED	PHASE In which impact is anticipated	Size and Scale of Disturbance	Magnitude	Duration	Scale	Probability	Significance	Significance without Mitigation	Magnitude	Duration	Scale	Probability	Significance	Significance with Mitigation	Detailed Mitigation Measures	Mitigation Type	Time period for implementation	Standards to be Achieved	Compliance with Standards	Responsible person
4.3	Vehicles and use of equipment/ machinery	Injury and mortality of bird SCC	Biodiversity	Construction phase		4	2	1	3	21	Low	4	2	1	2	14	Low	■ Construction activities should be scheduled to occur outside of the main bird breeding season, in order to minimise the risk of disturbance to breeding/nesting individuals/groups, where possible. ■ Speed limits on the mine should be expanded to construction areas via appropriate signage and enforced on all access roads to proposed new infrastructure locations. Dust suppression activities should also be expanded to include additional road at new infrastructure areas.	Minimise and control through impact management and monitoring.	Duration of operational phase	Impact avoided	Implementing the proposed mitigation measures to reduce the impact on flora.	Gamsberg Zinc Mine Environmental Manager, ECO, appointed business partners
4.4	Vehicles and use of equipment/ machinery	Injury and mortality of reptile SCC	Biodiversity	Construction phase		8	2	1	3	33	Moderate	6	2	1	2	18	Low	■ A search and rescue survey for herpetofauna species should be done immediately in advance of site clearance activities. Any observed individuals should be relocated to nearby areas of natural habitats. Where snakes require relocation, this should be done by a certified snake handler for health and safety reasons.	Minimise and control through impact management and monitoring.	Duration of operational phase	Impact avoided	Implementing the proposed mitigation measures to reduce the impact on flora.	Gamsberg Zinc Mine Environmental Manager, ECO, appointed business partners
4.5	Vegetation clearance, soil stripping and stockpiling during construction of additional infrastructure	Loss and fragmentation of faunal habitat	Biodiversity	Construction phase	17 ha	4	3	2	3	27	Low	2	3	2	2	14	Low	■ None required	N/A	N/A	N/A	N/A	N/A
Paleontological resources																							

EMPr Ref. Nr	ACTIVITY *whether listed or not listed.*	POTENTIAL IMPACT	ASPECTS AFFECTED	PHASE In which impact is anticipated	Size and Scale of Disturbance	Magnitude	Duration	Scale	Probability	Significance	Significance without Mitigation	Magnitude	Duration	Scale	Probability	Significance	Significance with Mitigation	Detailed Mitigation Measures	Mitigation Type	Time period for implementation	Standards to be Achieved	Compliance with Standards	Responsible person
5.1	Site clearance during construction of infrastructure	No impacts expected, but chance finds with potentially moderate impacts could occur	Palaeontological resources	Construction phase	17 ha	8	5	1	3	42	Moderate	4	1	1	2	12	Low	▪ Chance find procedure to be implemented immediately should any heritage resources be unearthed: ▪ Cease all work in the immediate vicinity of the find. ▪ Demarcate the area with barrier tape or other highly visible means. ▪ Notify the South African Heritage Resources Authority (SAHRA) immediately. ▪ Commission an archaeologist accredited with the Association for Southern African Professional Archaeologists (ASAPA) to assess the find and determine appropriate mitigation measures. These may include obtaining the necessary authorisation from SAHRA to conduct the mitigation measures. ▪ Prevent access to the find by unqualified persons until the assessment and mitigation processes have been completed.	Minimise and control through impact management and monitoring.	Duration of construction phase	Impact avoided	By monitoring construction activities and implementing the chance find procedure, damage to heritage resources can be avoided.	Gamsberg Zinc Mine Environmental Manager, ECO, appointed business partners
Heritage resources																							

EMPr Ref. Nr	ACTIVITY *whether listed or not listed.*	POTENTIAL IMPACT	ASPECTS AFFECTED	PHASE In which impact is anticipated	Size and Scale of Disturbance	Magnitude	Duration	Scale	Probability	Significance	Significance without Mitigation	Magnitude	Duration	Scale	Probability	Significance	Significance with Mitigation	Detailed Mitigation Measures	Mitigation Type	Time period for implementation	Standards to be Achieved	Compliance with Standards	Responsible person
6.1	Site clearance during construction of infrastructure	No impacts expected, but chance finds with potentially moderate impacts could occur	Heritage resources	Construction phase	17 ha	8	5	1	3	42	Moderate	4	1	1	2	12	Low	▪ Chance find procedure to be implemented immediately should any heritage resources be unearthed: ▪ Cease all work in the immediate vicinity of the find. ▪ Demarcate the area with barrier tape or other highly visible means. ▪ Notify the South African Heritage Resources Authority (SAHRA) immediately. ▪ Commission an archaeologist accredited with the Association for Southern African Professional Archaeologists (ASAPA) to assess the find and determine appropriate mitigation measures. These may include obtaining the necessary authorisation from SAHRA to conduct the mitigation measures. ▪ Prevent access to the find by unqualified persons until the assessment and mitigation processes have been completed.	Minimise and control through impact management and monitoring.	Duration of construction phase	Impact avoided	By monitoring construction activities and implementing the chance find procedure, damage to palaeontological resources can be avoided.	Gamsberg Zinc Mine Environmental Manager, ECO, appointed business partners
Socio-Economic																							

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7.1	Construction of additional infrastructure	Sustain current employment into the future	Socio-economic	Construction phase	N/A	2	2	2	4	24	Positive	2	2	2	4	24	Positive	None required	N/A	N/A	N/A	N/A	N/A
7.2	Construction of additional infrastructure	Increase economic revenue	Socio-economic	Construction phase	N/A	4	2	2	3	24	Positive	2	2	2	4	24	Positive	None required	N/A	N/A	N/A	N/A	N/A
7.3	Construction of additional infrastructure	Nuisance impacts	Socio-economic	Construction phase	N/A	6	2	2	4	40	Moderate	4	2	2	2	16	Low	Implement suitable mitigation measures for noise and air quality impacts	Minimise and control through impact management and monitoring.	Duration of construction phase	Impact avoided	Implement the proposed mitigation measures to reduce the health and safety risks.	Gamsberg Zinc Mine Environmental Manager, ECO, appointed contractors
Operational Phase																							
Air Quality																							

1.2	Emissions from the coarse ore stockpile, crusher, material handling and storage tanks.	Impact on surrounding sensitive receptors due to increased dust, particulate matter and VOC levels	Ambient air quality	Operational Phase	17 ha	4	3	2	3	**27**	Low	2	3	1	2	**12**	Low	■ The conveyor belts are cleaned on a regular basis through the use of belt scrapers, washers and or combinations of both. Implementing wet dust suppression sprays at conveyor tip points are also recommended. ■ Tasking a team to be responsible for the removal of all deposited dust from machinery, enclosures and conveyors within the crushing plant and tip areas, resulting in less deposited dust available for wind entrainment. ■ Deploy a dust sweeper in the plant, capable of collecting all deposited fines, reducing the amount of dust available for wind entrainment. ■ Erecting porous wind breaks at the base of screens, crushers and transfer points, approximately 2 m high, completely enclosing the base of the structure. This method will ensure deposited fines from the activity are not entrained by winds. These areas can then be routinely cleaned. ■ Wash down the plant areas on a periodic basis via water sprays. ■ For the fuel facilities, maintaining stable tank pressure and vapour space: ▪ All tank lines should remain charged (i.e. liquid full), and only emptied for maintenance or product change. ▪ Coordinating filling and withdrawal	Minimise and control through impact management and monitoring.	Duration of operational phase	Compliance with NAAQA at the mine boundary.	By implementing dust and emission control measures at significant emission sources, the cumulative ambient particulate load will be reduced.	Gamsberg Zinc Mine Environmental Manager

																		schedules, and implementing vapour balancing between tanks. ▪ Thermal relief valves should be present to protect the pipes against overpressure due to solar heating. ■ Use of bottom loading truck/rail car filling systems. ■ Establishing a procedure for periodic monitoring of fugitive emissions from pipes, valves, seals, tanks and other infrastructure components with vapour detection equipment, and with subsequent maintenance or replacement of components as needed. The procedure should specify the monitoring frequency and locations, as well as the trigger levels for repairs. ■ The quantity of vapour in an air-and-vapour mixture can be measured by means of a gas detector. Gas detector scales are graduated from 0 to 100, their graduation being based on the lower limit of flammability of 1 %. A reading of 50 indicates 50 % of the lower limit of flammability (i.e. the mixture contains 0,5 % of vapour), and a reading of 20 on that scale indicates 0,2 % of vapour (SANS 10089-1). ■ The instrument used for recording the concentration of this vapour should be of an approved design and shall be regularly calibrated					

																	and tested for accuracy. ■ During fuel tank cleaning, the following should be observed: ■ Tank degassing vapours should be routed to an appropriate emissions control device. Other practices include restricting activities to a season when the potential for ozone formation is reduced or to a time of the day when the potential for ozone formation is less. ■ Tanks should be periodically inspected internally. An inspection frequency based on the condition of the tank at the previous internal inspection should be established (typically 10 years or less). ■ During the operational phase passive monitoring campaign should be undertaken annually for a minimum of three months during the winter and summer seasons to determine the VOC concentrations liberated in the general vicinity of the operations. If concentrations levels are low, monitoring can stop.					
Surface Water																							

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2.5	Vehicles and use of equipment/ machinery	Contamination of soils and downstream water resources from fuel/emulsion spills/ leaks.	Downstream water resources	Operational Phase	17 ha	6	2	2	3	**30**	**Moderate**	4	2	1	3	**21**	**Low**	■ Fuel tanks and emulsion facilities must be placed in bunded structures, designed with the correct capacity to handle an emergency event. ■ Ensure proper handling of fuel and emulsion as per their corresponding Safety Data Sheets (SDS) and the Gamsberg Zinc Mine spill response procedures. ■ Accidental spills need to be reported immediately so that effective remediation and clean-up strategies and procedures can be implemented. ■ Soil that is will either be collected to be treated at a pre-determined and dedicated location, or will be cleaned up and treated in situ, using sand, soil or a suitable absorption medium.	Minimise and control through impact management and monitoring.	Duration of operational phase	Regulation GN 704 for storm water management at mines.	Compliance with GN 704 Implement the proposed mitigation measures to ensure compliance to the WUL conditions.	Gamsberg Zinc Mine Environmental Manager
2.6	Channels and pipelines system operations	Sediment depositions in channels causing blockages and deterioration of pipelines.	Downstream water resources	Operational Phase		6	2	2	3	**30**	**Moderate**	4	2	1	3	**21**	**Low**	■ Design stormwater management facilities to comply with regulation GN 704. ■ Regularly schedule inspection and maintenance of water management facilities, to include inspection of drainage structures and liners for any in channel erosion or cracks. Pipelines should be maintained according to manufacturer's specifications.	Minimise and control through impact management and monitoring.	Duration of operational phase	Impact avoided	Compliance with GN 704 Implement the proposed mitigation measures to ensure compliance to the WUL conditions.	Gamsberg Zinc Mine Environmental Manager

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2.7	Attenuation weir operations	Potential overflow from the attenuation weir.	Downstream water resources	Operational Phase		6	2	2	3	**30**	**Moderate**	4	2	1	3	**21**	**Low**	■ Implement the proposed attenuation weir to comply with regulation GN 704 so that it can contain a 1: 50 flood event.	Minimise and control through impact management and monitoring.	Duration of operational phase	Regulation GN 704 for storm water management at mines.	Compliance with GN 704 Implement the proposed mitigation measures to ensure compliance to the WUL conditions.	Gamsberg Zinc Mine Environmental Manager
Soil, land use and land capability																							
3.7	Movement of vehicles and employees around infrastructure and storage od dangerous goods.	Soil contamination	Soils, land use and land capability	Operational phase	17 ha	6	4	1	3	**33**	**Moderate**	4	4	1	2	**18**	**Low**	■ Fuel tanks and emulsion facilities must be placed in bunded structures, designed with the correct capacity to handle an emergency event. ■ Ensure proper handling of fuel and emulsion as per their corresponding Safety Data Sheets (SDS) and the Gamsberg Zinc Mine spill response procedures. ■ Accidental spills need to be reported immediately so that effective remediation and clean-up strategies and procedures can be implemented. ■ Soil that is will either be collected to be treated at a pre-determined and dedicated location, or will be cleaned up and treated in situ, using sand, soil or a suitable absorption medium.	Minimise and control through impact management and monitoring.	Duration of operational phase	Impact avoided	Implementing the proposed mitigation measures to reduce the impact on soils, land use and land capability.	Gamsberg Zinc Mine Environmental Manager
Biodiversity																							
4.6	Dust deposition from WRD	Indirect loss and disturbance of natural habitat and associated flora SCC	Biodiversity	Operational phase	17 ha	6	4	2	3	36	**Moderate**	4	4	1	3	27	**Low**	■ Implement dust suppression in the area of the WRD	Minimise and control through impact management and monitoring.	Duration of operational phase	Impact avoided	Implementing the proposed mitigation measures to reduce the impact on flora.	Gamsberg Zinc Mine Environmental Manager

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4.7	On-site traffic	Spread of alien and invasive species	Biodiversity	Operational phase	17 ha	6	6	2	4	56	Moderate	2	6	1	3	27	Low	■ The alien and invasive species management plan should be implemented. A combined approach using both chemical and mechanical control methods, with periodic follow-up treatments informed by regular monitoring, is recommended.	Minimise and control through impact management and monitoring.	Duration of operational phase	Impact avoided	Implementing the proposed mitigation measures to reduce the impact on flora.	Gamsberg Zinc Mine Environmental Manager
4.8	On-site traffic	Injury and mortality of fauna SCC	Biodiversity	Operational phase	17 ha	4	6	2	3	36	Moderate	2	6	1	2	18	Low	■ The speed limit on the mine (40 km/h) should be communicated and enforced.	Minimise and control through impact management and monitoring.	Duration of operational phase	Impact avoided	Implementing the proposed mitigation measures to reduce the impact on fauna.	Gamsberg Zinc Mine Environmental Manager
Socio-economic																							
7.4	Operation of additional infrastructure (contribute to ramped up 10 million ton per annum operation)	Sustain current employment into the future	Socio-economic	Operational phase		2	2	2	4	24	Positive	2	2	2	4	24	Positive	■ None required	N/A	N/A	N/A	N/A	N/A
7.5	Operation of additional infrastructure (contribute to ramped up 10 million ton per annum operation)	Skills transfer and development	Socio-economic	Operational phase		2	4	2	3	24	Positive	6	4	2	4	48	Positive	■ Ensure transfers of skills and career development for employees in accordance with the Gamsberg Zinc Mine training and development programmes.	Minimise and control through impact management and monitoring.	Duration of operational phase	N/A	N/A	Gamsberg Zinc Mine Human Resources Manager
7.6	Operation of additional infrastructure (contribute to ramped up 10 million ton per annum operation)	Nuisance impacts	Socio-economic	Operational phase		2	1	3	3	18	Low	2	1	3	2	12	Low	■ Implement suitable mitigation measures for noise and air quality impacts	Minimise and control through impact management and monitoring.	Duration of operational phase	Impact avoided	Implement the proposed mitigation measures to reduce the health and safety risks.	Gamsberg Zinc Mine Environmental Manager, Health and Safety Manager
Decommissioning and Closure Phase																							
Air Quality																							

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1.3	Emissions from the decommissioning activities.	Impact on surrounding sensitive receptors due to increased dust and particulate matter	Ambient air quality	Decommissioning and closure phase	17 ha	6	2	2	3	**30**	**Moderate**	4	2	1	2	**14**	**Low**	■ Modifying or ceasing loading activities during dry and high wind conditions. ■ Avoid double handling of material, where possible. ■ Minimising the drop height of the material from truck loads/transfer points. A drop height policy should be maintained on site and all equipment operators should be trained in the policy such that drop height reduction is implemented during materials handling activities. ■ Using water carts with boom sprayers or wet suppression systems. ■ The height of existing berms at stockpiles must be increased, reducing the impact of winds on the stockpile. ■ Maintaining the stockpile moisture level to avoid further entrainment of particles.	Minimise and control through impact management and monitoring.	During decommissioning and closure phase	Compliance with NAAQA at the mine boundary.	By implementing dust control measures at significant emission sources, the cumulative ambient particulate load will be reduced.	Gamsberg Zinc Mine Environmental Manager, ECO, appointed business partners
Surface Water																							

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2.8	Removal of redundant infrastructure	Spillage of chemical solutions during the dismantling of plant equipment, pipelines and channels which were in contact with chemicals solution may contaminate the soils; Spillage of diesel, oils, and greases from the dismantled plant equipment, resulting in hydrocarbon contamination of exposed soils.	Downstream water resources	Decommissioning and closure phase	17 ha	6	4	3	3	**39**	**Moderate**	4	2	1	2	**14**	**Low**	■ All pollution control mechanisms are to be in accordance with GN 704, and all necessary pollution control mechanisms must be protected and repaired or established when stockpiles or residue deposits are reclaimed, removed, or rehabilitated so that water pollution is minimized and abated.	Minimise and control through impact management and monitoring.	During decommissioning and closure phase	Regulation GN 704 for storm water management at mines.	Compliance with GN 704 Implement the proposed mitigation measures to ensure compliance to the WUL conditions.	Gamsberg Zinc Mine Environmental Manager, ECO, appointed business partners
2.9	Grading of the project site to ensure long-term drainage conditions on site	Contamination of soils by hydrocarbons, and downstream areas during compaction in areas where active heavy machinery will be mobilised for the shaping of the final landform.	Downstream water resources	Decommissioning and closure phase	17 ha	6	3	2	3	**33**	**Moderate**	4	3	2	2	**18**	**Low**		Minimise and control through impact management and monitoring.	During decommissioning and closure phase	Regulation GN 704 for storm water management at mines.	Compliance with GN 704 Implement the proposed mitigation measures to ensure compliance to the WUL conditions.	Gamsberg Zinc Mine Environmental Manager, ECO, appointed business partners
2.10	Soil placement and revegetation of project site	Erosion and sedimentation of downstream resources from areas not adequately revegetated.	Downstream water resources	Decommissioning and closure phase	17 ha	6	3	2	3	**33**	**Moderate**	4	3	2	2	**18**	**Low**		Minimise and control through impact management and monitoring.	During decommissioning and closure phase	Regulation GN 704 for storm water management at mines.	Compliance with GN 704 Implement the proposed mitigation measures to ensure compliance to the WUL conditions.	Gamsberg Zinc Mine Environmental Manager, ECO, appointed business partners
Soil, land use and land capability																							

EMPr Ref. Nr	ACTIVITY *whether listed or not listed.*	POTENTIAL IMPACT	ASPECTS AFFECTED	PHASE In which impact is anticipated	Size and Scale of Disturbance	Magnitude	Duration	Scale	Probability	Significance	Significance without Mitigation	Magnitude	Duration	Scale	Probability	Significance	Significance with Mitigation	Detailed Mitigation Measures	Mitigation Type	Time period for implementation	Standards to be Achieved	Compliance with Standards	Responsible person
3.8	Removal of redundant infrastructure, grading of project site to ensure long-term drainage conditions on site.	Erosion and sedimentation	Soils, land use and land capability	Decommissioning and closure phase	17 ha	2	2	1	3	**15**	Low	2	2	1	2	**10**	Low	Same as for construction	Minimise and control through impact management and monitoring.	During decommissioning and closure phase	Impact avoided	Implementation of Rehabilitation standards/objectives and requirements of GNR. 331. Norms and Standards for Remediation of Contaminated Land & Soil Quality will reduce the impact on soils in the immediate area.	Gamsberg Zinc Mine Environmental Manager, ECO, appointed business partners
3.9		Soil contamination	Soils, land use and land capability	Decommissioning and closure phase	17 ha	4	4	1	3	**27**	Low	4	2	1	2	**14**	Low	Same as for construction	Minimise and control through impact management and monitoring.	During decommissioning and closure phase	Impact avoided	Implementation of Rehabilitation standards/objectives and requirements of GNR. 331. Norms and Standards for Remediation of Contaminated Land & Soil Quality will reduce the impact on soils in the immediate area.	Gamsberg Zinc Mine Environmental Manager, ECO, appointed business partners
Biodiversity																							
4.9	Removal of redundant infrastructure	Establishment and spread of alien and invasive species	Biodiversity	Decommissioning and closure phase	17 ha	8	5	1	3	42	Moderate	4	5	1	2	20	Low	■ The alien and invasive species management plan should be implemented. A combined approach using both chemical and mechanical control methods, with periodic follow-up treatments informed by regular monitoring, is recommended.	Minimise and control through impact management and monitoring.	During decommissioning and closure phase	Impact avoided	Implementing the proposed mitigation measures to reduce the impact on flora.	Gamsberg Zinc Mine Biodiversity Manager, ECO, appointed business partners

EMPr Ref. Nr	ACTIVITY *whether listed or not listed.*	POTENTIAL IMPACT	ASPECTS AFFECTED	PHASE In which impact is anticipated	Size and Scale of Disturbance	Magnitude	Duration	Scale	Probability	Significance	Significance without Mitigation	Magnitude	Duration	Scale	Probability	Significance	Significance with Mitigation	Detailed Mitigation Measures	Mitigation Type	Time period for implementation	Standards to be Achieved	Compliance with Standards	Responsible person
4.10	Vehicles and use of equipment/ machinery	Injury and mortality of bird SCC	Biodiversity	Decommissioning and closure phase	17 ha	4	2	1	3	21	Low	4	2	1	2	14	Low	■ Decommissioning and rehabilitation activities should be scheduled to occur outside of the main bird breeding season, in order to minimise the risk of disturbance to breeding/nesting individuals/groups, where possible. ■ Speed limits on the mine should be applicable to all demolition areas via appropriate signage and enforced on all access roads. ■ Dust suppression activities should also be expanded to include all roads during decommissioning activities.	Minimise and control through impact management and monitoring.	During decommissioning and closure phase	Impact avoided	Implementing the proposed mitigation measures to reduce the impact on fauna.	Gamsberg Zinc Mine Environmental Manager & Biodiversity Manager, ECO, appointed business partners
4.11	Vehicles and use of equipment/ machinery	Injury and mortality of reptile SCC	Biodiversity	Decommissioning and closure phase	17 ha	8	2	1	3	33	Moderate	6	2	1	2	18	Low	■ A search and rescue survey for herpetofauna species should be done immediately in advance of site clearance activities. Any observed individuals should be relocated to nearby areas of natural habitats. Where snakes require relocation, this should be done by a certified snake handler for health and safety reasons.	Minimise and control through impact management and monitoring.	During decommissioning and closure phase	Impact avoided	Implementing the proposed mitigation measures to reduce the impact on fauna.	Gamsberg Zinc Mine Biodiversity Manager, ECO, appointed business partners
4.12	Vehicles and use of equipment/ machinery	Injury and mortality of fauna SCC	Biodiversity	Decommissioning and closure phase	17 ha	4	6	2	3	36	Moderate	2	6	1	2	18	Low	■ The speed limit on the mine (40 km/h) should be communicated and enforced.	Minimise and control through impact management and monitoring.	During decommissioning and closure phase	Impact avoided	Implementing the proposed mitigation measures to reduce the impact on fauna.	Gamsberg Zinc Mine Environmental Manager, ECO, appointed business partners
Socio-economic																							

EMPr Ref. Nr	ACTIVITY *whether listed or not listed.*	POTENTIAL IMPACT	ASPECTS AFFECTED	PHASE In which impact is anticipated	Size and Scale of Disturbance	Magnitude	Duration	Scale	Probability	Significance	Significance without Mitigation	Magnitude	Duration	Scale	Probability	Significance	Significance with Mitigation	Detailed Mitigation Measures	Mitigation Type	Time period for implementation	Standards to be Achieved	Compliance with Standards	Responsible person
7.7	Decommissioning of the infrastructure at the closure phase of the mine	Loss of employment	Socio-economic	Decommissioning and closure phase	N/A	6	5	2	4	52	**Moderate**	4	5	2	4	44	**Moderate**	■ Timely and adequate consultation with employees who are dependent on the mine for employment. ■ Assisting employees in seeking alternative employment at other mining operations. ■ Training and education of employees to equip them with skills that could benefit them in other industries. ■ Implement Closure plan. ■ Implement Social and Labour Plan reduce negative impact of mine closure.	Minimise and control through impact management and monitoring.	Decommissioning and closure phase	N/A	Implement the proposed mitigation measures to reduce the impacts as a result of loss of employment.	Gamsberg Zinc Mine Human Resources Manager

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APPENDIX Q

Gamsberg Zinc Mine Competence and Awareness Standard Operating Procedure

black mountain complex

COMPETENCE AND AWARENESS

SSD-ENV-SOP-026

Version: 10

black mountain complex	Safety & Sustainable Development ENVIRONMENTAL	Doc #	SSD-ENV-SOP-026
		Version #	10
		Implementation Date:	2006/10/27
Approval / Owner:	Environmental Manager	Last Reviewed/Update Date:	2021/02/15
Author:	Environmental Officer	Sanction:	General Manager

ENVIRONMENTAL COMPETENCE AND AWARENESS

Table of Contents

black mountain complex	Safety & Sustainable Development ENVIRONMENTAL	Doc #	SSD-ENV-SOP-026
		Version #	10
		Implementation Date:	2006/10/27
Approval / Owner:	Environmental Manager	Last Reviewed/Update Date:	2021/02/15
Author:	Environmental Officer	Sanction:	General Manager

ENVIRONMENTAL COMPETENCE AND AWARENESS

1. POLICY STATEMENT

BMC's standard procedures (SOP's) shall be written in a clear concise manner, communicated to all employees and applied accordingly

2. OBJECTIVE

The BMC Environmental competence and resources standard is to achieve Environmental Performance and fulfil Compliance obligations by:

- Eliminating and/or minimising environmental incidents
- Increase management and reaction of environmental incidents and audit results,
- Increased awareness and knowledge on EMS (ISO14001:2015).

3. SCOPE

SSD-ENV-SOP-026 Refers to determining the competence and resources needed for employees and onsite Business Partners' that can affect BMC Environmental performance and fulfilment of compliance obligations.

4. DEFINITIONS AND ABBREVIATIONS

BMC: Black Mountain Complex, which consist of Deeps mine, Swartberg Mine, Gamsberg Mine with all associated supporting services and infrastructure.

Onsite BP: A company (Business Partner) established on Black Mountain property and in long-term partnership with Black Mountain to provide goods and/or services to Black Mountain.

Employee: Person working at BMC as either a direct paid person or a Business Partner. This includes employees working at Deeps and Swartberg with all associated support departments and the employees at Gamsberg Project.

PTO:	Personal Tasks Observations
Competence:	Ability to apply knowledge and skills to achieve intended results
Resources:	Includes Technology, Infrastructure, Financial, Human Resources, Time, and Natural Resources.
Education:	The process of receiving and/or giving systematic instruction, such as at a secondary of tertiary institution.
Experience:	Practical contact with and observation of facts or events
Training:	The action of teaching a person a particular skill or certain behaviour.

5. PROCEDURE

5.1 Competence

Competence is analysed by focusing on appropriate education, training and experience for operational employees and this is through the appropriate Human Resources systems.

To ensure that competence training is achieved the following requirements need to be met by the Human Resources system:

- Training needs for individuals need to be identified;
- A training plan and/or programme to address identified training needs should be developed;
- Where training is conducted in-house a training delivery method should be in place;
- Evaluation of the training results should be in place;
- Training received and the results should be documented and monitored.

5.2 Induction

All employees and onsite BP's working at BMC site shall attend an annual induction programme which include Environmental Module containing:

- Compliance obligations
- Environmental SOP's (Operational Controls)
- Environmental Aspects
- Environmental Emergency Response
- Environmental Objectives
- Actions to Achieve Objectives (AAO)
- Incident Reporting

There are four types of induction: annual general induction, site specific induction, visitor's induction, visitor's on-site induction.

5.2.1 General Induction (Annual induction)

Is presented at the Black Mountain training centre. Annual induction training is attended by all employees when initially employed and annually from there on. All onsite BPs attend BMC induction training before commencing work and, should they remain on site, annually thereafter. This is conducted by the HR Department at the training Centres of Black Mountain Operations and Gamsberg.

All employees attending annual induction training will be assess by means of an induction test and a competence of 90% is required. Records of individual induction results filed at the Training Centre.

5.2.2 Specific-on-site induction

Is facilitated by the section head and presented at the relevant section. All employees are required to obtain specific on-site induction which includes Environmental issues before work commence at the specific section. This induction can also be repeated annually. On-site induction is be signed off and records kept at the section.

5.2.3 Visitor's induction

Is presented at the Black Mountain security office for all visitors to before accessing BMC. The visitor's induction remains valid for the period specified by security. Re-entry by the same visitor will require attendance of visitor's induction if the validity period of the previous

induction has expired. It is the responsibility of the person receiving visitors to ensure the persons have been inducted.

5.2.4 Visitor's on-site induction

Shall be conducted when and where required depending on the activities and areas that will be accessed by the visitor (for example, all visitors to Gamsberg receive on-site induction at the processing plant). The supervisor of the section decides whether or not on-site visitor's induction is required according to the activities and areas that will be accessed.

5.3 Identification of Training needs

Environmental training needs for each section are to be identified and addressed to ensure environmental management is part of day-to-day operations. This will be done in conjunction with the Training Centres and the Heads of Department.

The environmental risk responsibilities guides the training requirements of each individual based on their respective task/work.

Environmental training recommended for the different levels of management as set out in SSD-ENV-SS-031 guide the training needs identification process. This is a minimum guideline and any additional training can be added where section specific issues or high risk items require training and awareness (for example, the Cyanide COP that is a high environmental risk issue, but only applicable to a small number of persons at the Plant)

It is the responsibility of the line manager to ensure environmental training needs for individual staff members are identified, agreed to, facilitated and tracked according to SSD-ENV-BMF-051

5.4 Environmental Procedures Training

All employees and business partners should be able to understand and apply the relevant procedures in their section (as listed in SSD-ENV-SS-031)

It is the responsibility of the line manager to facilitate environmental procedure training either by allowing staff to attend training presented by the environmental unit, getting an external presenter; or using the procedures to train the staff him-/herself.

Records of training attendance should be kept at the section for tracking purposes.

5.5 Training Material Development & Review

Environmental Training register shall be updated and maintained by the Environmental unit in conjunction with the Training Centre.

The Environmental officer is responsible for develop and updating training material when changes to procedures, policy or legislation occur.

Annual review of the Environmental Induction will be done to ensure that training material is consistent with the company needs.

5.6 Determining training outcomes

Planned Tasks Observation will be utilised to determine if employees is competent after receiving the relevant training

- The line managers at the sections are responsible for conducting **a planned tasks observation** (PTO) after training has been presented by the environmental officer at the specific sections.
- The Environmental officer will verify the completed **PTO`s,** where such PTO's is environmental in nature, at the specific sections and feedback will be given to the section line manager.

6. AWARENESS

Environmental awareness is a mine wide responsibility that is facilitated by the environmental unit.

These documents should be communicated:

- Environmental Policy
- Significant Aspects and related actual or potential Impacts associated with a person's tasks
- The contribution of an employee to the effectiveness of the EMS
- Implications of not conforming with EMS and Compliance obligations

Line management and Green File holders facilitates knowledge transfer of the above communications to all employees during daily toolbox meetings, communication meetings or any other suitable means.

Line managers that facilitate or provide environmental communication and training should ensure that it is specific and that records of knowledge transfer can be tracked (for example by completing and signing SSD-ENV-BMF-058).

Awareness also takes place through the display of environmental topics and issues on display notice boards.

7. RESPONSIBILITY

- The environmental officer shall implement and maintain this Document.
- Department Heads shall ensure that this standard procedure is applied with due diligence.
- Deviations from this standard procedure shall be documented via approved "Deviations from Standard" documentation.
- Should additional precautions, due to special circumstances unique to that Department/Section, over-and-above the requirements of the Procedure be necessary, then the Department Head shall ensure that, in consultation with the relevant specialists, such requirements are specified in writing and is/are conveyed over to the end users and recorded as such.

8. REVISION HISTORY

Revision 6 of 'Environmental Training' dated 22 April 2014.

- Update document to change new document numbering in relation to the document control in place at BMM
- Update document into new format
- Document name changed to Environmental training as it reflects standard on training and the communication of training and not general communication.

Revision 7 of 'Environmental Training' dated 26 February 2015.

- Inclusion of the associated documents heading
- Section 4.5 Gamsberg training

Revision 8 of SSD-ENV-SOP-026 Environmental Communications and Training dated January 2016.

- Define employees to include both Deeps/Swartberg operation and the Gamsberg project as employees.
- Include Gamsberg specific requirements as per the Gamsberg EMPR.

Revision 9 of SSD-ENV-STD-026 Competence and Awareness dated January 2018.

- Procedure name changed from Environmental Training to Environmental Competence and Awareness.
- To align the procedure with the new ISO 14001:2015 requirements.

Revision 10 of SSD-ENV-SOP-026 Competence and Awareness dated 15 February 2021

- Change STD abbreviation to SOP
- Update BMC logo
- Update signature field
- SSD-ENV-BMF-003 Proof of Communication changed to SSD-ENV-BMF-058 Environmental Communication and Awareness Record.

9. DISTRIBUTION AND ACCESS

- The latest revision of this document is available as a read only on the document on the Intranet. The Compliance Officer shall maintain an authorised hard copy of this policy/procedure in the relevant location.
- Line Managers, who have staff reporting to them that do not have access to the Intranet, shall ensure that these personnel are adequately guided and informed.

10. ASSOCIATED DOCUMENTS

Forms:

SSD-ENV-BMF-058: Environmental Communication and Awareness Record.

SSD-ENV-BMF-051: Training ID and Tracking

11. APPROVAL AND SANCTION

Author	Anne-Marie Cloete
Approver/Owner	Anne-Marie Cloete
Sanctioned	Sean Jenniker

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