FINAL ENVIRONMENTAL IMPACT ASSESSMENT AND ENVIRONMENTAL MANAGEMENT PROGRAMME

Gamsberg Smelter Project

NOVEMBER 2020

SUBMITTED FOR ENVIRONMENTAL AUTHORISATION IN TERMS OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT (ACT 107 OF 1998) AND THE NATIONAL ENVIRONMENTAL MANAGEMENT WASTE ACT (ACT 59 OF 2008) IN RESPECT OF LISTED ACTIVITIES THAT HAVE BEEN TRIGGERED BY APPLICATIONS IN TERMS OF THE MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT (ACT 28 OF 2002) (AS AMENDED)

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NON-TECHNICAL SUMMARY

Introduction

This Non-Technical Summary provides a synopsis of the Final Environmental Impact Assessment (EIA) and Environmental Management Programme (EMPr) Reports prepared for the Gamsberg Smelter Project for submission to the Northern Cape Department of Mineral Resources and Energy (DMRE).

Black Mountain Mining (Pty) Ltd, a subsidiary of Vedanta Zinc International (VZI), owns and operates the Gamsberg Zinc Mine. The Gamsberg Zinc Mine has been in operation since June 2016 and is currently mining up to 4 million tonnes per annum (mtpa) and producing up to 250 000 tonnes per annum (tpa) of zinc concentrate for export. Phase 2 will expand the mining capacity to 10 mtpa. The Gamsberg Zinc Mine is located in the Northern Cape Province of South Africa, approximately 14 km east of the town of Aggeneys and 120 km east of Springbok along the N14.

Black Mountain Mining (Pty) Ltd is now proposing to construct a new zinc smelter and associated infrastructure to produce 300 000 tpa special high grade zinc metal by processing 680 000 tpa of zinc concentrate (Gamsberg Smelter Project). As a by-product 450 000 tpa of pure sulphuric acid will be produced for both export and consumption within South Africa.

SLR Consulting South Africa (Pty) Ltd has been appointed by Black Mountain Mining (Pty) Ltd as the Environmental Assessment Practitioner for the EIA process.

Project Description

Black Mountain Mining (Pty) Ltd is proposing the following as part of the Gamsberg Smelter Project:

- A smelter complex using the Roast-Leach-Electrowinning (R-L-E) process with Jarosite precipitation and Jarofix conversion process;
- The development of a 21 ha secured landfill facility for the disposal of the Jarofix;
- A new 7 km water pipeline from Horseshoe reservoir to the smelter complex;
- A laydown area and business partner camp for the construction phase; and
- Associated new roads and transmission line upgrades.

Policy and Legislative Context

Prior to the commencement of the proposed Gamsberg Smelter Project, Environmental Authorisations are required from the following competent authorities:

- Environmental Authorisation from the DMRE in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA), as amended .
- A Waste Management Licence (WML) from the DMRE in terms of the National Environmental Management Waste Act, 2008 (Act No. 59 of 2008) (NEM:WA).
- A Water Use Licence (WUL) from the Department of Human Settlements, Water and Sanitation (DHSWS) in terms of the National Water Act, 1998 (No. 36 of 1998) (NWA).
- An Atmospheric Emission Licence (AEL) in terms of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) (NEM:AQA).

Need and Desirability of the Project

The Gamsberg Smelter Project is in line with the 'Beneficiation Strategy for the Minerals Industry of South Africa' (DMR, 2011) in terms of aiming to beneficiate the zinc in concentrate to produce high quality zinc ingots for sale/export. The benefits would not only contribute to the country's Gross Domestic Product (GDP) but would additionally significantly contribute to the economies and people of the Northern Cape Province, and specifically the Namakwa District.

Beneficiation to final metal at the mine source has long been part of Vedanta's philosophy thus ensuring that all benefits of beneficiation, including socio-economic benefits, are realised within the country and the region in which the metal is mined. As operations within the Gamsberg Zinc Mine now indicate sufficient capital is being generated, the Gamsberg Smelter Project can now be considered for development.

In addition, the South African National Development Plan aims to eliminate poverty and reduce inequality by 2030. The Gamsberg Smelter Project would contribute to achieving this plan in terms of employment of people from the local and district municipalities as well as investment in the region and on a national scale.

Key Environmental and Social Sensitivities

The affected environment can be divided into three categories: (1) Physical, (2) Biological and (3) Social.

Physical Environment

The part of the Northern Cape Province where the Gamsberg Smelter Project is located, is classified as a hot desert region and has an arid climate where rainfall can occur in summer and winter (average of 98 mm/year) as the area lies in a transition zone between winter and summer rainfall areas. Summers are hot with cooler winters.

Groundwater levels as measured from regional monitoring boreholes have an average groundwater level of 30.8 metres below ground level (mbgl) and mine monitoring boreholes an average of 30.6 mbgl. Groundwater monitoring results for boreholes within the Gamsberg Zinc Mine Mining Right Area (MRA) and on neighbouring farms indicate that the present groundwater conditions do not indicate negative impacts on the groundwater environment as a result of current mining and processing operations.

In terms of surface water, the Gamsberg Zinc Mine MRA is influenced by four quaternary catchments D81G, D82A, D82B and D82C with the Gamsberg inselberg situated within quaternary catchment D81G, which drains in a northerly direction towards the Orange River. Most of the water courses in the area are ephemeral with the most significant watercourse for the Gamsberg Smelter Project being a drainage line running parallel to the N14 at the base of the northern side of the Gamsberg inselberg, and its tributaries from the north.

Biological Environment

The proposed Gamsberg Smelter Project is situated within a Critical Biodiversity Area Category 1 (CBA1) designated primarily for threatened and range-restricted flora and plant communities.

Three different habitat units within the Bushmanland Arid Grassland vegetation type namely were identified in the area, plains sand flats (Bushmanland Flat Arid Grassland), plains hummocky (Bushmanland Hummock Arid Grassland) and plains gravel calcrete.

Within the typical flat sandy plains habitat of the project footprint the abundance of species of conservation concern is relatively low, although some protected and red-listed species such as *Hoodia gordonii* and *Aloidendron dichotomum*) are present at a relatively low density.

Of particular relevance to the proposed Gamsberg Smelter Project is the calcrete gravel plains habitat which is considered irreplaceable. There are three large patches in the vicinity of the proposed Gamsberg Smelter Project

infrastructure; one located south of the secured landfill facility and two to the east of the proposed smelter complex with a few other small patches in the area.

Alien plant species abundance at the site is low. This can partly be ascribed to the prevailing drought conditions as well as an actual low abundance of such species within the site.

The mammalian community at the project site is likely to be of moderate diversity. Although more than 50 species of terrestrial mammals are known from the wider area, the habitat diversity of the Gamsberg Smelter Project site is low and would not support a very wide range of mammals.

Three Red-listed species have been confirmed or may occur in the broader area, the Black-footed cat (*Felis nigripes*) (Vulnerable), Brown Hyaena (*Hyaena brunnea*) (NT) and Leopard (*Panthera pardus*) (Vulnerable). Given the existing levels of anthropogenic disturbance at the site, it is not likely that these three species remain active in close proximity to the Gamsberg Zinc Mine and the proposed Gamsberg Smelter Project.

Although reptile diversity in the broader area is high with as many as 60 species known from the area, a much smaller subset of these is likely to be present within the site). A total of 24 species have previously been recorded from the site. Species observed within the study area and are typical of the area and include Verrox's Tent Tortoise (*Psammobates tentorius verroxii*), Western Rock Skink (*Trachylepis sulcata sulcate*), Western Three-striped Skink (*Trachylepis occidentalis*), Namaqua Sand Lizard (*Pedioplanis namaquensis*), Spotted Desert Lizard (*Meroles suborbitalis*), Southern Rock Agama (*Agama atra*) and Plain Sand Lizard (*Pedioplanis inornata*). No snakes were observed during the January 2020 site visit, although species likely to occur include Black Spitting Cobra (*Naja nigricincta*) and Cape Cobra (*Naja nivea*). Eight frog species are known from the area around the site.

Red-listed avifauna species which occur in the wider area include Martial Eagle (*Polemaetus bellicosus*) (Endangered), the endemic Red Lark (*Calendulauda burra*) (Vulnerable), Verreaux's Eagle (*Aquila verreauxii*) (Vulnerable), Lanner Falcon (*Falco biarmicus*) (Vulnerable), Secretarybird (*Sagittarius serpentarius*) (Vulnerable), and the near-endemic Sclater's Lark (*Spizocorys sclateri*) (Near-threatened).

Socio-economic Environment

The Gamsberg Smelter Project is situated in the Khâi-Ma Local Municipality, which is one of six local municipalities within the Namakwa District Municipality in the Northern Cape Province.

The Khâi-Ma Municipality had a population of ~12 000 people in 2016. Population density is around one person per square kilometre, with the majority of the population living in the rural areas.

More than 92% of households live in formal dwellings, while 6.4% live in informal dwellings. The language most spoken at home is Afrikaans (95%).

Close to 45% of the working age population are unemployed. Around 80% of Black Mountain Mining (Pty) Ltd employees are from the Northern Cape, including 60% from the Namakwa district (mainly Khâi-Ma and Nama Khoi municipal areas).

The main economic sectors in the Municipality are agriculture, mining, tourism and community services, with renewable energy projects now also coming online.

EIA Findings and Recommendations for the Gamsberg Smelter Project

An impact assessment was undertaken to determine the potential impacts associated with the proposed construction, operational and decommissioning phases of the Gamsberg Smelter Project. The findings of this assessment are included in Table 1, Table 2 and Table 3.

Construction Phase

Most of the impacts can be managed or mitigated to a level that is considered acceptable, particularly as the construction phase is short-term. The significance of all negative impacts are rated medium to very low after mitigation. The impact on the local ecology during the construction phase is considered to be of medium to low significance provided strict management of the construction activities is undertaken. In addition, there are a number of socio-economic impacts, while resulting in short term benefits, are nevertheless rated as high significance should the necessary enhancement measures be effectively implemented.

Table 1 Summary of Construction Phase Impacts Identified and their Pre and Post Mitigation Rating

Potential Impact	Unmitigated	Mitigated
Biophysical		
Change in groundwater levels due to smelter complex	Very Low	Very Low
Deterioration of groundwater quality	Very Low	Very Low
Contamination of surface water resources	Medium	Low
Flooding	High	Medium
Alteration of natural drainage patterns	Medium	Very Low
Impact on vegetation and flora due to construction phase site clearance	Medium	Medium
Impact on vegetation and flora due to construction-related dust	Medium	Low
Impact on fauna due to construction phase site clearance	Medium	Medium
Impact on fauna due to construction phase noise and disturbance	Low	Low
Change in ambient air quality	Very Low	Very Low
Increase in ambient noise levels	Low	Very Low
Loss of soil resources and land capability	Low	Low
Loss of soil resources due to contamination	Medium	Low
Change in landscape and related visual impacts due to the smelter complex	High	Medium
Change in landscape and related visual impacts due to the secured landfill facility	Medium	Medium
Impact of the project on climate change	Low-Medium	Low-Medium
Socio-economic		
Significance of project expenditure	Medium +	High +
Impact on tourism	Medium	Low
Impacts on surrounding landowners and land uses	Medium	Low
Impacts on municipal finances	Low	Low +
Road disturbance and traffic safety	Medium	Low

Potential Impact	Unmitigated	Mitigated
Damage to or disturbance of heritage (including cultural)	Low	Very Low
Damage to or disturbance of palaeontological resources	Low	Very Low
Employment creation and economic stimulus	High +	Very High +
Multiplier effect on the local and regional economy	Medium +	High +
Project-induced population influx	High	Low
Negative impacts related to the presence of construction workers	Medium	Very Low
Health, safety and security	Medium	Low
Skills development and capacity building	High +	Very High +

Operational Phase

Potential impacts during the operational phase are assessed to be within acceptable levels (medium to insignificant) provided all mitigation and management measures are implemented. Although the visual impact of the secured landfill facility is rated as high due to the long-term impact on sensitive receptors along the N14 Highway, in the context of the current mining activities this is not considered a fatal flaw.. The impact on climate change is also rated as high due to the total project inventory being approximately 0.3% of South Africa's carbon budget. There are again a number of positive impacts related to expenditure in the local area and employment opportunities which can be significantly enhanced if properly managed. It is, however, imperative that throughout the operational phase monitoring is undertaken to identify any potential changes to the baseline conditions and provide early warning should there appear to be any changes occurring. This is particularly important for the biodiversity, air quality and groundwater. Should negative impacts be found to be in excess to what was predicted, additional measures need to be implemented.

Table 2 Summary of Construction Phase Impacts Identified and their Pre and Post Mitigation Rating

Potential Impact	Unmitigated	Mitigated
Biophysical		
Change in groundwater levels due to smelter complex	Low	Insignificant
Change in groundwater levels due to secured landfill facility	Low	Very Low
Deterioration of groundwater quality due to smelter complex	Low	Insignificant
Deterioration of groundwater quality due to secured landfill facility	Medium	Very Low
Contamination of surface water resources	High	Medium
Flooding	High	Medium
Alteration of natural drainage patterns	Medium	Very Low
Impact on vegetation due to dust deposition during operational phase	Medium	Medium
Impact on vegetation due to increased air emissions (SO_2, NO_2, Pb and Zn during operational phase	Medium	Medium

Potential Impact	Unmitigated	Mitigated
Impact on vegetation due to groundwater contamination in operational phase	Low	Low
Faunal impacts due to operational activities: dust, noise, and traffic	Medium	Low
Change in ambient air quality	Low	Very Low
Increase in ambient noise levels	Low	Very Low
Loss of soil resources due to contamination	Medium	Low
Change in landscape and related visual impacts due to the smelter complex	High	Medium
Change in landscape and related visual impacts due to the secured landfill facility	High	High
Impact of the project on climate change	High	High
Socio-economic		
Significance of project expenditure	High +	High +
Impacts on key macro-economic variables	High +	High +
Impact on tourism	Medium	Low
Impacts on surrounding landowners and land uses	Medium	Low
Impacts on municipal finances	Medium	Low +
Road disturbance and traffic safety	Medium	Medium
Employment creation and economic stimulus	High +	Very High +
Health, safety and security	Medium	Low
Skills development and capacity building	High +	Very High +

Decommissioning Phase

At decommissioning and closure the bulk of the impacts would cease, and the levels of impact would rate as low to insignificant provided that the infrastructure is decommissioned and rehabilitated according to the approved closure plan. The visual impact related to the secured landfill facility would remain in the landscape permanently. The most significant impact after decommissioning would be the negative impact on the local area as a result of the loss of employment and the associated benefits in the local economy. If not managed properly and planned for well in advance, through a well-structured and implemented mine closure plan, the negative impacts on the local communities and surrounding towns would be of extremely high significance. Careful consideration needs to be given to creating alternative economic activities through the life of mine and upskilling of staff to allow them to source alternative work when the mine and smelter close.

Table 3 Summary of Construction Phase Impacts Identified and their Pre and Post Mitigation Rating

Potential Impact	Unmitigated	Mitigated
Biophysical		
Change in groundwater levels due to smelter complex	Low	Insignificant
Change in groundwater levels due to secured landfill facility	Low	Very Low
Deterioration of groundwater quality due to smelter complex	Low	Insignificant
Deterioration of groundwater quality due to secured landfill facility	Medium	Very Low
Contamination of surface water resources	Medium	Low
Flooding	High	Medium
Alteration of natural drainage patterns	Medium	Very Low
Ecological impacts during decommissioning phase	Medium	Low
Change in ambient air quality	Very Low	Very Low
Increase in ambient noise levels	Low	Very Low
Loss of soil resources and land capability	Low	Low
Loss of soil resources due to contamination	Medium	Low
Change in landscape and related visual impacts due to the smelter complex	High	Low
Change in landscape and related visual impacts due to the secured landfill facility	High	High
Socio-economic		
Impact on tourism	Low	Very Low
Impacts on surrounding landowners and land uses	Medium	Low
Impacts on municipal finances	Low	Low +
Road disturbance and traffic safety	Medium	Low
Employment creation and economic stimulus	Very High	High

Consideration of Biodiversity Offsets

The proposed Gamsberg Smelter Project must be seen in the context of the original ESIA for the Gamsberg Zinc Mine, its conditions of authorisation and the biodiversity offset requirements that were associated with the mine development. Determination of the Gamsberg Zinc Mine offset was based on quantification of the footprint of each of the mapped habitat units from the fine-scale vegetation mapping within i) the mine and associated infrastructure footprint, ii) all habitat units within the modelled 50 mg/m^2/day dust deposition zone (i.e. residual impacts due to dust fall-out) and iii) irreplaceable habitats within the 20 mg/m^2/day dust deposition zone (including all calcrete gravel plains habitat) (i.e. residual impacts due to dust fall-out), and iv) the modelled groundwater drawdown zone. That is, the offset calculation essentially assumed the 'loss' of biodiversity in these areas either through complete removal or smothering for the Gamsberg Zinc Mine infrastructure or from dust

impacts or from a drop in the water table for groundwater dependent biodiversity (notably associated with the Gamsberg Kloof). Although the offset was calculated assuming the loss of biodiversity within these areas, some components, namely calcrete gravel patches, are considered to be 'irreplaceable' habitat for the presence of locally endemic succulents, and would thus generally be regarded as 'no go' areas.

The context of the Gamsberg Zinc Mine offset is relevant to the proposed Gamsberg Smelter Project as a key potential issue is whether the direct and indirect residual impacts on biodiversity of the construction and operation of the smelter, secured landfill facility and associated infrastructure (after mitigation is implemented) may extend beyond the original area of residual impact used to determine the Gamsberg Zinc Mine Biodiversity Offset. If the residual impacts of the proposed Gamsberg Smelter Project remain within the modelled areas used as the basis for calculating the Gamsberg Zinc Mine Biodiversity Offset requirements, then an argument can be made that no additional offset would be required. Alternatively, if significant residual impacts of the proposed Gamsberg Smelter Project occur outside of the 20 and 50 mg/m^2/day modelled dust deposition areas (or groundwater drawdown area) then an additional offset could be required.

Nonetheless, given: i) the uncertainty on the predicted residual air quality impacts on vegetation; ii) the need for additional monitoring to improve understanding of dust impacts on vegetation, and iii) the need to expand the mine offset to fully compensate for predicted dust impacts on irreplaceable habitats such as calcrete patches, it is incumbent on Black Mountain Mining (Pty) Ltd to implement strict mitigation measures to minimise biodiversity impacts; to implement the full mine offset requirements (including compensation for calcrete patches), and to start detailed monitoring to better understand the air quality impacts on vegetation and to verify the basis for the mine offset.

Environmental Management Programme

Based on the outcome of the Impact Assessment and where applicable the recommendations from specialists the proposed management objectives and outcomes specific to the proposed Gamsberg Smelter Project are included into the EMPr. Specific environmental objectives and actions to control, remedy or prevent potential impacts are specified to either mitigate negative impacts or enhance positive impacts throughout the planning and design, construction, operational and decommissioning phases.

Conclusion and Recommendations

The full Scoping and EIA process was undertaken by the independent consultant, SLR Consulting South Africa (Pty) Ltd with input from the following specialists: Groundwater, Surface Water, Terrestrial Biodiversity, Air Quality, Noise, Visual, Traffic, Climate Change, Social, and Economic.

The findings indicate that while the benefits of the Gamsberg Smelter Project appear to outweigh the negative impacts, careful consideration needs to be given to several key areas including management of impacts on biodiversity and enhancement of local benefits combined with proactive closure planning.

It follows therefore, that provided the EMPr is effectively implemented, there is no biophysical, social or economic reason why the project should not proceed.

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ACRONYMS AND ABBREVIATIONS

Acronym / Abbreviation	Definition
ABA	Acid Base Accounting
AEL	Atmospheric Emission Licence
AoI	Area of Influence
AP	Acid Potential
ARD	Acid Rock Drainage
ASTM	American Standard Testing Method
ASU	Air Separation Unit
BID	Background Information Document
BIR	Bushmanland Inselberg Region
BMM	Black Mountain Mining (Pty) Ltd
CAMP	Conservation Area Management Plan
CCTV	Closed Circuit Television
CEMPr	Construction Environmental Management Programme
CEP	Community Engagement Plan
CGG	Continuous Galvanizing Grade
CO2	Carbon Dioxide
CO2e	Carbon Dioxide Equivalent
CSR	Corporate Social Responsibility
DAFF	Department of Agriculture, Forestry and Fisheries
DALRRD	Department of Agriculture, Land Reform and Rural Development
DCDA	Double Conversion and Double Absorption
DEFF	Department of Environment Forestry and Fisheries
DEDAT	Department of Economic Development and Tourism
DENC	Department of Environment and Nature Conservation
DHSWS	Department of Human Settlements, Water and Sanitation
DM	Demineralised
DMR	Department of Mineral Resources
DMRE	Department of Mineral Resources and Energy
DPW	Department of Public Works
DRDLR	Department of Rural Development and Land Reform
DSD	Department of Social Development
DT	Department of Transport
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EIA Regulations	Environmental Impact Assessment Regulations, 2014
EMF	Environmental Management Frameworks
EMPr	Environmental Management Programme

EO	Environmental Officer
EPRP	Emergency Preparedness and Response Plan
ERM	Environmental Resources Management
ESIA	Environmental and Social Impact Assessment
ESP	Electrostatic Precipitator
ETP	Effluent Treatment Plant
GCP	Gas Cleaning Plant
GDP	Gross Domestic Product
GRDP	Gross Regional Domestic Product
GHG	Green House Gas
GHS	Global Harmonised System
GNR	Government Notice Regulation
Ha	Hectare
HDPE	High Density Polyethylene
HR	Human Resources
HSA	Hazardous Substances Act
I&APs	Interested & Affected Parties
IBA	Important Bird Area
IDP	Integrated Development Plan
IDZ	Industrial Development Zone
IFC PS6	International Finance Corporation Performance Standard 6
IPCC	The Intergovernmental Panel on Climate Change
ISO	International Organisation for Standardization
IWUL	Integrated Water Use Licence
Km	Kilometre
ktpa	kilotons per annum
Kv	Kilovolt
LAeq's	A-weighted equivalent sound pressure level
LDV	Light Duty Vehicle
LED	Local Economic Development
LFA	Landscape Function Analyses
LM	Local Municipality
MAE	Mean Annual Evaporation
mbgl	meters below ground level
MES	Minimum Emissions Standards
MHSA	Mine Health and Safety Act
MRA	Mining Right Area
Mt	Million tons
mtpa	million tons per annum
ML	Million Litres
mm	millimetre

MS	Method Statement
MVA	Mega Volt Amp
MVWA	Medium Velocity Water Spray
MW	Mega Watt
NAAQS	National Ambient Air Quality Standards
NAG	Net-Acid Generating Capacity
NCDENC	Northern Cape Department of Environment and Nature Conservation
NCNCA	Northern Cape Nature Conservation Act, 2003 (Act No.9 of 2003)
NDCR	National Dust Control Regulations
NDM	Namakwa District Municipality
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NEM:AQA	National Environmental Management Air Quality Act, 2004 (Act No. 39 of 2004)
NEM:BA	National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004)
NEM:PAA	National Environmental Management Protected Areas Act, 2003 (Act No. 57 of 2003)
NEM:WA	National Environmental Management Waste Act, 2009 (Act No. 59 of 2008)
NFA	National Forest Act, 1998 (Act No. 84 of 1998)
NFPA	National Fire Protection Association
NG	Net Gain
NGO	Non-Governmental Organisation
NHRA	National Heritage Resource Act (Act No. 25 of 1999)
NIP	National Infrastructure Plan
NL	Neutral Leaching
NNL	No Net loss
NNP	net neutralising potential
NOX	Nitrous Oxides
NP	Neutralising Potential
NPR	Neutralising Potential Ratio
NSDP	National Spatial Development Plan
NSSD	National Strategy for Sustainable Development
NWA	National Water Act, 1998 (Act No. 36 of 1998)
OEMPr	Operational Environmental Management Programme
PAT	Potassium Antimony Tartrate
$PM_{2.5}$	Particulate Matter 2.5 Microns in size
PM10	Particulate Matter 10 Microns in size
PPE	Personal Protective Equipment
PPP	Public participation Process
PSDF	Provincial Spatial Development Framework
PV	Photovoltaic
RE	Resident Engineer
R-L-E	Roast-Leach-Electrowinning
RO	Reverse Osmosis

ROM	Run of Mine
SABS	South African Bureau of Standards
SAHRA	South African Heritage Resources Agency
SANP	South African National Parks
SANS	South African National Standards
SDF	Spatial Development Framework
SHEQ	Safety, Health, Environment & Quality
SHG	Special High Grade
SIA	Social Impact Assessment
SLP	Social and Labour Plan
SMME	Small, Medium and Micro-Enterprises
SO_2	Sulphur Dioxide
SPLUMA	Spatial Planning and Land Use Management Act
STG	Steam Turbine Generator
STP	Sewage Treatment Plant
t	Ton
TCE	Tata Consulting Engineers
TDS	Total Dissolved Solids
TMP	Traffic Management Plan
tpa	tons per annum
TSF	Tailings Storage Facility
VSD	Variable Speed Drive
WAL	Weak Acid Leach
WML	Waste Management Licence
WMP	Waste Management Plan
WRC	Water Research Commission
WUL	Water Use Licence
WQ	Water Quality

INTRODUCTION

PROJECT INTRODUCTION

Black Mountain Mining (Pty) Ltd, part of Vedanta Zinc International (VZI), owns and operates the Gamsberg Zinc Mine. In 2010 Vedanta Resources Limited acquired Black Mountain Mining (Pty) Ltd from Anglo American as part of the acquisition of the zinc base metal mine take over. Following the acquisition of the Black Mountain Mining (Pty) Ltd properties and rights a feasibility and optimisation of technology for the Gamsberg Zinc Mine was done.

An Environmental Impact Assessment (EIA) process was completed in 2013 (and approved on 12 August 2013 – Permit 43/2013) and amended on 2 December 2014 (Permit 43/2013 Amendment 2) (Ref: NC/EIA/NAM/KHA/AGG/2012). In addition, a Waste Management Licence (WML) (Ref: 12/9/11/L955/8) and Water Use Licence (WUL) (Ref:14/D82C/ABCGI/2654) for their open pit mining activities and concentrator plant were approved.

The mining activities commenced in June 2016 when overburden stripping for the open pit commenced. The mining plan for Phase 1 consisted of three smaller open pits in the footprint of the 10 million ton per annum footprint. Development of the opencast mine and concentrator plant has been done in phases. The construction of the concentrator plant commenced in 2017 with the official opening in February 2019. Phase 2 will expand the mining capacity to 10 million ton per annum (mtpa). The Gamsberg Zinc Mine is currently mining up to 4 mtpa and producing up to 250 000 tonnes per annum (tpa) of zinc concentrate for export.

Black Mountain Mining (Pty) Ltd is now proposing to construct a new zinc smelter and associated infrastructure to produce 300 000 tpa special high grade zinc metal by processing 680 000 tpa of zinc concentrate (Gamsberg Smelter Project). As a by-product 450 000 tpa of 98.5% pure sulphuric acid will be produced for both export and consumption within South Africa. In addition, a new secured landfill facility is planned for the storage of Jarofix, a waste product generated during the smelting process.

SUMMARY OF ENVIRONMENTAL AUTHORISATION REQUIREMENTS

Prior to the commencement of the proposed Gamsberg Smelter Project, Environmental Authorisations are required from the following competent authorities:

- Environmental Authorisation from the Department of Mineral Resources and Energy (DMRE) in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). The proposed Gamsberg Smelter Project incorporates several activities listed in the Environmental Impact Assessment Regulations, 2014 (EIA Regulations): Listing Notice's 1, 2 and 3, published in Government Notice Regulation (GNR) 983, 984 and 985 of 4 December 2014 and amended by GNR 327, 325 and 324 of 7 April 2017. The EIA regulations being followed in this study are the EIA Regulations, 2014 published in GNR 982 of 4 December 2014 and amended by GNR 326 of 7 April 2017.
- A Waste Management Licence (WML) from the DMRE in terms of the National Environmental Management Waste Act, 2008 (Act No. 59 of 2008) (NEM:WA). The proposed Gamsberg Smelter Project incorporates waste management activities listed in GNR 921 of 29 November 2013, as amended.
- A Water Use Licence (WUL) from the Department of Human Settlements, Water and Sanitation (DHSWS) in terms of the National Water Act, 1998 (No. 36 of 1998) (NWA). The proposed Gamsberg Smelter Project incorporates water uses in terms of Section 21 of the NWA.
- An Atmospheric Emission Licence (AEL) in terms of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) (NEM:AQA).

A new bulk water pipeline is proposed to replace the existing underground pipeline that was constructed in the 1970's which connects the Gamsberg Zinc Mine and the towns of Pella, Pofadder and Aggeneys as well as farmers along the pipeline route to the existing abstraction point at the Orange River. This pipeline requires replacement (as it is 40 years old) and would not be able to cope with the expected demands. The necessary environmental

and water use permits would be applied for under a separate application (NC-BA-08-NAM-KHA-PEL1-2020) which will be submitted by Sedibeng Water to the Northern Cape Department of Environment and Nature Conservation (NCDENC). The new underground pipeline would pump water into a new 2 ML reservoir at the existing Horseshoe Reservoir (located to the north of the N14, approximately 1 km east of the Mining Right Area (MRA) boundary) from where it would be gravity fed to the smelter complex via an additional section of the new above-ground pipeline (part of this application).

INTRODUCTION TO THE ENVIRONMENTAL ASSESSMENT PROCESS

An EIA is conducted in two phases. The first is the Scoping phase and the second is the EIA phase. The Final Scoping Report was submitted to the DMRE on 11 March 2020 and was accepted on 28 July 2020. The objectives of the Scoping phase were in line with Chapter 4, Part 3 of the EIA Regulations.

The terms of reference as identified in the Scoping Report for further assessment during the EIA phase enable the meaningful assessment of all relevant biophysical and socioeconomic issues.

In accordance with Appendix 3 of GNR 982 the key objectives of this EIA are to:

- Determine the policies and legislation relevant to the activity and document how the proposed activity complies with and responds to the policy and legislative context;
- Describe the need and desirability of the proposed activity in the context of the development footprint on the preferred site as contemplated in the accepted Scoping Report;
- Identify feasible alternatives related to the project proposal;
- Ensure that all potential key environmental issues and impacts that will result from the proposed project are identified;
- Assess potential impacts of the proposed project alternatives during the different phases of project development;
- Identify the most ideal location of the activity within the development footprint of the preferred site based on the lowest level of environmental sensitivity identified during the assessment;
- Present appropriate mitigation or optimisation measures to avoid, manage or mitigate potential impacts or enhance potential benefits, respectively; and
- Identify residual risks that need to be managed and monitored.

This EIA and Environmental Management Programme (EMPr) provides a description of the proposed project and the affected environment; summarises the EIA process followed to date; identifies and assesses the key project impacts and presents management and mitigation measures that are recommended to enhance positive and limit negative impacts.

The EIA and EMPr were compiled and distributed for review and comment as part of the Scoping and EIA processes. Interested and Affected Parties were provided with an opportunity to comment on the EIA and EMPr for the project. Where relevant, the document has been updated following the review and comment period. The EIA and EMPr has been submitted to the DMRE for consideration as part of the application for Environmental Authorisation in terms of Chapter 5 of the NEMA, as amended.

STRUCTURE OF THE REPORT

This document has been prepared in accordance with the DMRE EMPr Report template format. This is in accordance with the requirements of the MPRDA. This report also complies with the requirements of the NEMA and Appendix 3 and Appendix 4 of EIA Regulations 2014 (as amended).

Table 0-1 Structure of the EIA and EMPr

EMPr report requirement as per the DMRE template	EMPr report requirements as per the 2014 NEMA regulations (as amended)	Reference in the report
Part A of DMRE report template	**Appendix 3 of the NEMA regulations**	**Section/Appendix**
The EAP who prepared the report	Details of the EAP who prepared the report	Section 1
Expertise of the EAP	Details of the expertise of the EAP, including curriculum vitae	Section 1.3
Description of the property	The location of the activity, including - the 21 digit Surveyor General code of each cadastral land parcel. Where available the physical address and farm name. Where the required information is not available, the coordinates of the boundary of the property or properties	Section 2
Locality plan	A plan which locates the proposed activity or activities applied for as well as the associated structures and infrastructure at an appropriate scale, or, if it is a linear activity, a description and coordinates of the corridor in which the proposed activity or activities is to be undertaken or on land where the property has not been defined, the coordinates within which the activity is to be undertaken	Section 2.2
Description of the scope of the proposed overall activity	A description of the scope of the proposed activity, including all listed and specified activities triggered	Section 3.2.2
Description of the activities to be undertaken	A description of the scope of the proposed activity, including all listed and specified activities triggered and being applied for and a description of the associated structure and infrastructure related to the development	Section 3
Policy and legislative context	A description of the policy and legislative context within which the development is located and an explanation of how the proposed development complies with and responds to the legislation and policy context	Section 4
Need and desirability of the proposed activity	A motivation for the need and desirability for the proposed development including the need and desirability of the activity in the context of the preferred location	Section 5
Motivation for the preferred development footprint within the approved site including	A motivation of the preferred development footprint within the approved site including	Section 6
A full description of the process followed to reach the proposed development footprint within the approved site	A full description of the process followed to reach the proposed development footprint within the approved site	Section 6.1
Details of the development footprint alternatives considered	Details of all the alternatives considered	Section 6.1.2
Details of the public participation process followed	Details of the public participation process undertaken in terms of regulation 41 of the	Section 6.2

EMPr report requirement as per the DMRE template	EMPr report requirements as per the 2014 NEMA regulations (as amended)	Reference in the report
	Regulations, including copies of the supporting documents and inputs	
Summary of issues raised by I&APs	A summary of the issues raised by interested and affected parties, and an indication of the manner in which the issues were incorporated, or the reasons for not including them	Section 6.3
Environmental attributes associated with the development footprint alternatives	The environmental attributes associated with the alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects	Section 6.4
Impacts and risks identified including the nature, significance, consequence, extent, duration and probability of the impacts including the degree of the impacts	The impacts and risks identified, including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts can be reversed, may cause irreplaceable loss of resources and can be avoided, managed and mitigated	Section 6.5
Methodology used in determining the nature, significance, consequence, extent, duration and probability of potential environmental impacts and risks	The methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks	Section 6.6
The positive and negative impacts that the proposed activity (in terms of the initial site layout) and alternative will have on the environment and the community that may be affected	Positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community that may be affected focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects	Section 6.7
The possible management actions that could be applied and the level of risk	The possible management actions that could be applied and level of residual risk	Section 6.8
Motivation where no alternative sites were considered	If no alternatives, including alternative locations for the activity were investigated, the motivation for not considering such	Section 6.9
Statement motivating the alternative development location within the overall site	A concluding statement indicating the preferred alternatives, including preferred location within the approved site	Section 6.10
Full description of the process undertaken to identify, assess and rank the impacts and risks the activity will impose on the preferred site (in respect of the final site layout) through the life of the activity	A full description of the process undertaken to identify, assess and rank the impacts the activity and associated structure and infrastructure will impose on the preferred location through the life of the activity including a description of all environmental issues and risks that were identified during the environmental impact assessment process and an assessment of the significance of each issue and risk and an indication of the extent to which the issue and risk could be avoided or addressed by the adoption of management actions	Section 7.2

EMPr report requirement as per the DMRE template	EMPr report requirements as per the 2014 NEMA regulations (as amended)	Reference in the report
Assessment of each identified potentially significant impact and risk	An assessment of each identified potentially significant impact and risk including cumulative impacts, the nature, significant and consequence of the impact and risk, the extent and duration of the impact and risk, the probability of the impact and risk occurring, the degree to which the impact can be reversed, the degree to which the impact and risk may cause irreplaceable loss of a resources and the degree to which the impact and risk can be mitigated.	Section 8
Summary of specialist reports	Where applicable the summary of the findings and recommendations of any specialist report complying with Appendix 6 of these Regulations and an indication as to how these findings and recommendations have been included in the final assessment report	Section 9
Environmental impact statement	An environmental impact statement which contains a summary of the key findings of the environmental impact assessment, a map at an appropriate scale which superimposes the proposed activity and its associated structures and infrastructure on the environmental sensitivities of the preferred site indicating any areas that should be avoided, including buffers and a summary of the positive and negative impacts and risks of the proposed activity and identified alternatives	Section 10
Proposed impact management objectives and the impact management outcomes for inclusion in the EMPr	Based on the assessment, and where applicable, recommendations from specialist reports, the recording of proposed impact management objectives, and the impact management outcomes for the development for inclusion in the EMPr as well as for inclusion as conditions of authorisation	Section 11
Final proposed alternatives	The final proposed alternatives which respond to the impact management actions, avoidance, and management actions identified through the assessment	Section 12
Aspects for inclusion as conditions of authorisation	Any aspects which were conditional to the findings of the assessment either by the EAP or specialist which are to be included as conditions of authorisation	Section 13
Description of any assumptions, uncertainties and gaps in knowledge	A description of any assumptions, uncertainties and gaps in knowledge which relate to the assessment and management actions proposed	Section 14
Reasoned opinion as to whether the proposed activity should or should not be authorised	Reasoned opinion as to whether the proposed activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation	Section 15

EMPr report requirement as per the DMRE template	EMPr report requirements as per the 2014 NEMA regulations (as amended)	Reference in the report
Period for which environmental authorisation is required	Where the proposed activity does not include operational aspects, the period for which the environmental authorisation is required and the date on which the activity will be concluded and the post construction monitoring requirements finalised	Section 16
Undertaking	An undertaking under oath or affirmation by the EAP in relation to the correctness of the information provided in the reports, the inclusion of comments and inputs from stakeholders and I&APs, the inclusion of inputs and recommendations from the specialist reports where relevant and any information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested or affected parties	Section 17
Financial provision	Where applicable, details of any financial provisions for the rehabilitation, closure, and ongoing post decommissioning management of negative environmental impacts	Section 18
Deviation from the approved scoping report and plan of study	An indication of any deviation from the approved scoping report, including the plan of study, including any deviation from the methodology used in determining the significance of potential environmental impacts and risks; and a motivation for the deviation	Section 19
Other information required by the competent authority	Any specific information required by the competent authority.	Section 20
Other matter required in terms of section 24(4)(a) and (b) of the Act	Any other matter required in terms of section 24(4)(a) and (b) of the Act	Section 21
Part B of DMRE report template	**Appendix 4 of the NEMA regulations**	**Section/Appendix**
Details of EAP	Details of the EAP who prepared the EMPr and the expertise of that EAP to prepare the EMPr, including a curriculum vitae	Section 1
Description of the aspects of the activity	A detailed description of the aspects of the activity that are covered by the EMPr as identified by the project description	Section 23
Composite map	A map at an appropriate scale which superimposes the proposed activity, its associated structures, and infrastructure on the environmental sensitivities of the preferred site, indicating any areas that any areas that should be avoided, including buffers	Section 24
Description of impact management objectives including management statements	A description of the impact management objectives, including management statements, identifying the impacts and risks that need to be avoided, managed and mitigated as identified through the environmental impact assessment	Section 25
The determination of closure objectives		Section 25.1

EMPr report requirement as per the DMRE template	EMPr report requirements as per the 2014 NEMA regulations (as amended)	Reference in the report
	process for all phases of the development including planning and design, pre-construction activities, construction activities, rehabilitation of the environment after construction and where applicable post closure; and where relevant, operation activities	
The process for managing any environmental damage, pollution, pumping and treatment of extraneous water or ecological degradation as a result of undertaking a listed activity	-	Section 25.1
Potential acid mine drainage	-	Section 25.3
Steps taken to investigate, assess and evaluate the impact of acid mine drainage	-	Section 25.4
Engineering or mine design solutions to be implemented to avoid or remedy acid mine drainage	-	Section 25.5
Measures that will be put in place to remedy any residual or cumulative impact that may result from acid mine drainage	-	Section 25.6
Volumes and rate of water use required for the mining	-	Section 25.7
Has a water use licence been applied for?	-	Section 25.8
Impacts to be mitigated in their respective phases	-	Section 25.9
Impact management outcomes	A description and identification of impact management outcomes required for the aspects contemplated in paragraph	Section 26
Impact management actions	A description of proposed impact management actions, identifying the manner in which the impact management objectives and outcomes be achieved, and must, where applicable, include actions to avoid, modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation; comply with any prescribed environmental management standards or practices; comply with any applicable provisions of the Act regarding closure, where applicable comply with any provisions of the Act regarding financial provisions for rehabilitation, where applicable	Section 27
Financial provision		Section 28
Mechanism for monitoring compliance with and performance assessment against the environmental management programme and reporting thereon	The method of monitoring the implementation of the impact management actions	Section 29
	The frequency of monitoring the implementation of the impact management actions	

EMPr report requirement as per the DMRE template	EMPr report requirements as per the 2014 NEMA regulations (as amended)	Reference in the report
	An indication of the persons who will be responsible for the implementation of the impact management actions	
	The time periods within which the impact management actions must be implemented	
	The mechanism for monitoring compliance with the impact management actions	
	A program for reporting on compliance, taking into account the requirements as prescribed by the Regulations	
Environmental Awareness Plan	An environmental awareness plan describing the manner in which the applicant intends to inform his or her employees of any environmental risk which may result from their work; and risks must be dealt with in order to avoid pollution or the degradation of the environment	Section 30
Specific information required by the competent authority	Any specific information that may be required by the competent authority	Section 31
Undertaking	-	Section 32

PART A - SCOPE OF ASSESSMENT REPORT

1 APPLICANT, EAP AND SPECIALISTS

1.1 APPLICANT DETAILS

The applicant for the Gamsberg Smelter Project is Black Mountain Mining (Pty) Ltd. Details of the applicant are included in Table 1-1.

Table 1-1 Details of the Applicant

Project Applicant	Black Mountain Mining (Pty) Ltd
Postal address	1 Penge Road Aggeneys, Northern Cape
Telephone number	+27 54 983 8520
Contact person	Pieter van Greunen
Email address	PVanGreunen@vedantaresources.co.za

1.2 DETAILS OF THE EAP WHO PREPARED THE REPORT

SLR Consulting South Africa (Pty) Ltd (SLR) has been appointed as the independent Environmental Assessment Practitioner (EAP) to undertake the EIA process for the proposed project. The details of the EAP project team are provided in Table 1-2 and Section 1.3.

Table 1-2 Details of the EAP

Details	Reviewer and Project Director	Project Manager and Author
Name of the practitioner	Stuart Heather-Clark	Kate Hamilton
Tel No.:	021 461 1118	011 467 0975
Fax No.:	N/A	N/A
E-mail address	shclark@slrconsulting.com	khamilton@slrconsulting.com

1.3 EXPERTISE OF THE EAP

Project Director (Reviewer) – Stuart Heather-Clark (EAP Registration No.: 2019/613)

Stuart has over 24 years of environmental and social consulting experience in Africa. Having worked on over 100 development projects in Africa, his key strength is identifying and managing Environmental, Social and Governance (ESG) risks for major capital projects from the concept phase through to the pre-feasibility, feasibility and implementation phases. Stuart has worked across various sectors including oil; and gas, mining, infrastructure and power. Through leading Environmental & Social Screening Studies, Environmental & Social Impact Assessments and Environmental & Social Due Diligences for major capital projects in over 13 African countries; Stuart has developed a deep appreciation of key sustainability challenges facing development in Africa. He has excellent project management skills with the ability to manage projects from the concept phase through to project completion.

Project Manager: Kate Hamilton

Kate is a Senior Consultant based in Johannesburg and holds an Honours Degree in Environmental and Geographical Science. As a specialist environmental project manager, she has over 12 years of private sector experience in Environmental Consulting. Kate has worked as a project manager in environmental management, project management and coordination and environmental monitoring, with a focus in the mining sector. Kate has worked on projects throughout the project lifecycle from exploration/ site identification through pre-feasibility to feasibility, to operation and closure for the mining sector. This includes conducting site screening and scoping studies, baseline studies, impact assessments, monitoring, management planning and implementation, and public consultation processes; for local regulatory permitting processes. Kate has worked extensively in the SADC region and has experience in managing large scale environmental projects with large integrated teams.

Relevant curricula vitae (including proof of registrations) are attached in Appendix A.

1.4 SPECIALIST STUDIES

Specialist studies have been undertaken to inform the EIA process. The specialist studies involved the gathering of baseline data (desktop and site visit, where applicable) relevant to identifying and assessing environmental and social impacts that may occur as a result of the proposed project. These impacts have been assessed according to pre-defined rating scales (see Section 6.6). Specialist studies included recommended mitigation measures to minimise potential impacts or optimisation measures to enhance potential benefits as well as monitoring requirements, where necessary. These have been incorporated into the EMPr. The methodologies applied to each specialist study are included in the specialist reports attached as appendices to this EIA and EMPr.

Specialists who provided input to the EIA process are listed in the Table 1-3.

Table 1-3 Specialist Studies Undertaken

Specialist field	Name and Surname	Company	Expertise
Groundwater	Mihai Muresan	SLR	Hydrogeologist
Surface Water	Kevin Bursey	SLR	Hydrologist
Terrestrial Biodiversity	Simon Todd	Simon Todd	Ecologists
Air Quality	Renee von Gruenewaldt	Airshed Planning Professionals	Air quality specialist
Noise	Renee von Gruenewaldt	Airshed Planning Professionals	Noise specialist
Visual	Stephen Stead	Visual Resource Management	Visual specialist
Traffic	Paul van der Westhuizen	Siyazi Gauteng Consulting Services (Pty) Ltd	Traffic engineer
Climate Change	Karien Erasmus and Robbie Louw	Promethium Carbon	Climate change advisor
Social	Nic Boersema	Nic Boersema	Social specialist
Economic	Dr Hugo van Zyl	Independent Economic Researchers	Economic specialist
Mine Closure Update	Steve van Niekerk	SLR	Closure specialist

2. PROPERTY DESCRIPTION

2.1 PROPERTY DESCRIPTION

The description of the property on which the Gamsberg Smelter Project is to be developed is described in Table 2-1.

Table 2-1 Property Information

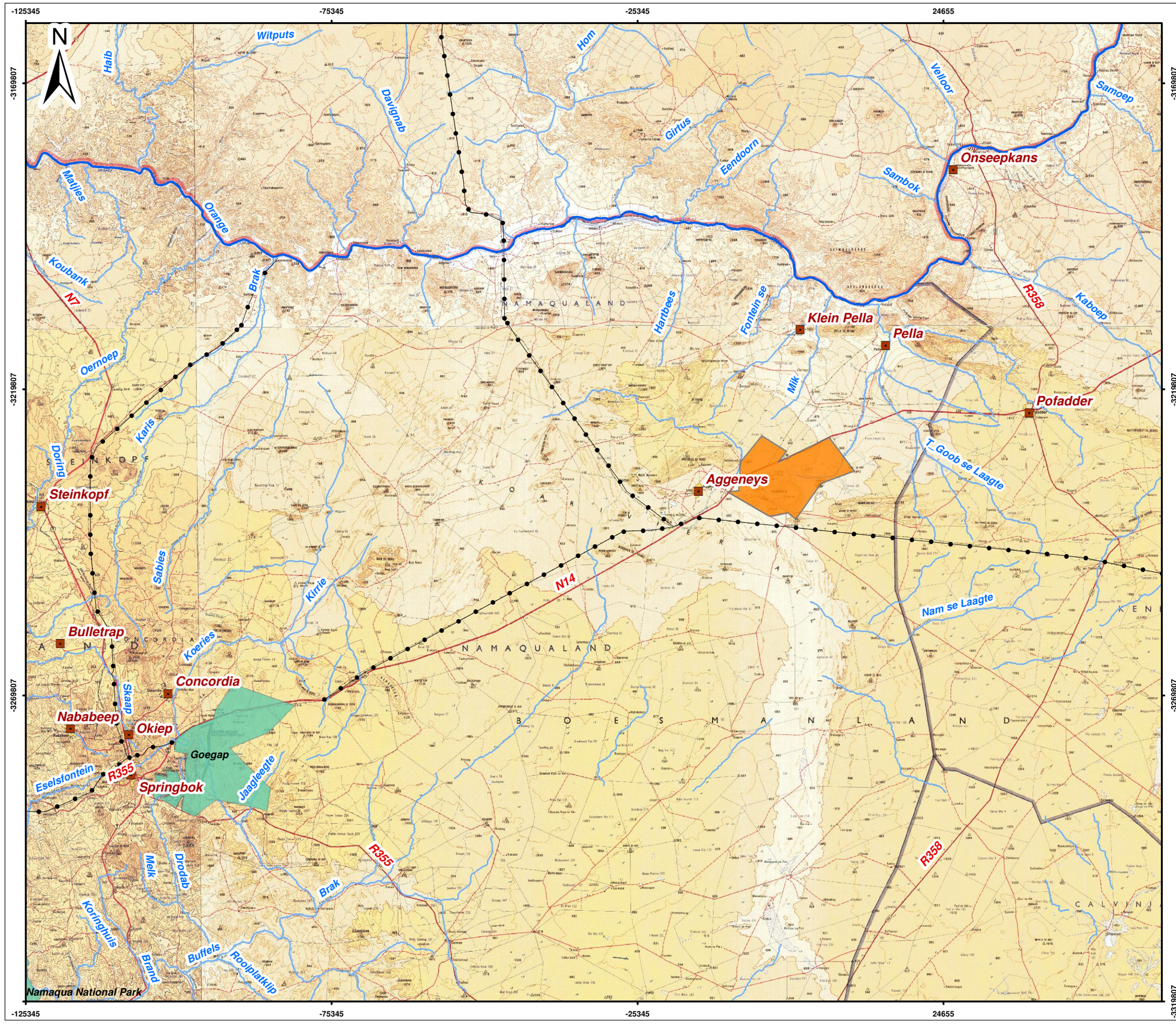
Description	Details	
Farm Name	Bloemhoek 61 Portion 1 Gams 60 Portion 1 Aroams 57 RE	
Application area (Ha)	A surface disturbance area of approximately 22 ha for the smelter, 21 ha for the secured landfill facility, 15 ha for the laydown area and 12 ha for the business partners camp. A total footprint area of approximately 90 ha would be required. The total Mining Right Area is 9 505.73 ha	
21 digit Surveyor General Code for each farm portion	Bloemhoek 61 Portion 1 Gams 60 Portion 1 Aroams 57 RE	C05300180000006100001 C05300180000006000001 C053001800000057000RE

2.2 PROJECT LOCALITY

A description of the project locality is provided in Table 2-2. The regional and local settings are illustrated in Figure 2-1 and Figure 2-2, respectively.

Table 2-2 Project Locality Information

Description	Details
Centre co-ordinates for the proposed Gamsberg Smelter Project	Smelter - 18°57'9.699"E 29°12'53.046"S Secured Landfill Facility - 18°56'1.231"E 29°13'13.234"S
Nearest towns	The Gamsberg Zinc Mine is located in the Northern Cape Province of South Africa, approximately 14 km east of the town of Aggeneys and 120 km east of Springbok along the N14.
Province	Northern Cape Province
Local authority	Northern Cape DMRE, Springbok
Water catchment and management area	The Gamsberg Zinc Mine MRA spans over four quaternary catchments D81G, D82A, D82B and D82C. The D81G catchment drains into the Orange River and the D82C catchment is an interior drainage basin that does not drain into the sea.



Legend

- Towns / Villages
- Protected Areas (NBA 2011)
- Main Roads
- Power Line
- Rivers and Streams
- Gamsberg Zinc Mine MRA

0 10 20 Kilometers

Scale: 1:600 000 @ A3

Projection: Transverse Mercator
Datum: WGS1984, Lo19

Gamsberg Smelter Project

Figure 2-1

Regional Map of the Gamsberg Smelter Project

SLR Consulting (Africa) (Pty) Ltd
P O Box 1596, Cramerview, 2060, South Africa
Tel: +27 (11) 467-0945 Fax: +27 (11) 467-0978

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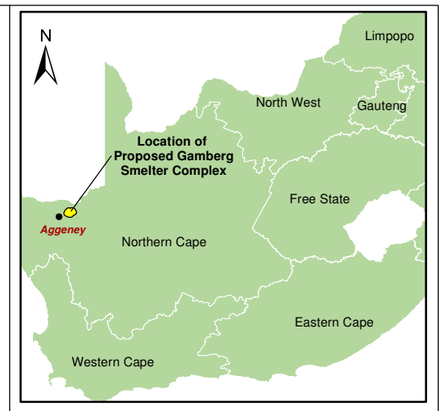

Legend

- Towns / Villages
- Rivers
- Gamsberg Zinc Mine MRA
- Existing Infrastructure

Proposed Infrastructure

- Access Road
- Transmission Line
- Bulk Water Pipeline
- Secured Landfill Site
- Switch Yard
- Smelter Complex Footprint

0 1 000 2 000 Meters

Scale: 1:69 700 @ A3

Projection: Transverse Mercator
Datum: WGS1984, Lo23

Gamsberg Smelter Project

Figure 2-2

Locality Map of the Gamsberg Smelter Project

SLR Consulting (Africa) (Pty) Ltd
P O Box 1596, Cramerview, 2060, South Africa
Tel: +27 (11) 467-0945 Fax: +27 (11) 467-0978

720.22013.00002 | 2020/09/23

3. DESCRIPTION OF THE SCOPE OF THE ACTIVITY

Black Mountain Mining (Pty) Ltd is proposing to construct a new zinc smelter and associated infrastructure to produce 300 000 tpa special high grade zinc metal by processing 680 000 tpa of zinc concentrate (Gamsberg Smelter Project). As a by-product 450 000 tpa of 98.5% pure sulphuric acid will be produced for both export and consumption within South Africa. A new secured landfill facility is also planned for the storage of Jarofix, a waste product generated during the smelting process.

3.1 LISTED AND SPECIFIED ACTIVITIES

The proposed project triggers activities for which various decisions are required. All activities that have been identified as being associated with the Gamsberg Smelter Project are included in Table 3-1 and further assessed in terms of Listed Activities in Table 3-2, Table 3-3, Table 3-4 and Table 3-5.

Table 3-1 Activities Associated with the Proposed Gamsberg Smelter Project

Description of Activity	Approximate Aerial Extent of Activity (ha)	Listed Activity and/ or Water Use
Site preparation and construction activities		
Selective clearing of vegetation (in line with a biodiversity management plan to be developed for the project).	Within the footprint of the smelter complex and the secured landfill facility: Approximately 90 ha.	GNR 984 (15) or GNR 985 (12). NEMA GNR 983 (30).
Establishing a Business Partner area and laydown area.		
Stripping, handling and stockpiling of topsoil (in line with a soil management plan to be developed for the project).		
Cleaning, grubbing and bulldozing activities.		Not applicable
Establishing storm water controls (in line with a Regulation 704 compliant storm water management plan to be developed for the project).		NEMA GNR 983 (34). NWA 21(b) and 21(g).
Excavations and establishing secured landfill facility.		
Bulk earthworks including foundations, trenches, berms.		Not applicable.
Establishing additional road networks.	New road to secured landfill facility approx. 1 ha.	NEMA GNR 983 (19) and (24). NEMA GNR 985 (4).
Smelter Complex		
General building activities, erection of structures and concrete and steel work associated with infrastructure complexes and the related support facilities (including road development and power supply).	Smelter complex footprint: 22 ha Laydown area: 15 ha Business Partner Camp: 12 ha	Not applicable
Storage of fuel and/ or other hazardous substances. 1 x 30 m^3 diesel storage tank within smelter complex 2 x 3 m^3 diesel storage tanks for emergency generators 4 x 2 800 m^3 tanks for storage of sulphuric acid 1 x 1 900 m^3 tank for the storage of liquid oxygen	Within smelter complex footprint: 22 ha	NEMA GNR 984 (4)

Description of Activity	Approximate Aerial Extent of Activity (ha)	Listed Activity and/ or Water Use
Atmospheric emissions associated with operation of the Smelter.	Smelter complex footprint: 22 ha.	NEMA GNR 983 (34) and NEMA GNR 984 (6). NEM: AQA GNR 893 4.11, 4.14 and 4.16.
Transportation		
Vehicle, machinery and/or material movement within the site boundary.	Restricted to new and existing roads.	Not applicable
Use of access road and public roads for transporting staff, consumables and general/industrial waste.	Restricted to new and existing roads.	
Transportation of product and by-product to port for export.	Restricted to new and existing roads.	
Business Partner Camp		
A new Business Partner camp will be constructed for the Gamsberg Smelter Project.	Camp to be constructed to the north of the N14. Approximately 12 ha.	GNR 984 (15) or GNR 985 (12). NEMA GNR 983 (30).
Water Supply and Management		
Potable water supply from Sedibeng Water.	New bulk water pipeline from Horseshoe Reservoirs to the smelter complex. New bulk water pipeline: additional 5 ha area to be cleared where outside of existing pipeline servitude.	Not applicable
Process/make-up water supply from local municipality.		NEMA GNR 983 (9) & (45)
Treatment and storage of sewage and effluent.	Within overall application area of ~ 90 ha. Increase in sewage treatment plant (STP) capacity from 500 m^3/day by 500 m^3/day to treat a total of 1 000 m^3/day. Effluent Treatment Plant (ETP) will treat approximately 5 000 m^3/day.	NEMA GNR 983 (25) and 984 (6).NEM:WA GNR 921 B (7) and (10). NWA 21 (g).
Clean water storage (new concrete reservoir of approximately 10 ML). Water storage below 50 000 m^3.	Within the smelter complex footprint: 22 ha.	NWA 21(b).
Dirty water storage and management.	Water from the STP and ETP would be pumped to the Return Osmosis Plant (RO) for treatment and will be reused in the smelter.	NWA 21 (g)

Description of Activity	Approximate Aerial Extent of Activity (ha)	Listed Activity and/ or Water Use
Storm water management.	Within the smelter complex footprint: 22 ha. Secured landfill facility: 21 ha	NWA 21 (b) and 21 (g).
Dust suppression.	Dust suppression with water is mainly envisaged in the concentrate storage yard.	Not applicable.
Power Supply		
A new 132 kV transmission line would be constructed from the ESKOM Aggeneys substation (approximately 20 km west of the Gamsberg Zinc Mine).	Approximately 20 km.	Not applicable.
Two 2 500 kV emergency generators will be installed within the smelter complex footprint.	Within smelter complex footprint: 22 ha.	NEMA GNR 984 (4)
General and Hazardous Waste Management		
Temporary storage and sorting of general and hazardous waste at a waste/salvage yard for re-use or recycling. Hazardous wastes removed by a licensed contractor within 90 days.	Within smelter complex footprint: 22 ha.	Not applicable.
Management of brine and solids produced by the wastewater treatment plant (WWTP). ETP and Return Osmosis (RO) Plant also within the smelter complex footprint.		NEM:WA GNR 921 Category B (7) and (10).
Removal of waste by contractor for recycling, re-use or final disposal at permitted waste disposal facilities.		Not applicable.
Secured Landfill Facility		
Return water pipeline from the secured landfill facility.	Approximately 1 km pipeline from secured landfill facility to smelter complex.	NEMA GNR 983 (10)
Disposal of Jarofix to the secured landfill facility.	Approximately 21 ha.	NEM:WA GNR 921 Category B (7) and (10). NWA 21 (c), (i) and 21 (g).

Description of Activity	Approximate Aerial Extent of Activity (ha)	Listed Activity and/ or Water Use
Disposal of ETP Cake to the secured landfill facility.	ETP cake generated would be ~21,000 tpa and would be disposed in the secured landfill facility.	NEM:WA GNR 921 Category B (7) and (10). NWA 21 (c), (i) and 21 (g).

3.1.1 NEMA and the EIA Regulations 2014

The EIA Regulations promulgated in terms of Chapter 5 of NEMA provide for control over certain listed activities. These listed activities are detailed in Listing Notice 1 (as amended by GN No. 327 of 7 April 2017), Listing Notice 2 (as amended by GN No. 325 of 7 April 2017) and Listing Notice 3 (as amended by GN No. 324 of 7 April 2017). The undertaking of activities specified in the Listing Notices is prohibited until Environmental Authorisation has been obtained from the competent authority. Such Environmental Authorisation, which may be granted subject to conditions, will only be considered once there has been compliance with the EIA Regulations. The EIA Regulations are being applied to this project.

The EIA Regulations set out the procedures and documentation that need to be complied with when applying for Environmental Authorisation. Where a development triggers activities listed in Listing Notice 2, a Scoping and EIA process must be applied to the application. As the proposed project would trigger activities specified in Listing Notices 1, 2 and 3 (see Table 3-2) a Scoping and EIA process has to be conducted.

3.1.2 NEM:WA

The NEM:WA regulates all aspects of waste management and has an emphasis on waste avoidance and minimisation. NEM:WA creates a system for listing and licensing waste management activities which may have a detrimental effect on the environment.

Listed waste management activities are included in GN R 921 of November 2013. Category A and B listed waste management activities are subject to a Scoping and EIA process and licensing. The proposed project would trigger Category A and B listed activities (see Table 3-3) which require an application for NEM:WA authorisation and therefore a Scoping and EIA process is being conducted.

3.1.3 NWA

The proposed project would require a WUL for water uses in terms of Section 21 of the NWA. Water uses identified have been included in Table 3-4.

3.1.4 NEM:AQA

The proposed project would require an AEL in terms of Category 4 of the NEM:AQA. Listed activities are included in Table 3-5.

Table 3-2 Description of the EIA Regulations Listed Activities Being Applied for as Part of the Proposed Gamsberg Smelter Project

Activity No.	Listed Activity	Applicability of the Activity
NEMA Listing Notice 1, 2014 (GNR 983 in Government Gazette 38282 dated 4 December 2014)		
9	The development of infrastructure exceeding 1 000 metres in length for the bulk transportation of water or storm water— (i) with an internal diameter of 0.36 metres or more; or (ii) with a peak throughput of 120 litres per second or more; excluding where - (a) such infrastructure is for bulk transportation of water or storm water or storm water drainage inside a road reserve or railway line reserve; or (b) where such development will occur within an urban area.	A new above ground pipeline of approximately 7 km will be constructed from the Horseshoe Reservoir to the Gamsberg smelter complex.
10	The development and related operation of infrastructure exceeding 1 000 metres in length for the bulk transportation of sewage, effluent, process water, waste water, return water, industrial discharge or slimes – (i) with an internal diameter of 0.36 metres or more; or (ii) with a peak throughput of 120 litres per second or more excluding where— (a) such infrastructure is for the bulk transportation of sewage, effluent, process water, waste water, return water, industrial discharge or slimes inside a road reserve or railway line reserve; or (b) where such development will occur within an urban area.	New above ground pipeline of approximately 2 km for leachate from secured landfill facility to smelter complex. A new pipeline of approximately 2 km will be constructed from the STP to the ETP for the treatment of water.
19	The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse.	Where the construction of new pipelines, roads and any other construction activities requires crossing of watercourses.
24	The development of a road - (i) for which an environmental authorisation was obtained for the route determination in terms of activity 5 in Government Notice 387 of 2006 or activity 18 in Government Notice 545 of 2010; or (ii) with a reserve wider than 13,5 meters, or where no reserve exists where the road is wider than 8 metres;	Construction of new roads around the smelter complex as well as the new road to the secured landfill facility.

Activity No.	Listed Activity	Applicability of the Activity
	but excluding a road - (a) which is identified and included in activity 27 in Listing Notice 2 of 2014; (b) where the entire road falls within an urban area; or (c) which is 1 kilometre or shorter.	
25	The development and related operation of facilities or infrastructure for the treatment of effluent, wastewater or sewage with a daily throughput capacity of more than 2 000 cubic metres but less than 15 000 cubic metres.	Construction and operation of the new ETP and upgrade of the current STP. 5 000 m^3/day effluent generated from the smelter complex to be pumped to ETP for further treatment.
30	Any process or activity identified in terms of section 53(1) of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004).	The removal of protected plants and trees may be required.
34	The expansion of existing facilities or infrastructure for any process or activity where such expansion will result in the need for a permit or licence or an amended permit or licence in terms of national or provincial legislation governing the release of emissions, effluent or pollution, excluding— (i) where the facility, infrastructure, process or activity is included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case the National Environmental Management: Waste Act, 2008 applies; (ii) the expansion of existing facilities or infrastructure for the treatment of effluent, wastewater, polluted water or sewage where the capacity will be increased by less than 15 000 cubic metres per day; or (iii) the expansion is directly related to aquaculture facilities or infrastructure where the wastewater discharge capacity will be increased by 50 cubic meters or less per day.	The operation of the smelter will require an Atmospheric Emission Licence (AEL), a Waste Management Licence (WML) and a Water Use Licence (WUL).
45	The expansion of infrastructure for the bulk transportation of water or storm water where the existing infrastructure— (i) has an internal diameter of 0,36 metres or more; or (ii) has a peak throughput of 120 litres per second or more; and (a) where the facility or infrastructure is expanded by more than 1 000 metres in length; or (b) where the throughput capacity of the facility or infrastructure will be increased by 10% or more; excluding where such expansion— (aa) relates to transportation of water or storm	Storm water designs will cater for 1:100 year flood events.

Activity No.	Listed Activity	Applicability of the Activity
	water within a road reserve or railway line reserve; or (bb) will occur within an urban area.	
NEMA Listing Notice 2, 2014 (GNR 984 in Government Gazette 38282 dated 4 December 2014)		
4	The development and related operation of facilities or infrastructure, for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of more than 500 cubic metres.	1 x 30 m^3 diesel storage tank within smelter complex 2 x 3 m^3 diesel storage tanks for emergency generators 4 x 2 800 m^3 tanks for storage of sulphuric acid 1 x 1 900 m^3 tank for the storage of liquid oxygen
6	The development of facilities or infrastructure for any process or activity which requires a permit or licence or an amended permit or licence in terms of national or provincial legislation governing the generation or release of emissions, pollution or effluent, excluding - (i) activities which are identified and included in Listing Notice 1 of 2014; (ii) activities which are included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case the National Environmental Management: Waste Act, 2008 applies; (iii) the development of facilities or infrastructure for the treatment of effluent, polluted water, wastewater or sewage where such facilities have a daily throughput capacity of 2 000 cubic metres or less; or (iv) where the development is directly related to aquaculture facilities or infrastructure where the wastewater discharge capacity will not exceed 50 cubic metres per day.	The operation of the smelter will require an Atmospheric Emission Licence (AEL), a Waste Management Licence (WML) and a Water Use Licence (WUL).
15	The clearance of an area of 20 hectares or more of indigenous vegetation, excluding where such clearance of indigenous vegetation is required for— (i) the undertaking of a linear activity; or (ii) maintenance purposes undertaken in accordance with a maintenance management plan.	Approximately 90 ha of indigenous vegetation will have to be cleared for the construction of the smelter complex, secured landfill facility, business partner camp and associated roads and pipelines.
NEMA Listing Notice 3, 2014 (GNR 985 in Government Gazette 38282 dated 4 December 2014)		
4	The development of a road wider than 4 metres with a reserve less than 13.5 metres.	New bitumen road of approximately 10 m in width from the smelter complex to the secured landfill facility. The road will be approximately 2 km long.

Activity No.	Listed Activity	Applicability of the Activity
	g. Northern Cape ii. Outside urban areas: (ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; (gg) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of the National Environmental Management: Protected Areas Act (Act No. 57 of 2003) (NEM:PAA) or from the core areas of a biosphere reserve, excluding disturbed areas;	Critical Biodiversity Areas to be assessed during the Biodiversity Specialist Study. Within 5 km from the declared protected area: farms for declared for offset include the neighbouring farm Achab. The Gamsberg Nature Reserve declared under NEM:PAA is further than 5 km from the Gamsberg Smelter Project.
12	The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan. g. Northern Cape i. Within any critically endangered or endangered ecosystem listed in terms of section 52 of the National Environmental Management: Biodiversity Act (Act No.) (NEM:BA) or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004; ii. Within critical biodiversity areas identified in bioregional plans;	Up to 90 ha of indigenous vegetation would need to be cleared for the construction of the smelter complex, secured landfill facility and associated facilities.

Table 3-3 NEM:WA Category B Listed Activities (GNR 921)

Activity No.	Listed Activity	Applicability of the Activity
7	The disposal of any quantity of hazardous waste to land.	Development of the secured landfill facility for the disposal of Jarofix, ETP Cake and precipitated salts from RO plant.
10	The construction of a facility for a waste management activity listed in Category B of this Schedule (not in isolation to associated waste management activity).	The secured landfill facility is being constructed for the disposal of both Jarofix, ETP cake and precipitated salts.

Table 3-4 Water Uses that Apply to the Gamsberg Smelter Project

Use No.	Water Uses	Applicability of the Activity
21 (b)	Storing water	Water would be stored in a 10 ML reservoir to be constructed with the smelter complex.
21 (c)	Impeding or diverting the flow of water in a watercourse	Watercourse crossings may be required for the new road from the smelter to the secured landfill facility as well as crossings for the proposed return water pipeline from the secured landfill facility to the smelter complex.
21 (i)	Altering the bed, banks, course or characteristics of a watercourse	
21 (g)	Disposing of waste in a manner which may detrimentally impact on a water resource	A secured landfill facility will be developed for the disposal of Jarofix and ETP cake which has the potential to leach into underground water sources.

Table 3-5 NEM: AQA Listed Activities for Atmospheric Emission Licence (GN 893 in Government Gazette 37054 Dated 22 November 2013. As Amended By: GN 551 In 2015)

Activity No.	Listed Activity	Applicability of the Activity
Category 4: Metallurgical Industry		
4.11	Agglomeration Operations	Production of pellets or briquettes using presses, inclined discs or rotating drums.
4.14	Production and Processing of Zinc, Nickel and Cadmium	The extraction, processing and production of zinc, nickel or cadmium by the application of heat
4.16	Smelting and Converting of Sulphide Ores	Processes in which sulphide ores are smelted, roasted calcined or converted (Excluding Inorganic Chemicals-related activities regulated under Category 7).

3.2 DESCRIPTION OF THE ACTIVITIES TO BE UNDERTAKEN

3.2.1 Current Mining Operations

Gamsberg Zinc Mine

The Gamsberg Zinc Mine is an approved open pit zinc mine and is currently approved to mine 10 mtpa to produce zinc and lead concentrate. The information in Table 3-5 is sourced from the Environmental Resources Management (ERM) EIA for the Gamsberg Zinc Mine (2013)[1].

Table 3-6 Gamsberg Zinc Mine Existing Activities

Infrastructure	Description of Activity
Open Pit	The final open pit is expected to cover a total area of 600 ha, which is expected to be the result of the extraction of some 1.65 billion tons of material. The final depth of the open pit is estimated at approximately 650 metres, while the width and length of the pit are expected to extend 2 220 metres and 2 700 metres. The current pit is indicated in Figure 3-1. Blasting takes place on average once per day with the explosive's magazine situated to the south east of the existing concentrator plant. Hauling of ore to the primary crusher and waste rock to the waste rock dump is undertaken using large capacity haul trucks (typically between 220 t and 300 t capacity).
	 **Figure 3-1 Current Gamsberg Zinc Mine open pit (North Pit)**
Primary Crusher	Upon stripping of overburden, the ore is transported via haul trucks to the primary crusher located adjacent to the open pit along the northern slope. The bulk ore is transported to the primary crushers that have a total processing capacity of 10 mtpa (currently processing 4 mtpa). From the Primary Crushers the ore is transported to the Run of Mine (ROM) ore stockpile via a conveyor system. Ore is conveyed through a reclaim conveyor to the milling circuit.

[1] Environmental and Social Impact Assessment Report for the Gamsberg Zinc Mine and Associated Infrastructure in the Northern Cape: FINAL REPORT. Black Mountain Mining (Pty) Ltd. June 2013

Infrastructure	Description of Activity
Waste Rock Dumps	An estimated 1.5 billion tons of waste rock will be generated during the life of mine. The trucks transport the waste material to the edge of the inselberg where it is tipped over the edge to form a waste rock dump. In order to achieve the natural angle of repose, the footprint of the rock dump is estimated to cover 490 hectares. The current waste rock dumps can be seen in Figure 3-2.
	 **Figure 3-2 Gamsberg Zinc Mine waste rock dumps with Tailings Storage Facility (TSF) in the foreground**
Mine Bulk Fuel and Lubricant Storage Facility	The mine bulk storage tank farm is located adjacent to the Mine workshop area. This tank farm stores approximately 500 m^3 of diesel and covers a total area of approximately 2,500 m^2. Approximately 5 000 litres of various grades of lubricants are stored in a bunded area adjacent to the Mine workshop area.
Concentrator Plant	The full production capacity of the mine will be 10 mtpa of ore, the current production capacity is 4 mtpa. The concentrator plant will produce 1.1 mtpa of zinc and lead concentrate. The concentrator processing plant area consists of the following: • Milling circuit; • Ore stockpile; • Flotation; • Dewatering, filtration and zinc concentrate handling; • Tailings facility (see tailings section below); • Material lay down and storage areas; • Bulk storage of diesel and petrol (a total capacity of 100 m^3 of diesel and petrol covering an area of 400 m^2); • Equipment wash areas; and • Additional on-site plant infrastructure.
Tailings Storage Facility	The treatment of 10 mtpa ROM ore is expected to lead to approximately 9 mtpa of tailings material (approximately 6.9 million m^3 of slurry containing approximately 4.5 million m^3 of water). The mineral wastes (tailings) are sent to the thickener to reduce the water content and then pumped to the TSF (Figure 3-3). Percolated water in the tailings dam is extracted, returned to a process plant and re-used in the concentrating process, via a return water dam. Based on the expected production of tailings material, two tailings dams in close proximity on the 290 hectare footprint will be constructed (one of which has already been constructed), with a total storage capacity of 132 million tons. The tailings dam is situated to the north of the N14.

Infrastructure	Description of Activity
	To mitigate risk, use of a suitable impermeable lining system with HDPE geomembrane liner, was constructed along the entire TSF footprint area. The lining system constructed consist of a 1.5 mm thick HDPE geomembrane as approved by DHSWS. The geomembrane was placed over 300 gsm non-woven needle-punched geotextile and was placed all along the slopes and base of the TSF.
	 **Figure 3-3 Tailings storage facility July 2019**
Services	Power Supply The current power supply consists of the following infrastructure: • The 220kV/66V substation; • 66 kV/11kV sub-station; and • Two 66 kV distribution lines from Aggeneys to the Gamsberg Zinc Mine.
Water	Water is currently supplied by Sedibeng Water via two existing pipelines from the Orange River. The existing water system has a common intake, low lift pump house and low lift pipeline. The low lift pumping system is feeding two circuits, namely the Black Mountain Mine circuit and the Gamsberg Zinc Mine circuit. Both the circuits consist of a flash mixer, clarifier, dosing system, sludge handling facility, balancing reservoir, high lift pump house, high lift pipelines and Horseshoe Reservoir with associated facilities. The current water demand, with the Black Mountain Mine operation and Phase 1 concentrator plant at Gamsberg, is 28 ML/day, the existing intake water pumping system has been designed for 40.8 ML/day. The existing bulk water pipeline infrastructure running from the Horseshoe Reservoirs to the Gamsberg takeoff covers a distance of approximately 4 km and consists of one 400 mm diameter underground pipeline and one 400 mm aboveground pipeline. A 400 mm High Density Polyethylene (HDPE) diameter aboveground bulk water pipeline runs from the Gamsberg takeoff where the pipeline splits off from the Main Bulk Water Pipeline to the Gamsberg reservoir (25 Ml) extending over a distance of 3 km. The water supplied by these pipelines also supplies water to the towns of Aggeneys, Pofadder and Pella on the original Black Mountain Mine underground pipeline. The raw water storage dam at the concentrator plant has a total capacity of 6 800 m^3 and provides water to the plant, mine and fire hydrant systems. A process water dam is fed with recycled water from the plant, treated water and make-up water from the raw water dam and also has a total storage capacity of 25,000 m^3.

Infrastructure	Description of Activity
	The sewage treatment plant is also located at the concentrator plant and has a daily processing capacity of approximately 500 m³/day.

3.2.2 Proposed Gamsberg Smelter Project

Black Mountain Mining (Pty) Ltd is proposing to construct a new zinc smelter and associated infrastructure to beneficiate 680 000 tpa of zinc concentrate produced by the concentrator plant.

The smelter complex would comprise of the following major components (Table 3-7). These components are discussed in detail in the following sections.

Table 3-7: Plant Complex Major Components

No.	Smelter Plant
1	Raw Material storage and handling:
2	Two Roasters, two waste heat recovery boilers, two Steam Turbine Generators (STG), one gas cleaning plant, one acid plant and acid loading section including acid storage tanks
3	Leaching area including calcine silo and manganese removal
4	Purification section
5	Enrichment plant
6	Gypsum removal section
7	Cell house
8	Melting and casting including product storage
9	Zinc dust plant
	Utility Services/Facilities
1	Raw water reservoir, water treatment plant, cooling towers
2	Oxygen Plant
3	Power supply
4	ETP and Oxygen/Ozone plant (for Manganese removal)
5	Laboratory
6	Central stores
7	Workshop
8	Plant office
9	Weighbridge
10	Access road
11	Gate house and security
12	Raw water reservoir, water treatment plant, cooling towers and air compressors
	Non Plant Facilities
1	Business partners camp
2	Sewage treatment plant

No.	Smelter Plant
3	Change house
4	Canteen
5	Fire and first aid station
	Secured Landfill Facility for Waste Disposal and Evaporation Ponds
	Water supply pipeline
1	Section of pipeline from Horseshoe Reservoirs to Gamsberg Zinc Mine

3.2.3 Smelter Plant

The conventional roast-leach-electro winning (R-L-E) process has been chosen for the production of zinc metal at the Gamsberg Smelter (the alternatives analysis is included in Section 6.1). The full process will involve the treatment of zinc concentrate from the concentrator plant to produce high grade zinc ingots for export. The following sections describe each of the individual processes within the smelting process. The process flow is summarised in Figure 3-4.

All technical information in this section was taken from the Tata Consulting Engineers Limited "Pre-feasibility Study Report: 250 ktpa Zinc Smelter Refinery with Infrastructure at Gamsberg, South Africa" dated August 2019.

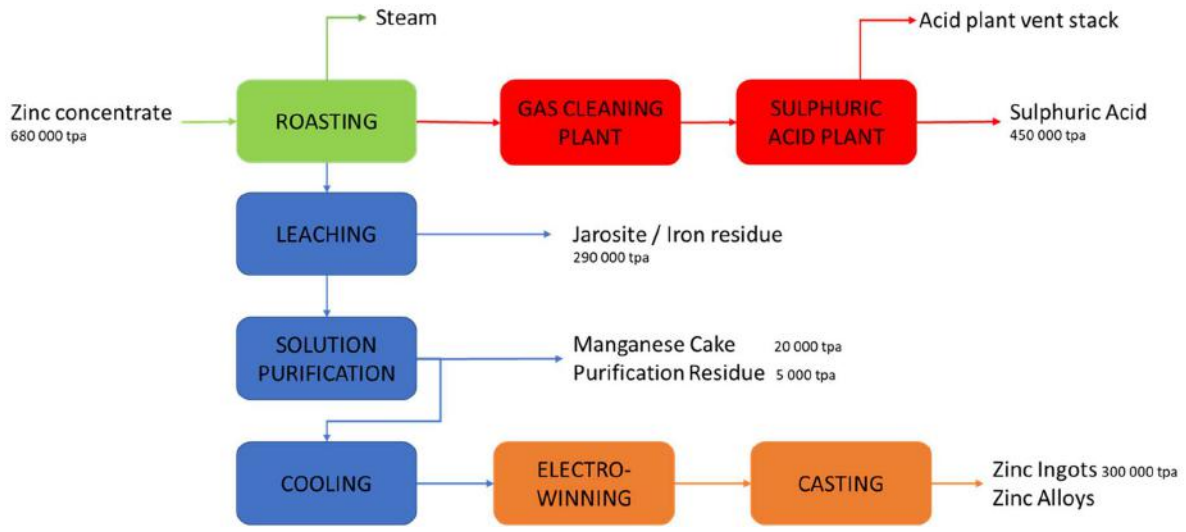

Figure 3-4 Process Flow Diagram

Raw Material Handling and Storage

Zinc concentrate would be transported from the concentrator plant using internal roads by side tipper trucks to the designated stockpiles within the smelter complex footprint (50 trucks per day carrying a volume of 30 tonnes/truck). A total of 680,000 tpa of zinc concentrate from the concentrator plant would be fed into the smelter. Two stockpiles with storage for five days each are proposed. Front-end loaders would then be used to reclaim material from the stockpiles and feed concentrate into the ground hoppers. From the ground hoppers material would be extracted by weigh feeders which in turn would feed the material to the belt conveyor. Zinc concentrate would be transferred into the respective day bins at each roaster plant via a series of conveyor belts. Dross material from the cathode melting and casting process would be added to the feed material before the

vibrating screen. Several spraying nozzles in the concentrate storage hall, as well as on the conveying belt before the concentrate feed bin, would moisten the concentrate. The concentrate composition and particle size is included in Table 3-8 and Table 3-9.

Table 3-8: Major Elements in the Concentrate

Element	Unit	Min.	Max.	Design
Zinc	%	48.0	54.0	50.0
Lead	%	0.1	1.0	0.5
Silicon Dioxide	%	0.5	3.0	3.0
Copper	%	0.2	1	0.3
Lead+Silicon+Copper	%	0.4	7.7	4.5
Manganese	%	2.0	4.5	3.5
Iron	%	9	11	10
Sulphur	%	29	34	31
Carbon	%	0.0	0.5	0.2

Table 3-9: Particle Size Distribution of Concentrate

Size Micron	Gamsberg Cumulative % passing		Design Range	
	Coarse	Fine	Coarse	Fine
500	100.0	100.0	100.0	100.0
300	99.3	100.0	99.3	100.0
75	94.8	100.0	68.0	100.0
53	84.1	99.7	43.0	99.7
38	69.8	98.0	29.0	98.0
25	56.9	81.3	19.0	81.3

Roasting Plant

The roasting plant comprises a number of processes which are discussed in Table 3-10.

Table 3-10: Roasting Plant Process

Process	Process Description
Pre-treatment of fine feed material	Gamsberg concentrate is much finer than usual zinc concentrates and requires granulation before feeding to the roaster. During the granulation process concentrate undergoes size enlargement which is facilitated through the addition of water or a purified solution. The size is enlarged to optimum values for fluidized bed processing. Granulator discharge is stored in a buffer bin, which is an integral part of the granulator. The associated weighing belt, conveyor, rotary feeder and slinger feeder distributes granulated material across the furnace bed area.
Roaster	The concentrate is roasted in a fluid bed composed of dead roasted concentrate (zinc oxide). Process air is injected to the roaster with the roaster air blower. The process air is controlled via a variable

Process	Process Description
	speed drive (VSD) at the blower motor and the adjustable inlet guide vanes (IGV). It serves both as a carrier medium for the fluidized bed and as a source of oxygen for the predominant reaction, which converts zinc sulphide to zinc oxide and sulphur dioxide. The reaction in the roaster is strongly exothermic, and the gases leave the roaster at a temperature of approximately 930 °C – 975 °C and with a Sulphur Dioxide (SO_2) concentration of approximately 10% by volume, dry basis. A slight draught suction is maintained at the roaster gas outlet to ensure the safety of the roaster operation and operate the system in slight suction to eliminate dust and SO_2 emissions. The SO_2 blower of the acid plant controls the required draft. Calcine is the metal containing portion of the concentrate after the sulphurous component has been roasted off. Calcine produced at the roasting plant is used as feed material to the leaching plant.
Calcine Discharge System	During normal operation calcine is discharged at the roaster, waste heat boiler, cyclones and the hot electrostatic precipitator (ESP). Calcine from the roaster and waste heat boiler requires primary cooling as well as grinding before feeding to the leaching process.
Waste Heat Recovery Boiler	The hot, dust-laden gas stream leaving the roaster is drawn into the waste heat boiler. A water-tube boiler is installed behind the fluid bed reactor, where the dust-laden and SO_2-containing roaster off-gases are cooled. For the purpose of controlling the bed temperature, the fluid bed roaster comprises a certain number of cooling coils which are connected to the boiler water circulation system. The waste heat boiler is a horizontal-pass boiler directly connected with the gas outlet flange of the roaster. In the boiler, the dust-laden gases are cooled down from roasting temperature to about 350 °C before entering the dust precipitation system. The boiler produces steam in a forced circulation system and is equipped with two circulating pumps. Each pump is capable of handling the maximum rating of the boiler continuously. The stand-by steam-driven circulating pump would start automatically when the electric power supply fails or when the flow of circulating water falls below a pre-set quantity. The water-steam mixture, produced in the forced circulation system, would be separated in the steam drum by means of a demister. The superheated steam collected in the steam drum would then be used in the downstream processing units for heating and also for power generation through steam turbine generator.
Hot Gas Cleaning	The hot gas cleaning consists of the pre-de-dusting cyclone stage and the hot gas ESP. From the exit of the boiler the cooled and dust-laden gas would be guided to two parallel cyclones for pre-de-dusting. Final de-dusting occurs in the hot ESP. Calcine from the de-dusting cyclone and hot ESP proceeds to a series of two rotary valves before reaching the collecting point from where it is stored in calcine silos.
Wet Gas Cleaning	Hot gases containing some dust and fumes would be further cleaned before feeding the gases to the sulphuric acid plant to ensure a quality acid product, eliminate corrosion issues and other issues in the downstream acid plant. In the wet gas cleaning plant, the gases would be processed in the following six stages: the quench tower; the high-efficiency scrubber; the packed gas cooling tower with sodium silicate dosing system; the first stage wet ESP's; the second stage wet ESP; and mercury-removal stage.
Acid Plant	The sulphuric acid (H_2SO_4) plant is designed based on SO_2 feed gas from the roasting and gas cleaning plant. The plant would be based on the double conversion and double absorption (DCDA) process, whereby the converter consists of four beds. In the conversion and acid sections of the plant, the following exothermal chemical reactions take place: a. Conversion of SO_2 to sulphur trioxide (SO_3) (the reaction is performed in the converter in contact with catalyst vanadium pentoxide); and b. Production of sulphuric acid ($SO_3 + H_2O \rightarrow H_2SO_4$) (the reaction would occur in the interim and final absorption towers). The following are the main processing units in the acid plant: a. Air filter system and SO_2 blower; b. Converter section with gas/gas heat exchangers; c. Strong acid system: drying and absorption, chemical pure acid production; and

Process	Process Description
	d. Acid plant preheating. The purpose of the converter section is to convert SO_2 to SO_3 promoted by a catalyst. This reaction is highly exothermic and follows thermodynamic equilibrium depending on temperature, gas composition and pressure. Excess heat is used to heat up process gas leaving the SO_2 gas blower and intermediate absorption tower. During start-up sequences for heating the plant to reaction temperatures, a preheater system is used to achieve operating conditions in the converter including the heat exchangers. Cold SO_2 containing gas from the outlet of the SO_2 gas blower would be preheated to the required catalytic temperature utilizing existing steam from the various catalytic beds of the converter. The product acid is then cooled and stored in Acid storage tanks for despatch and sale.

Leaching

The feed material to the leaching plant is the metal containing calcine, which is produced at the roasting plant. The main function of the leaching plant is to dissolve and to recover the zinc contained in the calcine as a solid free, pre-purified neutral zinc sulphate solution. The leach residue together with the iron, precipitated as sodium Jarosite, is removed as a cake with an iron content of approximately 25%. The leaching plant is a continuous operating plant and can be divided into the following main units: calcine storage and dosing; neutral leaching (NL); weak acid leach (WAL); manganese removal; conversion section; Jarosite filtration; Jarofix and magnesium removal. These units are discussed in Table 3-11.

Table 3-11: Leaching Process

Process	Process Description
Calcine storage and dosing	The storage system consists of two calcine storage silos, one manganese dioxide (MnO_2) bin, one sodium sulphate (Na_2SO_4) bin and one calcine day bin. The calcine storage silos serve as a buffer between the roasting plant and the leaching plant, allowing a roaster shutdown of approximately seven days without disturbing the operation of the leaching section. Calcine produced in the roasting section would be conveyed to the calcine silos by a pneumatic calcine transport system. Chain conveyors and a bucket elevator transport the calcine between the storage bins and the day bin. The bins and conveyors would be connected to the de-dusting units. The extracting of calcine from the day bin would be done with two parallel units, each consisting of a variable speed rotary valve, a weighing belt conveyor and a screw conveyor for controlled addition of calcine. Na_2SO_4 and MnO_2 required for the process are stored in storage bins.
Neutral leaching (NL-)	In the first neutral leaching section, approximately 70% of the total zinc is dissolved. The main aim is to leach the zinc oxide from the calcine and oxidise the ferrous iron to a ferric state. In addition to being an important zinc leaching step, the NL step is also an important purification step. Impurities like iron (Fe), arsenic (As), antimony (Sb) and germanium (Ge) would be precipitated in the last tanks of neutral leaching. NL consists of one receiving tank, five leaching tanks, two thickeners and two thickener overflow tanks. Receiving tanks and leaching tanks are covered and equipped with agitators and stacks with air ejector fans. Tanks are equipped with injectors for oxygen gas. The last three leaching tanks are equipped with elements for indirect steam heating. The receiving tank and the five leaching tanks would be arranged in a cascade and are interconnected with an overflow launder, so that the solution fed to the first tank would flow using gravity to all the tanks and to the thickener without pumps. The main acid bearing solutions, which would be used to leach the calcine added into the neutral leach step, are the spent electrolyte from the tank house with approximately 180 g/l free H_2SO_4 and the thickener overflows from the WAL step and conversion step (approximately 30-40 g/l free H_2SO_4). The solution mixture from the receiving tank, with a free acidity of about 100 g/l H_2SO_4, flows to the first leaching tank. The acidity would be lowered in the leaching tank series by calcine addition in two steps. The calcine feeding rate is controlled based on the pH readings to maintain acidity in the third tank overflow. The main goal would be to stabilize the final

Process	Process Description
	thickener overflow pH to 4.7-5.0 to achieve better settling properties in the thickener. To control the ferrous iron content in the last leaching tank, MnO_2, is added to the launder before the receiving tank. However, MnO_2 dosing would be reviewed due to naturally high manganese levels in the Gamsberg concentrate. Oxygen gas would be injected into the leaching tanks to keep manganese levels below 4 g/l in the electrolyte and to support the ferrous iron oxidation to ferric form in the NL environment. A potassium permanganate ($KMnO_4$) addition facility is also envisaged. In the last leaching tanks, due to the high pH, the ferric iron would be precipitated as iron hydroxide. The suspension would then flow to the NL thickeners (normally in series) for solid liquid separation. To accelerate the separation diluted flocculant would be added to the launder before thickening. Slurry drawn from the thickener underflow would consist mainly of zinc ferrites, some unreacted calcine, insoluble and precipitated iron hydroxides which would then be pumped to the WAL step. The overflows of the two NL thickeners would be collected in two neutral leach overflow tanks from where the solid free neutral solution would be pumped to the next processing step, manganese removal. Flocculant would be prepared in a common area and then supplied to all thickeners in the plant. Flocculant for the conversion area would be prepared using an acidic solution.
Manganese removal	Manganese would be removed from the side stream of spent electrowinning solution by oxidizing with ozone in multiple agitated tanks connected with the overflow launder. Precipitated MnO_2 slurry would flow by gravity to the thickener for solid-liquid separation. Flocculant would be added to accelerate the solid-liquid separation. Overflow from the thickener would then be sent to the electrowinning circulation tank with underflow filtered and washed in a vacuum belt filter. Filtrate and wash water would then be pumped to the electrowinning circulation tank. Ozone is recommended as the method for removing manganese, however, further studies would be carried out to decide upon suitable precipitation process due to the high cost of ozone generation. Other methods of manganese precipitation like SO_2: Air/O_2 and Caro Acid have also been considered. MnO_2 will be stored as a by-product for sale.
Weak Acid leaching (WAL)	Feed to WAL would be the underflow from the NL thickener. The main function of the WAL step would be to dissolve the remaining zinc oxide, which was not dissolved during NL, and to reach a zinc oxide leaching efficiency of more than 95%. WAL would consist mainly of four leaching tanks, one thickener and one overflow tank. All leaching tanks would be covered and equipped with agitators, indirect steam heating elements and stacks with air ejector fans. Overflow from the thickener would be pumped to NL and the underflow is pumped to the conversion process.
Conversion process and Jarosite filtration	The main function of the conversion process would be to simultaneously leach the zinc ferrite and precipitate iron as sodium Jarosite. The conversion process consists of ten leaching tanks arranged in series, three counter current decantation (CCD) thickeners, one thickener overflow tank and one condensate tank. Each tank would be covered and equipped with an agitator, a vent stack, an oxygen injector and steam heating elements. WAL underflow would be pumped from the feed launder to conversion tanks along with MnO_2 for iron oxidation and Na_2SO_4 (Soda Ash) for Jarosite formation. In addition to spent acid from the tank house, fresh acid would also be dosed to maintain sufficient free acid for the optimum process conditions. For Jarosite formation the following conditions are required: acidity in the range of 30 to 40g/l, all iron in ferric form, sodium ion concentration in the range of 1-3g/l, a solution temperature 96 °C, a long residence time and Jarosite seeds. The slurry from the magnesium removal plant (vacuum belt filter cake) containing basic zinc sulphate and gypsum crystals, and gypsum removal thickener underflow would be pumped into the launder before the ninth conversion tank to recover zinc and discard solid gypsum along with the Jarosite. The suspension from the last conversion tank would flow via launder to the first thickener for solid-liquid separation. Underflow from the first thickener would then be pumped to the other two thickeners for counter current washing. Overflow from the thickener would be collected in a tank and pumped mainly to NL and the manganese removal plant for re-pulping. The Jarosite slurry collected in the last thickener underflow cone would be pumped to two horizontal vacuum belt filters. Filtrate would then be returned to thickener (and part to manganese removal area). Cake is further re-pulped with process water and sent to the Jarofix section.

Process	Process Description
Jarofix	In the Jarofix section, Jarosite filter cake is mixed with a lime solution and cement and stored in a curing bay for further disposal in a secure landfill area. Lime solution is provided from the common lime preparation area. The Jarofix section consists of cement silos, a cement extraction system and a paddle mixer for lime and cement mixing.
Magnesium removal	The magnesium removal plant would be required to maintain a magnesium tenor at 10 g/l Mg in process solutions. A fraction of the spent electrolyte from the cell house would be bled off to the effluent treatment section instead of being returned to the leaching plant. This bleed stream would control accumulations of magnesium, other soluble alkalis, halides and sulphate in the recalculating electrolyte. With the Gamsberg concentrate, the magnesium would be the impurity which sets the minimum purge rate. The magnesium removal section would consist of two precipitation tanks, one thickener and one belt filter. The purge stream would be treated with lime for neutralisation of the free acid to create gypsum and to raise the pH to 6.3 to precipitate the zinc as a basic zinc sulphate. This would leave the magnesium in solution as magnesium sulphate along with minor amounts of aluminium, sodium and potassium sulphates. This solution would be combined with the other purge streams for disposal to the ETP. The solids resulting from this precipitation step would contain the basic zinc sulphate and gypsum. The resulting slurry would be sent back to the conversion unit for recovery of the zinc and disposal of the gypsum with the Jarosite residue.

Purification

The purification of the neutral solution would be carried out in two steps: hot purification for the removal of copper (Cu), cadmium (Cd), cobalt (Co) and nickel (Ni) as major impurities and the polishing step to ensure the required quality of the purified solution.

Table 3-12: Purification Process

Process	Process Description
Hot purification	The hot purification section consists of heat exchangers, seven purification tanks, eight parallel filter presses and reagent preparation and dosing systems. The solution would be heated up using a heat exchanger to around 87°C and fed into purification tanks. The pH-control in the hot purification tanks would be done by increasing or decreasing the addition of spent electrolyte into each tank. To improve the precipitation of the impurities, the filter cake from the polishing step is recycled to the hot purification step. The zinc dust (purification reagent) for the sedimentation reaction in the purification tanks would be delivered from the zinc dust plant. To improve the reactivity of the zinc dust, copper sulphate and potassium antimony tartrate (PAT) is added. The amount of copper and antimony added to the first hot purification tank would be such as to obtain a copper and antimony concentration of 30 to 40 ppm and 0.5 to 1.0 ppm respectively. Copper sulphate ($CuSO_4$) and antimony PAT would be mixed with water in the reagent preparation tanks. This copper and antimony solution would then be pumped into the feed launder. Charcoal is added to remove organic components such as oil from the solution. Pressure filters would be fed from the last purification tank to remove cemented impurities and excess zinc dust from the solution. Filtrate would then be sent to the polishing step and re-slurried cake sent to the enrichment step.
Polishing	In the polishing step, mainly cadmium that may have slipped through in the purification step, would be removed. The polishing step consists of mainly, zinc dust dosing systems, four purification tanks, and seven chamber filter presses. The pre-purified solution (filtrate from the hot purification filter presses) flows via the launder to the first polishing step by gravity. The process temperature for the polishing step is approximately 70-82°C. No heating or cooling of the solution is required. After the polishing step tanks, the solution containing cemented cadmium and copper as well as some excess zinc dust is filtered in pressure filters. Cleaned filtrate would then be sent to the filtrate tanks for further pumping to the cooling towers. The filter cake collected in the polishing filter presses would mainly consist of zinc dust and some minor amounts of cadmium and copper which would be