IRON ORE
KUMBA IRON ORE LTD

SISHEN IRON ORE COMPANY (PTY) LTD

SISHEN MINE

THE PROCESSING OF LOW GRADE IRON ORE MATERIAL AT SISHEN MINE

(DMS UPGRADE PROJECT)

KATHU, NORTHERN CAPE

ENVIRONMENTAL IMPACT ASSESSMENT

&

ENVIRONMENTAL MANAGEMENT PROGRAMME

PART A

FOR SUBMISSION TO DMR

DMR REFERENCE: NC 30/5/1/2/3/2/1/ (259) MR

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PART A

FOR SUBMISSION TO DMR

NAME OF APPLICANT: Sishen Iron Ore Company (Pty) Ltd – Sishen Mine

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REF NUMBER: NC 30/5/1/2/3/2/1/ (259) MR

SUBMITTED FOR AUTHORISATION IN TERMS OF:

SECTION 102 OF THE MINERALS AND PETROLEUM RESOURCES DEVELOPMENT ACT

LISTED ACTIVITIES UNDER THE NATIONAL ENVIRONMENTAL MANAGEMENT: WASTE ACT

AMENDMENT OF AN AUTHORISATION UNDER THE EIA REGULATIONS OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT.

PREPARED BY: EXM Advisory Services (Pty) Ltd

DATE: 23 April 2018

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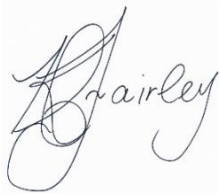
Kerry Fairley	EAP Director Pr.Sci.Nat		23 April 2018
Joshua O'Brien	Environmental Scientist		23 April 2018

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ACRONYMS AND ABBREVIATIONS

	Definition
BID	Background Information Document
CSI	Corporate Social Investment
DMR	Department of Mineral Resources
DMS	Dense Media Separation
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
GHG	Greenhouse Gases
IAP	Interested and Affected Party
IWWMP	Integrated Water and Waste Management Plan
LED	Local Economic Development
LOM	Life of Mine
Mtpa	Million tons per annum
MPRDA	Mineral and Petroleum Resources Development Act
NAAQS	South African National Ambient Air Quality Standards
NDCR	National Dust Control Regulations
NEMA	National Environmental Management Act
NEM: AQA	National Environmental Management Air Quality Act
NEM: BA	National Environmental Management Biodiversity Act
NEM: WA	National Environmental Management Waste Act
NFEPA	National Freshwater Ecosystem Priority Areas
NHRA	National Heritage Resources Act
PM10	Particulate matter less than 10 microns
PM2.5	Particulate matter less than 2.5 microns
ROM	Run of mine
SACNASP	South African Council for Natural & Scientific Professionals
SAHRA	South African Heritage Resource Agency
SAMRAD	South African Mineral Resources Administration (System)
SANS	South African National Standards
SIOC	Sishen Iron Ore Company (Pty) Ltd
SLP	Social Labour Plan
TDS	Total Dissolved Solids
TOPS	Threatened or Protected Species
UHDMS	Ultra-High Dense Media Separation
UPC	UHDMS Primary Crusher

1. EXECUTIVE SUMMARY

1.1 Introduction and Purpose

Sishen Mine is an existing mining operation, operating under an existing mining right (NC 259 MR) and approved Environmental Management Programme (2002, as amended) for the mining and processing of iron ore, located near Kathu in the Gamagara Local Municipality of the Northern Cape Province. The mine has been in operation since 1953 with the main focus being the beneficiation of A-grade ore (haematite containing >58% iron) by means of Dense Media Separation (DMS). Since 2006, the inclusion of a JIG plant has allowed for B-grade material (haematite containing >48% iron) also to be processed. All other material originating from the run of mine (low grade material) has been placed on site as residue dumps or stockpiles due to the absence of a suitable beneficiation process available to process to the low-grade ore.

Ultra-High Dense Media Separation (UHDMS) is a recently proven technology that will allow for the processing of future low-grade material (particularly C-grade material) originating from the ongoing mining operations as run of mine (ROM) as well as some of the low-grade material that has historically been dumped on site due to the lack of available technology. C-grade material refers to lower grade ore types containing between 40% and 48% iron.

The Sishen Iron Ore Company (Pty) Ltd (SIOC) is investigating the feasibility of upgrading the existing DMS Plant at Sishen Mine to UHDMS to allow for the processing of low grade iron ore material to produce a saleable iron ore product. The project has completed a prefeasibility study (first quarter of 2018) and is currently entering into the feasibility phase, which is due for completion in the third quarter of 2019. It is anticipated that the implementation of the project will allow for the processing of approximately 7-26 Mtpa of C-grade material to produce 1.5-6 Mtpa of standard grade lump and fine product over the remaining life of mine (LOM) of Sishen. The project location is shown in Figure 1-1.

Application is thus made for amendment of the EMPr to include the DMS Upgrade Project in terms of Section 102 of the Minerals and Petroleum Resource Development Act as well as Regulation 31 of Part 2 of Chapter 5 of the Environmental Impact Assessment Regulation GNR. 982 of 4 December 2014, as amended by GNR. 324-327 of 7 April 2017. Application is also made for a Waste Management Licence for the authorisation of the recovery and processing of residue stockpiles at Sishen Mine which is a listed activity under Regulation GN. 921 (November 2013), as amended by GN. 633 of 24 July 2015 of the National Waste Act.

This document serves as the Environmental Impact Assessment undertaken in support of the above applications.

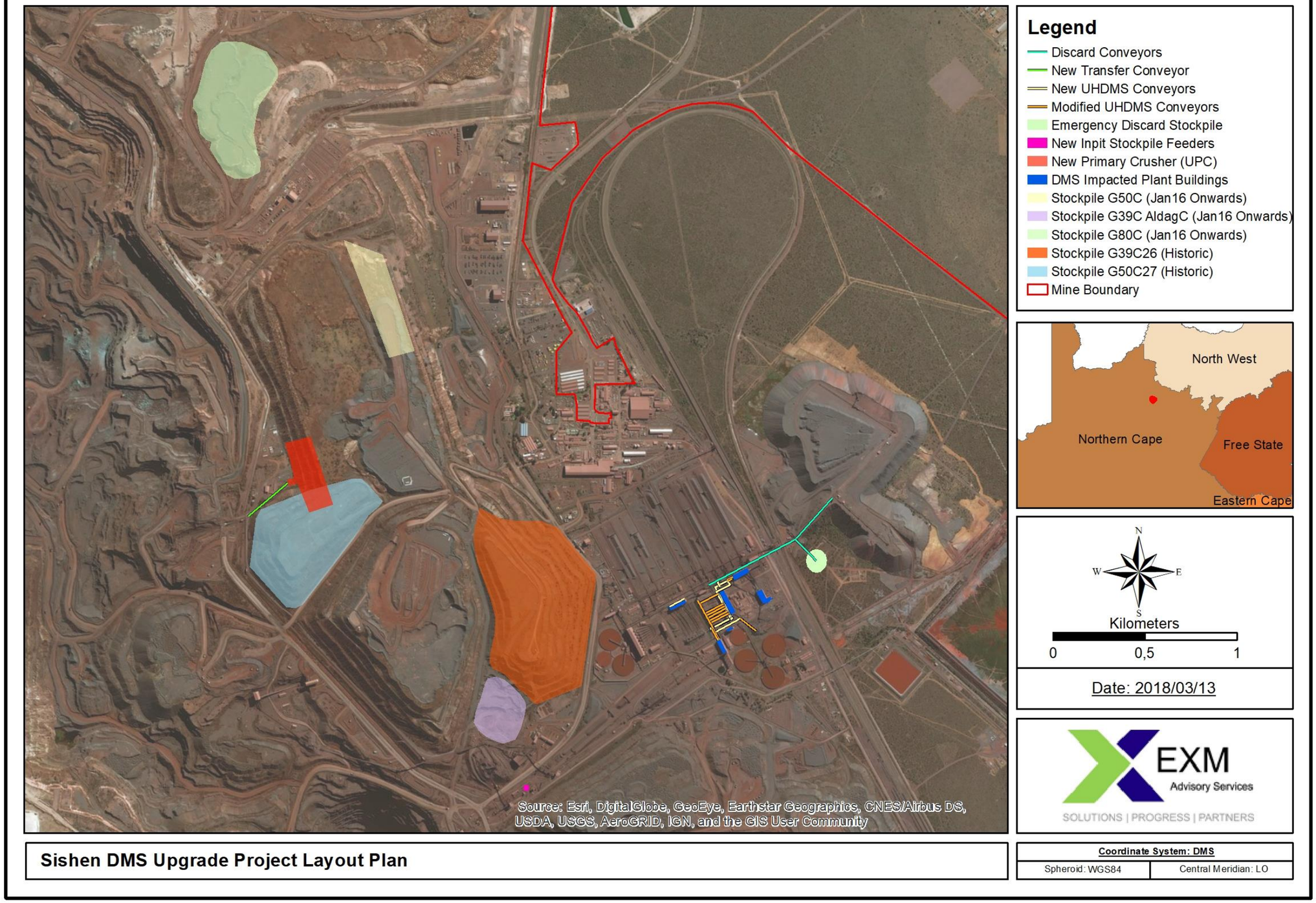


FIGURE 1-1: PROJECT LAYOUT SISHEN DMS UPGRADE PROJECT

1.2 Project Overview

The DMS Upgrade Project is a brownfields development to be incorporated into existing operations at Sishen Mine. The DMS Plant will be upgraded to UHDMS capable of processing both high (A-grade) and low grade (C-grade) ore simultaneously, to produce a saleable iron ore product. The upgrade will involve the modifications of the components within the DMS infrastructure and the inclusion of some additional conveyors to form additional links between the plant components. An additional primary crusher (UPC) will be erected to provide additional crushing capacity for the processing of C-grade material.

Low grade material to be processed will originate primarily during the run-of-mine and will be processed directly. However, some material originating from certain mine residue stockpiles or waste rock dumps will also be added to the process. Process waste will be deposited on the existing Plant Discard Dump and Tailings Storage Facility at the mine.

Should the project be deemed feasible, construction activities would commence in 2020 with the upgraded plant reaching full production in 2022. Operations will continue throughout the remaining life of Sishen Mine.

1.3 Environmental Impacts

A summary of the key environmental impacts of the DMS Upgrade Project if unmitigated and with the inclusion of mitigation are provided in Table 1-1. Note that there are no negative impacts of high significance associated with the project. This is largely as a result of the brownfields nature of the development. The project is deemed however to present high positive socio-economic impacts. The following have been identified as the positive and negative impacts of the project:

1.3.1 Employment, Local Procurement and Economic Development

- The construction phase of the project will provide for ~495 jobs. The predicted indirect job opportunities that could be created due to the capital input will be 2 075.
- The operational phase of the project will provide ~128 additional job opportunities at Sishen Mine. However, due to the additional annual operational expenditure associated with the project, a total of 1 059 employment positions could be created.
- The project will have a significant impact on the local and regional economy both during construction (~additional GGP of R1.9 billion) and during the life of the operations (~R485 million per annum), based on direct, indirect and induced impacts.
- An increase in production will be associated with an increase in expenditure by Sishen Mine on Corporate Social Investment and Local Economic Development, in line with the SLP commitments.

TABLE 1-1: SUMMARY OF KEY POSITIVE AND NEGATIVE IMPACTS IDENTIFIED FOR THE MITIGATED AND UNMITIGATED SCENARIOS

ACTIVITY	ASPECT	IMPACT DESCRIPTION	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION	SIGNIFICANCE WITH MITIGATION
UPGRADE OF DMS TO UHDMS INCLUDING NEW CONVEYORS	Water Consumption	Consumption of additional water as a result of UHDMS process	Moderate	Sishen is to maximise the opportunity for the recycling of water to accommodate additional water requirements at the mine.	Low
	Surface Water Resources	Contamination of surface water resources due to contaminated run-off originating from upgraded components of the UHDMS.	Moderate	Run-off to be managed through the stormwater management systems at Sishen Mine (in the process of being upgraded). Upgraded stormwater management infrastructure is to be in place prior to commencement of construction.	Low
	Air Quality	Increase in dust emissions as a result of the UHDMS.	Moderate	Ensure that current systems at Sishen Mine to be used by UHDMS for dust extraction are working efficiently. Implement measures for dust suppression at additional handling points. Maintenance of dust-control equipment and visual inspections of effectiveness.	Low
	Soils	Loss of available soils within the footprint area of the Discard Emergency Stockpile and Laydown areas.	Moderate	Topsoil to be removed from footprint areas and stockpiled for use in rehabilitation.	Low
DEVELOPMENT OF UPC, RAMPS, STOCKPILES AND CONVEYOR	Water Consumption	Consumption of additional water as a result of additional dust suppression required at the crusher.	Moderate	Sishen is to maximise the opportunity for the recycling of water to accommodate additional water requirements at the mine.	Low

ACTIVITY	ASPECT	IMPACT DESCRIPTION	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION	SIGNIFICANCE WITH MITIGATION
	Surface Water Resources	Contamination of surface water resources due to contaminated run-off originating from the UPC and associated infrastructure.	Moderate	Run-off from the UPC is to be integrated into the upgraded stormwater management system at Sishen Mine. The upgraded infrastructure is to be in place prior to construction. Run-off that could be potentially contaminated with hydrocarbons is to be separated at the UPC. This water is to be contained and prevented from entering stormwater canals. The water is to report to the future Aldag PCD which is designed for the management of hydrocarbons and water is recycled for use at the mine. The remaining run-off is to pass through a sediment trap before entering the stormwater management canals.	Low
	Air Quality	Increased dust emissions due to entrainment from construction activities associated with the development of the UPC.	Moderate	Dust suppression to be implemented in areas of work where earth moving is to take place. Dust suppression to be implemented at laydown areas and additional roads established to access laydown areas and work areas.	Low
		Increase in dust emissions as a result of the additional handling, stockpiling and crushing at the UPC.	Moderate	Dust extraction to be implemented at the UPC. Dust suppression to be in place at new handling points. Dust aside to be in place at all new roads leading to the UPC and associated infrastructure. Maintenance of dust-control equipment and visual inspections of effectiveness.	Low

ACTIVITY	ASPECT	IMPACT DESCRIPTION	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION	SIGNIFICANCE WITH MITIGATION
	Topography	Change in landforms for the development of new infrastructure	Moderate	Platforms and ramps associated with the development of the UPC are to be included in the final landscape planning (if not to be used in future) Infrastructure to be removed at the end of the LOM. Financial provision to be updated to provide for the removal of additional infrastructure.	Moderate
DMS UPGRADE PROJECT	Socio-Economics	Additional procurement for construction	High Positive	Local Procurement to be implemented in line with Sishen's Local Procurement Strategy aimed at achieving SLP commitments.	High Positive
		Additional employment created during construction	High Positive	Resourcing Plan to be developed and aligned with Sishen's commitments for preferential local procurement. Contractors to comply with preferential employment targets for the project in line with the Sishen's Contractor Social Management Procedure.	High Positive
		Added value to the economy due to construction expenditure	High Positive	Preferential procurement and employment to enhance benefits to the local economy.	High Positive
		Added value to the economy due to operational expenditure.	High Positive	Sishen's expenditure on LED and CSI to be increased in line with increased revenue associated with the project in accordance with SLP commitments.	High Positive

ACTIVITY	ASPECT	IMPACT DESCRIPTION	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION	SIGNIFICANCE WITH MITIGATION
		Increase in social pathologies (crime, prostitution, alcohol abuse, spread of HIV, poor living conditions) due to influx of persons	Moderate	Develop a stakeholder engagement plan. Clear communication and engagement on public as to local procurement policies. Sishen's Social Management Plan to be updated to consider implications of the project. Sishen to continue to work together with local authorities and social services who are to be informed of the pending project in order that issues can be pre-empted and managed,	Moderate
		Increase pressure on local services and infrastructure due to influx of persons.	Moderate	Stakeholder engagement plan. Capacity building programme for municipal employees. Collaboration with local municipalities as to infrastructure development needs and priorities for LED requirements. Collaboration with community forums	Moderate
		Strained relationships with selected stakeholders due to unmet expectations of economic benefits from the mine	Moderate	Engagement plan to ensure that stakeholders are being kept up to date with the project and the opportunities for local community members – management of expectations. Effective engagement with key stakeholders. Open door to listen to aggrieved groups. Communicate the mine's performance on socio-economic benefit delivery to the local community.	Moderate

1.3.2 Influx of Persons

- The construction and increased production at Sishen Mine may result in an influx of persons into the area.
- Influx of persons places additional pressure on municipal infrastructure and community services including: health care, poverty alleviation, and education.
- Sishen is to incorporate the project into its Social Management Plan.

1.3.3 Community Expectations

- Possible strained relationships with surrounding communities may result due to the failure to meet expectations in terms of employment and socio-economic development initiatives associated with the project and increased production.
- Sishen is to include the project in a Stakeholder Engagement Plan which gives consideration to all development taking place at the mine.

1.3.4 Soil and Groundwater Contamination

- The risks of contamination of soils and groundwater result due to the storage of hazardous chemical substances such as hydrocarbons. The impact significance is low and can be managed through the implementation of measures to contain and manage spills and leaks.
- Discard and slimes originating from the processing of C-grade material is not expected to result in a contamination risk for groundwater. This material will be placed on existing waste management facilities at Sishen Mine. There is no need to expand the discard dump or tailings storage facility.
- Of importance is the potential of the water fraction from slimes to contaminate groundwater resources due to high nitrate levels. The return water management at Sishen's tailings storage facility is in the process of being upgraded. Provision is to be made for the lining of the return water dam.

1.3.5 Water Consumption

- The processing of C-grade material will result in additional water consumption of ~100m^3/hr. This water will be supplied largely through initiatives for the recycling of water at the mine.

1.3.6 Surface Water Management

- The DMS Upgrade Project will be incorporated into existing stormwater management systems at Sishen Mine.

- Sishen is in the process of upgrading existing stormwater management systems which includes provision for containment and recycling of water.
- The existing systems will be able to accommodate the project and the surface water resource risks are expected to be low.
- The upgraded stormwater management systems are to be in place prior to commencement of construction of the project.

1.3.7 Increased Dust Levels

- The project is expected to result in a 2.5 - 5% increase in dust emissions as a result of the processing of C-grade material.
- Although the increase in dust emissions is of low significance, the cumulative impact of Sishen Mine is high and exceeds legislative requirement at some sensitive receptors.
- Sishen Mine is to implement dust management actions to address dust levels as a matter of urgency.

1.3.8 Climate Change

- The mining and processing of C-grade material will result in an increase in electricity consumption and diesel consumption.
- The contribution of these increases is considered to be low.

1.3.9 Increased Noise Levels

- The project is to result in an increase in noise levels at sources such as the UPC, UHDMS and conveyors.
- The increase will not result in any change in noise levels in the ambient environment.

1.3.10 Change of Landforms and Rehabilitation Requirements

- The processing of C-grade material will result in less material being placed on residue stockpiles/waste rock dumps during the remaining life of Sishen Mine.
- The project will result in the removal of surface material from residue stockpiles and waste rock dumps at the mine.
- The cumulative positive impact on the change in landforms and rehabilitation at Sishen Mine will however be low.
- Opportunities for the processing of additional low-grade material and enhancing the benefits to existing landform impacts and rehabilitation requirements are to be investigated.

1.3.11 Disturbance Footprint

- The DMS Upgrade Project is a brownfields project. The development of the Discard Emergency stockpile will require clearing of soils and vegetation, but this will take place within the existing authorised footprint area of the Discard Dump.

1.4 Conclusions and Recommendations

It is the opinion of the Environmental Assessment Practitioner that the DMS Upgrade Project should be authorised based on the following reasons:

- The project is a brownfields development within Sishen Mine with low to moderate risks to the environment.
- The projects will result in significant socio-economic benefit in terms of capital projection into the local economy as well as ongoing benefits due to the increased production at Sishen Mine.
- Low grade iron ore material is currently being placed on residue stockpile areas and is regarded as "waste" due to the absence of suitable technology for the processing of the material. UHDMS presents the technology for the processing of this low grade material from ROM and from current stockpile/waste areas reducing the amount of waste produced at Sishen Mine.
- The project presents an opportunity for Sishen Mine to investigate opportunity for the processing of additional low-grade material at the mine and the possible extension of the life of mine.

2. CONTACT PERSON AND CORRESPONDENCE ADDRESS

2.1 Details of EAP who prepared the report

Name of The Practitioner: Kerry Fairley

Affiliation: Head Environmental Management Services and Director, EXM Advisory Services

Tel No.: 082 871 2959 or 010 0073617

E-mail address: kerry@exm.co.za

2.2 Expertise of the EAP

Qualifications

- BSc Botany Honours (University of the Witwatersrand)
- Registered as Professional Natural Scientist with the South African Council for Natural and Scientific Professionals (SACNASP) Registration Number: 400054/03

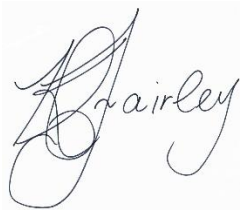
Expertise and Experience

Kerry Fairley has over 18 years of experience in environmental management in the mining industry as one of the most experienced environmental assessment practitioners in South Africa. Kerry is the author of numerous environmental impact assessment reports for both green fields mining projects as well as for expansions and amendment to existing mining operations in South Africa and as well as other African countries (Namibia, Malawi).

Declaration of Independence

The undersigned declare that this report represents an independent and objective assessment of the risks associated with the proposed development.

Curriculum vitae and proof of registration of the EAP is provided in Appendix A.

Name	Affiliation	Designation	Signature	Date
Kerry Fairley	EXM Advisory Services (Pty) Ltd	Pr.Sci.Nat. Director		23 April 2018

3. DESCRIPTION OF THE PROPERTY

Refer to Figure 3-1.

Farm Name:	The DMS Upgrade Project will take place on the following properties which form part of Sishen Mine (within the mining right area): Remainder of Portion 1 of Bruce 544 Remainder of Sekgame 461 Remainder of Portion 1 of Sims 462 Remainder of Sishen 543
Application area (Ha)	The application area forms part of Sishen Mine mining right area of **26 032 ha**. The DMS Upgrade project including the plant upgrade, recent stockpiles and historical dumps covers an area of approximately **135 ha** within the disturbed footprint at Sishen Mine.
Magisterial district:	District Hay, Northern Cape Province
Distance and direction from nearest town	Kathu is located approximately 3.5 km north east of Sishen Mine processing plant.
21 digit Surveyor General Code for each farm portion	Remainder of Portion 1 of Bruce 544: C04100000000054400001 Remainder of Sekgame 461: C04100000000054300000 Remainder of Portion 1 of Sims 462: C04100000000046100000 Remainder of Sishen 543: C04100000000056200001
Locality map	Attach a locality map at a scale not smaller than 1:250000 and included as Figure 3-1 and 3-2.
Description of the overall activity. **(Indicate Mining Right, Mining Permit, Prospecting right, Bulk Sampling, Production Right, Exploration Right, Reconnaissance permit, Technical co-operation permit, Additional listed activity)**	The project will involve the upgrading of the existing Dense Media Separation (DMS) plant at Sishen Mine to allow for processing using Ultra High Dense Media Separation (UHDMS) technology. The upgraded process plant will have the capability of processing both high (A-grade) and low grade (C-grade) ore simultaneously, to produce a saleable iron ore product. A primary crusher will be erected to provide additional crushing capacity for the processing of C-grade material. Low grade material to be processed will originate primarily during the run-of-mine and will be processed directly. However, some material originating from certain residue stockpiles will also be added to the process. Sishen Mine has an existing mining right (NC 259 MR) with an approved Environmental Management Programme (EMPr). Application is thus made for amendment of the EMPr to include the DMS Upgrade Project in terms of Section 102 of the Minerals and Petroleum Resource Development Act as well as Regulation 31 of Part 2 of Chapter 5 of the Environmental Impact Assessment Regulation GNR. 982 of 4 December 2014. Application is also made for a Waste Management Licence for the authorisation of the recovery and processing of residue stockpiles at Sishen Mine which is a listed activity under Regulation GN. 921 (November 2013), as amended by GN. 633 of 24 July 2015 of the National Waste Act. The plant upgrade area, primary crusher as well as the residue stockpiles are illustrated in Figure 3-1.

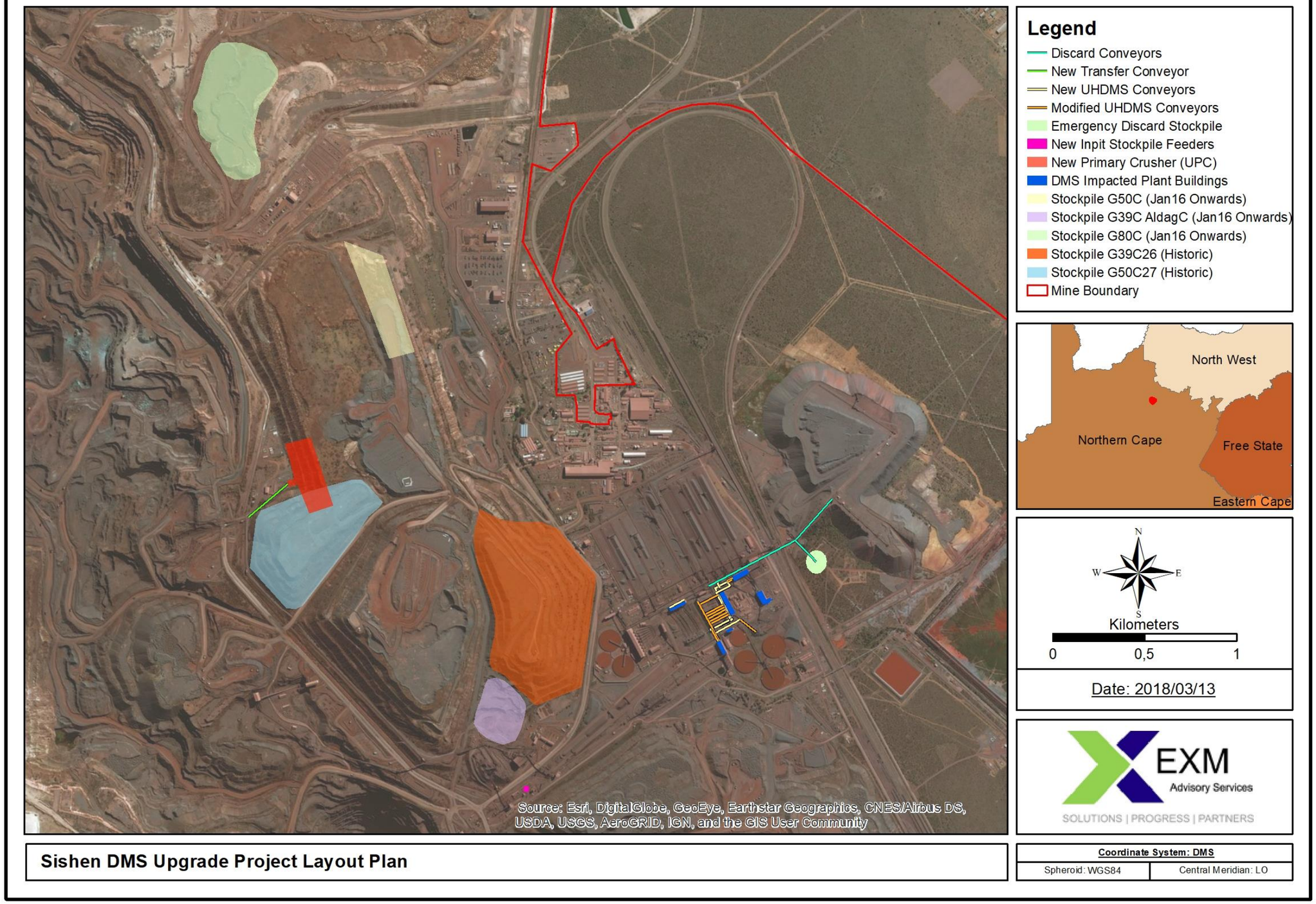


FIGURE 3-1: PROJECT LAYOUT SISHEN DMS UPGRADE PROJECT

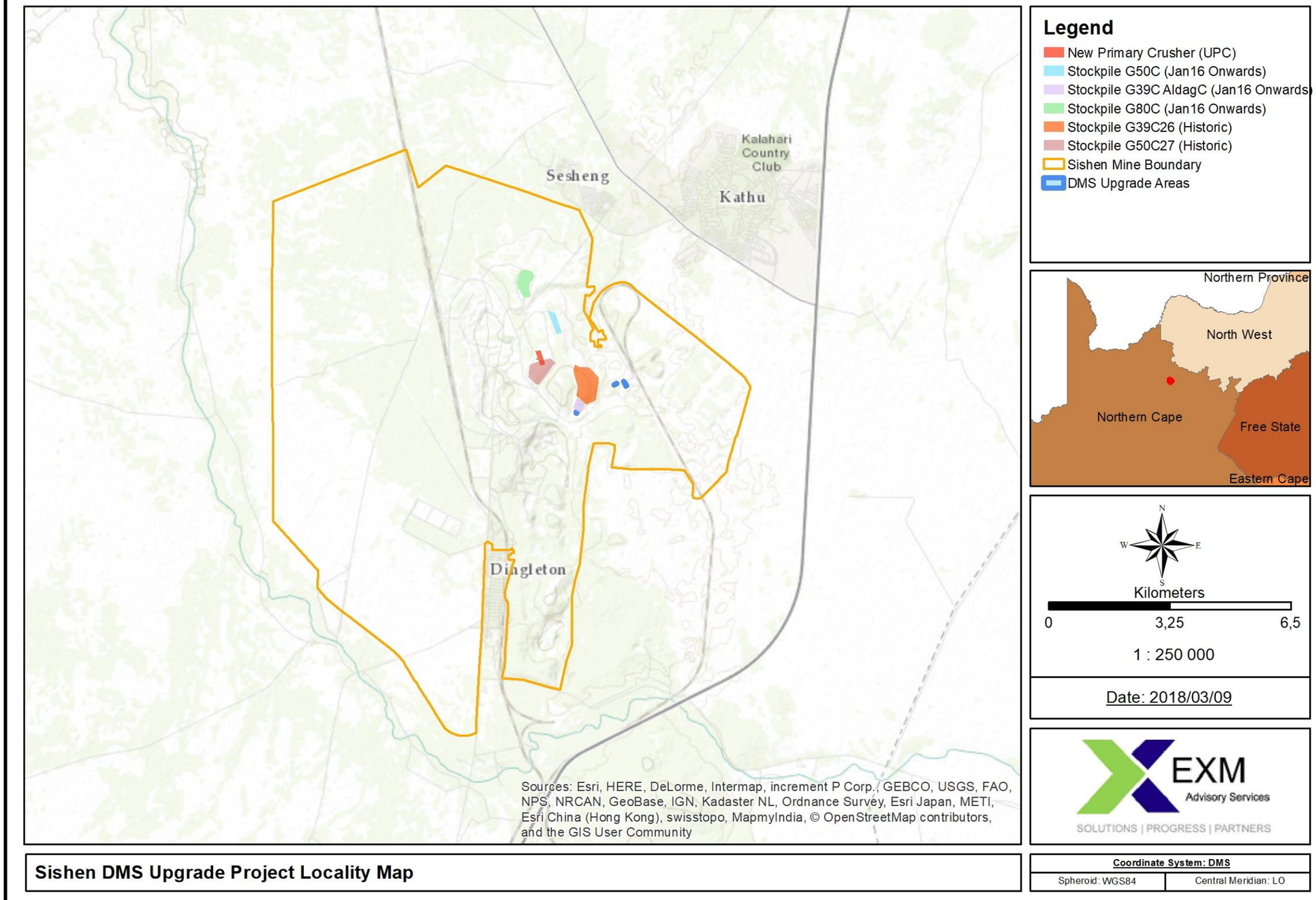


FIGURE 3-2: LOCALITY MAP OF THE SISHEN DMS UPGRADE PROJECT

4. DESCRIPTION OF THE SCOPE OF THE PROPOSED OVERALL ACTIVITY

4.1 Activity listed and specified activities

NAME OF ACTIVITY **(E.g. For prospecting -** drill site, site camp, ablution facility, accommodation, equipment storage, sample storage, site office, access route **etc…etc…etc** **E.g. for mining**,- excavations, blasting, stockpiles, discard dumps or dams, Loading, hauling and transport, Water supply dams and boreholes, accommodation, offices, ablution, stores, workshops, processing plant, stormwater control, berms, roads, pipelines, power lines, conveyors, etc…etc…etc.)	**Aerial extent of the Activity** **Ha or m²**	**LISTED ACTIVITY** (Mark with an **X** where applicable or affected).	**APPLICABLE LISTING NOTICE** ***(GNR 983, GNR 984 or GNR 984)***	**WASTE MANAGEMENT AUTHORISATION** (Indicate whether an authorisation is required in terms of the Waste Management Act). **(Mark with an X)**	**APPLICABLE LISTING NOTICE** ***(GNR 921 as amended by GN 633)***
The upgrade of the existing DMS Plant to UHDMS (including new conveyors and stockpiles)	6 ha (footprint of buildings to be upgraded & conveyors)	**Section 102 amendment** (Minerals & Petroleum Resources Development Act)			
The development of a new primary crusher, and a new conveyor	9 ha (footprint of crusher and laydown area)	**Section 102 amendment** (Minerals & Petroleum Resources Development Act)			
The mining of C-grade material from ROM	No new areas or haul roads	**Section 102 amendment** (Minerals & Petroleum Resources Development Act)			

NAME OF ACTIVITY **(E.g. For prospecting -** drill site, site camp, ablution facility, accommodation, equipment storage, sample storage, site office, access route **etc…etc…etc** **E.g. for mining**,- excavations, blasting, stockpiles, discard dumps or dams, Loading, hauling and transport, Water supply dams and boreholes, accommodation, offices, ablution, stores, workshops, processing plant, stormwater control, berms, roads, pipelines, power lines, conveyors, etc…etc…etc.)	**Aerial extent of the Activity** **Ha or m²**	**LISTED ACTIVITY** (Mark with an **X** where applicable or affected).	**APPLICABLE LISTING NOTICE** ***(GNR 983, GNR 984 or GNR 984)***	**WASTE MANAGEMENT AUTHORISATION** (Indicate whether an authorisation is required in terms of the Waste Management Act). **(Mark with an X)**	**APPLICABLE LISTING NOTICE** ***(GNR 921 as amended by GN 633)***
The recovery of stockpiles containing low grade iron ore material	120 ha	**X**	None	**X**	**Category B:** **Activity 3** The recovery of waste including the refining, utilisation, or co-processing of the waste at a facility that processes in excess of 100 tons of general waste per day or in excess of 1 ton of hazardous waste per day, excluding recovery that takes place as an integral part of an internal manufacturing process within same premises. **AND** **Category B:**

NAME OF ACTIVITY **(E.g. For prospecting -** drill site, site camp, ablution facility, accommodation, equipment storage, sample storage, site office, access route **etc…etc…etc** **E.g. for mining**,- excavations, blasting, stockpiles, discard dumps or dams, Loading, hauling and transport, Water supply dams and boreholes, accommodation, offices, ablution, stores, workshops, processing plant, stormwater control, berms, roads, pipelines, power lines, conveyors, etc…etc…etc.)	**Aerial extent of the Activity** **Ha or m²**	**LISTED ACTIVITY** (Mark with an **X** where applicable or affected).	**APPLICABLE LISTING NOTICE** ***(GNR 983, GNR 984 or GNR 984)***	**WASTE MANAGEMENT AUTHORISATION** (Indicate whether an authorisation is required in terms of the Waste Management Act). **(Mark with an X)**	**APPLICABLE LISTING NOTICE** ***(GNR 921 as amended by GN 633)***
					Activity 11 The establishment or reclamation of residue stockpiles or residue deposits resulting from activities which require a mining right, exploration right or production right in terms of the MPRDA
The disposal of plant waste at existing waste disposal facilities	No changes required	No authorisation required (already authorised**)**			

4.2 Project Overview

Sishen Mine is an existing mining operation, operating under an existing mining right (NC 259 MR) and approved EMPr (2002, as amended) for the mining and processing of iron ore, located near Kathu in the Gamagara Local Municipality of the Northern Cape Province. The mine has been in operation since 1953 with the main focus being the beneficiation of A-grade ore (haematite containing >58% iron) by means of Dense Media Separation (DMS). Since 2006, the inclusion of a JIG plant has allowed for B-grade material (haematite containing >48% iron) also to be processed. All other material originating from the run of mine (low grade material) has been placed on site as residue dumps or stockpiles due to the absence of a suitable beneficiation process available to process to the low-grade ore.

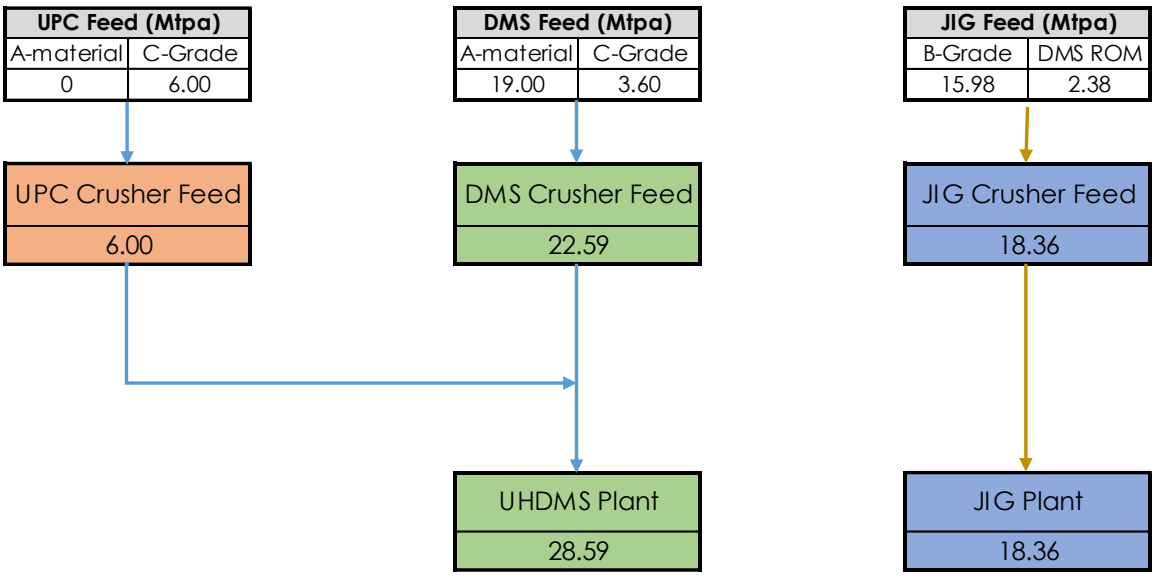
Ultra-High Dense Media Separation (UHDMS) is a recently proven technology that will allow for the processing of future low-grade material (particularly C-grade material) originating from the ongoing mining operations as run of mine (ROM) as well as some of the low-grade material that has historically been dumped on site due to the lack of available technology. C-grade material refers to lower grade ore types containing between 40% and 48% iron.

The Sishen Iron Ore Company (Pty) Ltd (SIOC) is investigating the feasibility of upgrading the existing DMS Plant at Sishen Mine to UHDMS to allow for the processing of low grade iron ore material to produce a saleable iron ore product. The project has completed a prefeasibility study (first quarter of 2018) and is currently entering into the feasibility phase, which is due for completion in the third quarter of 2019.

The project plans to process approximately 7-26 Mtpa of C-grade material to produce 1.5-6 Mtpa of standard grade lump and fine product over the remaining life of mine (LOM) of Sishen.

The production through each of the plants with the inclusion of the UHDMS and an additional primary crusher (UPC Crusher) is indicated in Figure 4-1.

Note: The outcomes of the pprefeasibility study has been used as a basis of the EIA studies, based on a ROM of 12.3 Mtpa to produce ~3 Mtpa of product (see Figure 4-1).



Notes:

1) The figures indicates an **average over the LOM**

2) UPC crusher feed could have a maximum of 13Mtpa and be fed with future DMS feed materials that would also include A-grade material

3) C-Grade feed to DMS would start in 2022, with a tonnages ranging from **7.23 Mtpa** (min) to **25.6 Mtpa** (max). High C-grade tonnage is during 2029 to 2031 production years

FIGURE 4-1: PLANNED FUTURE PRODUCTION AT SISHEN MINE PROCESS PLANTS INCLUDING UHDMS & UPC

4.3 Project Description

4.3.1 Run of Mine

The C-grade material to be processed will be sourced from the ROM (is part of the hanging and footwall that are already included in the mining sequence) as well as surface stockpiles. C-grade material arising from the ROM since January 2016 has also been stockpiled separately on some of the waste rock dump areas with the anticipation that it could be processed through the future UHDMS plant. The anticipated ROM of C-grade material is 7-26 Mtpa.

This material is considered to be captured under the definition of "residue stockpile" and is also waste as defined in Schedule 3 of the National Environmental Management: Waste Act, as amended (see Section 5.3). The processing of the material is thus the recovery of waste. Based on the outcomes of the Waste Assessment (Jones & Wagener, June 2017) undertaken in accordance with the National Norms and Standards for the Assessment of Waste for Landfill Disposal (GNR. 635 of 23 August 2013), the C-Grade ROM material should be considered a Type 4 Waste (inert waste).

The location of the recent stockpiles as well as the dumps to be processed are provided in Figure 3-1.

4.3.2 UHDMS Primary Crusher (UPC)

An additional primary crusher (UPC) will be required for the processing of some of the material as the existing DMS and JIG plant crushers do not have capacity to process all of the additional ROM. A-grade and/or C-grade ore shall be crushed by the existing primary and secondary DMS crushers which have capacity of 26 Mtpa. The UPC will serve to crush additional feed material to the UHDMS and this could include both A-grade, B-grade & C-grade as well as lower grade material.

The crushed material from these crushers shall then be delivered to the existing DMS tertiary crushers and the DMS stockpile (see Figure 4-2). The material from the DMS stockpile is fed into the Washing & Screening Plant.

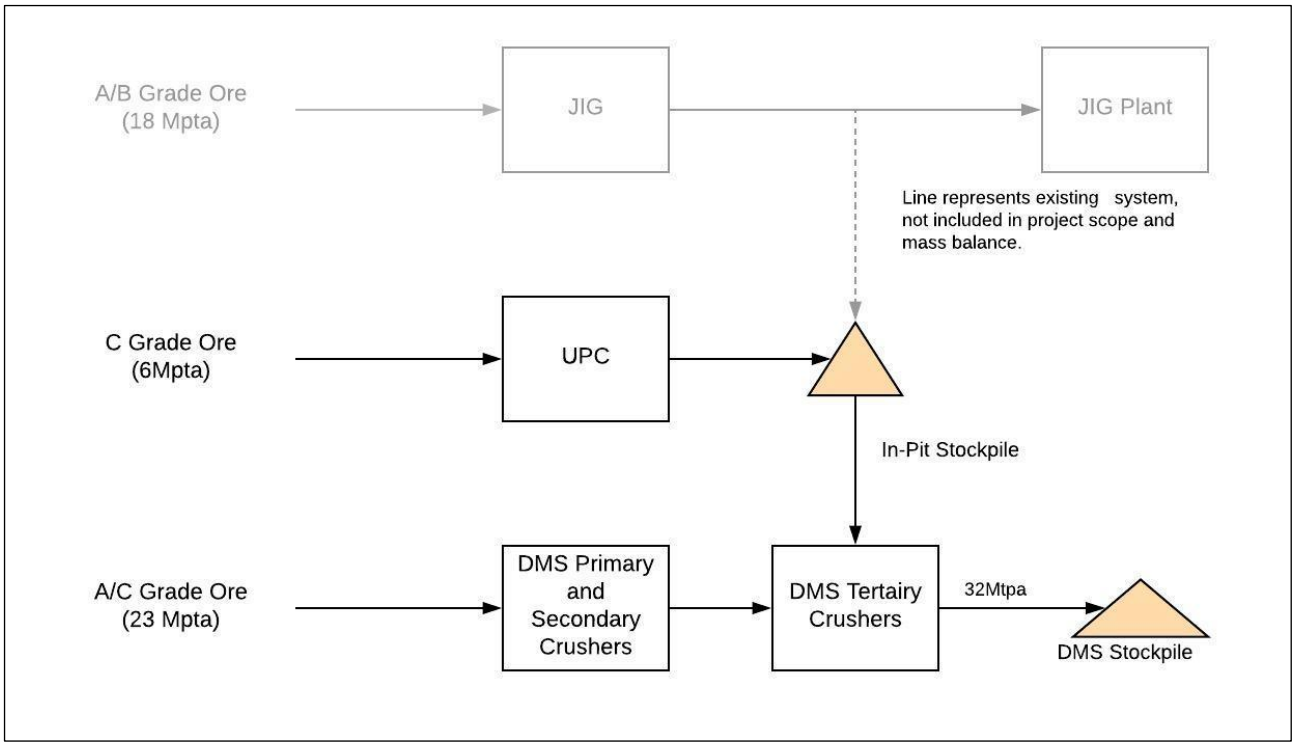


FIGURE 4-2: DMS UPGRADE PROJECT PROPOSED ORE FEED STRATEGY

4.3.3 DMS Upgrade

The existing DMS Processing Plant at Sishen is to be upgraded to allow for the incorporation of UHDMS which will allow for the co-processing of both high (A-grade) and low (C-grade) grade material. The JIG plant will continue to process the B-grade material and some of the A-grade material due to a revised feed strategy.

The current DMS plant comprises the following sections (see Figure 4-3):

- Washing & Screening Plant
- A Coarse Drum Plant;
- A Medium Drum Plant;

- A Coarse Cyclone Plant;
- A Fine Cyclone Plant;
- An Up-Current Classifier (UCC) Plant.

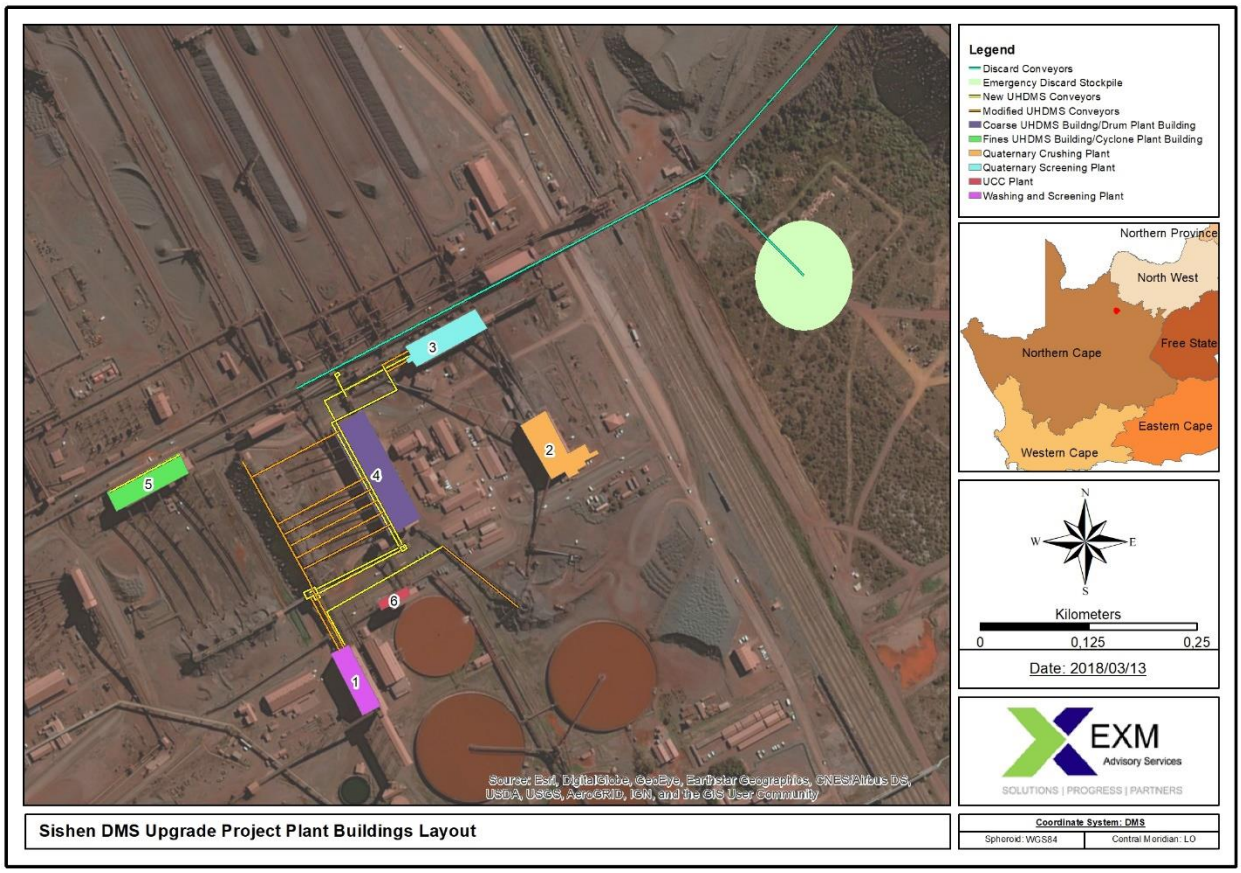


FIGURE 4-3: SISHEN DMS/UHDMS PLANT LAYOUT

The DMS components at the existing DMS Processing Plant will be converted to UHDMS processes by the replacement of the drums currently used in the beneficiation process with cyclones; and also modifying the existing media density circuits as well as crushing circuits. The following changes are currently envisaged for the existing DMS Plant:

- The existing Washing & Screening Plant **(Building 1)** at the DMS Plant will be modified. This will involve the modification of the screen panel sizes.
- The material from the Washing & Screening plant shall be sent to the Quaternary Crushing Plant to crush the material as required by UHDMS technology.
- A new oversize conveying system will be erected from the existing Washing & Screening Plant to the existing conveyor feeding the stockpiles ahead of the exiting Quaternary Crushing Plant.
- No changes will be made to the Quaternary Crushing Plant **(Building 2).**
- The crushed material from the Quaternary Crushers shall be sent to the Quaternary

Screening plant which will separate the material into three size fractions. The existing Quaternary Screening Plant **(Building 3)** will be modified to Screen Quaternary oversize material after Quaternary Crushing.

- Upgrade of the existing Drum Plant by removing drums and replacing with cyclones **(Building 4).** The Drum Plant will be converted to a coarse UHDMS Plant.
- Development of a new conveyor from the Quaternary Screening Plant to the existing Drum Plant.
- Upgrade of the existing Coarse and Fine Cyclone Plant involving upgrades to specific densification systems **(Building 5).**
- The existing Coarse Cyclone Plant will be converted to the Fine UHDMS Plant.
- The existing Fine Cyclone Plant will be converted to the Superfine UHDMS Plant.
- Development of a new conveyor from the Quaternary Screening Plant to the existing Fine Cyclone Plant.
- The UCC Plants will be modified to treat grits, if required **(Building 6)**
- Feeders at the in-pit stockpile will be replaced next to the DMS Tertiary Crushers.
- Modification of the product transfer, common lump product and plant discard conveyor;
- Two new conveyors at the Discard Transfer Station and a new Discard Emergency Stockpile at the foot of the existing Discard Dump.

Figure 4-4 presents an overview of the UHDMS process.

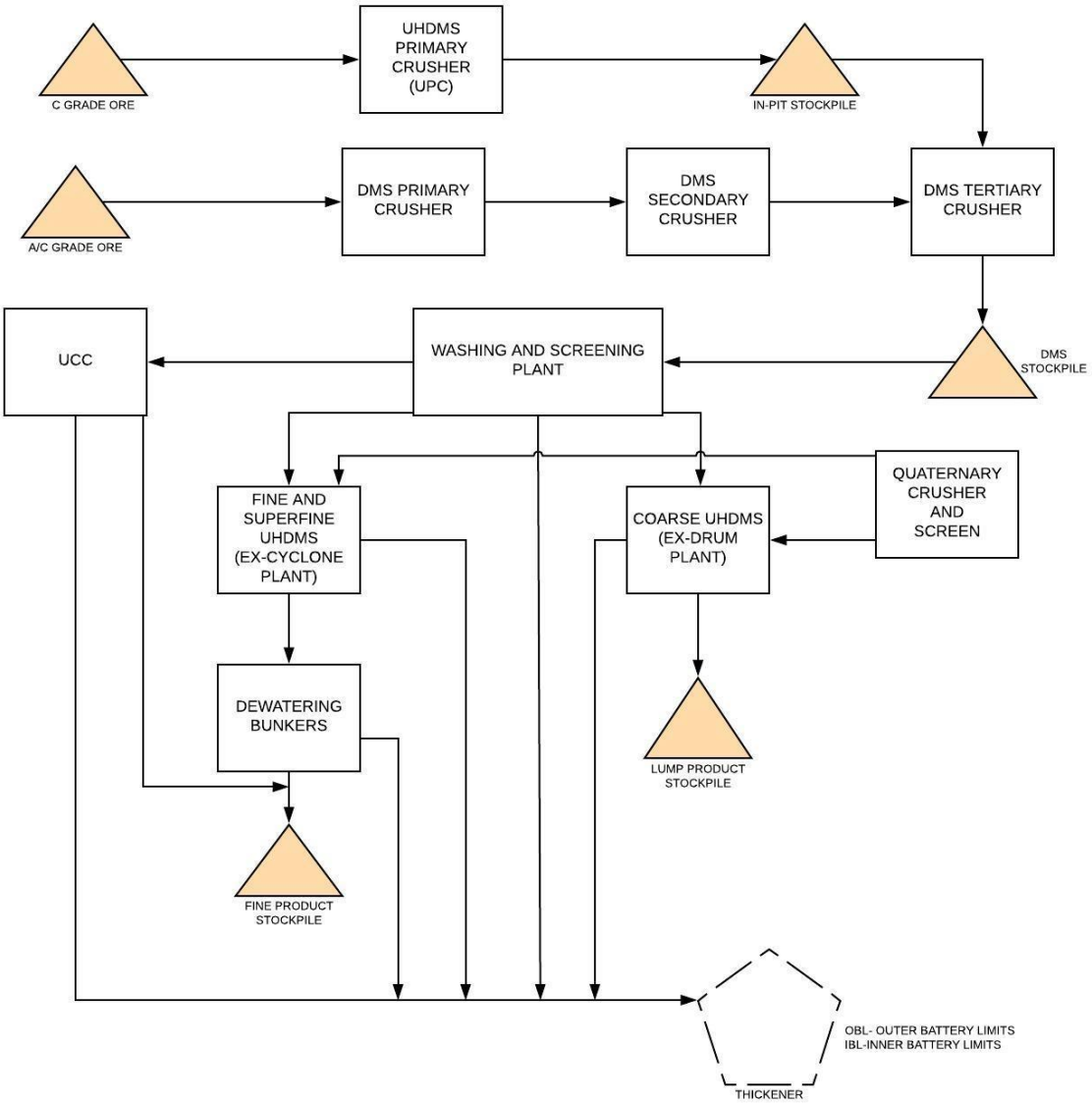


FIGURE 4-4: UHDMS PROCESS OVERVIEW

4.3.4 Media Consumption

Ferrosilicon (FeSi) is the medium used in DMS including UHDMS processes. The consumption of FeSi within the UHDMS plant results from losses through adhering medium to product and discard, inefficiencies from the magnetic separators, and spillages and corrosion of FeSi. It is estimated that 225 g/ton of FeSi make-up is required for the Coarse UHDMS and 165 g/ton Fine and Superfine UHDMS. New FeSi make-up systems may be required i.e. Fine UHDMS FeSi System for the Fine and Superfine UHDMS Plant and a Coarse UHDMS FeSi System to treat the Coarse UHDMS Plant. The Coarse FeSi make-up System will be incorporated into the old Drum Plant.

4.3.5 Dust Management

The following dust management will be incorporated into the design of the UPC and UHDMS plant components:

- Dust suppression with water/fogging systems at the UPC tip bin and crusher feed bin;
- Dust extraction with dust extraction scrubbers at the UPC;
- Dust suppression with water/fogging systems at the UPC systems at the UPC discharge conveyor;
- Existing dust extraction scrubbers at the quaternary crushing and screening plant; and
- Dust suppression with water/fogging on the quaternary screening plant discharge conveyors feeding the coarse and superfine UHDMS stockpiles.

4.3.6 Stormwater Management

Surface water management at the UPC and the UHDMS will be incorporated into existing and planned infrastructure at Sishen Mine. Sishen is in the process of upgrading the infrastructure; this includes development of the D2 and D3 Pollution Control Dams (PCDs), the Aldag Dam and the G80 Sumps as well a proposed new Tailings Return Water Dam.

Stormwater runoff from the UHDMS plant area will be accommodated by the proposed D2 and D3 PCDs (see Figure 4-5). These dams are yet to be constructed but have been authorised in the 2016 addendum to the Sishen Water Use Licence (Licence No. 10/D41J/BCGI/2643). These dams have been sized to accommodate the "first flush" i.e. 20% of a 1 in 50-year storm event. Overflows from the D2 and D3 PCDs drain to the Eastern and Western Stormwater Management Canals, respectively. The G80 Western and Eastern Stormwater Recovery Sumps (licenced and currently under construction) located on these canals provides additional stormwater retention, and water is then recovered from these sumps and sent back to the plant and mining areas for reuse.

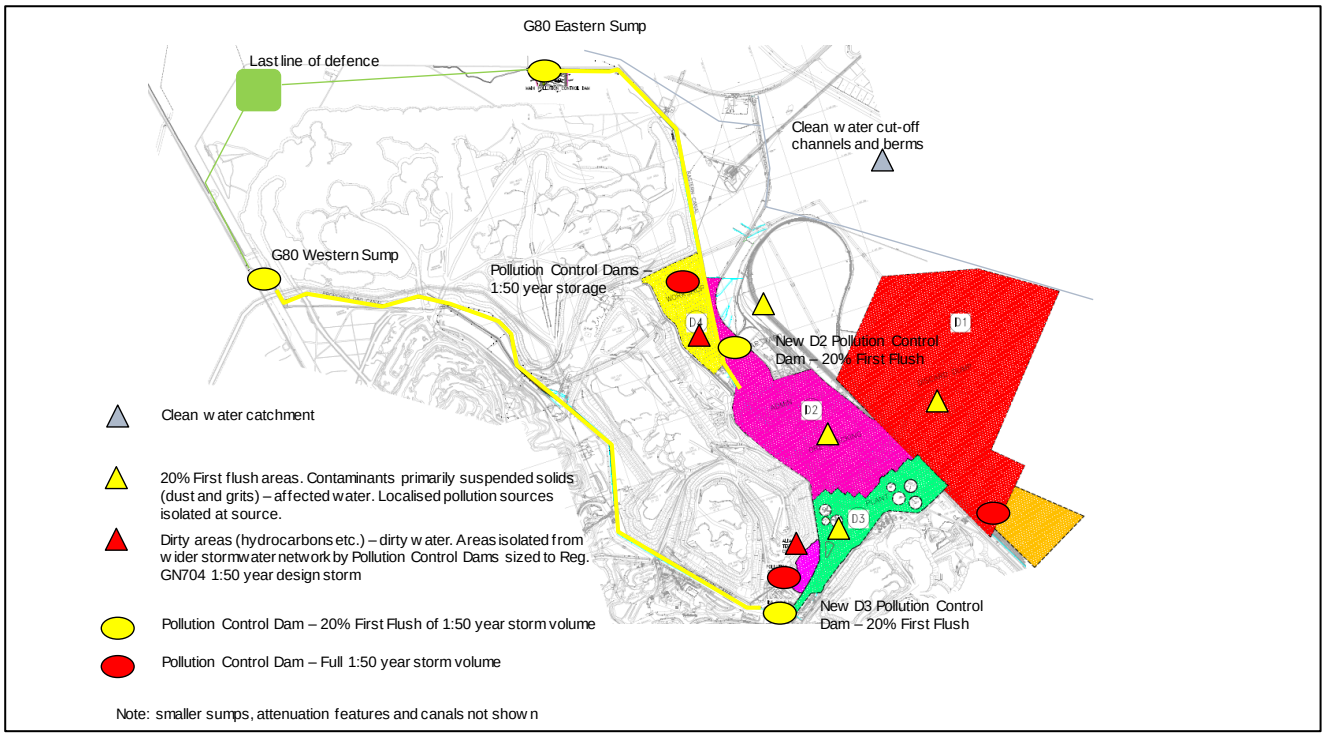


FIGURE 4-5: PROPOSED STORMWATER MANAGEMENT UPGRADE AT SISHEN MINE

Dirty water run-off at the UPC will report to the sumps. Stormwater run-off from areas potentially contaminated with hydrocarbons will be separated from other run-off originating at the UPC. Silt traps will be put in place for the desilting of all stormwater run-off. Water potentially contaminated with hydrocarbons will report to the Aldag PCD. Water from other areas will pass through a sediment interceptor and then report to the Western Stormwater Management Canal where it will be recycled from the G80 sump, back into processes at Sishen Mine. The Aldag PCD is to be located to intercept run-off which is potentially contaminated with hydrocarbons. From here water will be recycled back into process. The Aldag PCD is licensed in the 2016 addendum, but an environmental authorisation process is currently underway to allow for the expansion of the dam to ensure that it can contain a 1 in 50-year storm event.

4.3.7 Water Supply

Water is required for dust extraction and suppression, washing and screening, spray water for floats and sinks, FeSi make-up water, wash water, fire water and potable water.

Water consumption at Sishen Mine will increase due to the upgrade of the DMS to UHDMS and the installation of the UPC, driven primarily by the additional coarse waste and additional slurry tonnages, which result in increased losses in the system. The increase in make-up water demand is predicted to be below 100 m^3/h and will be supplied predominantly by additional treated sewage effluent and recovered stormwater from the eastern and western stormwater sumps, and the PCD's. This additional make-up supply is also supported by the construction of the

additional buffer storage volume in the return water dam extension project, which will be constructed in 2018.

Use will be made of the existing infrastructure at the DMS for the purposes of water supply and management. There are three thickener dams, with a combined storage capacity of 156 000 m^3 and one existing process water supply dam with a storage capacity of 25 000 m^3. These existing facilities will have sufficient capacity to facilitate the UHDMS plant. The dams are included in the Sishen Mine water use licence and no additional licensing is required.

4.3.8 Mineral Waste Management

Processing C-grade material using UHDMS will also generate mineral waste in the form of plant discard and tailings slurry (slimes) from the thickener process. This waste will be deposited at the existing plant discard dump and tailings storage facility at Sishen Mine. The existing plant infrastructure will be used for plant discard disposal and slimes disposal. The existing plant discard conveyors will be upgraded as part of the DMS Upgrade Project.

The estimated tonnages and volumes of waste to be produced over the remaining LOM at Sishen including the DMS Upgrade Project is provided in Table 4-1and Table 4-2, respectively.

TABLE 4-1: SLIMES AND DISCARD WASTE TONNAGES PRODUCED AT SISHEN OVER THE REMAINING LOM

	SLIMES AND DISCARD (Mt)			
	DMS Slimes	**Jig Slimes**	**DMS Discard**	**Jig Discard**
2018	1.738	1.523	2.964	4.300
2019	1.764	1.131	3.077	4.214
2020	1.715	1.223	2.969	4.477
2021	1.269	1.328	1.920	4.912
2022	2.280	1.363	6.646	5.348
2023	2.418	1.363	7.818	5.498
2024	2.418	1.363	6.978	5.615
2025	2.418	1.363	8.955	5.387
2026	2.418	1.363	7.532	5.624
2027	2.418	1.363	7.279	5.398
2028	2.418	1.363	9.805	5.061
2029	2.418	1.246	17.805	4.372
2030	2.418	0.622	17.934	2.344
2031	1.411	0.000	12.563	0.000
Total	**29.52**	**16.61**	**114.24**	**62.55**

TABLE 4-2: SLIMES AND DISCARD WASTE TONNAGES PRODUCED AT SISHEN OVER THE REMAINING LOM

	SLIMES AND DISCARD (m^3)			
	DMS Slimes	**Jig Slimes**	**DMS Discard**	**Jig Discard**
2018	789,957	1,015,053	1,347,343	1,954,600
2019	801,898	754,070	1,398,750	1,915,333
2020	779,564	815,057	1,349,767	2,034,847
2021	576,761	885,084	872,651	2,232,703
2022	1,036,320	908,507	3,020,915	2,431,069
2023	1,099,301	908,507	3,553,611	2,499,027
2024	1,099,301	908,507	3,171,668	2,552,143
2025	1,099,301	908,507	4,070,548	2,448,569
2026	1,099,301	908,507	3,423,593	2,556,477
2027	1,099,301	908,507	3,308,418	2,453,486
2028	1,099,301	908,507	4,456,883	2,300,436
2029	1,099,301	830,740	8,093,080	1,987,280
2030	1,099,301	414,836	8,151,645	1,065,333
2031	641,264	0	5,710,494	0
Total	**13,420,169**	**11,074,386**	**51,929,367**	**28,431,302**

The additional waste as a result of the processing of C-grade material can be accommodated within the footprint of the existing authorised discard and tailings storage facilities at Sishen Mine and no expansions are currently envisaged for the LOM.

The existing Integrated Water Use Licence at Sishen (Licence No.: 10/D41J/BCG/2643) allow for the disposal of 3 045 370 m^3/annum of slimes and 5 947 500 m^3/annum. As indicated in Table 4-2, the discard volumes will however exceed the licensed volumes from 2023 (6 052 638 m^3) and be at a maximum in 2029 (10 080 360 m^3). The licence will need to be amended to allow for the increase in annual deposition.

Based on the outcomes of the Waste Assessment (Jones & Wagener, June 2017), the waste streams do not present any additional risk of contamination than existing wastes deposited at the facilities. Although these wastes are classified as Type 3 wastes, it is unlikely that the material will be subject to the chemical processes that result in the mobilisation of metals and anions. It is therefore considered that the mineral wastes, including those originating from the processing of C-grade material, will not have a significant impact on the water environment and should be classified as Type 4 wastes.

4.3.9 Non-Mineral Waste Management

The construction and operation with the DMS Upgrade Project will be incorporated into Sishen Mine and will make use of existing non-mineral waste management facilities including the

General Waste Disposal Site; the Recycling Facility, which provides for temporary storage of hazardous waste; and the Bioremediation Facility for treating contaminated soils.

4.4 Project Schedule

The feasibility study for the DMS upgrade project will be completed in the third quarter of 2019. Should the project be deemed feasible, construction activities would commence at the start of 2020 with the upgraded plant reaching full production in the second quarter of 2022. The life of the project coincides with the life of Sishen Mine. The project has thus been planned on the current Sishen LOM of 2031. Note however, that the project does present the possibility for the extension of the LOM.

4.5 Employment

4.5.1 Construction Phase

It is estimated that ~495 persons will be required at the peak of construction activities. This includes, 120 persons for the construction of the UPC, 280 persons for the Plant Feed, 80 persons for the Discard Management Systems and 15 persons from an EPCM including mangers, safety officers, site supervisors, administrators etc.

4.5.2 Operational Phase

The increase in labour compliment required for the operation of the project is ~128 additional employees. A preliminary indication as to the increase in personnel required at Sishen Mine for the DMS Upgrade Project is given in Table 4-3.

TABLE 4-3: PRELIMINARY ADDITIONAL EMPLOYMENT REQUIREMENTS FOR THE DMS

CONSTRUCTION	**495**	
OPERATION	**128**	
Mining (66)	66	Operators (GR1)
Plant (38)	18	Operators (GR2)
	12	Operators (GR1)
	4	Shift Supervisor Assist
	4	Operations Controller
Engineering (22)	12	Artisans
	1	Supervisor
	2	Operators (GR1)
	2	Boiler makers
	2	Fitters
	3	Master Fitters
Mine Technical Services (2)	1	Geo technician
	1	Geologist

5. POLICY AND LEGISLATIVE CONTEXT

This document has been prepared strictly in accordance with the DMR Report template format. This is in accordance with the requirements of the Minerals & Petroleum Resources Development Act (MPRDA) (No. 28 of 2002). In addition, this report complies with the requirements of the National Environmental Management Act (NEMA) (Act 107 of 1998) and the EIA Regulations (2014, as updated).

This section outlines the key legislative requirements applicable to the project.

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

The MPRDA regulates the requirements for a mining right in order to mine a mineral and undertake associated activities. Mining can either include removal of an underground mineral or mineral occurring in a residue deposit or residue stockpile. The MPRDA requires the holder of a mining right not to cause any significant pollution or environmental degradation. The Sishen mining right is valid until 2039. The holder of a mining right is required to comply with the requirements of the approved EMPr (2002), as amended.

The Sishen Mine EMPr and its amendments are approved under Section 39 of the MPRDA, and despite the section being repealed with all future environmental authorisations being regulated under NEMA, existing authorisations remain valid and activities can be considered to be environmentally authorised. All future environmental authorisations are now regulated under NEMA and its associated regulations, but still administered by the Department of Mineral Resources (DMR).

The Sishen Mine EMPr (2002, as amended) provides for the processing of ore using DMS and subsequent approved amendments allowed for the incorporation of the JIG processing (SEP and SEP1a). Since there is a change in the process description as contained in the EMPr and amendments to allow for UHDMS, an amendment to the EMPr is required. An application has thus been made for authorisation in terms of Section 102 of the MPRDA.

Sections 53 and 54 of the Regulations require the holder of a mining right to make financial provision for rehabilitation and to action closure objectives of the Mine. These sections are however a consequence of Section 41 of the MPRDA (also now repealed) that requires the holder to make financial provision for closure and rehabilitation of the Mine. Financial provision for mine rehabilitation and closure is now regulated under NEMA and subsequent regulations. However, since the MPRD Regulations are not repealed, Section 53 and 54 can still be considered to be applicable.

Application has been made in terms of Section 102 of the MPRDA for the amendment of the Sishen Mine EMPr.

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

Section 24 of NEMA provides for the Minister of Environmental Affairs to include activities in a list that require environmental authorisation before commencement. This has resulted in the promulgation of Listing Notices 1 (GN. 983), 2 (GN. 984) and 3 (GN. 985) with the Environmental Impact Assessment (EIA) Regulations (GNR. 982) of December of 2014 as amended by GNR. 324-327 of 7 April 2017, guiding the requirements to undertake an environmental impact assessment and apply for an environmental authorisation should a listed activity be triggered. As of 4 December 2014, activities at mining operations are also to be authorised under NEMA, with the DMR acting as the Competent Authority.

The project presents an amendment to an existing operation which commenced prior to the publishing of listed activities related to primary processing at a mining operation. No activities listed under the EIA Regulations are triggered by the development.

As indicated in Section 6.1, the DMS Upgrade Project does present a change in the type of processing activities at Sishen Mine. As such, there is a requirement for the amendment of the existing authorised Sishen Mine EMPr.

An amendment of an environmental authorisation is required in terms of Part 1 or Part 2 of Chapter 5 of the Regulations. It is possible that the processing of the C-grade material may require additional mitigation measures to be put in place at Sishen Mine and thus an amendment under Part 2 is considered to be applicable.

Authorisation is being sought in terms of Regulation 31 of Part 2 of Chapter 5 of EIA Regulation GNR. 982 of 4 December 2014 as amended by GNR. 326 of 7 April 2017 under NEMA for the amendment of the EMPr.

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

In terms of Section 19 of NEM: WA, a list of waste management activities that is likely have a detrimental effect on the environment was promulgated through Regulation GN. 921 (November 2013). The listed activities were amended by GN. 633 of 24 July 2015 to include waste management activities at mining operations.

The project intends including the processing of stockpiled C-grade material. This material is considered to be captured under the definition of "residue stockpile" and is also waste as defined in Schedule 3 of NEMWA, as amended:

"**residue stockpile**" means any debris, discard, tailings, slimes, screening, slurry, waste rock, foundry sand, mineral processing plant waste, ash or **any other product derived from or incidental to a mining operation which is stockpiled, stored or accumulated within a mining area for potential re-use**….

The processing of waste at the upgraded DMS plant requires a Waste Management Licence. This requires a Scoping and EIA Process to be completed in support of the application.

The project will also generate mineral waste in the form of dry plant discard and tailings slurry for the thickener process. The project will utilise the existing plant discard dump and tailings storage facility at Sishen Mine. Both these facilities are authorised in the existing water use licence as well as the approved EMPr (as amended to include the JIG processing facilities). The project will not increase the footprints or exceed the allowable limits of the existing discard facility and there is therefore no need for a waste management license to extend the facility.

A waste classification and assessment of the process wastes (slimes and solid discard) will be undertaken in accordance with Regulation GN. 634 and 635 of 23 August 2013 as part of the EIA process to assess any additional risks to the environment and appropriate mitigation will be put in place if required.

Application is made for a Waste Management Licence for the authorisation of Waste Management Activities 3 & 11 of Regulation GN. 921 as amended by GN. 633 of 24 July 2015 under NEM: WA for the reclamation of residue stockpiles containing C-grade material.

5.4 National Environmental Management Act: Air Quality Act (No. 39 of 2004)

NEMA: AQA controls and regulates atmospheric emissions and provides for Listed Activities (GN. 893, November 2010) which have or may have a significant effect on the environment, including health, social conditions, economic conditions, ecological conditions or cultural heritage. Any activity captured under this list require the person undertaking the activity to apply for an Atmospheric Emissions Licence. The project will not trigger any activities listed in the Regulation and there is therefore no need for an atmospheric emissions licence.

The Mine, and project, are also required to comply with the National Dust Control Regulations (GN. 827 of 1 November 2013) and the National Ambient Air Quality Standards (NAAQS, GN 1210 of 24 December 2009). The regulations provide limits for $PM_{2.5}$. PM_{10} and dust fallout in residential and industrial areas.

5.5 National Environmental Management: Biodiversity Act (No. 10 of 2004)

Section 57 of NEM: BA restricts certain activities involving threatened and protected species (as listed in Regulation GN. 151 and 152, February 2007) without a permit. Restricted activities applicable to the project are limited to the removal of Threatened or Protected Species (TOPS) plants during the clearance of vegetation. The Sishen DMS upgrade project is a brownfields project and no clearance of vegetation will be undertaken and no permit is therefore required.

5.6 National Water Act (No. 36 of 1998)

Section 21 of the NWA requires that any person undertaking a water use activity must either register or licence such use unless it was an existing lawful use prior to the Act. Sishen Mine has an existing Integrated Water Use Licence issued in 2015 and a separate Licence for additional facilities including upgraded stormwater management issued in 2016 (Licence No.: 10/D41J/BCG/2643). The licence authorises the use of 7 124 457 m^3/annum of water by the mine for processing and other activities. The processing of C-grade material will require and additional ~100 m^3/h, however the overall consumption of water at Sishen will not be exceeded due to the additional water requirements.

In addition, Sishen Mine is licensed under Section 21(g) for the storage of dirty water and the disposal of process waste. The project does not require any additional storage dams or any new disposal facilities, however the volumes to be disposed exceed the authorised volumes and the licence is to be amended to accommodate the additional volumes (see Section 4.3.8). Sishen is due to commence an amendment to licence and this requirement will be included in the next amendment.

Regulations for the use of water for mining and related activities aimed at protected water resources (GNR. 704, June 1999) were promulgated in terms of Section 26 of the NWA. Section 6 of the Regulations require any person undertaking a mining or related activity to separate its clean and dirty water. The plant falls within the current water management at Sishen Mine. The mine is in the process of upgrading the management systems at the mine and the project will be accommodated within the planned upgrades.

Application is to be made for an amendment to the existing Water Use Licence

5.7 National Heritage Resources Act, 1999

The National Heritage Resources Act provides for the protection of all archaeological and paleontological sites and meteorites. In terms of Section 34 of the Act, no person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant heritage resources authority. The Sishen DMS Upgrade Project is a brownfields project taking place within the current disturbed footprint at the mine. There are no heritage resources within the mine area and the upgrade will not result in the alteration of any building older than 60 years.

6. NEED AND DESIRABILITY OF THE PROPOSED ACTIVITIES

Sishen Mine currently produces high quality iron ore using both DMS and JIG processing. Material below the cut-off-grade of 48% Fe cannot be beneficiated through these processes and is thus dumped on surface as "waste material" in the form of residue stockpiles or waste rock dumps. Recently (2014) it was demonstrated that some of the material, categorised as C-grade (40-48% Fe) could be processed to a saleable product using a unique UHDMS technology. The DMS upgrade project involves the modification of the current DMS process plant to allow for the processing of both A-grade and C-grade material. The project seeks to meet the following objectives:

- Optimise value of current operations

  The drop in iron ore prices has resulted in significant pressure on Sishen Mine operations to meet operating cost targets. In 2016, restructuring at Sishen Mine to reduce costs related to a substantial drop in the iron ore price resulted in a decreased production rate. Production has increased but is still substantially less than historical maximum production rates at Sishen Mine. The UHDMS process will augment the reduced production at Sishen by an additional 1.5-6 Mtpa of product for the LOM.

  The DMS upgrade project can add relief to the operations by reducing the stripping ratio and waste profiles as it would be capable for producing product from ROM material that is already mined but currently stockpiled as waste.

- Increased iron ore resources and reserves

  UHDMS technology is capable of extracting economic value from material that was previously considered as waste. Some waste material can now be considered for conversion to a resource and reserves. At the end of 2016 an additional 213.4 million tons of resources were included in the Sishen Mine resource statements by conversion of C-grade material to reserves from the planned mining operations and further stockpiled on surface of waste dumps/residue deposits is pending evaluation.

- Reduced waste production

  The UHDMS process is capable of beneficiating efficiently at higher cut densities than was traditionally believed possible. This has allowed the cut-off-grade to be substantially reduced at Sishen meaning that C-grade material originating from the ROM can be processed and will no longer need to be placed on surface as "waste". This means that less waste will be stockpiled on surface at Sishen Mine in future. In addition, UHDMS means that some of the C-grade material already on surface can also be processed to form a saleable product

- Possibility of extending the life of mine

  The DMS upgrade project is proposed to run over the remaining LOM. There is however significant low-grade potential at Sishen beyond the current LOM plan and successful implementation of UHDMS technology through this project could mean that future additional low-grade material and a possible extension to the Sishen LOM. The current project however only considered processing over the LOM, but there is the distinct possibility that processing of low-grade material could extend beyond 2031 pending project development and evaluation

7. MOTIVATION FOR THE PREFERRED DEVELOPMENT FOOTPRINT WITHIN THE APPROVED SITE INCLUDING A FULL DESCRIPTION OF THE PROCESS FOLLOWED TO REACH THE PROPOSED DEVELOPMENT FOOTPRINT WITHIN THE APPROVED SITE

(The determination of the site layout taking into consideration the comparison of the original site plan with a plan which takes (1) environmental features; (2) current land uses, (3) issues raised by IAPs and (4) consideration of alternatives, to the initial layout into account).

7.1 Details of alternatives considered

7.1.1 Design or layout alternatives

The project forms part of an existing mining operation involving the processing of material from the ROM as well as stockpiles. The development will thus take place within disturbed areas within the mining right area. All property is owned by SIOC. No areas outside of the mining right area or any alternative properties were considered. The mining right area is indicated in Figure 3-1. The location of the alternatives is provided in Figure 7-1.

7.1.2 Plant location alternatives

Two locations were considered for the implementation of the UHDMS technology (see Figure 7-1) as part of the prefeasibility study:

- The development of a new UHDMS stand-alone plant, adjacent to the existing processing area at Sishen Mine, approximately 750 m south west of the existing JIG plant and 1 500 m south west of the existing DMS plant. The new plant would have been brownfields development taking place on a disturbed site within Sishen Mine.
- The upgrade of the existing DMS Plant to UHDMS with changes taking place largely within the existing footprint of the DMS plant with some additional infrastructure to support the upgrade.

Both location alternatives allow for the use of the existing Sishen plant solid waste (plant discard dump) and slimes (tailings storage facility) disposal sites.

The stand-alone alternative **has been excluded from the project** based on technical, financial and environmental considerations. From an environmental perspective, the development of a new plant is considered to be less favourable due to the increase in closure liabilities associated with the development of the additional infrastructure at the mine. The option would also require an amendment to the existing Sishen Water Use Licence as it presents new pollution sources at the mine in the form of additional thickeners that will need to be licensed under Section 21(g) of the National Water Act.

Note that the stand-alone option has been excluded and has not been considered further in this EIA report.

7.1.3 New primary and secondary crusher location alternatives

During the prefeasibility study (Prefeasibility B) for the project, the opportunity for additional C-grade material as feed to the UHDMS plant was identified. This prompted the need for an additional primary crusher to be included in the project, as the existing crushers at the mine do not have the full capacity for the additional material. The location of the UHDMS Primary Crusher (UPC) was investigated as part of the prefeasibility study (Prefeasibility B) and included the following alternatives (see Figure 7-1):

- Preferred Project UPC Location Alternative

  This position is outside the pit boundaries and thus does not interfere with mining activities or pit development. Shorter conveyors will be required. There is however higher haulage cost to elevate ore from low inside the pit to high above natural ground level. There will also be more traffic outside of the pit area.

  This option is considered to be the **preferred alternative** for the purposes of implementing the DMS Upgrade Project, however considerations of the Sishen Mine operation as a whole need to be made.

- Mine UPC Location Alternative

  This position is inside the mine pit. It requires longer conveyors and there are more conveyor routing challenges to cross haul roads. There are however lower haulage costs due to shorter distances and less elevation changes. There will also be less traffic outside of the pit. The option of also crushing some material from the north mine at this crusher is also under consideration.

The preferred project UPC location was selected as an outcome of the prefeasibility study for the reasons indicated above. Both UPC location alternatives present the same potential impacts on the environment and the decision on the location was based on technical and financial feasibility rather than on environmental considerations. The preferred UPC location has been considered for the purposes of the EIA.

The inclusion of an additional secondary crusher adjacent to the UPC was also considered in the prefeasibility study, however the crusher has been excluded at this stage as it is not necessary for the implementation of the project. The inclusion of a secondary crusher has not been considered further in EIA.

7.1.4 Type of activity alternatives

The following alternatives were considered as part of the prefeasibility study (Prefeasibility A)

for the project:

- Development of new UHDMS stand-alone plant

  The development of a new UHDMS plant. A new secondary and tertiary crusher would be put in place and a stand-alone beneficiation plant constructed adjacent to the existing Sishen Mine processing area. New pipelines / conveyors to the existing plant discard dump and the slimes dams and also new process dams and thickeners will also be required.

- Upgrade of the existing DMS plant to UHDMS

  This alternative involves changes to the existing Sishen DMS Plant using existing primary, secondary and tertiary crushers as well as an additional primary crusher and possibly a secondary crusher. The upgrade would largely involve internal changes to plant components. New conveyors linking existing plant areas would be required. Existing process dams and thickeners as well as pipeline would be used.

All alternatives make use of existing process waste facilities at Sishen Mine, namely the plant discard dump and the Tailings Storage Facility.

As indicated in Section 7.1.2 the stand-alone option was considered to be least favourable due to the increase in the closure liability associated with the development of additional infrastructure. The **stand-alone option has been excluded** from the project and the impacts thereof are not considered further in the EIA.

7.1.5 Design or layout alternatives

Various design alternatives for the project have been considered during the prefeasibility study (Prefeasibility A) in order to confirm the process to be implemented. Further investigations will be carried out as part of the feasibility studies. Three internal options were considered for the upgrade of the existing DMS plant to UHDMS. One of these options, would involve the development of a new quaternary crusher. The other options are similar from an environmental perspective, with differences being the modifications requiring the differences in the changes to be made to the existing cyclone sections at the existing DMS. The development of a new quaternary crusher would add to the rehabilitation requirements at the mine and was thus considered to be less preferable from an environmental perspective. The upgrade option selected for the Prefeasibility B study **excludes the need for a new quaternary crusher**.

7.1.6 Technology alternatives

The DMS Upgrade Project is based on the implementation of UHDMS technology at Sishen Mine. UHDMS presents an alternative to beneficiation by DMS and Jigging which are the

current processes in place at Sishen Mine. The technology has been demonstrated to allow for the beneficiation of C-grade ore at Sishen Mine. This was achieved through collaborative technology development with Exxaro and resulted in Kumba being licensed (by Exxaro) to use the technology at its operations. The process is similar to DMS processes that are currently used at Sishen. The separation efficiency has been demonstrated to be better than that of Jigs thereby allowing the ROM cut-off to be reduced at Sishen thus presenting the opportunity for processing material that previously could not be beneficiated at Sishen.

The project is based on the implementation of UHDMS technology. No other alternative is under consideration.

7.1.7 Option of not implementing the activity

In accordance with the NEMA Regulations, the no-go alternative is required to be investigated and assessed.

Low grade iron ore material is currently being placed on residue stockpile areas and is regarded as "waste" due to the absence of suitable technology for the processing of the material. UHDMS presents the technology for the processing of low grade material from ROM and from current stockpile/waste areas. The project will allow for the processing of material that is currently considered to be waste to produce product. Furthermore, the project is a brownfields development taking place within existing disturbed areas and a low cumulative contribution to existing impacts at Sishen Mine. Furthermore, the implementation of UHDMS technology could present the opportunity for Sishen Mine to process other low grade ore which are currently waste streams and possibly even extending the life of Sishen Mine.

The project will result in the production of an additional 1.5-6 Mtpa of product from Sishen Mine when implemented (from 2022). In addition, the project will result in additional employment both during the construction (~495 persons) and the operational phases (~128 persons) of the project. According to Demacon (October, 2017), the capital expenditure equates to the opportunity of R2.7 billion new business sales and R1.9 billion to the GGP with over 4 000 direct, indirect and induced jobs created. The additional operational expenditure at Sishen Mine will potentially create R709 million in new business sales and R484 million in additional GGP per annum as well as over 1 000 sustained employment opportunities (Demacon, October 2017). Furthermore, the upgrade to UHDMS provides the opportunity for the extension of the LOM meaning the positive economic impacts associated with Sishen will be sustained.

The no-go alternative would mean that the DMS Upgrade Project is not undertaken and therefore the positive environmental and social benefits will not be realised which for this project far outweigh the possible environmental impacts of this brownfields project.

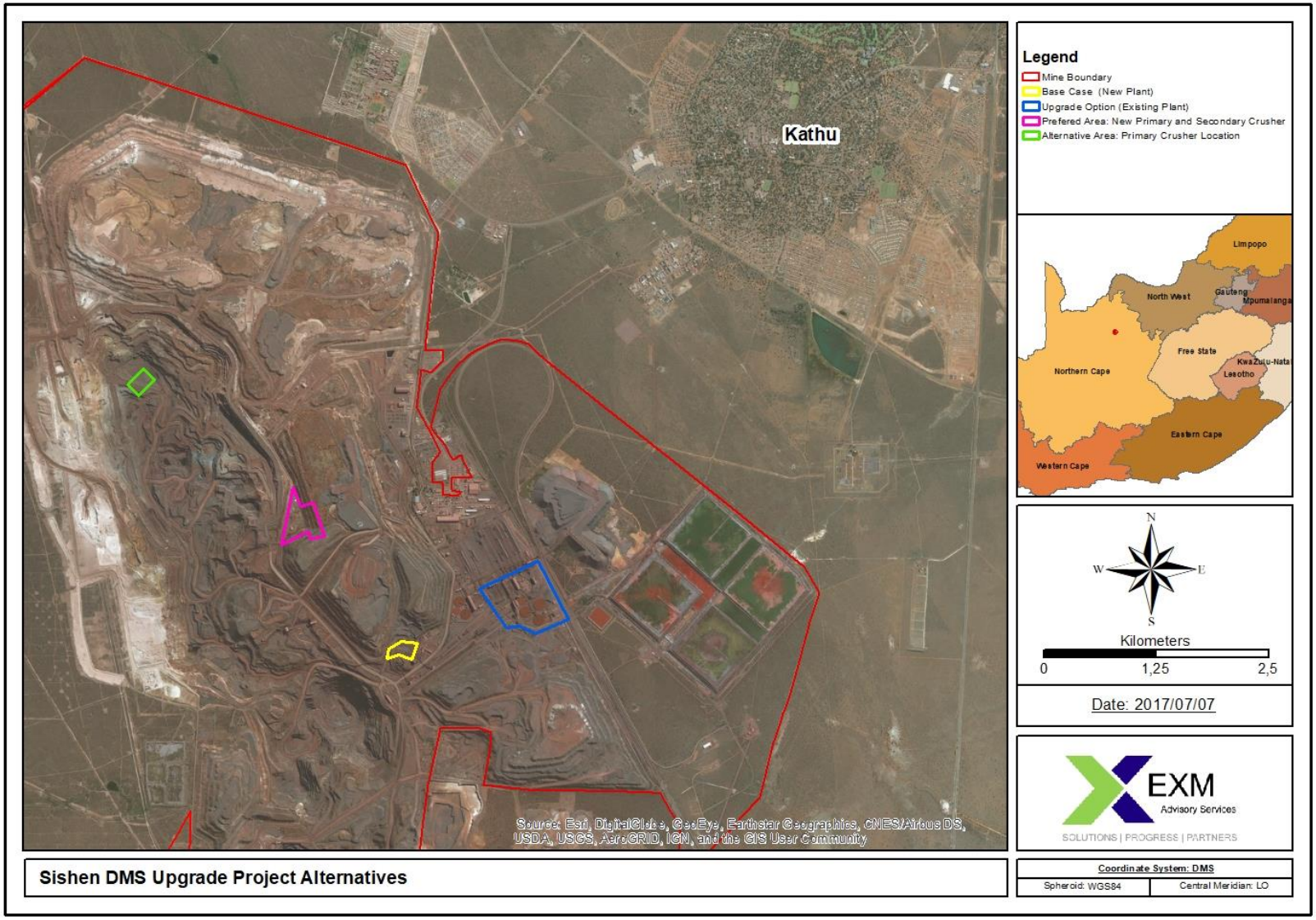


FIGURE 7-1: PROJECT ALTERNATIVES FOR THE PROCESSING OF C-GRADE MATERIAL AT SISHEN MINE

7.2 Details of the public participation process followed

7.2.1 Identification of Interested and Affected Parties

Existing databases held by Sishen Mine were updated for the purposes of this project. Potential Interested and Affected Parties (IAPs) were identified based on the definition of IAPs in the EIA regulations. This includes:

- Landowners or tenants adjacent to or within 100 m from the proposed study area.

  Since the project occurs within the Sishen Mine fenced-off area, this definition was expanded to include neighbours to the mine. The members of the Sishen Environmental Forum include neighbouring landowners and all members were included in the IAP database.

- Representatives of the local municipality/ward councillor with jurisdiction in the area.

  This definition was expanded for the purposes of the assessment to include the mayor, councillors of the local council as well as members of the district municipality. This included representatives of:

  - Gamagara Municipality (including councillors)
  - Joe Morolong Municipality
  - Ga Segonyana Municipality
  - John Taolo Gaestsewe District Municipality

- Representatives of ratepayers associations

- Authority or organ of state having jurisdiction in respect of any aspect of the activity, including.

  The following organs of state have been notified:

  - Department of Agriculture, Land Reform and Rural Development
  - Department of Education
  - Department of Agriculture, Forestry and Fisheries
  - Department of Home Affairs
  - Department of Justice
  - Department of Environment and Nature Conservation
  - Department of Water Affairs
  - South African Heritage Resources Agency
  - Northern Cape Provincial Government

- Persons who responded to the Background Information Document (BID), press advertisements and site posters

- Persons who attended the public meeting during the scoping phase

A list of all parties that have been identified thus far is included as Appendix B1

Note that the IAP database will continue to be updated as IAPs become apparent throughout the scoping and EIA phases.

7.2.2 Notifications

In accordance with the Section 41(2)(b) of Chapter 6 of the EIA Regulations (GN. 982 of 4 December 2014, as amended), written notification (including BID document by email or facsimile) has been given to:

- Surrounding landowners;
- Representatives of local government and the local municipalities;
- Ratepayer's association;
- Organs of state.

Proof of the notification is provided in Appendix B3.

The Background Information Document (BID) is provided in Appendix B4.

Persons on the IAP database were notified of the project and invited to the public information-sharing meeting by:

- Email including BID (where email addresses are available); and/or
- SMS (where cell phone numbers are available); and/or
- Facsimile (where contact details are available); and/or
- Telephonically (where only land lines where available).

7.2.3 Media advertisements and Site Notices

Press advertisements were placed in the following newspapers:

- The Volksblad on 29 June 2017 in Afrikaans; and
- The Kathu Gazette on 30 June 2017 in English.

The advertisements included an invitation to the public information-sharing meeting.

Site notices (A2 size) were placed (one in English and on in Afrikaans) at the entrance to Sishen Mine. Notices were also placed at strategic public locations in Kathu:

Proof of placement of advertisements and site notices is included in Appendix B2.

7.2.4 Public and authority meetings

A meeting was held on Wednesday 5 July 2017 with the mayor and municipal manager of

the Gamagara Local Municipality. The purpose of the meeting was to inform them of the project and to collate initial issues and concerns.

An open public information-sharing meeting was held in Kathu on Wednesday 5 July 2017.

The project was presented at the Sishen Future Forum meeting held on 14 December 2017. The meeting was attended by representatives of Sishen Mine, local (including feeder) municipalities, district municipality, and unions.

The minutes of the meetings and authority meetings are included in Appendix B5.

7.2.5 Public and Authority review of draft scoping report

The draft scoping report was made available for public and authority review from 10 July - 8 August 2017. (30 calendar days) in accordance with Section 40 (3) of the 2014 EIA regulations.

Notification of availability of the draft scoping report is provided in Appendix B6.

Hardcopy distribution of the draft scoping report is provided in Appendix B8.

7.2.6 Authority acceptance of final scoping report

The final scoping report was submitted to the DMR on 15 August 2017 and was accepted by the DMR on 12 December 2017. The letter of acceptance is included in Appendix B9.

7.2.7 Public and authority review of Draft EIA Report

The draft EIA Report including appendices and specialist study reports was made available for public review from 16 March 2018 until 18 April 2018 (30 calendar days, excluding public holidays).

Notification of availability of the draft environmental impact assessment report and draft environmental management programme is provided in appendix B6.

Hardcopy distribution of the draft environmental impact assessment report and draft environmental management programme is provided in appendix B8.

7.3 Summary of issues raised by IAPs

Please refer to Appendix B5, for the full comments in minutes and correspondence with IAPs and authorities. Correspondence received to date is included in the Table below. Comments and responses received for the draft EIA and EMPr is also provided in the table below and repeated in Appendix B7.

DATE	NAME	CORRESPONDENCE RECEIVED	EAPs RESPONSE TO ISSUES AS MANDATED BY THE APPLICANT	CONSULTATION STATUS (consensus, dispute, not finalised, etc.)
AFFECTED PARTIES				
Landowners/Lawful Occupiers of Adjacent Properties No comments received yet.				
Local Authorities				
05/07/2017	Dineo Moyo (Major of the Gamagara Municipality)	Issues raised during a meeting held on the 5 July 2017: 1) Has the Municipality been sent any correspondence regarding the project? 2) It is important to get approval from the whole council and that she will give the documents to the council. EXM and the team should come and represent at the next council meeting. 3) What are the project benefit for the Gamagara Municipality?	1) The Gamagara Municipality has been notified of the proposed project. The meeting with the Major was also intended to act as a notification of the project. The Municipality is identified as one of the key commenting authorities that needs to provide input. 2) EXM has given a presentation at the Sishen Future Forum on 14 December 2017. 3) An Economic Impact Assessment has been completed for the project. Indications are that the economic benefits to the local and regional economy are substantial both during the construction and operational phase. The direct and indirect employment opportunities will also benefit the local and regional communities. The inclusion of UHDMS also presents the potential to extend the LOM of Sishen. The Gamagara Municipality will definitely benefit from the project.	Finalised.

DATE	NAME	CORRESPONDENCE RECEIVED	EAPs RESPONSE TO ISSUES AS MANDATED BY THE APPLICANT	CONSULTATION STATUS (consensus, dispute, not finalised, etc.)
03/07/2017	Natasha Higgitt	Thank you for notifying SAHRA of the proposed development. Please note that SAHRA does not accept hardcopy, posted, emailed or website links as official submission. Please create an application on the South African Heritage Resources Information System (SAHRIS) and upload all documents to the application. Please follow the step by step guide on the SAHRIS homepage (http://sahra.org.za/sahris/). Please ensure that when all documents have been uploaded (including all appendices and location .kml file), the status of the case is changed from DRAFT to SUBMITTED. Once this is completed, please inform me, referencing the SAHRIS Case ID number.	The required document will be uploaded on SAHRIS. We will distribute the reference number once completed.	Consensus
29/06/2017	Pierre Burger	I have been trying to phone you, but the telephone is engaged. You can phone me: XXX	As per our telephonic discussion on the 30 June 2017. We have registered you for the project and will keep you informed on the availability of the draft reports for comment.	Consensus
10/07/2017	Natasha Higgitt	Thank you for the update to the case. Please note that the case has been left in the DRAFT status. Cases left in the DRAFT status do not get processed. Please ensure that when all documents have been uploaded to the case, and comments are required on these documents, the status of the case must be changed to SUBMITTED. Please inform me when this is completed.	The required documentation will be uploaded onto the SAHRIS system.	Finalised
Organs of state (Responsible for infrastructure that may be affected Roads Department, Eskom, Telkom, DWA etc.)				
07/07/2017	Tshegofatso Nnene	Eskom has a proposed power line on farm Sekgame no. 461, Kuruman road. Please see the attached route and the EA attached. The approved route is the blue line; preferred alternative 1.	The proposed Sishen DMS Plant Upgrade project is a brownfields project located within the existing footprint/mining right area of the Sishen Mine. The project will therefore not affect the proposed Eskom power line.	Consensus

DATE	NAME	CORRESPONDENCE RECEIVED	EAPs RESPONSE TO ISSUES AS MANDATED BY THE APPLICANT	CONSULTATION STATUS (consensus, dispute, not finalised, etc.)
15/04/2018	Nokulunga Memela/Lerato Mokhoantle (Department of Water and Sanitation)	Comments: (a) The nature activities the mine is proposing to engage in has potential for significant environmental impacts especially on water resources (Potential to contaminate both surface water and groundwater) and the Department has no confidence in some of the proposed mitigation measures. (b) The Department does not have confidence that the current facilities or systems will be able to accommodate the or handle the additional water use proposed (c) A water use authorisation will be applicable for possibly 21(g) as well as GN704 exemption due to the nature of the activities that Sishen Iron Ore Company (Pty) Ltd – Sishen Mine will engage in. (d) Assuming the mine operates for 24 hours (with the proposed additional water f ~100 m3/hr) the water consumption of the activity will be 876 000 m3/a, but according to the report this additional water will be supplied largely through recycling of water at the mine, however there is a lack of confidence in the supply of the volume for recycling. The mine is advised to explore other options to meet the required estimated volume. (e) A Section 21(a) water use authorisation may be applicable should the required additional water be supplied by a borehole, dewatering and or from a surface water resource.	Dear Nokulunga Introduction This letter serves as a response to comments raised by the Department in the letter dated 16 April 2018, with respect to the Environmental Impact Assessment (EIA) and Environmental Management Programme (EMPr) for the proposed upgrading of the Dense Media Separation Plant to Ultra High Dense Media Separation for the purposes of processing low grade iron ore at Sishen Mine. An additional primary crusher (UPC) and conveyors are also proposed as part of the project. Response to Comments (a) As indicated in the Environmental Impact Assessment Report and supporting documentation, the project is unlikely to result in significant impacts on groundwater and surface water resources. Based on the outcomes of the waste assessment undertaken, discard and slimes originating from the processing of C-grade material is not expected to result in a contamination risk for groundwater. This material will be placed on existing waste management facilities at Sishen Mine and there is no need to expand the discard dump or tailings storage facility. It is noted that the return water fraction of the slimes material does pose some risk of nitrate contamination. Nitrate contamination is also currently being detected in the existing return water management at Sishen Mine. The return water management at Sishen's tailings storage facility is in the process of being upgraded and this will be lined to protect groundwater resources. (b) Note that the proposed DMS Upgrade Project does not trigger any new water uses in terms of Section 21 of the National Water Act. The processing of low grade ore through the UHDMS process will result in the formation of plant discard and slimes which will be deposited on Sishen's existing waste management facilities which are included in the existing licence (No.: 10/D41J/BCG/2643). The current stormwater management system at Sishen is in the process of being upgraded, this includes development of the D2 and D3 Pollution Control Dams (PCDs), the Aldag Dam and the G80 Sumps as well a proposed new Tailings Return Water Dam. Stormwater runoff from the UHDMS plant area will be accommodated by the proposed D2 and D3 PCDs. Overflows from the D2 and D3 PCDs drain to the Eastern and Western Stormwater Management Canals, respectively. The G80 Western and Eastern Stormwater Recovery Sumps (licenced and currently under construction) located on these canals provides additional stormwater retention, and water is then recovered from these sumps and sent back to the plant and mining areas for reuse.	DWS Comments and responses given submitted to DMR.

DATE	NAME	CORRESPONDENCE RECEIVED	EAPs RESPONSE TO ISSUES AS MANDATED BY THE APPLICANT	CONSULTATION STATUS (consensus, dispute, not finalised, etc.)
		(f) Please note that a risk matrix has to be conducted by an Aquatic/Wetland and or Freshwater specialist (whom must be a suitably qualified SACNASP professional member) and submitted to the Department in order to determine the impacts of the proposed activities on the watercourse should activities trigger Section 21(c) and (i) of the NWA. The information will assist the Department to decide on the type of water use authorisation requirements for the proposed activities. (g) Assuming that only Section 21(g) of the NWA is applicable, the mine will have to appoint specialists to conduct a Geohydrological Assessment. (h) The following must be updated (but not limited to) should the mine desire to process with the proposed activity: Stormwater Management Plan, Integrated Water and Waste Management Plan, Rehabilitation Plan and Water Balance. (i) All hydrocarbon facilities have to be in a bunded area as part of the mines mitigation measures. (j) The mine is to ensure that the proposed mitigation measures are fully implemented to prevent contamination of surface water resources and groundwater resources. (k) Should residue or low grade material be utilized to construct berms, haul roads, parking areas or for any construction in the mine as per Government notice. No. 704 Regulation 5, the mine will have to motivate for exemption by the Department. (l) A pre-consultation meeting has to be arranged between DWS and the applicant to advice on the project, water uses that would require authorisation and relevant reports before submission of the complete application to DWS.	Construction activities for the DMS Upgrade Project will commence in 2020, and the proposed upgraded stormwater management infrastructure described above will be in place prior to the commencement of construction. (c) Sishen Mine is licensed (Licence No.: 10/D41J/BCG/2643) under Section 21(g) for the storage of dirty water and the disposal of process waste. The project does not require any additional storage dams or any new disposal facilities. The existing licence allows for the disposal of 3 045 370 m3/annum of slimes and 5 947 500 m3/annum of discard. The discard volumes will however exceed the licensed volumes from 2023 (6 052 638 m3) and a be at a maximum in 2029 (10 080 360 m3). The licence will need to be amended to allow for the increase in annual deposition. The amendment will be included in the current Water Use Licence Consolidation Process being undertaken at Sishen. (d) The Sishen Mine Water Use Licence allows for the mine to use 7 124 457 m3/annum under Section 21(a) of the National Water Act for the purposes of mining and beneficiation processes at the mine. This equates to 2 936 m3/hr. Actual consumption of water in 2015, when production was at approximately 49 Mtpa, was calculated to be 1 658 m3/hr and was thus well within the licenced volumes. In 2016, consumption was less at 1 647 m3/hr and in 2017 it was 1 661 m3/hr, which can be expected due to lower production and the decommissioning of the in-pit crusher. There is thus more than sufficient buffer to accommodate the additional water requirements of the DMS Upgrade Project. (e) See answer given above to comment (d). Any additional water requirements can be accommodated in the existing licensed volumes. (f) The project does not trigger any new water uses. The project is a brownfields development with no activities taking place within watercourses, 1 in 100 year flood lines or within 500 m of wetlands. No authorisation in terms of Section 21(c) and (i) is required. (g) Note that the project does not require any additional activities that require authorisation in terms of Section 21(g). (h) Sishen Iron Ore Company (Pty) Ltd will take a decision to proceed with the project during Q4 of 2019. The above plans will then be updated to include the project as per your request. (i) This requirement is noted and will be adhered to. (j) This requirement is noted and will be adhered to. (k) The requirement is noted. Sishen Mine is currently in the process of applying for exemption from GNR. 704 Regulation 5 as part of the consolidation of the integrated water use licence process. It is confirmed that no such material will be used for construction unless exemption has been granted from GNR. 704 Regulation 5.	

DATE	NAME	CORRESPONDENCE RECEIVED	EAPs RESPONSE TO ISSUES AS MANDATED BY THE APPLICANT	CONSULTATION STATUS (consensus, dispute, not finalised, etc.)
		(m) No activity may occur within the 1:100 year flood line of a river/drainage limes without authorisation. No activity may occur within the 500 metres of a pan/wetland (perennial/non perennial) without authorisation. (n) Section 19 & 20 of the National Water Act, 1998 (Act No 36 of 1998) should be adhered to. (o) The disposal of general waste and that of hazardous waste will be carried out in an environmentally safe way as to prevent and/or minimise the potential for pollution of water resources and collection of which should be done by an accredited waste collector, All applicable section of the National Environmental Management: Waste Act 59 o 2008 should be strictly adhered to.	(l) Only an amendment to the existing licence for additional annual discard volumes is required to accommodate the project. It is however suggested that a meeting be set up with the Department to discuss the project and to provide further clarification on comments raised on the DMS Upgrade Project. (m) See response to comment (f). No such activities will take place as part of the DMS Upgrade Project. (n) Noted. (o) The requirement is noted and will be complied with. Note that the processing of low grade material is in itself a listed activity under the National Environmental Management: Waste Act. Authorisation is being sought in terms of the Act. Conclusion Thank-you for the comments received and these will be included in the documentation submitted to the Department of Mineral Resources for consideration in the authorisation process. We suggest that a meeting be set up in the near future to discuss the project and provide further clarity on your comments.	
Traditional Leaders	No comments received yet.			
Competent Authorities affected	No comments received yet.			
INTERESTED PARTIES				
30/06/2017	Tshegofatso Nnene	Do you perhaps have the property description of where this activity will be taking place?	Thank you for contacting us. The proposed project is a brownfield project located within the existing footprint/mining right area of the Sishen Mine. The only affected properties within the Sishen Mining boundary are as follows: • Remainder of Portion 1 of Bruce 544: C04100000000054400001 • Remainder of Sekgame 461: C04100000000054300000 • Remainder of Portion 1 of Sims 462: C04100000000046100000 • Remainder of Sishen 543: C04100000000056200001 Please also refer to attached layout plan and supporting Background Information Document.	Consensus
01/07/2017	Mev. Mimi Swart	Met dank kennis geneem. ek moet ongelukkig Raadsopleiding op 5e in Upington underran en sale nice can bison nine.	We have registered you as part of the project and take note of your absence for the public meeting.	Consensus
03/07/2017	Dicky Marais	We are interested to obtain more information and register for the Sishen Mine DMS Plant Upgrade. We are from Kathu. We are Red Sand Engineering.	Thank you for contacting us and we have registered you for the project. We will inform you of the available reports for comment once finalised. Please refer to attached Background Information Document (BID) regarding the project.	Consensus

DATE	NAME	CORRESPONDENCE RECEIVED	EAPs RESPONSE TO ISSUES AS MANDATED BY THE APPLICANT	CONSULTATION STATUS (consensus, dispute, not finalised, etc.)
		Attached is a letter with our history and experience. Can you please supply us with the necessary information to be part of the information sharing meeting.	Please note that the information sharing meetings purpose is to discuss **environmental** related matters concerning the project. This forms part of the environmental authorisation process required in terms of National Environmental Management Act, 1998. EXM has been appointed by Sishen Mine as independent environmental practitioners to facilitate the process. This process is mainly to provide comments and raise potential concerns relating to environmental and social impacts and does not form part of the mines procurement processes for the project. The project is only planned for construction after all the required approvals are obtained in 2022. An application is being sought for authorisation in terms of: • Section 102 of the Minerals and Petroleum Resources Development Act for an amendment to the Sishen Mine Environmental Management Programme. • Regulation 31 of Part 2 of Chapter 5 of the Environmental Impact Assessment Regulation GN. 982 of 4 December 2014 under the National Environmental Management Act for an amendment to the Environmental Management Programme. • Waste Management Activities 3 & 11 of Regulation GN. 921 as amended by GN. 633 of 24 July 2015 under National Environmental Management: Waste Act for the reclamation of low grade iron ore material from residue stockpiles.	
05/07/2017	Jan Beukes	Issues raised during the public meeting held on the 5 July 2017: 1) We are involved in a project where they are crushing and screening for blasting services and need to understand how this project will affect their process outside the mine. 2) How will this project accommodate the community at large?	1) These are two different projects and that the product use is a completely different material and that there are different types of stockpiles. The project will therefore not impact on your business. 2) At the end of the pre-feasibility stage they will have developed the supply chain contract and strategy and in the supply chain report they will specify the strategy which will be used obtaining quotations as well as when it will go out on tender.	Consensus
10/07/2017	Jurie Swanepoel	Is it possible to send me the electronic copy of the report of the upgrade of the plant.	Thank you for contacting us regarding the project. A copy of the report was provided in electronic format via email.	Consensus
10/07/2017	Judi Bolweg	Thank you for including the Kathu Gazette as an interested and affected party regarding projects at Sishen mine. Would you kindly remember to contact me as soon as the new crusher has been installed, as I would like to run an article on the upgrade of the DMS plant then.	The proposed project is only expected to start with construction in 2019.	Consensus

DATE	NAME	CORRESPONDENCE RECEIVED	EAPs RESPONSE TO ISSUES AS MANDATED BY THE APPLICANT	CONSULTATION STATUS (consensus, dispute, not finalised, etc.)
	Jan Beukes	Kindly send me an electronic copy of the report, for viewing purposes.	Thank you for contacting us regarding the project. A copy of the report was provided in electronic format via email.	Consensus
15/03/2018	Jurie Swanepoel (Anglo American)	Josh Is it possible to send me a copy of this report. Thanks Jurie	Good Morning Jurie, As requested, please find attached the following files: - Part A: EIA Draft Report and Appendices A & B - Part B: Draft Environmental Management Programme - Part C: Specialist Study Reports (Appendix 1 – 7). Should you have any questions, comments or concerns, please feel free to contact me on or before 18 April 2018. Kind regards, Josh. e: joshua@exm.co.za	Consensus
15/03/2018	Paul Henderson	Dear Josh, Thanks for your email. I no longer provide services for Assmang/KHDC, and would therefore be grateful if my contact details could be deleted from your address list, and substituted by those of Retha Mboya, of African Rainbow Minerals, who has been copied on this email. Thanks and regards. Paul	Hi Paul I have deleted your contact details from the database and added Retha Mboya's, as requested. Have a good day. Kind regards Josh	Consensus
19/03/2018	Danie Krige	Dear Joshua O'Brien Could I please ask for an electronic copy of "The Draft Environmental Impact Assessment (EIA) Report for the Sishen Mine DMS Upgrade Project". I use to be an employee of Kumba and had been involved in the DMS upgrade project and hence my interest in the report. Kind regards, Danie Krige	Good Morning Danie, Thank you for your email. Please find attached the following files: - Part A: EIA Draft Report and Appendices A & B - Part B: Draft Environmental Management Programme. - Part C: Specialist Study Reports (Appendix 1 – 7). Should you have any questions, comments or concerns, please feel free to contact me on or before 18 April 2018. Kind regards. Josh. e: joshua@exm.co.za	Consensus
20/03/2018	Douglas Kennedy	Hi Joshua Could you please send us an electronic copy of the report? Kind regards Douglas	Good afternoon Douglas Thank you for your email. Please find attached the following files: - Part A: EIA Draft Report and Appendices A & B. - Part B: Draft Environmental Management Programme. - Part C: Specialist Study Reports (Appendix 1 – 7). Should you have any questions, comments or concerns, please feel free to contact me on or before 18 April 2018.. Kind regards, Josh. e: joshua@exm.co.za	Consensus
22/03/2018	Albertus Viljoen	Hallo Joshua Will you please share the document electronically? Regards, Albertus Viljoen	Good morning Albertus Please find attached the following files: - Part A: EIA Draft Report and Appendices A & B. - Part B: Draft Environmental Management Programme. - Part C: Specialist Study Reports (Appendix 1 – 7). Should you have any questions, comments or concerns, please feel free to contact me on or before 18 April 2018. Kind regards, Josh. e: joshua@exm.co.za	Consensus

8. THE ENVIRONMENTAL CONTRIBUTION ASSOCIATED WITH THE DEVELOPMENT FOOTPRINT ALTERNATIVES.

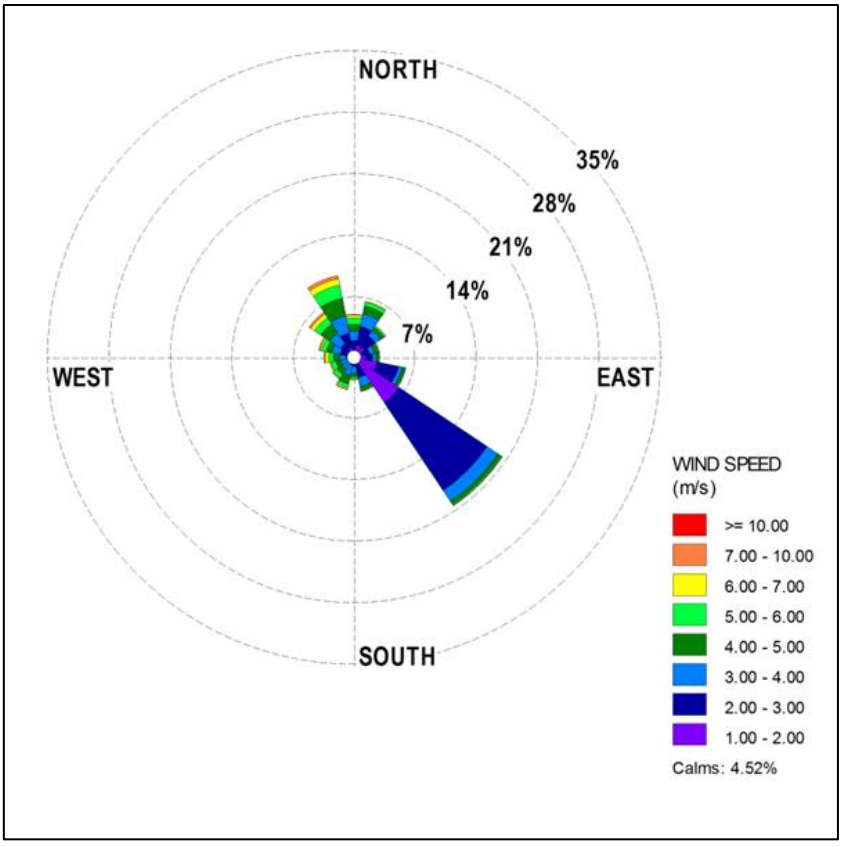
8.1 Types of baseline environments affected by the proposed project

The DMS Upgrade Project is a brownfields development and will take place within already disturbed areas within the fenced-off area at Sishen Mine.

8.1.1 Climate

8.1.1.1. Wind

The regional wind direction and speeds are of importance as they provide an indication of the receptor areas that will experience the greatest impacts resulting from atmospheric emissions and dust. The wind rose for the period of July 2015 to June 2016 (as provided by Airshed, January 2018) is provided in Figure 8-1. The wind field is dominated by winds from the north-west and south east with calm conditions occurring only 5% of the time. During the day, more frequent winds at higher wind speeds occurred from the north-westerly sector with 3% calm conditions. Night-time airflow had less frequent winds from the north-westerly sector and at lower wind speeds with winds mostly occurring from the south-easterly sector. The percentage calm conditions increased to 7%.



Source: Air Quality Impact Assessment (Airshed January 2018)

FIGURE 8-1: PERIOD AVERAGE WIND ROSE FOR SISHEN MINE JULY 2015 TO JUNE 2016

8.1.1.2. Temperature

Minimum, maximum and mean temperatures for the project area, as obtained from on-site data, are shown in Table 8-1. Diurnal monthly average temperatures are shown in Figure 8-2. Maximum, minimum and average temperatures were 34°C, 5°C and 21°C, respectively. The month of July experienced the lowest temperature whereas the maximum temperature occurred in December. Temperatures reach a minimum just before sunrise and a maximum between midday and sunset.

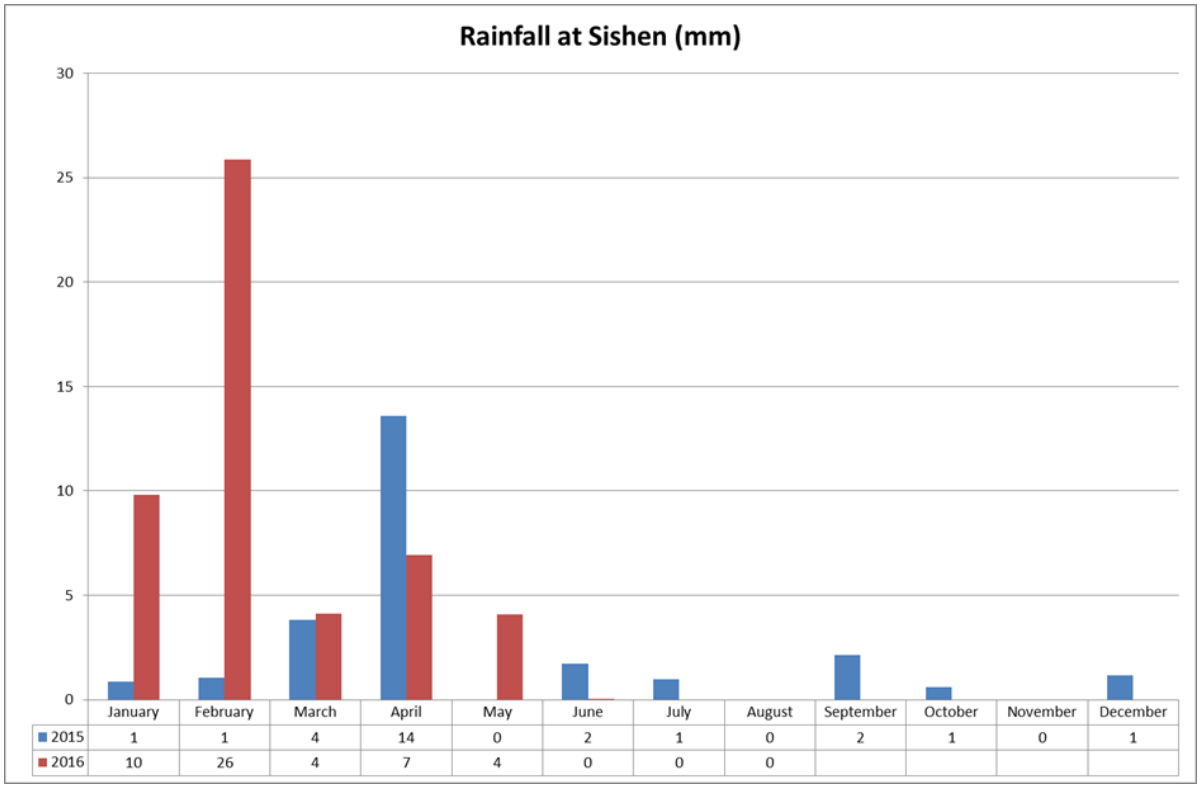
TABLE 8-1: MONTHLY TEMPERATURE SUMMARY

Hourly Minimum, Hourly Maximum and Monthly Average Temperatures (°C)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Minimum	20	18	16	12	8	5	4	8	12	16	14	19
Maximum	34	35	31	28	27	22	22	27	29	35	32	36
Average	27	27	23	19	16	12	12	16	20	26	24	28

Source: Air Quality Impact Assessment (Airshed, January 2018)

8.1.1.3. Rainfall

Rain typically occurs primarily as storms and individual rainfall events can be intense. This creates an uneven rainfall distribution over the wet season (November to March). The largest amount of rain fell during February 2016 (Figure 8-2).



Source: Air Quality Impact Assessment (Airshed, January 2018)

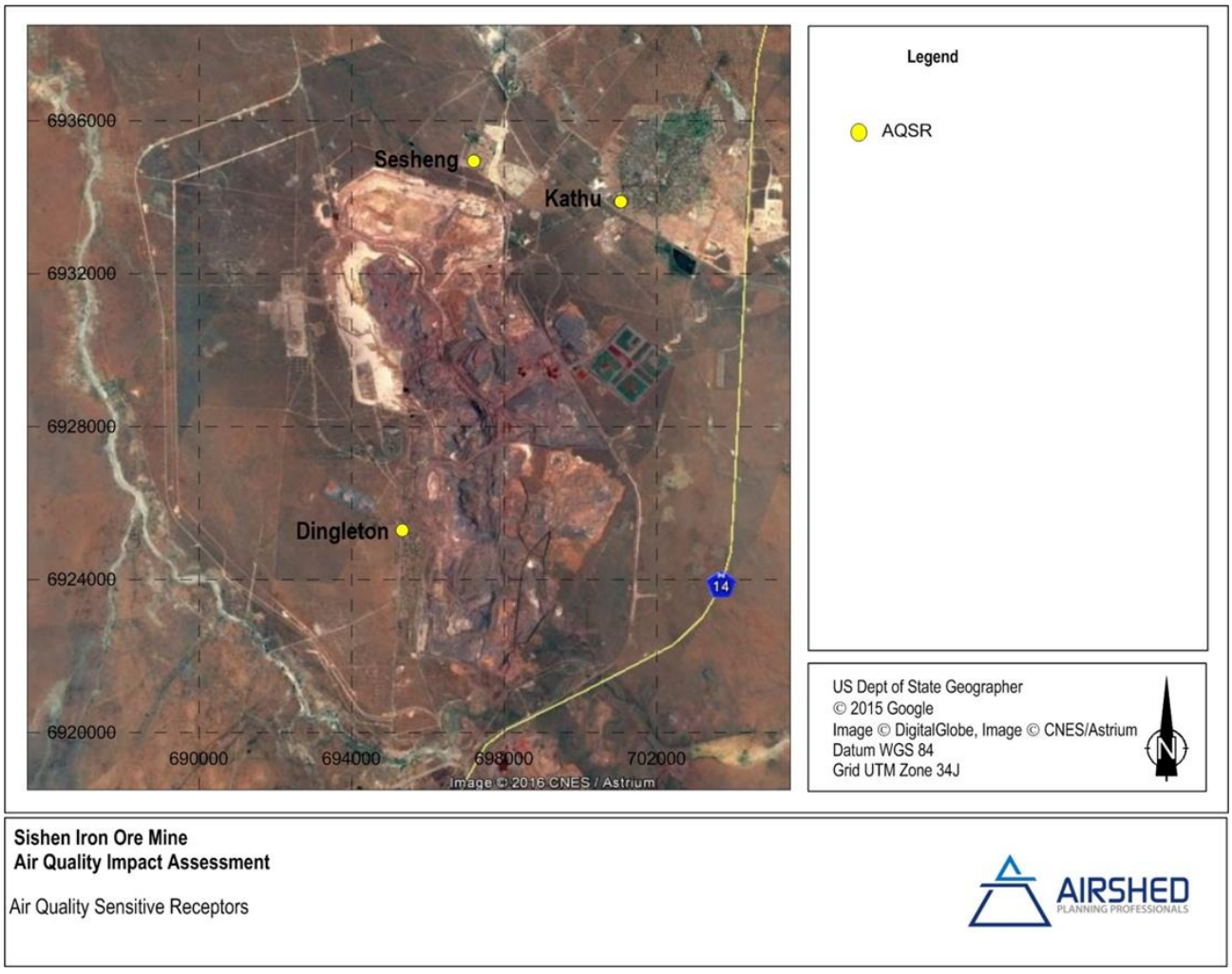
FIGURE 8-2: MONTHLY RAINFALL AT SISHEN (2015 – 2016)

8.1.2 Air Quality

The description of the existing air quality environment has been sourced from work undertaken as part of the Air Quality Impact Assessment (Airshed, January 2018), see Part C – Appendix 1

The region is characterised as being a relatively dry, arid, and dusty environment. It is expected that various local and far-a-field sources contribute to suspended fine particulate ($PM_{2.5}$ and PM_{10}) concentrations in the region. Local sources include wind erosion from exposed areas, fugitive dust from agricultural and mining activities, and vehicle entrainment from roadways.

The locations of the three sensitive receptors where measurements were taken are shown in Figure 8-3.



Source: Air Quality Impact Assessment (Airshed, January 2018)

FIGURE 8-3: MAIN AIR QUALITY SENSITIVE RECEPTORS AROUND SISHEN MINE

The monitored ambient PM_{10} and $PM_{2.5}$ and collected dust fallout data are screened against the NAAQS (based on international best practice PM_{10} and $PM_{2.5}$) and the National Dust Control Regulations (GN. 827 of 1 November 2013), respectively. The ambient measurements account for all emission contributions in the region, not just the mine. The results of the 2016 PM_{10} and $PM_{2.5}$ monitoring are shown in Table 8-2 and Table 8-3, respectively. The PM_{10} concentrations at Dingleton and Sesheng are not in compliance with the NAAQS. The ambient air quality also does not meet the Anglo internal air quality target as it contributes more than 70% of the EC Limit Value (28 µg/m³ for annual and 35 µg/m³ for daily). The $PM_{2.5}$ concentrations at all three receptors (Dingleton, Sesheng, and Kathu) are, however, in compliance with NAAQS.

TABLE 8-2: SUMMARY OF PM_{10} CONCENTRATIONS FOR THE SISHEN MINE FOR 2016 (BASED ON SCREENED DAILY DATA RECEIVED FROM SISHEN)

Receptor	Annual Average Conc. (µg/m3)	Days of Exceedance of 75 µg/m3	Days of Exceedance of 35 µg/m3	Data availability (%)
Dingleton	39	**30**	**131**	78
Sesheng	**47**	**35**	**227**	90
Kathu	28	2	**87**	84
NAAQS (Daily and annual)	**40**	**4**	**35 (EC)**	

: Source: Air Quality Impact Assessment (Airshed, January 2018)

TABLE 8-3: SUMMARY OF $PM_{2.5}$ CONCENTRATIONS FOR THE SISHEN MINE FOR 2016 (BASED ON SCREENED DAILY DATA RECEIVED FROM SISHEN)

Receptor	Annual Average Conc. (µg/m3)	Days of Exceedance of 40 µg/m3	Data availability (%)
Dingleton	8.3	0	67
Sesheng	13.4	1	86
Kathu	7.9	1	78
NAAQS (Daily and annual)	**20**	**4**	

Source: Air Quality Impact Assessment (Airshed, January 2018)

Dustfall also shows non-compliance with the national dust fallout limits. Non-compliances with the National Dust Control Regulations during the 2015 - 2016 monitoring campaign are given in Table 8-4. The national dustfall limit for residential areas is 600 mg/m²/day, and for non-residential areas is 1 200 mg/m²/day (Airshed, January 2018). The location of the Sishen buckets is illustrated in Figure 8-4. Site classification according to residential or non-residential was done by Gondwana who also manage the dust fallout network (Gondwana Environmental Solutions, 2016; Airshed, 2018).

TABLE 8-4: SUMMARY OF MONTHS DURING WHICH DUSTFALL EXCEED ACCEPTABLE LEVELS AS SPECIFIED IN THE NATIONAL DUST CONTROL REGULATIONS (JULY 2015-JUNE 2016)

Residential Areas (limit = 600 mg/m²/day)	**Months of Non-Compliance**
SB14 – Kathu	October 2015
SB16 – Sesheng	October 2015
SB31 - Tannic Kale Farm	October and December 2015
SB36 – Frum Sub Station	**September, October and November 2015[1]**
SB39 – Voëltjieklub	October 2015
SB41 – Dingleton	October and December 2015
SB71 – New Dingleton PPK Church	February 2016
Non-residential Areas (limit = 1 200 mg/m²/day)	**Months of Non-Compliance**
SB15 – Wincanton	October 2015 and January 2016
SB27 – Demaneng	**October 2015, January and March 2016[1]**
SB28 – Lylyveld North	October 2015 and January 2016
SB29 – Tamaga	October 2015
SB30 – Fritz	October 2015
SB34 – Vliegveld	October 2015
SB44 – Pipeline manhole	October 2015
SB45 – Pipeline T-joints	**September and October 2015[1]**

[1]Non-compliance with the NDCR permitted frequency of 2 exceedances per year, not in sequential months

Source: Air Quality Impact Assessment (Airshed, January 2018)

The residential and non-residential dustfall rate results (from the 2015 – 2016 dustfall sampling campaign) are shown in Figure 8-5 and 8-6, respectively.

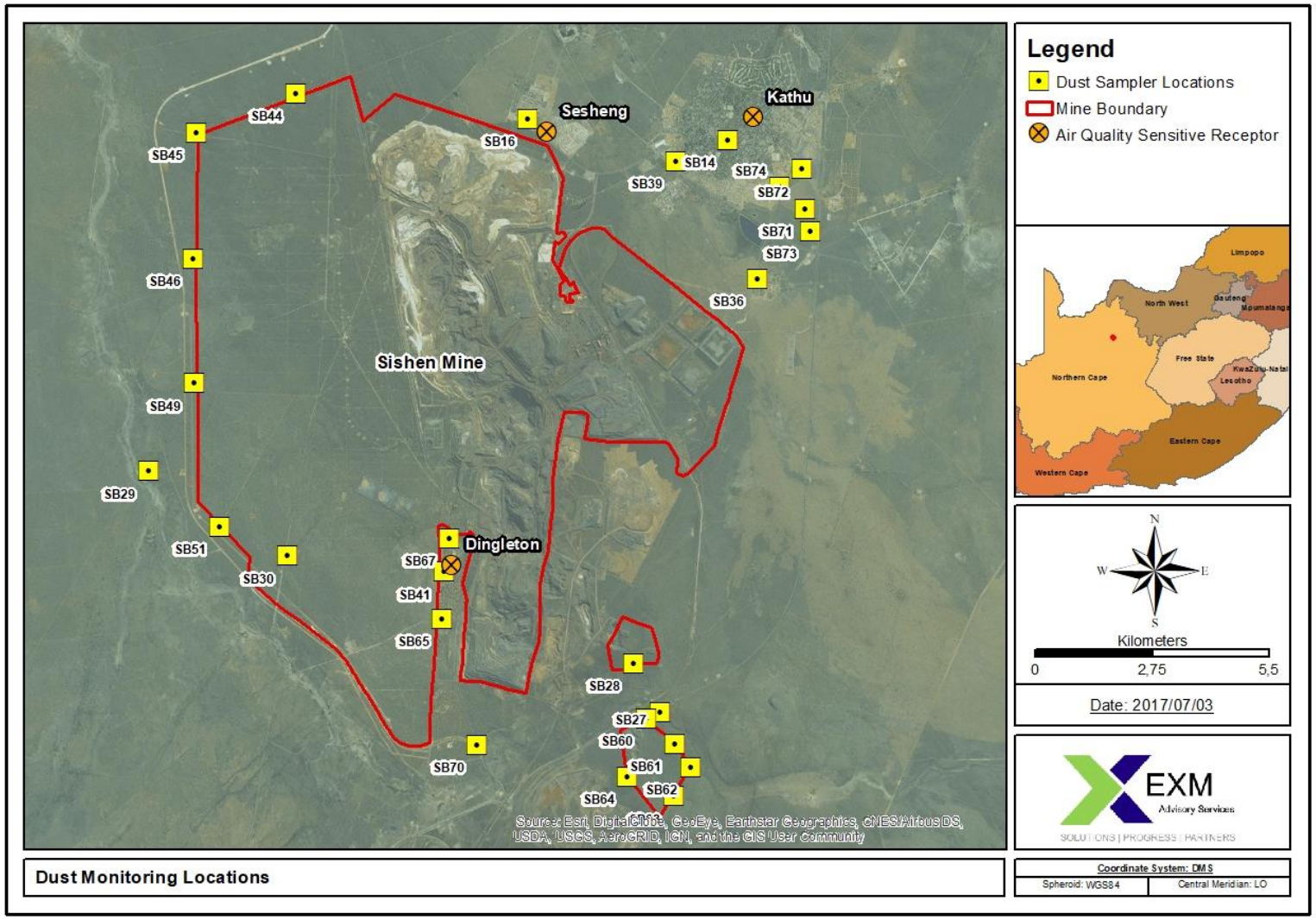
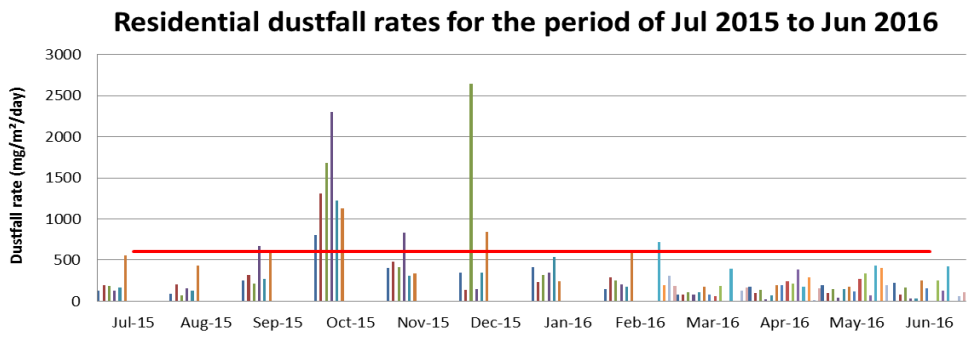


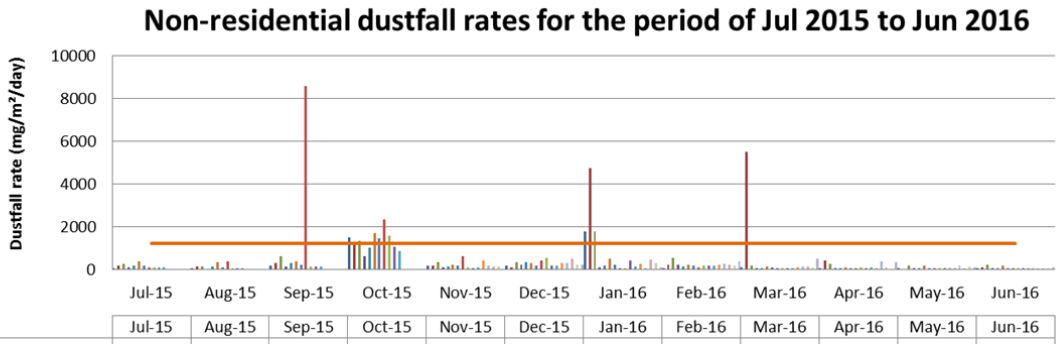
FIGURE 8-4: LOCATION OF DUST MONITORING STATIONS AND KEY RECEPTORS AT SISHEN MINE



	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16
SB14 Kathu Town	129	93	253	805	402	342	417	150	76	179	198	222
SB16 Sesheng Town	194	205	314	1314	478	138	228	293	84	96	95	80
SB31 Farm Tannie Kalp	183	70	209	1679	414	2648	315	249	113	133	142	169
SB36 Ferrum Sub Station	129	157	668	2303	834	147	346	204	77	26	43	35
SB39 Voëltjieklub	168	123	266	1224	310	343	538	173	109	71	144	36
SB41 Dingleton	557	432	586	1131	337	838	237	594	175	193	178	247
SB65 Dingelton South									77	192	118	158
SB66 Dingleton Centre									59	241	268	
SB67 Dingleton North									182	216	336	248
SB70 South old Dingleton										387	74	126
SB71 New Dingleton PPK Church								714	392	179	436	420
SB72 New Dingleton Centre								198		285	405	
SB73 New Dingleton N14								313	129	11	196	59
SB74 New Dingleton Christian Assembly Church								184	162	158		106
Limit	600	600	600	600	600	600	600	600	600	600	600	600

Source: Air Quality Impact Assessment (Airshed, 2018)

FIGURE 8-5: RESULTS OF THE RESIDENTIAL DUSTFALL MONITORING CAMPAIGN FOR SISHEN



	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16
SB15 Wincanton farm	69	46	194	1509	188	184	1796	37	94	47	29	35
SB27 Demaneng ESKOM line	194	143	285	1300	159	111	4752	215	5522	398		89
SB28 Lylyveld North Mine Gate	240	156	605	1351	321	331	1776	556	164	260	196	216
SB29 Farm Tamaga	108		155	629	112	202	116	199	40	26	26	21
SB30 Farm Fritz	180	155	284	1013	122	347	177	156	68	46	40	34
SB34 Vliegveld South East	397	319	385	1685	200	280	508	212	129	107	192	163
SB44 Pipeline Manhole AV82	158	115	221	1458	160	175	232	173	114	50	57	51
SB45 Pipeline T-joint	81	386	8597	2328	636	421	57	90	49	33	49	33
SB46 Pipeline Manhole AV67	90	45	149	1592	106	522	63	165	2	108	19	21
SB49 Pipeline Waterpoint #2	95	42	133	1062	70	177	421	194	47	38	25	17
SB51 Pipeline Waterpoint #1	111	63	138	841	103	163	133	186	53	102	11	31
SB60 Lylyveld South (Main Gate)					406	311	257	203	86	66	49	64
SB61 Lylyveld South (Fence #1)					191	286	71	269	124	393	188	59
SB62 Lylyveld South (Fence #2)					151	485	460	222	122	81	59	29
SB63 Lylyveld South (Demaneng East)					133	235	294	162	92		154	59
SB64 Lylyveld South (Tower)						204	116	359	484	327	97	89
Limit	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200

Source: Air Quality Impact Assessment (Airshed, January 2018)

FIGURE 8-6: RESULTS OF THE NON-RESIDENTIAL DUSTFALL MONITORING CAMPAIGN FOR SISHEN

According to Airshed (January 2018), the main sources of dust emanating from Sishen's operations are: crushing and screening; drilling and blasting (in the open pit); handling of waste and ore (in the open pit, at the waste dumps, and at the siding); transport of waste and ore on the haul roads; and windblown dust from the waste dumps. The contribution of the sources during the high production scenario (**56 Mtpa** production, prior to downscaling of operations) and low production scenario (**38 Mtpa** production, after downscaling) during the 2015 – 2016 period are illustrated in Figure 8-8. The DMS upgrade project will result in the processing of an additional ~ 8 - 16 Mtpa, however overall production rates although higher than low production scenario will not reach the high production scenario of 2015.

8.1.3 Noise

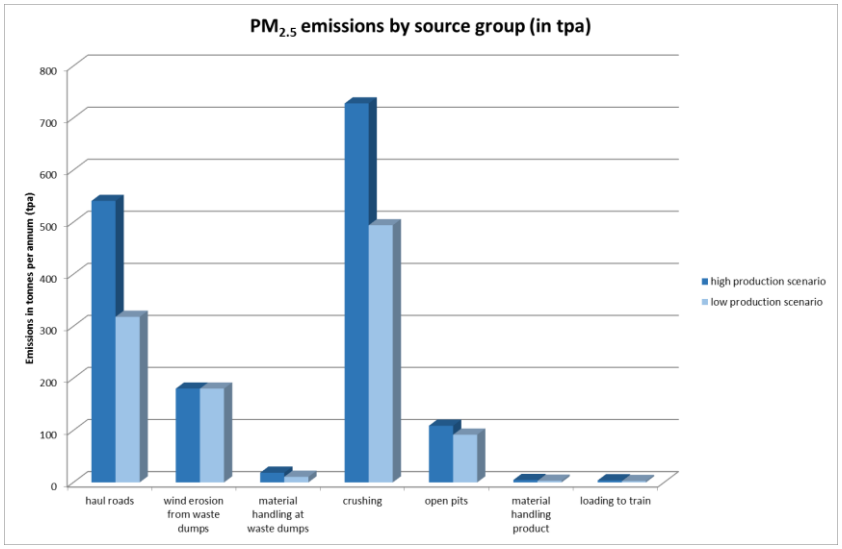
The description of the existing ambient noise environment has been sourced from work undertaken as part of the Noise Specialist Study (dBAcoustics, February 2018), see Part C – Appendix 2.

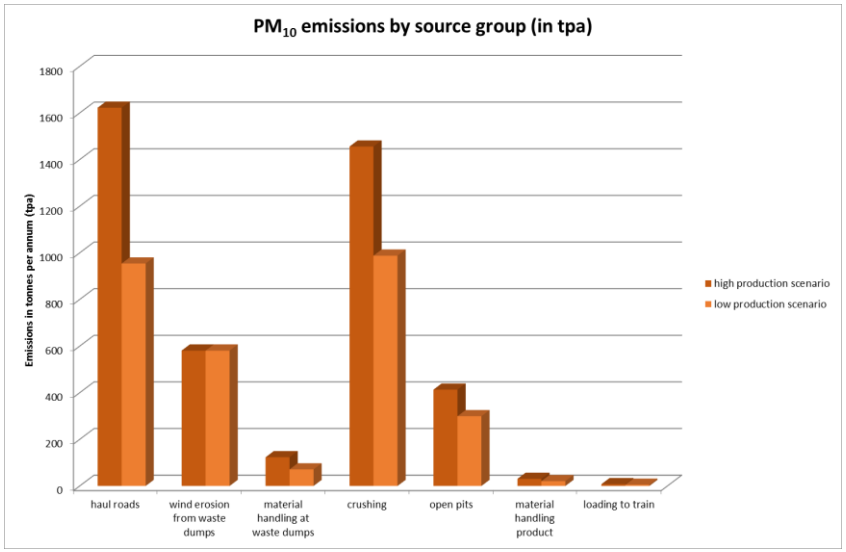
A noise survey was conducted by dBAcoustics during the winter (14 & 15 August) and summer (22 & 23 November) of 2017. The Environmental Health and Safety Guidelines for Noise are given in Table 8-5. The distance (m) between the measuring locations (noise sensitive areas) and the UPC & Overland conveyor and UHDMS are illustrated in Table 8-6.

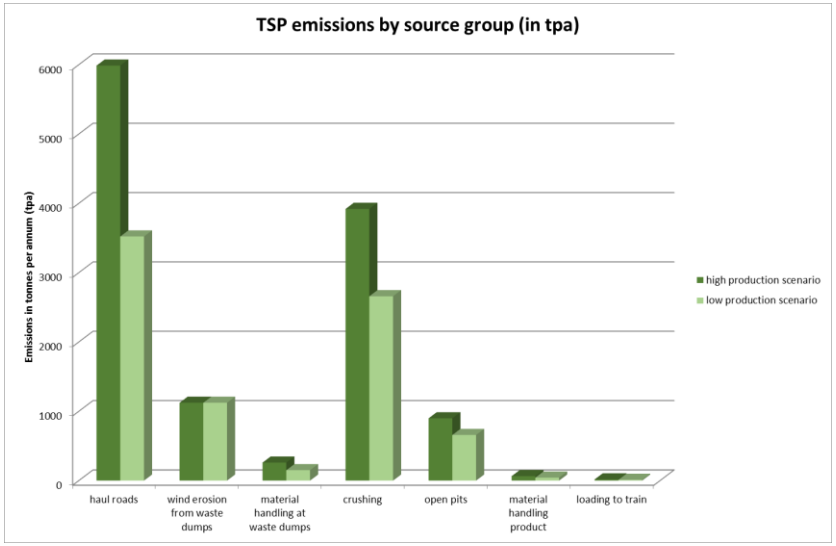
TABLE 8-5: ENVIRONMENTAL HEALTH AND SAFETY GUIDELINES FOR NOISE

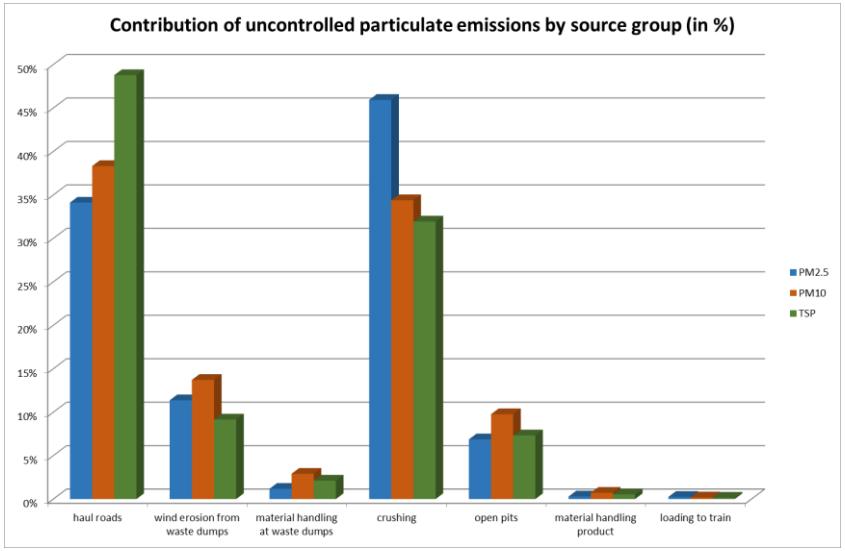
Receptor	Either		Or
	Period		Where baseline exceeds IFC guideline
	Daytime (07h00 - 22h00)	Night time (22h00 – 7h00)	
Residential, institutional and educational	55.0dBA	45.0dBA	3dB increase over baseline
Industrial and commercial	70.0dBA	70.0dBA	

Source: Noise Impact Assessment (dBAcoustics, February 2018)









Source: Air Quality Impact Assessment (Airshed, January 2018)

FIGURE 8-7: SOURCE GROUP CONTRIBUTIONS TO THE ESTIMATED ANNUAL DUST EMISSIONS FOR LOW AND HIGH PRODUCTION SCENARIOS

TABLE 8-6: DISTANCES BETWEEN THE PROPOSED PROJECT AREAS AND THE MEASURING POINTS

Location	Distance between the measuring point and the proposed project sections in meters	
	UPC & Overland conveyor	UHDMS
Sheseng	4 435	5 627
Western side of Kathu	5 754	5 346
Eastern side of Sishen mine	4 031	2 373
Kathu Agricultural Holdings	9 131	7 030
Dingleton	4 050	5 210
Farms to the west of Sishen mine	8 934	11 071

Source: Noise Impact Assessment (dBAcoustics, February 2018)

The noise levels at the different locations recorded by dBAcoustics are given for the winter and summer periods in Table 8-7 and Table 8-8, respectively.

TABLE 8-7: ARITHMETIC PREVAILING NOISE LEVELS DURING THE WINTER

Location	Prevailing ambient noise levels in dBA	
	Prevailing ambient noise level - day	Prevailing ambient noise level - night
Sheseng	41.9	32.6
Western side of Kathu	47.1	37.7
Eastern side of Sishen mine	39.5	34.4
Kathu Agricultural Holdings	38.2	28.3
Dingleton	44.1	43.9
Farms to the west of Sishen mine	31.7	30.3

Source: Noise Impact Assessment (dBAcoustics, 2018)

TABLE 8-8: ARITHMETIC PREVAILING NOISE LEVELS DURING THE SUMMER

Location	Prevailing ambient noise levels in dBA	
	Prevailing ambient noise level - day	Prevailing ambient noise level - night
Sheseng	44.0	37.8
Western side of Kathu	47.3	39.6
Eastern side of Sishen mine	40.4	37.8
Kathu Agricultural Holdings	37.0	35.1
Dingleton	47.3	47.3
Farms to the west of Sishen mine	36.9	31.1

Source: Noise Impact Assessment (dBAcoustics, 2018)

The noise levels at Sishen Mine are considered to be normal and in line with the recommended noise levels as prescribed in SANS 10103 of 2008, as well as international best practice (described by the IFC).

8.1.4 Groundwater

There is an extensive groundwater monitoring network at Sishen Mine (see Figure 8-8). The quality of primary and shallow groundwater at Sishen Mine has been impacted on by historic pollution, with hydrocarbons being the most important contaminants, resulting in pollution at the mine. The areas where pollution has occurred are the Aldag Service Station, the existing Diesel Workshop, the Total Depot, the Load-out Station workshop area, the current hazardous waste storage yard and the Primary Crusher Tunnel.

Non-compliances of groundwater quality with South African National Standards for drinking water (SANS, 2015) are shown in Table 8-9. Exceedances include nitrate, ammonia, lead and manganese. Exceedances that present a health risk are indicated in red while those that are unacceptable form an aesthetic perspective are indicated in yellow.

Of consideration is the possible change in the leachate potential from discard and slimes as a result of the disposal and stockpiling of waste originating from the processing of C-grade material at these facilities. The existing residue from the slimes and discard facilities were found to comply with the leachate standards as set out in NEM: WA regulations (Regulation GN. 635 of 23 August 2013) for the liquid extraction phase (Exigo, December 2014). The total concentration of arsenic, barium, manganese, copper, lead and fluoride in this material exceeds the NEM: WA regulatory total concentration guideline values for the solid material. However, monitoring data (2004 - 2014) shows that none of these constituents exceed drinking water guidelines (see Table 8-9). This suggests that they are unlikely to leach from the residue material (Exigo, December 2014). The existing Sishen Mine residue material has been classified as inert. Current and long-term contamination of groundwater and surface water from the material is shown to be unlikely (Exigo, December 2014). It is not expected that the disposal of the material will result in any substantial change to the risks to the groundwater environment.

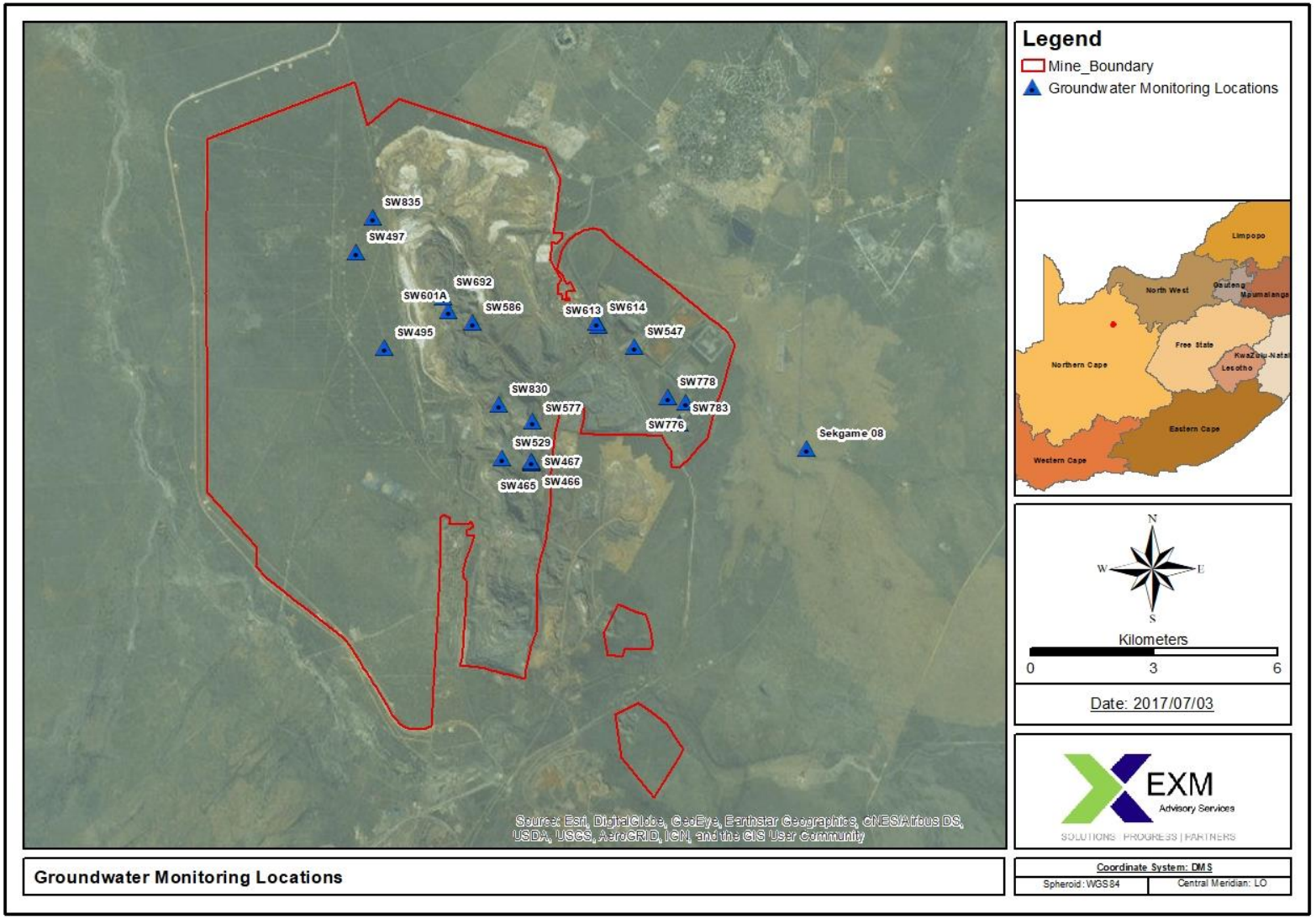


FIGURE 8-8: EXISTING GROUNDWATER MONITORING POINTS AT SISHEN MINE

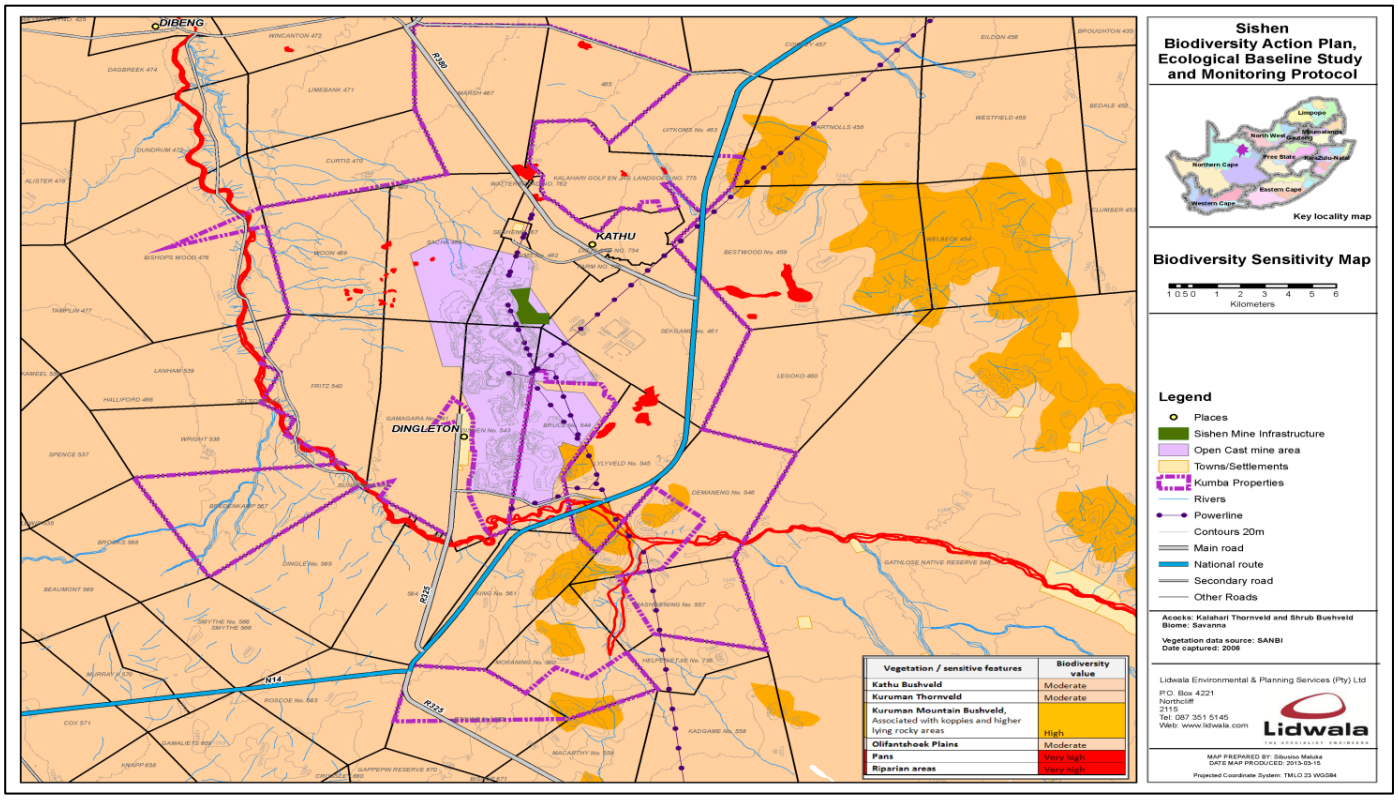
TABLE 8-9: NON-COMPLIANCES WITH SANS DRINKING WATER STANDARDS DETECTED IN GROUNDWATER AT SISHEN MINE (BASED ON 95TH PERCENTILE FROM 2003-2014)

Parameter	Symbol	Unit	Value	Risk	SW495	SW497	SW467	SW547	SW577
Total dissolved solids	TDS	mg/ℓ	1200	Aesthetic	430	386	415	956	414
pH	pH	pH units	5-9.7	Operational	7.6	7.5	7.4	7.7	7.5
Chemical determinants – Macro									
Nitrate	NO_3	mg/ℓ	50	Acute health-1	16	4	18	304	20
Sulfate	SO_4	mg/ℓ	500	Acute health-1	33	32	17	93	17
			250	Aesthetic	33	32	17	93	17
Fluoride	F	mg/ℓ	1.5	Chronic health	0.6	0.3	0.8	0.4	
Ammonia	NH_4	mg/ℓ	1.9	Aesthetic	0.1	0.2	0.2	2.5	0.2
Chloride	Cl	mg/ℓ	300	Aesthetic	39	37	30	100	32
Sodium	Na	mg/ℓ	200	Aesthetic	22	23	18	69	19
Zinc	Zn	mg/ℓ	5	Aesthetic	0	1	0	0	0
Chemical determinants – Micro									
Antimony	Sb	µg/ℓ	20	Chronic health	n.a.	n.a.	n.a.	n.a.	n.a.
Arsenic	As	µg/ℓ	10	Chronic health	b.d.	b.d.	b.d.	b.d.	b.d.
Cadmium	Cd	µg/ℓ	3	Chronic health	b.d.	b.d.	b.d.	b.d.	b.d.
Total Chromium	Cr	µg/ℓ	50	Chronic health	b.d.	2	b.d.	b.d.	b.d.
Cobalt	Co	µg/ℓ	500	Chronic health	2	3	b.d.	b.d.	b.d.
Copper	Cu	µg/ℓ	2000	Chronic health	37	35	31	51	33
Cyanide (recoverable)	CN	µg/ℓ	70	Acute health - 1	n.a.	n.a.	n.a.	n.a.	n.a.
Iron	Fe	µg/ℓ	2000	Chronic health	13	13	9	215	12
		µg/ℓ	300	Chronic health	13	13	9	215	12
Lead	Pb	µg/ℓ	10	Chronic health	0	19	16	1	14
Manganese	Mn	µg/ℓ	500	Chronic health	294	298	8	33	8
		µg/ℓ	100	Aesthetic	294	298	8	33	8
Mercury	Hg	µg/ℓ	6	Chronic health	b.d.	b.d.	b.d.	b.d.	b.d.
Nickel	Ni	µg/ℓ	70	Chronic health	12	11	9	b.d.	10
Selenium	Se	µg/ℓ	10	Chronic health	b.d.	b.d.	b.d.	b.d.	b.d.
Uranium	U	µg/ℓ	15	Chronic health	b.d.	b.d.	b.d.	b.d.	b.d.
Vanadium	V	µg/ℓ	200	Chronic health	54	45	48	b.d.	47
Aluminium	Al	µg/ℓ	300	Operational	b.d.	b.d.	b.d.	52	b.d.

Source: Mine Residue Leachate Assessment (Exigo, December 2014)

8.1.5 Biodiversity

Sishen Mine is located in the Kathu Bushveld/Kuruman Thornveld (Munica & Rutherford, 2006). The 'Sishen Mine Infrastructure' and 'Open Cast Mine' area has been described by Lidwala (March 2013) as having no biodiversity value (see Figure 8-9). The new primary crusher and infrastructure upgrades at the DMS plant will all take place within this area.



Source: Biodiversity Action Plan (Lidwala, March 2013)

FIGURE 8-9: SISHEN MINE BIODIVERSITY SENSITIVITY MAP (2013)

The existing mineral residue management areas, including the current slimes dams and plant discard dump, are included in the area as described by Lidwala (March 2013) as having moderate biodiversity value as they occur in the Kathu Bushveld (Lidwala, March 2013).

The DMS Upgrade Project will make use of these existing authorised (see Figure 8-10) waste facilities and no amendment to the facilities is included as part of this project. The project will thus not impact on any additional biodiversity at these sites.

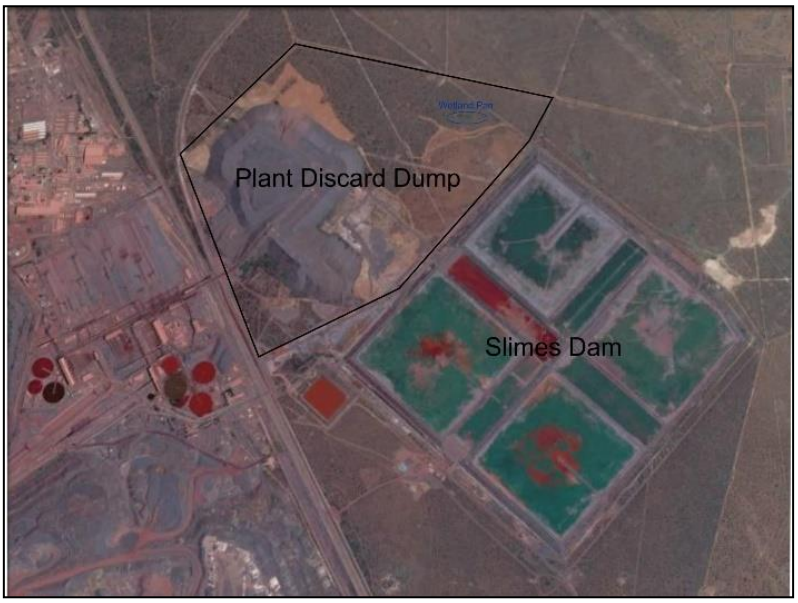


FIGURE 8-10: EXISTING AUTHORISED PLANT DISCARD DUMP AND SLIMES DAM

8.1.6 Surface Water Resources

Sishen Mine is located within the Vaal Water Management Area (WMA), in the D41J Quaternary Catchment drained by the endorheic Gamagara River. The regional drainage pattern of the area is primarily to the northwest in the direction of the endorheic Gamagara River (see Figure 8-11), but most of the drainage lines in the mining area have historically been impacted on by mining activities. The DMS Upgrade Project occurs within this disturbed area and the infrastructure that will be developed is over 9 km from the Gamagara River and will not result in any further disturbances to watercourses or natural drainage at Sishen Mine.

Wetland pans are prominent in the vicinity of Sishen Mine. There is a wetland pan located within the authorised footprint area of the plant discard dump (see Figure 8-11) which is listed as on the National Freshwater Ecosystem Priority Areas database of the South African Biodiversity Institute (SANBI, 2011). The pan will be destroyed by the deposition of discard. The disturbance to the pan is however already authorised and is not considered a risk to the project. Sishen has an existing environmental authorisation for the extension of the discard dump over the pan and the water use licence allows for the destruction of the pan. The impact has already been addressed in previous assessments and this is impact is not considered to be part of the DMS Upgrade Project.

According to the latest Integrated Water & Waste Management Plan (Shangoni, July 2017), surface water monitored at Sishen Mine exceeds the water use licence quality requirements. Total dissolved salts including calcium, sodium, potassium, chloride and sulfates tend to be high in stormwater management systems. Oils and greases are also detected. Nitrates with in pit water is high and levels in the Western Stormwater Canal also exceed requirements.

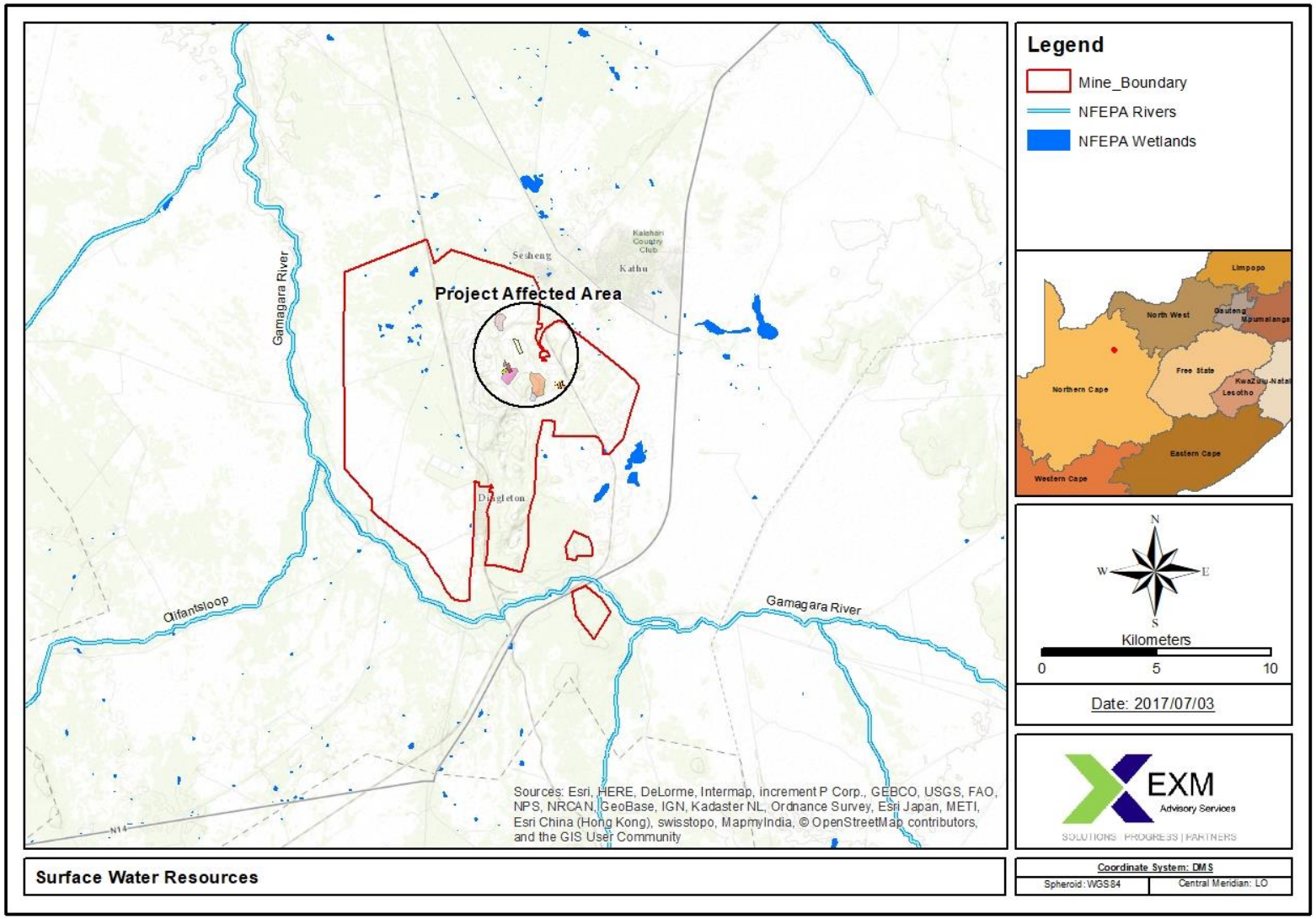


FIGURE 8-11: SURFACE WATER RESOURCES IN THE VICINITY OF SISHEN MINE

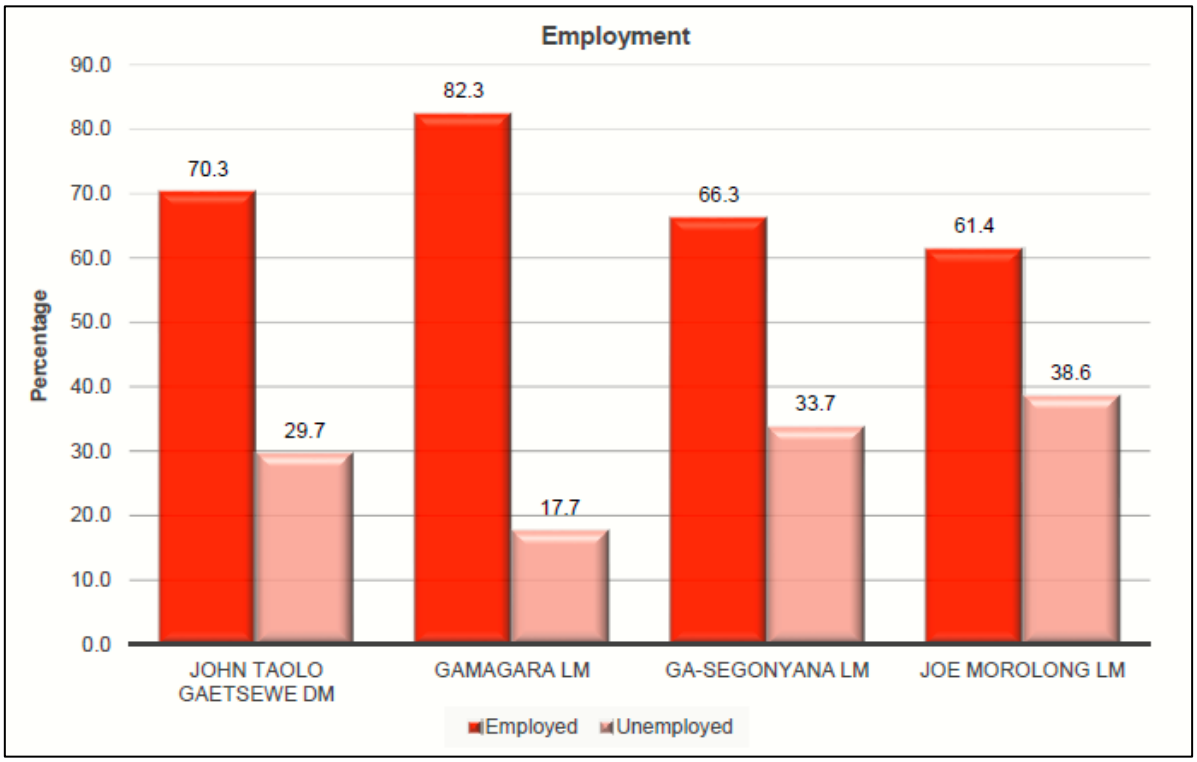
8.1.7 Socio-Economic Environment

An Economic Impact Study has been completed for the project (Demacon, October 2017), see Part C – Appendix 4. This information together with the Social Impact Assessment undertaken for Sishen Mine (Demacon, July 2016) has been used as a source of the information on the economic profile. Information on the existing social environment has been sourced from work undertaken as part of the Social Impact Assessment (Atlegang Social Intelligence, February 2018), see Part C – Appendix 5.

Sishen Mine is located in the Gamagara Local Municipality within the John Taolo Gaetsewe District Municipality, which includes the towns of Kathu, Dibeng, Sesheng and Olifantshoek. Sending municipalities include Joe Morolong Local Municipality and Ga-Segonyana Local Municipality.

The mine has played a significant role in the establishment and development of the town of Kathu and surrounds since 1953. The district is largely reliant on mining, with mining contributing 55.5% to the district and 77.5% to the local municipal economy. The mining sector is also the largest employer in the local economy. Trade is a major driver in both the district and local municipality economies. This illustrates the importance of the mining industry in the area. According to Demacon (July 2016) there are approximately 50 000 people living in the Gamagara municipal area of which 65% are economically active and 82.3% are formally employed. The sending municipalities show lower economically active segments with approximately 51% and 26% of persons being economically active in Ga- Segonyana Local Municipality and Joe Morolong Local Municipality, respectively. Unemployment in these municipalities is also high at 33% and 39%, respectively. Similarly, the living standards in the sending municipalities are far lower than in Gamagara.

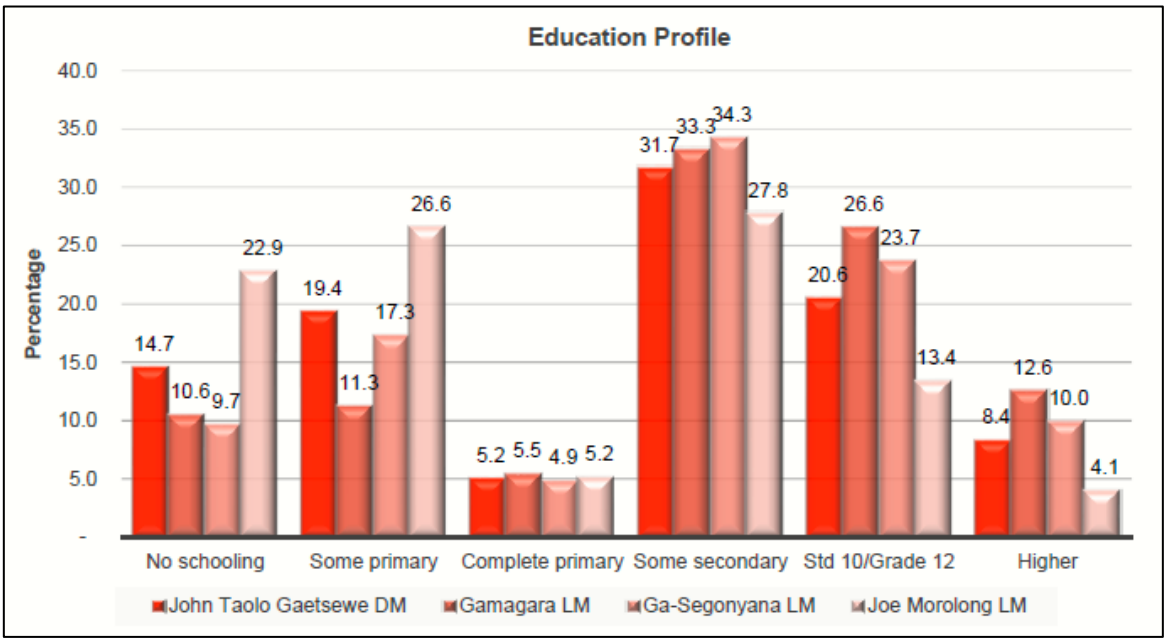
The level of employment reflects employment and unemployment levels in the district and local municipalities, which impacts on disposable income patterns. Level of employment, coupled with household size is also indicative of dependency ratios (refer to Figure 8-12). The Gamagara Local Municipality has a lower unemployment level than the national average of approximately 25.0%. High employment rate, coupled with a large percentage of people who are economically active, are indicative of lower dependency ratios. The two sending municipalities have a higher unemployment rate. This, coupled with a low percentage of people who are economically active and larger household sizes, means high dependency ratios will prevail. A large number of the households in the district municipality rely on employees in the Gamagara Local Municipality.



Source: Demacon ex Stats SA (seasonally adjusted), October 2017

FIGURE 8-12: EMPLOYMENT OF THE DISTRICT AND LOCAL MUNICIPALITIES

A relatively large segment of the population is educated in the Gamagara Local Municipality, whilst a large segment of the sending municipalities, especially Joe Morolong Local Municipality, is uneducated. The Gamagara Local Munipality has a higher percentage of people with Grade 12 or a higher degree. Figure 8-13 illustrates the highest level of education of the population in the district and local municipalities.



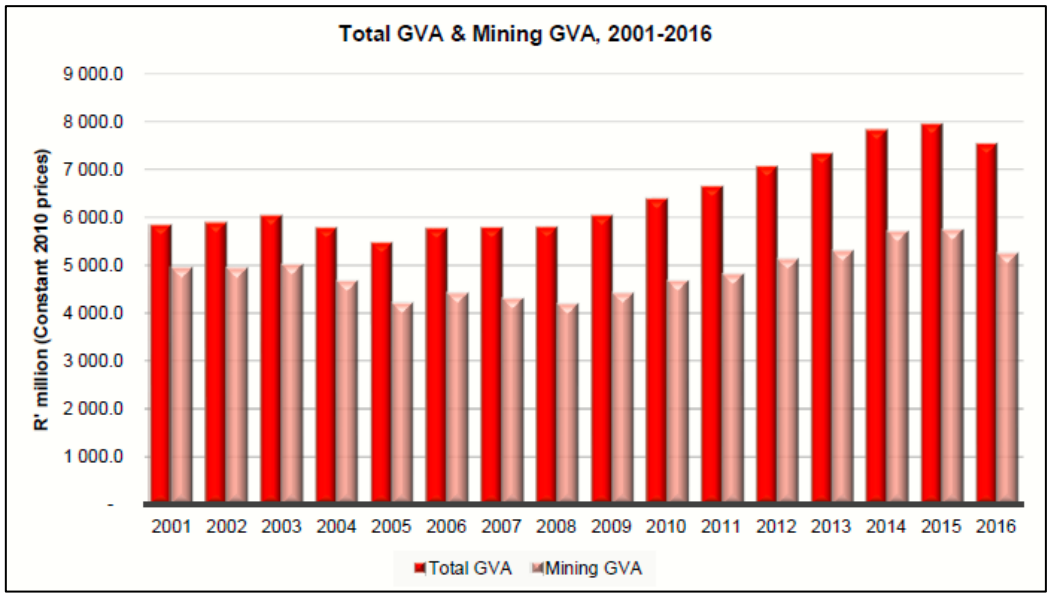
Source: Demacon ex Stats SA (seasonally adjusted), October 2017

FIGURE 8-13: HIGHEST LEVEL OF EDUCATION (POPULATION SEGMENT AGED 20 YEARS AND OLDER)

Sishen Mine plays a crucial role in both the local and provincial economy. For every employee working at the mine, approximately 5 other people are affected (Demacon, July 2016). Restructuring at Sishen Mine was implemented in 2016 in response to a slump in the iron ore price. Thus, both retrenchments in 2016 (approximately 4 000 persons including contractors) and a lowering of production at Sishen Mine since 2015 has had a major impact on the local economy; with an estimated 25 000 employees in various sectors both directly and indirectly reliant on the mine anticipated to have been affected (Demacon, 2016). This has had a significant impact on the district economy as Sishen accounts for approximately 60% of the annual total community income. Despite recent trends, it is likely that mining will continue as the main economic driver of all three local economies.

In terms of Gross Value Added (GVA)1; the size of the Gamagara LM mining remained steady for 2001 to 2003, after which a decline can be observed from 2003 to 2008. Total GVA began to increase again from 2008 to 2015 after which a slight decline can be seen in 2016. As a result of the dominance of mining in the local economy, the total GVA reflected the same trends over this period.

The Gamagara LM contributed approximately 50.0% to the district municipality in 2016. The district municipality contributed approximately 24.8% to the total Northern Cape economy in 2016. The size of the Gamagara LM and the relative size of mining for the Gamagara LM over a 15-year period is illustrated in Figure 8-14

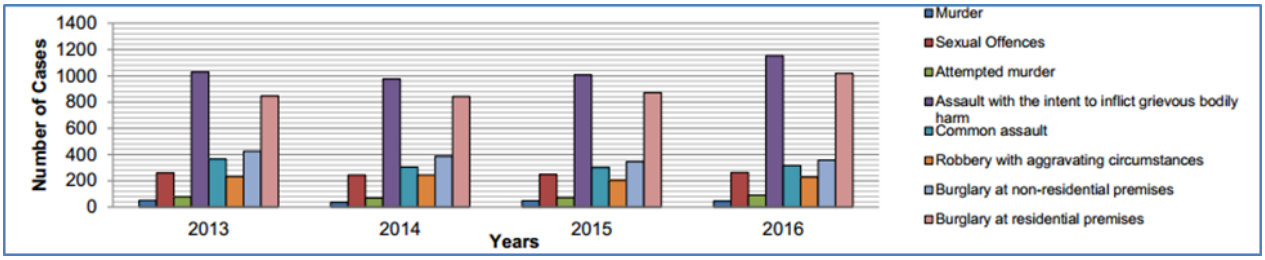


Source: Demacon ex Stats SA (seasonally adjusted), 2017

FIGURE 8-14: SIZE OF THE ECONOMY AND THE CONTRIBUTION OF MINING TO GAMAGARA LOCAL MUNICIPALITY, 2001 TO 2016.

[1] **Gross Value Added (GVA)** - The level of economic activities within a specific area. GVA is calculated as the difference between output and intermediate consumption in the economy. That is the difference between the value of goods and services produced and the cost of raw materials and other inputs, which are used up in production by all sectors of an economy.

According to the Sishen SEAT, there are 11 police stations/precincts in John Taolo Gaetsewe DM, three of which are located in Gamagara LM (Kathu, Dibeng and Olifantshoek), four in the Ga-Segonyana LM (Kuruman, Mothibistat, Wrenchville and Batlharos) and four in Joe Morolong LM (Bothitong, Heuningvlei, Tsineng and Vanzylsrus) (Atlegang Social Intelligence, February 2018). The most common crimes in all three LM are "assault with intent to inflict grievous bodily harm" and "common assault". Figure 8-15 shows the number of crimes reported in the district municipality between 2013 and 2016.



Source: John Taolo Gaetsewe SDF Review, 2017 (Atlegang Social Intelligence, February 2018).

FIGURE 8-15: NUMBER OF CASES REPORTED IN THE DISTRICT MUNICIPALITY (2013 – 2016)

There has not been a significant increase in the number of cases reported in Kathu, while Kuruman and Mothibistad have seen increased cases pertaining to non-residential premises burglaries, vehicle thefts, and robbery. There was an increase in the number of cases reported for Drug-related crime in Kathu, Kuruman and Mothibistad. There has been a significant population of destitute migrants in Kuruman, primarily from Joe Morolong LM, who have failed to get employment in the town as a result of limited number of job opportunities. The migration has led to among other impacts, an increase in crime. Although migration was primarily to Kuruman, Kathu has increasingly been targeted and it is envisioned that it will continue to grow in popularity given the lack of job prospects in Kuruman.

Despite social ills such as crime, the benefit of the mine is spread across the entire economy. While a significant part of this benefit is provided locally, mining contributes 28.4% towards the provincial economy, illustrating that Sishen mine is a main driver in the local, and even provincial economy. With regards to employment, it is evident that the mine provided a total of 5 466 employment opportunities (4 040 permanent employees, 1 426 contractors) in 2016. Mining provides 6.2% of employment within the provincial area, which equates to 15 143 jobs of the total 246 219 (2016). The mine may only account for 2.2% of employment in the province, but the mine accounts for 36.1% of total mining employment in the province. These numbers show the significance of the downstream effects on other sectors.

8.1.8 Culture Heritage

The project will take place within disturbed areas of Sishen Mine. There are no graves, heritage or cultural sites within the area. Existing infrastructure at Sishen Mine to be disturbed by the

project are less than 60 years old (built in 1976) and are thus not afforded any heritage status. The South African Heritage Resources Agency (SAHRA) will be consulted, but no heritage study is considered necessary.

8.2 Description of current land uses, environmental features and infrastructure on site

The DMS Upgrade Project will be located within the existing Sishen Mine, within the mining right area. The Sishen Mine surface rights and operating assets are owned by the Sishen Iron Ore Company (Pty) Ltd (SIOC). Land owned by SIOC are shown in Figure 8-10.

The properties on which the project will be located are provided in Table 8-10.

TABLE 8-10: PROJECT PROPERTY SURFACE RIGHT OWNERSHIP

Infrastructure	Location	Property Ownership*
UHDMS Plant (existing)+	Remainder of Portion 1 of Bruce 544	Sishen Iron Ore Company (Pty) Ltd
Low Grade Stockpiles (G39C AldagC, G39C 26, G50C27)	Remainder of Sishen 543	Sishen Iron Ore Company (Pty) Ltd
Low Grade Stockpiles (G50C & G80C)	Remainder of Portion 1 of Sims 461	Sishen Iron Ore Company (Pty) Ltd
Tailings Storage Facility (existing)	Remainder of Sekgame 461	Sishen Iron Ore Company (Pty) Ltd
Discard Dump (existing)	Remainder of Sekgame 461	Sishen Iron Ore Company (Pty) Ltd
Primary Crusher (UPC)	Remainder of Sishen 543	Sishen Iron Ore Company (Pty) Ltd

*the ownership information is extracted from the Vryburg deeds Office, June 2016

The DMS Upgrade Project is a brownfields project taking place within already disturbed areas as Sishen Mine (see Figure 8-16). The UPC will be developed adjacent to G39 Waste Rock Dump/Stockpile area. The changes from DMS to UHDMS will take place at the existing DMS Plant (as described in Section 4.3). C-grade material will be sourced from the ROM and from existing residue stockpiles and no additional areas will be disturbed.

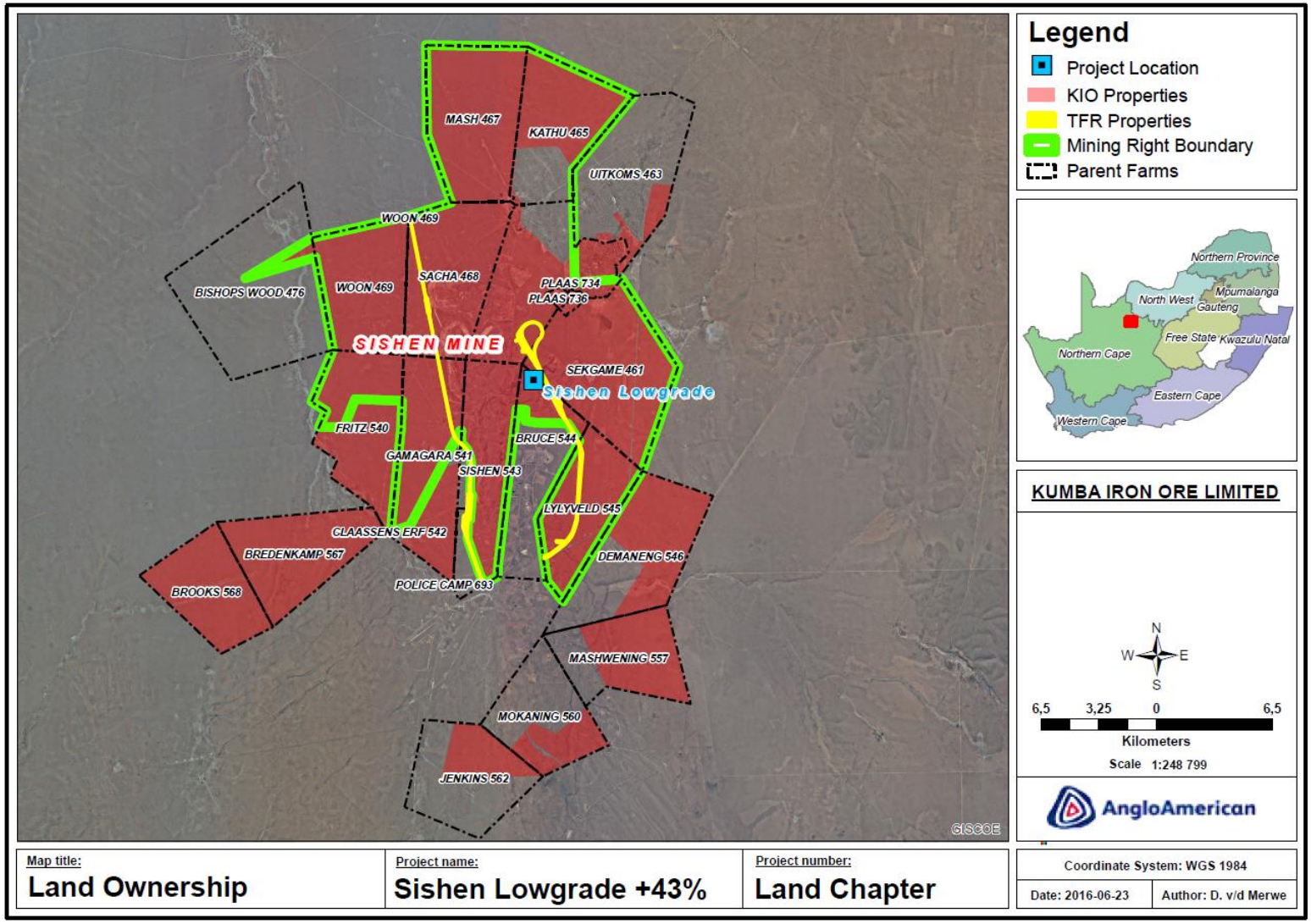


FIGURE 8-16: SISHEN IRON ORE COMPANY LAND OWNERSHIP.

8.3 Environmental and current land-use map

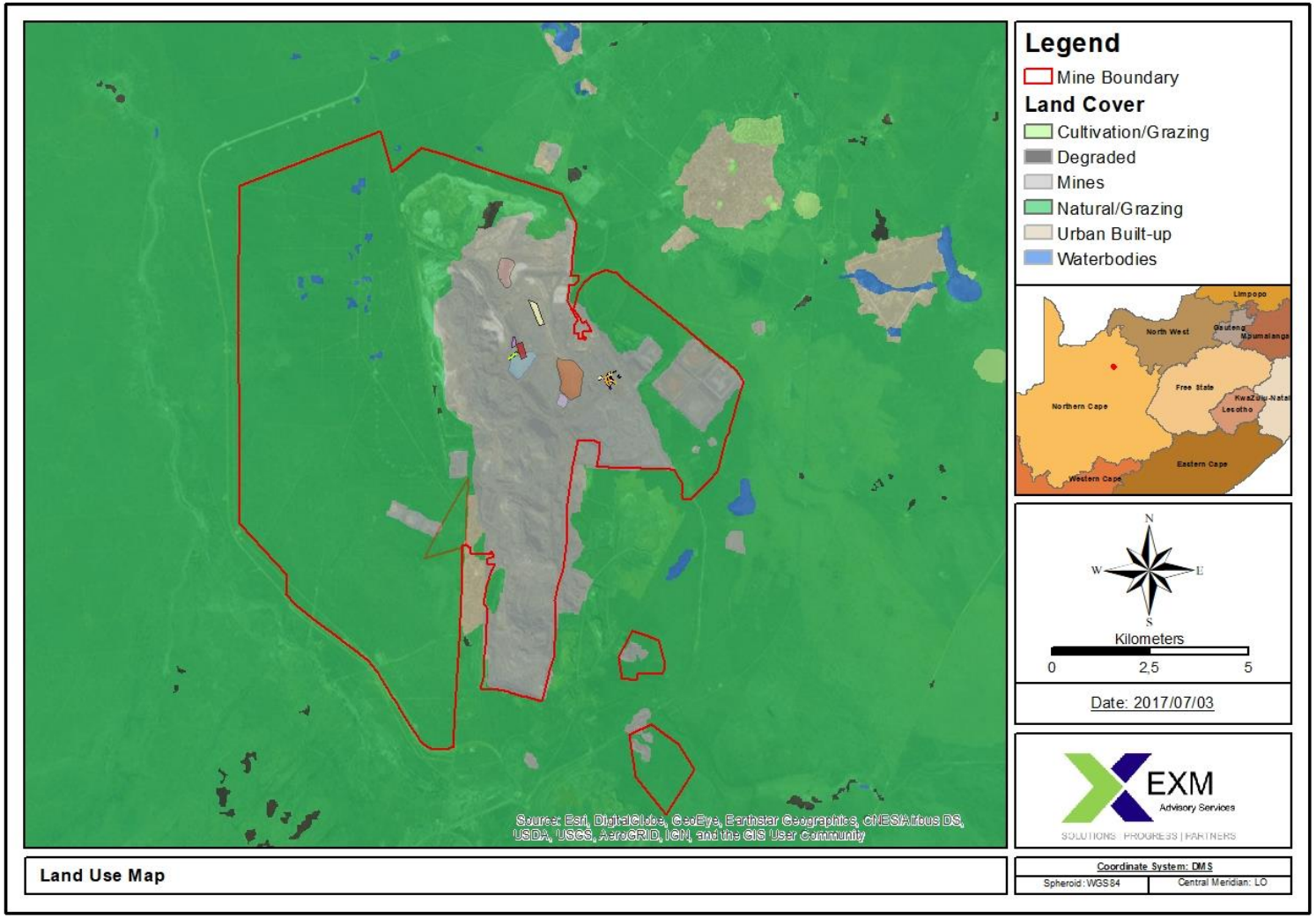


FIGURE 8-17: EXISTING LAND USE MAP SHOWING LOCATION OF DMS UPGRADE PROJECT

9. IMPACTS AND RISKS IDENTIFIED INCLUDING THE NATURE, SIGNIFICANCE, CONSEQUENCE, EXTENT, DURATION IN AND PROBABILITY OF THE IMPACTS, INCLUDING THE DEGREE TO WHICH THESE IMPACTS CAN BE REVERSED, AVOIDED, MANAGED, MITIGATED AND EXTENT TO WHICH THEY MAY CAUSE IRREPLACEABLE LOSS OF RESOURCES

9.1 List of impacts of activities in initial site layout

The list of the potential impacts of the activities that will be undertaken, as per the initial site layout planning are included below. This list of impacts has been informed by both the typical known impacts of such activities and consultation with interested and affected parties.

9.2 Methodology used in determining the significance of environmental impacts

9.2.1 Impact Ranking Criteria

The impact assessment method used in this assessment takes into account the current environment, the details of the proposed amendment activities and the findings of the specialist studies. Cognisance has been given to both positive and negative impacts that may result from the developments. The significance of the impact is dependent on the consequence and the probability that the impact will occur.

impact significance = (consequence x probability)

Where:

consequence = (severity + extent)/2

and

severity = [intensity + duration]/2

Each criterion is given a score from 1 to 5 based on the definitions given below. Although the criteria used for the assessment of impacts attempts to quantify the significance, it is important to note that the assessment is generally a qualitative process and therefore the application of this criteria is open to interpretation. The process adopted will therefore include the application of scientific measurements and professional judgement to determine the significance of environmental impacts associated with the project. The assessment thus largely relies on experience of the environmental assessment practitioner (EAP) and the information provided by the specialists appointed to undertake studies for the EIA.

Where the consequence of an event is not known or cannot be determined, the "precautionary principle" has been applied and the worst-case scenario assumed. Where possible, mitigation measures to reduce the significance of negative impacts and enhance positive impacts will be recommended. The significance of the impact in light of the mitigation measures has also been rated based on a confidence rating of the mitigation measures.

Consideration will be given to the phase of the project during which the impact occurs. The phase of the development during which the impact will occur will be noted to assist with the scheduling and implementation of management measures.

TABLE 9-1: SEVERITY CRITERIA FOR ASSESSING THE IMPACT SIGNIFICANCE

INTENSITY = MAGNITUDE OF IMPACT	**RATING**
Insignificant: impact is of a very low magnitude	1
Low: impact is of low magnitude	2
Medium: impact is of medium magnitude	3
High: impact is of high magnitude	4
Very high: impact is of highest order possible	5
DURATION = HOW LONG THE IMPACT LASTS	**RATING**
Very short-term: impact lasts for a very short time	1
Short-term: impact lasts for a short time e.g. construction period	2
Medium-term: impact lasts for the for less than the life of operation.	3
Long-term: impact occurs over the operational life of the project	4
Residual: impact is permanent (remains after mine closure)	5
EXTENT = SPATIAL SCOPE OF IMPACT/FOOTPRINT AREA/NUMBER OF RECEPTORS	**RATING**
Limited: Impact only affects the mine site or part there of	1
Neighbours: Limited to the immediate surroundings;	2
Local: Affecting a larger area (beyond immediate surroundings or neighbours)	3
District: Affects entire district or districts	4
Regional: Affects an entire region e.g. Province	5
PROBABILITY = LIKELIHOOD THAT THE IMPACT WILL OCCUR	**RATING**
Highly unlikely: the impact is highly unlikely to occur	0.2
Unlikely: the impact is unlikely to occur	0.4
Possible: the impact could possibly occur	0.6
Probable: the impact will probably occur	0.8
Definite: the impact will occur	1

NEGATIVE IMPACTS

≤1	Very low	Impact is negligible. No mitigation required.
>1≤2	Low	Impact is of a low order. Mitigation could be considered to reduce impacts. But does not affect environmental acceptability.
>2≤3	Moderate	Impact is real but not substantial in relation to other impacts. Mitigation should be implemented to reduce impacts.
>3≤4	High	Impact is substantial. Mitigation is required to lower impacts to acceptable levels.
>4≤5	Very High	Impact is of the highest order possible. Mitigation is required to lower impacts to acceptable levels. Potential Fatal Flaw.

POSITIVE IMPACTS

≤1	Very low	Impact is negligible.
>1≤2	Low	Impact is of a low order.
>2≤3	Moderate	Impact is real but not substantial in relation to other impacts.
>3≤4	High	Impact is substantial.
>4≤5	Very High	Impact is of the highest order possible.

DEVELOPMENT PHASE

C	Impact is applicable to the CONSTRUCTION PHASE ONLY
O	Impact is applicable to the OPERATIONAL PHASE ONLY
C&O	Impact is applicable to the CONSTRUCTION AND OPERATIONAL PHASE

9.3 The positive and negative impacts that the proposed activity (in terms of the initial site layout) will have on the environment and the community that may be affected

NOTE: A COMPREHENSIVE ASSESSMENT OF ALL IMPACTS IS GIVEN IN SECTION 9.5. A SHORT DESCRIPTION OF KEY IMPACTS IS PROVIDED BELOW.

9.3.1 Groundwater

9.3.1.1 Dewatering

As indicated in Section 4.3.1, the C-grade material to be processed by the UHDMS will not result in any expansion of pit areas. The material will be sourced from the ROM and existing residue stockpiles at the mine. The DMS Upgrade project therefore does not impact on the mine planning and no additional dewatering is required.

9.3.1.2 Groundwater Contamination

The impact prediction is based on the findings of the Waste Assessment Undertaken by Jones & Wagener Consulting Civil Engineers (June 2017). The report is included in Part C- Appendix 3.

The DMS Upgrade Project will be incorporated into Sishen Mine. Laydown areas to be used for the purposes of construction will be within existing disturbed areas in the mine. There is a risk of contamination of soils and possibly underlying aquifers if hazardous chemical substances and wastes are not properly managed during the construction period. Provision needs to be made

for adequate storage within bunded areas for all chemical substances, including hydrocarbons used in the construction period. The handling of such chemicals should also only take place over impervious surfaces. Temporary storage areas for construction waste are also to be provided within bunded areas to reduce the risk of spillage or seepage from such sources.

The UHDMS process will take place within existing buildings at Sishen Mine. Based on groundwater monitoring at Sishen Mine (see Section 8.1.4), there is no current indication of significant pollution sources within the plant area and it is assumed that no additional mitigation will be required. The UPC area is however to be provided with measures for the storage of hazardous chemical substances including hydrocarbons within bunded areas. Areas at the UPC where there is a potential for spillage or leaks are to be provided with impervious surfaces to protect groundwater from contamination.

As indicated in Section 4.3.8, the DMS Upgrade Project will result in 2 mineral waste streams, namely discard waste and slimes. The intention is for these wastes to be deposited at the existing Discard Dump and Tailings Storage Facility. It important that the waste does not pose any additional risks to the environment.

The various mineral waste streams to be produced as a result of the DMS Upgrade Project were assessed in terms of the National Norms and Standards for the Assessment of Waste for Landfill Disposal (GNR. 635 of 23 August 2013). These regulations consider the leachable concentrations (LC) and total concentrations (TC) of potential contaminants compared to legislated limits. The wastes are then defined as types based on the risk to the environment. The containment barriers required to protect the environment from the different waste types are defined in the National Norms and Standards for Disposal of Waste to Landfill (GNR. 636 of 23 August 2013).

C-grade material from the ROM was assessed to be a Type 3 waste (Jones & Wagener, June 2017). The results are summarised in Table 9-2. In the absence of existing technology for the processing of low grade material at Sishen, the material is currently stockpiled on site and contributes to the expansion of the stockpile areas (see Section 4.3.1). However, due to the absence of leachable contaminant, the material is considered to be inert and the current residue stockpiles do not pose a major risk of groundwater contamination at Sishen Mine.

Two samples of C-grade slimes and 1 sample of C-grade discard were assessed (see Table 9-2. The water fraction of the slimes was assessed separately from the solid fraction. The water fraction provides an indication of the risk to groundwater as a result of water managed at the Tailings Storage Facility.

TABLE 9-2: SUMMARY OF WASTE ASSESSMENT RESULTS

Waste	Description	LC Results	TC Results	Overall Result
C-grade ROM	No constituents exceed leachable limits/ Arsenic, barium, cadmium, antimony and fluoride exceed total limits, Slightly alkaline	Type 4	Type 3	Type 3
C-Grade Tailings 1 (including water fraction contribution)	Nitrate exceeds leachable limits arsenic, boron, barium, cadmium, copper and fluoride exceed total limits. Alkaline	Type 3	Type 3	Type 3
C-Grade Tailings 1: Solid fraction only	No constituents exceed leachable limits Arsenic, boron, barium, cadmium, copper and fluoride exceed total limits Alkaline	Type 4	Type 3	Type 3
C-Grade Tailings 1: Water fraction only	Nitrate exceeds leachable limit Slightly alkaline	Type 3	N/A	Type 3
C-Grade Discard Material	No constituents exceed leachable limits barium, cadmium and fluoride exceed leachable limits Slightly alkaline	Type 4	Type 3	Type 3
C-Grade Tailings 2: Solid fraction only	Iron exceeds* leachable limits Arsenic, barium, manganese and fluoride Alkaline	Type 3	Type 3	Type 3
C-Grade Tailings 2: Water fraction only	Nitrate exceeds leachable limits Slightly alkaline	Type 3	N/A	Type 3

Source: Jones & Wagener (June 2017)

* Although iron is not listed in the National Norms and Standards, it was compared to the SANS 241 2015 drinking water standard of 2.0 mg/ℓ, the chronic health limit, which is also the LCT0 value.

As shown in Table 9-7, based on their TCs the mineral wastes are Type 3 wastes. However, based on the LCs, the C-Grade ROM, C-Grade Tailings 1 and C-Grade Discard are Type 4 wastes. The C-Grade Tailings 2 will also classify as a Type 4 waste if the LC of iron is ignored. Based on this and the fact that, although the C-Grade ROM, C-Grade tailings and C-Grade discard material contain elevated total concentrations of metals, which result in them being assessed as Type 3 wastes, it is unlikely that these wastes will be subject to chemical processes that would mobilise metals and anions, i.e. residues associated with Sishen Mine are generally resistant to chemical weathering and thus have very slow reaction rates (Exigo[3], December 2014). It is therefore considered that the discard and tailings itself will not have a significant impact on the water environment and should rather be classified as a Type 4 waste.

Motivation for classifying the discard as a Type 4 waste is further supplemented by the fact that geochemical analyses of the discard material, conducted by Exigo[3] in 2014, classified the residue stockpiles as a Type 4 (inert waste).

The tailings water fractions on the other hand, have elevated nitrate concentrations and the groundwater in the vicinity of the tailings disposal facility appears to have been impacted by nitrate. Measures must therefore be put in place to reduce the impacts from the tailings water. It is thus recommended that a Class C barrier be considered for water management facilities (see Figure 9-1).

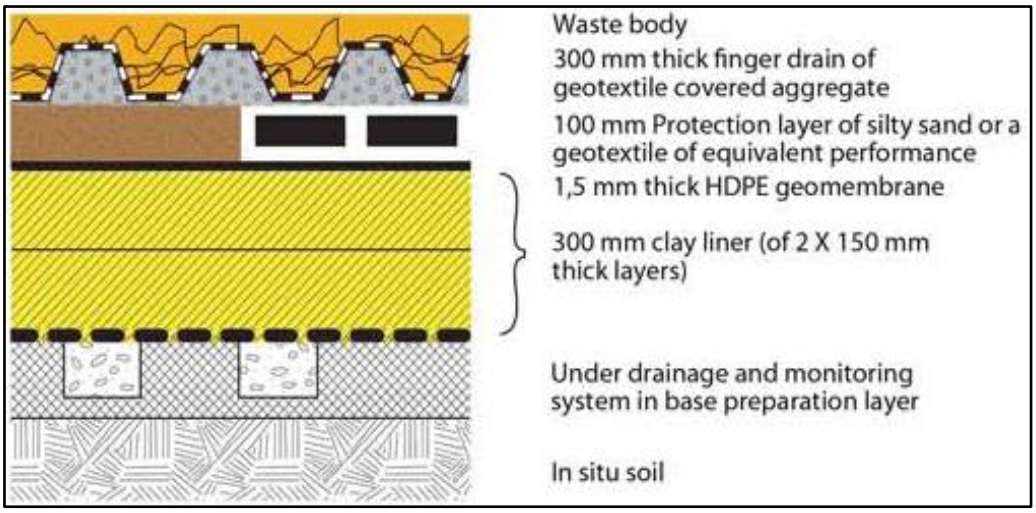


FIGURE 9-1: CLASS C BARRIER SYSTEM

The mineral residue from the processing of C-grade material does not pose any additional risk of pollution. High nitrate conditions are already evident in return water and the pollution risk has been identified by Sishen. Plans are already in place for the development of a new lined return water dam.

9.3.2 Water Balance

As indicated in Section 4.3.7, water consumption at Sishen Mine will increase due to the upgrade of the DMS to UHDMS and the installation of the UPC, but is predicted to be below 100 m^3/h. The water will be supplied predominantly by recycling initiatives currently being implemented at the mine including recovery of treated sewage effluent and stormwater from the eastern and western stormwater sumps, and the PCD's. This additional make-up supply is also supported by the construction of the additional buffer storage volume in the return water dam extension project which will be constructed in 2018. As indicated in Section 9.3.2, the return water dam is to be lined to reduced risk of groundwater contamination due to nitrates evident in the water fraction of the slimes.

9.3.3 Surface Water Resources

As described in Section 4.3.6, Sishen is in the process of upgrading the stormwater management system to meet the requirements of GNR. 704. Regulation 6(c) and (d) of GNR. 704 which require the mine to collect water arising within any dirty area into a dirty water system which is not likely to spill into any clean water system more than once in 50 years. As indicated in Section 4.3.6, stormwater runoff from the UHDMS plant area will be accommodated by the proposed D2 and D3 PCDs. These dams have been sized to accommodate the "first flush" i.e. 20% of a 1 in 50-year storm event. The overflow will then enter the Western or Eastern Stormwater Management Canals. This relaxation in terms of meeting the requirements of GNR. 704 is motivated by the fact that water within the D2 and D3 catchment areas is not expected to show high levels of contamination. Overflows from the D2 and D3 PCD's drain to the eastern or western stormwater management canals, respectively. The G80 Western and Eastern Stormwater Recovery Sumps located on these canals provide additional stormwater retention, and water is then recovered from these sumps back to the plant and mining areas for reuse. The G80 sumps will also be sized to contain the "first flush". The proposed changes to the DMS Plant to UHDMS does not affect the run-off to this proposed infrastructure. During the construction phase of the project, run-off is to be channelled to existing storm water management systems at the mine. This run-off should be free of hydrocarbons and sediment.

The proposed Aldag PCD, will have sufficient capacity to contain a 1 in 50-year flood event. Areas with a high risk of being contaminated from hydrocarbons will report to this dam with sufficient volume to retain the full 1 in 50-year 24-hour storm event. The volume of the dam, as currently authorised, is undersized and it is proposed that the dam be expanded. The authorisation process for this has already commenced.

Water from areas potentially contaminated with hydrocarbons at the UPC will be kept separate from the rest of the run-off. This water will report to the Aldag PCD. All other run-off water from the site will be released into the Western Stormwater Management Canal which enters the G80 Western Stormwater Recovery Sump. Sediment will be prevented from entering the sumps by the inclusion of silt traps at the UPC. The stormwater management at the UPC will be accommodated by the upgraded infrastructure at the mine.

9.3.4 Air Quality

The potential impacts on Air Quality are described by Airshed Planning Professionals (January, 2018). The report is included in Part C – Appendix 1.

Key sources of emissions and associated pollutants associated with the DMS Upgrade Project include:

- Crushing and screening (at new primary crusher) – $PM_{2.5}$, PM_{10} and TSP

- Handling of waste and ore (conveyor transfer points) – $PM_{2.5}$, PM_{10} and TSP.

Estimated annual average emissions (based on emission factors), per source group are presented in Table 9-3. The predicted increase in emissions at Sishen Mine as a result of the project are given in Table 9-4. The proposed DMS Upgrade Project will result in an increase in emissions from Sishen Mine by approximately 2.5% to 5 %.

TABLE 9-3: ESTIMATED ANNUAL AVERAGE EMISSION RATES FOR THE ADDITIONAL SOURCES FOR THE PROPOSED DMS UPGRADE PROJECT (WITH VARIOUS CONTROL EFFICIENCIES)

Source Group	TSP (tpa)	PM_{10} (tpa)	$PM_{2.5}$ (tpa)
Crushing (assuming 50% control efficiency)	246	98	49
Crushing (assuming 65% control efficiency)	172	69	34
Materials handling at conveyor transfer points (assuming 50% control efficiency)	123	49	2.5
Total Emissions	**295 - 369**	**118 - 147**	**36.5 - 51.5**

Source: Airshed Planning Professionals (January 2018)

TABLE 9-4: ESTIMATED INCREASE IN ANNUAL AVERAGE EMISSION RATES AT SISHEN MINE DUE TO THE PROPOSED DMS UPGRADE PROJECT

Source Group	TSP (tpa)	PM_{10} (tpa)	$PM_{2.5}$ (tpa)
Current Sishen source (based on 2017 study)	8 171 - 12 274	2 920 - 4 234	49
Additional sourced due to the proposed DMS Upgrade Project	295 - 369	118 - 147	36.5 - 51.5
Total increase in emissions (%)	**2.4 - 4.5**	**2.8 - 5**	**2.3 - 4.7**

Source: Airshed Planning Professionals (January 2018)

Although the impact of the DMS Upgrade Project is considered to be low, the impact of current operations on dust levels are high and any project or process that contributes additionally thus needs to be managed in order to ensure that dust levels are minimised. As indicated in Section 4.3.5, provision has been made for dust extraction at the UPC and dust suppression at all new handling points resulting from the project. Dust will also need to be managed during the construction phase, particularly during earthmoving activities and from sources at laydown areas, to minimise the cumulative impacts.

9.3.5 Climate Change

In line with Kumba's Climate-Change Strategy, consideration has been given to the use of premium energy efficiency motors for the DMS Upgrade Project. During the plant layout, care was taken not to pump material unnecessarily and use is made of gravity feed wherever

possible. The plant location was also chosen to maximise gravity feed.

The additional energy consumption required for the upgrade of the DMS Plant to the UHDMS is estimated at 11.6 MW. Based on carbon emissions of 1.03 tons CO2e/MWh, the CO_2 emissions will be 77 662 tons of CO2e per annum (assuming that operations will continue for 6 500 hours).

The additional diesel consumption required for the haulage of C-grade material has been estimated at 19 799 344 litres over LOM. Based on carbon emissions of 2.36 tCO_2/m^3, the CO_2 emissions will be 3 804.30 tCO_2/m^3 per annum.

The above calculations were completed in accordance with the methodology prescribed by Anglo American for estimating carbon emissions, using the IPCC 2006 guidelines on energy and carbon emission conversion factors.

9.3.6 Noise

Impacts on noise as a result of the DMS Upgrade Project have been assessed by dBAcoustics (February 2018). The report is included in Part C – Appendix 2.

In terms of the SANS 10103 (2008), a noise disturbance is created when the prevailing ambient noise level is exceeded by 5.0 dBA or more. The International Finance Corporation Health and Safety Guidelines allow for a benchmark noise level of exceedance of 3.0 dBA. It will therefore be more environmentally sustainable for a new development that the latter benchmark be used as a completely mechanised development will be introduced into the study area. Noise is part of our daily exposure to different sources which is part of daily living and some of these physical attributes which may at times be intrusive forms part of the ambient levels that people get used to without noticing the higher levels. Two aspects are important. Namely, increase in noise and the overall noise levels created by the project.

Noise point sources associated with the DMS Upgrade Project, include the UPC, UHDMS and Conveyors. The noise impacts take into consideration the distance from the point source to the receptor site. The projected noise levels from the proposed DMS Upgrade Project at various receptor points was calculated using the method prescribed by ISO 9313-1:1193 (dBAcoustics, March 2018).

The criteria for assessing the magnitude of the noise impacts are provided in Table 9-5.

TABLE 9-5: NOISE INTRUSION LEVEL CRITERIA

Increase Δ – dBA	Impact Magnitude	Colour Code
0<Δ≤1	Not audible	
1<Δ≤3	Very Low	
3<Δ≤5	Low	
5<Δ≤10	Medium	
10<Δ≤15	High	

Increase Δ – dBA	Impact Magnitude	Colour Code
<15	Very High	

Source: dBAcoustics (February 2018)

The projected noise levels at the different measuring areas are illustrated in Table 9-6 (winter period) and Table 7- (summer period).

TABLE 9-6: NOISE INTRUSION LEVELS DURING WINTER

		UPC	UHDMS	CONVEYOR	Cumulative Levels	Cumulative noise level Daytime	Cumulative noise level Night time	Intrusion noise level Day time	Intrusion noise level Night time
RECEPTORS	SHESENG	9.1	5.5	2.6	11.3	41.9	32.6	41.9	32.6
	WESTERN SIDE OF KATHU	6.8	5.9	0.3	9.9	47.1	37.7	47.1	37.7
	EASTERN SIDE OF KATHU	9.9	13.0	3.4	15.0	39.5	34.4	39.5	34.4
	KATHU AGRICULTURAL HOLDINGS	2.8	3.6	-3.7*	6.6	38.2	28.3	38.2	28.3
	DINGLETON	9.9	6.2	3.4	12.0	44.1	43.9	44.1	43.9
	FARMS TO THE WEST OF SISHEN MINE	3.0	-0.4*	-3.5*	5.2	31.7	30.3	31.7	30.3

*The negative value is an indication that the noise from the conveyor will not be audible at all. This value was replaced with a 0-value in calculating the intrusion levels

Source: dBAcoustics (February 2018)

TABLE 9-7: NOISE INTRUSION LEVELS DURING SUMMER

		UPC	UHDMS	CONVEYOR	Cumulative Levels	Cumulative noise level Daytime	Cumulative noise level Night time	Intrusion noise level Day time	Intrusion noise level Night time
RECEPTORS	SHESENG	12.6	5.5	7.6	14.4	44.0	37.8	0.0	0.0
	WESTERN SIDE OF KATHU	10.3	5.9	5.3	12.3	47.3	39.6	0.0	0.0
	EASTERN SIDE OF KATHU	13.4	13.0	8.4	16.9	40.4	37.8	0.0	0.0
	KATHU AGRICULTURAL HOLDINGS	13.4	13.0	8.4	16.9	40.4	37.8	0.0	0.0
	DINGLETON	13.4	6.2	8.4	15.1	47.3	47.3	0.0	0.0
	FARMS TO THE WEST OF SISHEN MINE	6.5	-0.4*	1.5	8.3	36.9	31.1	0.0	0.0

*The negative value is an indication that the noise from the conveyor will not be audible at all. This value was replaced with a 0-value in calculating the intrusion levels

Source: dBAcoustics (February 2018)

There will be no noise intrusion as the prevailing ambient noise levels will not be increased due to the three proposed point noise sources (UPC & overland conveyor and UHDMS). The noise source values were calculated at each of the noise receptors added logarithmically to get the cumulative noise level. The cumulative noise level was added to the prevailing ambient noise level as this will be the new prevailing noise level. This value is subtracted from the cumulative noise value to determine the intrusion level. There was a difference in the prevailing noise levels for the summer and the winter periods for the day and the night. There will be no noise intrusion during the winter or summer periods and the proposed upgrade will comply with the South African Standards and the IFC's Health and Safety Guidelines.

The noise intrusion levels during the operational phases will be insignificant as the proposed DMS upgrade project will take place in a disturbed area where there are industrial activities taking place which increase the prevailing ambient noise levels accordingly.

9.3.7 Topography

The project will result in the processing of C-grade material from ROM. As such less waste will be deposited on residue stockpiles (waste rock dumps) in the future LOM. The rate of expansion of dumps will thus be slowed, which is a positive impact on topography, ultimately reducing the LOM requirements for the rehabilitation of such waste. In addition, material will be removed from current stockpiles/dumps for processing at the plant. It should however, be noted that the cumulative impact of the reduction on the topographical impact, as a result of the processing of this material and the associated lowering of rehabilitation requirements at Sishen Mine, are considered to be minimal. Opportunities for processing additional low-grade material should however be investigated.

It should also be noted that the processing of the material will mean that the rate of production of process waste at Sishen Mine will increase. Therefore, the growth rate of the discard dump will increase. As indicated in Section 4.3.8, no amendments to the current environmental authorised footprints are required to accommodate the discard and slimes from the processing of C-grade material. The existing water use licence will however need to be amended to accommodate increased disposal rates at the existing Discard Dump and Tailings Storage Facility. The rehabilitation of the discard dump is addressed in current closure planning at Sishen Mine and is not addressed further as part of this project.

9.3.8 Soils

The project is a brownfields development taking place within Sishen Mine. Some additional vegetation areas will be cleared to accommodate the development the new Discard Emergency Stockpile area. This is within the authorised footprint area of the dump. The topsoil is to be conserved from these areas for the purposes of rehabilitation. It is important that laydown areas do not cause any unnecessary additional disturbance or contamination. As described in Section 9.3.1, measures are to be put in place to prevent contamination due to leaks and spills associated with the storage of hazardous chemical substances.

9.3.9 Biodiversity

The project is a brownfields development. Some additional vegetation clearance wil be required to accommodate the development of the Discard Emergency Stockpile area but this is immediately adjacent to the existing Discard Dump and within the authorised footprint area of the dump. As indicated in Section 8.1.5, wetland pans are prominent in the vicinity of Sishen Mine. There is a wetland pan located within the authorised footprint area of the plant discard dump. The pan will be destroyed by the deposition of discard. The disturbance to the pan is however already authorised and is not considered a risk to the project. Sishen has an existing environmental authorisation for the extension of the discard dump over the pan and the water use license allows for the destruction of the pan. The impact has already been addressed in previous assessments and this impact is not considered to be part of the DMS Upgrade Project

9.3.10 Cultural Heritage

No new areas will be developed and no buildings older than 60 years will be disturbed by the project.

9.3.11 Visual Impacts

As indicated in Section 9.3.7, the project will result in both positive and negative topographical changes, these however are considered to be insignificant in the greater context of the mine.

9.3.12 Socio-Economics

The Economic Impacts of the DMS Upgrade Project have been predicted by Demacon Market Studies (October 2017). The Economic Impact Assessment is included in Part C - Appendix 4.

Social Impacts are included in the Social Impact Assessment (Atlegang Social Intelligence, February 2018), see Part C – Appendix 5.

The economic impact is predicted using national multipliers. The multiplier effect refers to the increase in final income arising from any new injection of demand. The following is evident for iron ore mining in the Northern Cape:

- Output/Sales: For every R1 million in final demand from iron ore mining there is R1.37

million downstream variation in output/sales generated across the entire economy.

- Labour remuneration: Salaries and wages within the mining sector are on average higher than in the agricultural sector. As a result, the economy-wide impact is higher, as workers earn more, and can spend more money on goods and services than those in the agricultural sector. For every R1 million variation in final demand, labour remuneration gains R320 000.
- Employment: A total of 2 employment opportunities are created within the formal and informal sectors across the entire economy due to a R1 million variation in mining demand. The reverse is also true, with a loss in 2 employment opportunities across the economy if there is a R1 million decrease in iron ore mining demand.

The construction phase of the project will last approximately 2 years employing ~495 people. The predicted overall economic and employment impact of the construction phase of the DMS Upgrade Project, based on the current estimations of the capital expenditure, are provided in Table 9-8. The economy wide impact includes direct, indirect and induced impacts. The construction phase of the project is predicted to result in the following short-term impacts:

- Additional business sales of R2.7 billion;
- Additional GGP of R1.9 billion; and
- Additional employment of 2 070.

The economic impacts to the local and regional economies are significant.

TABLE 9-8: ECONOMIC IMPACT DURING THE CONSTRUCTION PHASE OF THE DMS UPGRADE PROJECT

Variable	Direct Impact	Indirect Impact	Induced Impact	Total Impact
Additional Business Sales	R1 040 831 570	R18 994 460	R326 068 981	R1 385 895 011
Additional GGP	R793 746 397	R8 285 538	R144 815 141	R6 251 290 378
Additional Employment	1 259	34	777	2 070

Source: Demacon Market Studies (October 2017)

The DMS Upgrade Project is currently planned for the remaining life of Sishen Mine (until 2031) and will increased production of 1.5 - 6 Mtpa of product. The economic impacts of the project during the LOM, based on an additional 3.2 Mtpa, as predicted by the outcomes of the Prefeasibility Study, and an operational expenditure of R162.17/ton ROM are provided in Table 9-9.

TABLE 9-9: ECONOMIC IMPACT DURING THE OPERATIONAL PHASE OF THE DMS UPGRADE PROJECT

Variable	Direct Impact	Indirect Impact	Induced Impact	Total Impact
Additional Business Sales	R532 652 521	R9 720 542	R166 867 983	R709 241 046
Additional GGP	R406 205 031	R4 240 180	R74 110 117	R484 555 328
Additional Employment	644	17	397	1 059

Source: Demacon Market Studies (October 2017)

In summary the DMS Upgrade project will result in

- Additional business sales of R709 million;
- Additional GGP of R485 million; and
- Additional employment of 1 059.

Sishen Mine, has, through its community development programmes, improved the lives of local people and households. Increased production will mean that the mine will increase its Social and Labour Plan and Corporate Social Investment expenditure. The increased expenditure by Sishen Mine will continue to be directed towards municipal infrastructure, welfare, poverty alleviation in the form of small business development, youth development initiatives and other projects as identified through Local Economic Development forums. The additional employment created by the project will result in more disposable income in the region which improves the quality of life for those persons. Construction, increased production and associated employment at Sishen Mine also creates opportunities for skills and human resource development for persons involved in these activities.

Any major development and an upturn in production at Sishen Mine and the associated increased hope for employment, will result in an influx of persons into the area. Such influx is associated with an increase in social ills such as crime, prostitution, alcohol abuse, levels of HIV etc., and also places pressure on social services. Sishen's Social Management Plan aims at addressing key social issues. Escalation of issues associated with the implementation of the DMS Upgrade Project are to be pre-empted and included in the updated Social Management Plan

Sishen Mine prioritises local employment and procurement and the project will be incorporated into existing programmes and initiatives aimed at achieving SLP targets in this regard. A Local Procurement Strategy is in place at Sishen Mine and the project will be aligned with this strategy. A Resourcing Plan will be developed for the project to ensure alignment with Sishen's commitments in this regard. The Resourcing Plan should be clearly communicated and show a transparent process of how preference will be given to local communities. Contractors involved in the project will be required to ensure compliance with the Resourcing Plan.

Of importance is the management of community expectations in terms of the benefits of the increased production and employment. If not communicated properly strained relationships may result if expectations are not realised. A community engagement strategy aimed at addressing such expectations is to be implemented prior to the implementation of the project.

9.4 The possible mitigation measures that could be applied and the level of residual risk

The mitigation measures for each of the identified impacts are included in **Table 9.10 of Section 9.8**.

The significance of the impact with mitigation has been weighted by multiplying the significance rating without significance by the following, depending on the confidence placed in the successful implementation of the mitigation measures or the effectiveness of those measures in reducing the impact.

1	Very low	Measures are very difficult or expensive to implement or are not expected to be effective in reducing the impact (No Confidence)
0.8	Low	Measures are difficult or expensive to implement or are expected to have limited effectiveness in reducing the impact (20% Confidence)
0.5	Moderate	Measures can be implemented with some effort and cost and/or the measures can be effective in mitigating the impact if implemented (50% Confidence)
0.2	High	There is high confidence that mitigation measures can be implemented and can be effective in mitigating the impact (80% Confidence)

9.5 Motivation where no alternative sites were considered

Not applicable as alternatives layouts have been considered. See Section 7.

9.6 Statement motivating the alternative development location within the overall site

The project alternatives and the motivation for the selection of the preferred alternative is provided in Section 7.1. The preferred layout alternative considered in the EIA is provided in Figure 3-1. Since the project is a brownfields development within Sishen Mine and largely involving the upgrade of the existing DMS plant to UHDMS, the layout alternatives are limited. The location of the UPC has been selected based on technical reasons for the project (see Section 7.1.3). The project layout has been incorporated into existing water and dust management systems in place at Sishen Mine. Where additional mitigation is required this have been incorporated in the planning.

It is not anticipated that the predicted impacts of the project will be reduced should the location of the development at the site be changed. There is no reason for a change in the layout of the project based on the outcomes of the EIA and associated specialist studies.

9.7 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 plan) through the life of the activity

Please refer to Section 9.2 for the methodology used in the ranking of impacts. Please refer to Section 9.4 for the methodology used for the application of a mitigation confidence ranking to the impact ranking.

9.8 Assessment of each identified potentially significant impact risk

IMPACT SIGNIFICANCE

NEGATIVE IMPACTS

≤1	Very low	Impact is negligible. No mitigation required.
>1≤2	Low	Impact is of a low order. Mitigation could be considered to reduce impacts. But does not affect environmental acceptability.
>2≤3	Moderate	Impact is real but not substantial in relation to other impacts. Mitigation should be implemented to reduce impacts.
>3≤4	High	Impact is substantial. Mitigation is required to lower impacts to acceptable levels.
>4≤5	Very High	Impact is of the highest order possible. Mitigation is required to lower impacts to acceptable levels. Potential Fatal Flaw.

POSITIVE IMPACTS

≤1	Very low	Impact is negligible.
>1≤2	Low	Impact is of a low order.
>2≤3	Moderate	Impact is real but not substantial in relation to other impacts.
>3≤4	High	Impact is substantial.
>4≤5	Very High	Impact is of the highest order possible.

TABLE 9-10: IMPACT RISK ASSESSMENT

UPGRADE OF DMS TO UHDMS INCLUDING NEW CONVEYORS

ACTIVITY	ASPECT	POTENTIAL IMPACT	PHASE	INTENSITY	DURATION	CONSEQUENCE	EXTENT	SEVERITY	PROBABILITY	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION	MITIGATION CONFIDENCE	SIGNIFICANCE WITH MITIGATION
UPGRADE OF DMS TO UHDMS INCLUDING NEW CONVEYORS AND STOCKPILES	Groundwater	Contamination of underlying aquifers due to storage and handling of potential pollutants at laydown areas and areas of work.	C	2	2	2	2	2	0.8	1.6	Hazardous substances are to be stored in bunded areas and handled on impervious surfaces. Wastes are to be separated and stored within receptacles within bunded areas. Additional temporary toilets and ablutions are to be provided in laydown areas and in areas of work where there are no existing facilities. Equipment which has the potential to leak oil or other chemicals are to be contained on impervious surfaces within bunded areas. Drip trays are to be provided where mobile equipment has the potential to drip oil. Implement spill prevention and emergency response procedure.	0.4	0.64
	Groundwater	Contamination of underlying aquifers due to storage and handling of potential pollutants stored and handled at the upgraded components of UHDMS.	O	2	4	3	2	2.5	0.4	1	Use will be made of existing facilities at Sishen Mine. The existing facilities at Sishen Mine have sufficient capacity for the storage and handling of chemicals used during operations. No additional mitigation is required.	1	1
	Water Consumption	Consumption of additional water as a result of UHDMS process	O	3	4	3.5	2	2.75	1	2.75	Sishen is to maximise the opportunity for the recycling of water to accommodate additional water requirements at the mine.	0.6	1.65
	Surface Water Resources	Contamination of surface water resources due to contaminated run-off originating from laydown areas and areas of work.	C	3	2	2.5	2	2.25	0.8	1.8	Implement measures described for the protection of soils which will also serve to contain spillages. Run-off from laydown areas and areas of work is to be directed to the upgraded (in process) water management systems at Sishen. This water is to be free of hydrocarbons and sediment (sediment and oil interceptors to be installed, if necessary).	0.8	1.44
	Surface Water Resources	Contamination of surface water resources due to contaminated run-off originating from upgraded components of the UHDMS.	O	3	4	3.5	2	2.75	0.8	2.2	Run-off to be managed through the stormwater management systems at Sishen (in the process of being upgraded). Upgraded stormwater infrastructure is to be in place prior to the commencement of construction of the project.	0.6	1.32
	Air Quality	Increased dust emissions due to entrainment from roads due to additional traffic associated with upgrade of the DMS.	C	2	2	2	2	2	0.6	1.2	Dust suppression to be implemented at laydown areas and new roads associated with access to laydown areas and areas of work. Sishen Mine to maintain roads including chemical suppression in existing areas with consideration given to additional wearing of surfaces as a result of the project.	0.6	0.72

ACTIVITY	ASPECT	POTENTIAL IMPACT	PHASE	INTENSITY	DURATION	CONSEQUENCE	EXTENT	SEVERITY	PROBABILITY	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION	MITIGATION CONFIDENCE	SIGNIFICANCE WITH MITIGATION
	Air Quality	Increase in dust emissions as a result of the UHDMS.	O	3	4	3.5	1	2.25	1	2.25	Ensure that current systems at Sishen Mine to be used by UHDMS for dust extraction are working efficiently. Implement measures for dust suppression at additional handling points. Maintenance of dust-control equipment and visual inspections of effectiveness.	0.6	1.35
	Climate Change	Increased electricity consumption resulting in more GHGs being released due to UHDMS.	O	2	4	3	1	2	1	2	Selection of motors during design to give priority to energy efficiency. Design to give consideration to use of gravity and the minimisation of pumping requirements.	0.6	1.2
	Noise	Increase in noise levels due to UHDMS	O	1	4	2.5	1	1.75	1	1.75	Equipment is to be kept in a high level of maintenance. Current noise monitoring undertaken at Sishen to continue unchanged. Noise complaints will continue to be monitored and managed through the Sishen External Complaints Procedure. Implement a noise management plan.	0.6	1.05
	Topography	Change in landforms for the development of new infrastructure	C	1	2	1.5	1	1.25	0.4	0.5	Developments will take place within existing buildings. New conveyors will be developed to link components between existing buildings with upgraded components. Infrastructure to be removed at the end of the LOM. Financial provision to be updated to provide for the removal of additional infrastructure.	1	0.5
	Soils	Soil contamination due to storage and handling of potential pollutants at laydown areas and areas of work.	C	3	2	2.5	1	1.75	0.8	1.4	Laydown areas to be developed within existing disturbed areas within the mine. Implement measures indicated for the protection of groundwater from contamination.	0.4	0.56
	Soils	Loss of available soils within the footprint area of the Discard Emergency Stockpile and Laydown areas.	C	2	5	3.5	1	1.75	1	2.75	Topsoil to be removed from footprint areas and stockpiled for use in rehabilitation.	0.4	1.1
	Soils	Soil contamination due to storage and handling of potential pollutants at the UHDMS.	O	3	4	3.5	1	2.25	0.6	1.35	Use will be made of existing facilities at Sishen Mine. The existing facilities at Sishen Mine have sufficient capacity for the storage and handling of chemicals used during operations.	1	1.35
	Biodiversity	Disturbance of vegetation and habitats for the development of lay down areas or areas of work.	C	2	2	2	1	1.5	1	1.5	Laydown areas to be developed within existing disturbed areas at the mine. Discard Emergency Stockpile to be developed within the authorised footprint of the Discard Dump.	0.4	0.6
	Cultural Heritage	Disturbance of heritage sites due to the development of laydown areas or the upgrading of existing infrastructure for the UHDMS.	C	2	5	3.5	1	2.25	0.4	0.9	Only previously disturbed areas are to be used for the establishment of laydown areas for the project. No additional mitigation required as a result of the project.	1	0.9

ACTIVITY	ASPECT	POTENTIAL IMPACT	PHASE	INTENSITY	DURATION	CONSEQUENCE	EXTENT	SEVERITY	PROBABILITY	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION	MITIGATION CONFIDENCE	SIGNIFICANCE WITH MITIGATION
	Visual Environment	Increased visual intrusion and loss of scenic quality.	C&O	2	4	3	2	2.5	0.4	1	The development of UHDMS and associated infrastructure is within the mine and will not change the visual environment. No additional mitigation required as a result of the project.	0.4	0.4

DEVELOPMENT OF UPC, RAMPS, STOCKPILES AND CONVEYOR

ACTIVITY	ASPECT	POTENTIAL IMPACT	PHASE	INTENSITY	DURATION	CONSEQUENCE	EXTENT	SEVERITY	PROBABILITY	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION	MITIGATION CONFIDENCE	SIGNIFICANCE WITH MITIGATION
DEVELOPMENT OF UPC, RAMPS, STOCKPILES AND CONVEYOR	Groundwater	Contamination of underlying aquifers due to storage and handling of potential pollutants at laydown areas and areas of work.	C	2	2	2	2	2	0.8	1.6	Hazardous substances are to be stored in bunded areas and handled on impervious surfaces. Wastes are to be separated and stored within receptacles within bunded areas. Additional temporary toilets and ablutions are to be provided in laydown areas and in areas of work where there are no existing facilities. Equipment which has the potential to leak oil or other chemicals are to be contained on impervious surfaces within bunded areas. Drip trays are to be provided where mobile equipment has the potential to drip oil. Implement spill prevention and emergency response procedure.	0.4	0.64
	Groundwater	Contamination of underlying aquifers due to storage and handling of potential pollutants stored and handled at the UPC.	O	3	4	3.5	2	2.75	0.6	1.65	Hazardous chemical substances (such as hydrocarbons) are to be stored within bunded areas. Areas where hazardous chemicals are handled are to be provided with impervious surfaces. Any part of the plant where there is a potential for the leaking of hazardous chemical substances; it to be provided with an impervious surface. Wastes are to be separated at source and incorporated into Sishen's Waste Management System. Implement spill prevention and emergency response procedure. Drip trays are to be provided where mobile equipment has the potential to drip oil.	0.6	0.99
	Water Consumption	Consumption of additional water as a result of additional dust suppression required at the crusher.	O	2	4	3	2	2.5	1	2.5	Sishen is to maximise the opportunity for the recycling of water to accommodate additional water requirements at the mine.	0.6	1.5
	Surface Water Resources	Contamination of surface water resources due to contaminated run-off originating from laydown areas and areas of work.	C	3	2	2.5	2	2.25	0.8	1.8	Implement measures described for the protection of soils which will also serve to contain spillages. Run-off from laydown areas and areas of work is to be directed to the upgraded (in process) water management systems at Sishen. This water is to be free of hydrocarbons and sediment (sediment and oil interceptors to be installed, if necessary).	0.8	1.44

ACTIVITY	ASPECT	POTENTIAL IMPACT	PHASE	INTENSITY	DURATION	CONSEQUENCE	EXTENT	SEVERITY	PROBABILITY	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION	MITIGATION CONFIDENCE	SIGNIFICANCE WITH MITIGATION
	Surface Water Resources	Contamination of surface water resources due to contaminated run-off originating from the UPC and associated infrastructure.	O	3	4	3.5	2	2.75	0.8	2.2	Run-off from the UPC is to be integrated into the upgraded stormwater management system at Sishen Mine. The upgraded infrastructure is to be in place prior to the commencement of construction of the project. Run-off that could be potentially contaminated with hydrocarbons is to be separated at the UPC. This water is to be contained and prevented from entering stormwater canals. The water is to report to the future Aldag PCD which is designed for the management of hydrocarbons and water is recycled for use at the mine. The remaining run-off is to pass through a sediment trap before entering the stormwater management canals.	0.6	1.32
	Air Quality	Increased dust emissions due to entrainment from construction activities associated with the development of the UPC.	C	4	2	3	2	2.5	1	2.5	Dust suppression to be implemented in areas of work where earth moving is to take place. Dust suppression to be implemented at laydown areas and additional roads established to access laydown areas and work areas.	0.8	2
	Air Quality	Increase in dust emissions as a result of the additional handling, stockpiling and crushing at the UPC.	O	3	4	3.5	1	2.25	1	2.25	Dust extraction to be implemented at the UPC. Dust suppression to be in place at new handling points. Dust aside to be in place at all new roads leading to the UPC and associated infrastructure. Maintenance of dust-control equipment and visual inspections of effectiveness.	0.6	1.35
	Climate Change	Increased electricity consumption resulting in more GHGs being released due to inclusion of UPC.	O	2	4	3	1	2	1	2	Selection of motors during design to give priority to energy efficiency. Design to give consideration to use of gravity and the minimisation of pumping requirements.	0.6	1.2
	Noise	Increase in noise levels due to the operation of the UPC and conveyor.	O	2	4	3	1	2	1	2	Equipment is to be kept at a high level of maintenance. Current noise monitoring undertaken at Sishen to continue unchanged. Noise complaints will continue to be monitored and managed through the Sishen External Complaints Procedure. Implement a noise management plan.	0.6	1.2

ACTIVITY	ASPECT	POTENTIAL IMPACT	PHASE	INTENSITY	DURATION	CONSEQUENCE	EXTENT	SEVERITY	PROBABILITY	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION	MITIGATION CONFIDENCE	SIGNIFICANCE WITH MITIGATION
	Topography	Change in landforms for the development of new infrastructure	C&O	3	5	4	1	2.5	1	2.5	Platforms and ramps associated with the development of the UPC are to be included in the final landscape planning (if not to be used in future) Infrastructure to be removed at the end of the LOM. Financial provision to be updated to provide for the removal of additional infrastructure..	1	2.5
	Soils	Soil contamination due to storage and handling of potential pollutants at laydown areas and areas of work.	C	3	2	2.5	1	1.75	0.8	1.4	Laydown areas to be developed within existing disturbed areas within the mine. Implement measures indicated for the protection of groundwater from contamination.	0.8	1.12
	Soils	Soil contamination due to storage and handling of potential pollutants at the UPC associated infrastructure areas.	O	3	4	3.5	1	2.25	0.6	1.35	Implement measures as described for the protection of groundwater from contamination during the operations.	0.6	0.81
	Biodiversity	Disturbance of vegetation and habitats for the development of lay down areas or areas of work.	C	2	2	2	1	1.5	0.4	0.6	No undisturbed vegetation or habitats are to be disturbed for the purposes of implementing the project.	1	0.6
	Cultural Heritage	Disturbance of heritage sites due to the development of laydown areas or earthmoving activities required for the development of the UPC.	C	2	5	3.5	1	2.25	0.6	1.35	Only previously disturbed areas are to be used for the establishment of laydown areas for the project. Should any heritage artefact be unearthed, activities are to be stopped and further action undertaken in accordance with the advice of a heritage specialist.	0.6	0.81
	Visual Environment	Increased visual intrusion and loss of scenic quality due to development of UPC.	C&O	2	4	3	2	2.5	0.4	1	The development of UPC and associated infrastructure is within the mine and will not change the visual environment. No additional mitigation required as a result of the project.	0.4	0.4

MINING OF C-GRADE MATERIAL

ACTIVITY	ASPECT	POTENTIAL IMPACT	PHASE	INTENSITY	DURATION	CONSEQUENCE	EXTENT	SEVERITY	PROBABILITY	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION	MITIGATION CONFIDENCE	SIGNIFICANCE WITH MITIGATION
MINING OF C-GRADE MATERIAL	Groundwater	Additional dewatering requirements to access C-grade material.	O	4	4	4	2	3	0.2	0.6	The C-grade material is included in the existing ROM. No additional mining areas are required to access C-grade material.	1	0.6
	Groundwater	Reduced risk of groundwater contamination due to processing rather than disposal of C-grade material.	O	1	5	3	2	2.5	0.2	0.5	The C-grade material does not pose a risk of groundwater contamination thus there are no real benefits in terms of groundwater contamination risks associated with processing rather than disposing of the material	1	0.5
	Water balance	Consumption of additional water as a result of additional dust suppression required for additional haulage of C-grade material.	O	2	4	3	1	2	0.4	0.8	The only additional roads required are 2 ramps to the new UPC. Some additional fleet is required as a result of the project, but it is unlikely to have a significant impact on dust suppression requirements.	1	0.8
	Surface Water Resources	C-grade material will no longer be placed on residue stockpiles. Any risks posed to surface water due to run-off from the material will be lowered.	C	1	2	1.5	1	1.25	0.2	0.25	The C-grade material does not pose a significant risk to surface water resources at Sishen Mine.	1	0.25
	Air Quality	Increased dust emissions due to additional fleet and haulage of C-grade material.	O	1	4	2.5	1	1.75	1	1.75	Some additional fleet and additional haulage required for C-grade material. No additional haul roads are required due to the mining of C-grade material. Haul roads to be maintained including the use of dust suppression.	0.8	1.4
	Climate Change	Increased diesel consumption and associated emissions of CO_2 due to increased haulage required for processing of C-grade material.	O	1	4	2.5	1	1.75	1	1.75	Kumba's Climate Change Strategy is aimed at reducing electricity consumption and emissions, through improved mine planning, reduced haulage distances, and reduced stripping ratios	0.6	1.05
	Noise	Increase in noise levels due to additional fleet and haulage as a result of the project.	O	1	4	2.5	1	1.75	0.4	0.7	Equipment and vehicles are to be kept in a high level of maintenance. Current noise monitoring undertaken at Sishen to continue unchanged. Noise complaints will continue to be monitored and managed through the Sishen External Complaints Procedure. Implement a noise management plan.	0.6	0.42
	Topography	C-grade material no longer be placed on residue stockpiles. Rate of expansion of dumps at Sishen will be reduced over the LOM as less mining waste is produced.	O	2	5	3.5	1	2.25	1	2.25	Current indications are that the impact on rehabilitation requirements for the mine will be minimal at the end of LOM. Investigate opportunities for processing of additional low-grade material types through UHDMS.	1	2.25
	Soils	Contamination of soils due to storage, handling and use of additional diesel due to additional fleet and haulage requirements.	O	1	4	2.5	1	1.75	0.2	0.4	Fleet to be kept in a high level of maintenance to prevent spills and leaks.	1	0.4

	Biodiversity	Disturbance of vegetation and habitats required for the mining of C-grade material.	O	2	4	3	1	2	0.2	0.4	No new mining areas will be required for the mining of C-grade material.	1	0.4
	Cultural Heritage	Disturbance of heritage sites due to the mining of C-grade ore.	O	2	4	3	1	2	0.2	0.4	No new mining areas will be required for the mining of C-grade material.	1	0.4
	Visual Environment	Less visual intrusion due to slower growth of residue stockpile areas.	O	1	5	3	2	2.5	0.4	1	Investigate opportunities for processing of additional low material types through UHDMS.	1	1

RECOVERY OF C-GRADE STOCKPILES

ACTIVITY	ASPECT	POTENTIAL IMPACT	PHASE	INTENSITY	DURATION	CONSEQUENCE	EXTENT	SEVERITY	PROBABILITY	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION	MITIGATION CONFIDENCE	SIGNIFICANCE WITH MITIGATION
RECOVERY OF C-GRADE STOCKPILES	Groundwater	Less contamination risk due to removal of mineral residue for processing.	O	2	5	3.5	1	2.25	0.4	0.9	The C-grade residue stockpile material is inert and does not present a risk of contamination of groundwater.	1	0.9
	Groundwater	Reduced risk of groundwater contamination due to processing rather than disposal of C-grade material.	O	1	5	3	2	2.5	0.2	0.5	The C-grade material does not pose a risk of groundwater contamination thus there are no real benefits in terms of groundwater contamination risks associated with the removal of C-grade material from surface and processing through the UHDMS.	1	0.5
	Water balance	Consumption of additional water as a result of additional dust suppression required for additional haulage of C-grade material.	O	1	4	2.5	1	1.75	0.4	0.7	The only additional roads required are 2 ramps to the new UPC. Some additional fleet is required as a result of the project, but it is unlikely to have a significant impact on dust suppression requirements.	1	0.7
	Surface Water Resources	Removal of residue material from residue stockpile areas reducing risks of contamination of surface water run-off.	O	2	4	3	1	2	0.6	1.2	C-grade material is inert and does not present a high risk of contaminants leaching from stockpiles/dumps. Removal of material from surface reduces the risk of contamination. Investigate opportunities for processing of additional low-grade material types through UHDMS.	1	1.2
	Air Quality	Increased dust emissions due to additional fleet and haulage of C-grade material.	O	1	4	2.5	1	1.75	1	1.75	Some additional fleet and additional haulage required for C-grade material. No additional haul roads are required due to the mining of C-grade material. Haul roads to be maintained including the use of dust suppression.	0.8	1.4
	Climate Change	Increased diesel consumption and associated emission of CO_2 due to increased haulage required for processing of C-grade material.	O	1	4	2.5	1	1.75	1	1.75	Kumba's Climate Change Strategy aimed at reducing electricity consumption and emissions, through improved mine planning, reduced haulage distances, reduced stripping ratios	0.6	1.05
	Noise	Increase in noise levels due to additional fleet and haulage as a result of the project.	O	1	4	2.5	1	1.75	0.4	0.7	Equipment and vehicles are to be kept in a high level of maintenance. Current noise monitoring undertaken at Sishen to continue unchanged. Noise complaints will continue to be monitored and managed through the Sishen External Complaints Procedure. Implement a noise management plan.	0.6	0.42
	Topography	Removal of residue material from residue stockpile areas on surface.	O	2	5	3.5	1	2.25	1	2.25	Current indications are that the impact on rehabilitation requirements for the mine will be minimal at the end of LOM. Investigate opportunities for processing of additional low-grade material types through UHDMS.	1	2.25

ACTIVITY	ASPECT	POTENTIAL IMPACT	PHASE	INTENSITY	DURATION	CONSEQUENCE	EXTENT	SEVERITY	PROBABILITY	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION	MITIGATION CONFIDENCE	SIGNIFICANCE WITH MITIGATION
	Soils	Contamination of soils due to storage, handling and use of additional diesel due to additional fleet and haulage requirements.	O	2	4	3	2	2.5	0.2	0.4	Fleet to be kept in a high level of maintenance to prevent spills and leaks.	1	0.4
	Biodiversity	Disturbance of vegetation and habitats to access residue stockpile areas.	O	1	4	2.5	1	1.75	0.2	0.35	No vegetation or habitats will be disturbed to allow access to residue stockpile areas.	1	0.35
	Cultural Heritage	Disturbance of heritage sites due the mining of C-grade material.	O	1	4	2.5	1	1.75	0.2	0.35	No material with a potential to contain artefacts will be disturbed to access material in residue stockpile areas.	1	0.35
	Visual Environment	Less visual intrusion due to the removal of residue material from residue stockpile areas on surface.	O	1	5	3	2	2.5	0.4	1	Current indications are that the impact on rehabilitation requirements for the mine will be minimal at the end of LOM. Investigate opportunities for processing of additional low-grade material types through UHDMS.	1	1

DISPOSAL OF PROCESS WASTE AT DISCARD DUMP AND TAILINGS STORAGE FACILITY

ACTIVITY	ASPECT	POTENTIAL IMPACT	PHASE	INTENSITY	DURATION	CONSEQUENCE	EXTENT	SEVERITY	PROBABILITY	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION	MITIGATION CONFIDENCE	SIGNIFICANCE WITH MITIGATION
DISPOSAL OF PROCESS WASTE AT DISCARD DUMP AND TAILINGS STORAGE FACILITY	Groundwater	Contamination of underlying aquifers due to pollutants leaching from discard and slimes originating from C-grade material.	O	3	5	4	1	2.5	0.8	2	The wastes are inert and don't present a risk of contamination. The future return water dam at the tailings storage facility is to be lined to protect aquifers from nitrates in the liquid fraction of slimes.	0.6	1.2
	Water balance	Consumption of additional water as a result of additional dust suppression required for handling of additional process waste.	O	1	4	2.5	1	1.75	0.6	1.05	Sishen is to maximise the opportunity for the recycling of water to accommodate additional water requirements at the mine.	1	1.05
	Surface Water Resources	Contamination of surface water resources due to contaminants emanating from discard and slimes from C-grade material.	O	3	4	3.5	1	2.25	0.8	1.8	The wastes are inert and don't present a risk of contamination. The return water dam at the tailings storage facility is to be lined to protect aquifers from nitrates in the liquid fraction of slimes.	0.6	1.08
	Air Quality	Increased dust emissions due to handling and disposal of additional process waste.	O	1	4	2.5	1	1.75	1	1.75	Dust suppression at handling points using existing systems at Sishen Mine. Systems are to be kept in a high state of maintenance to ensure that there is maximum efficiency through the life.	0.8	1.4
	Noise	Increase in noise levels due to handling of process waste from C-grade material.	O	1	4	2.5	1	1.75	0.2	0.35	Equipment and vehicles are to be kept in a high level of maintenance. Current noise monitoring undertaken at Sishen to continue unchanged. Noise complaints will continue to be monitored and managed through the Sishen External Complaints Procedure. Implement a noise management plan.	0.6	0.21
	Topography	Increased rate of expansion of discard dump.	O	3	4	3.5	1	2.25	1	2.25	No expansion of authorised dump footprint and volumes deemed necessary for the implementation of the project. Ongoing rehabilitation not possible. Dump rehabilitation covered in Sishen's existing closure planning. Final landform and rehabilitation requirements still to be confirmed as part of the closure planning.	1	2.25
	Soils	Contamination of soils due to disposal of process waste.	O	2	4	3	1	2	0.2	0.4	No additional areas outside of existing authorised facilities will be required for the disposal of C-grade process waste.	1	0.4
	Biodiversity	Disturbance of vegetation and habitats for the disposal of process waste.	O	1	4	2.5	1	1.75	0.2	0.35	No additional areas outside of existing authorised facilities will be required for the disposal of C-grade process waste. Destruction of wetland pan in the footprint is authorised.	1	0.35
	Cultural Heritage	Disturbance of heritage sites due the mining of C-grade material.	O	1	4	2.5	1	1.75	0.2	0.35	No additional areas outside of existing authorised facilities will be required for the disposal of C-grade process waste.	1	0.35
	Visual Environment	Visual intrusion due to increased rate of expansion of discard dump.	O	2	4	3	2	2.5	0.6	1.5	Implement measures as described for topographical impacts.	1	1.5

IMPLEMENTATION OF DMS UPGRADE PROJECT – SOCIO-ECONOMICS

ACTIVITY	ASPECT	POTENTIAL IMPACT	PHASE	INTENSITY	DURATION	CONSEQUENCE	EXTENT	SEVERITY	PROBABILITY	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION	MITIGATION CONFIDENCE	SIGNIFICANCE WITH MITIGATION
IMPLEMENTATION OF DMS UPGRADE PROJECT	SOCIO-ECONOMICS	Additional procurement for construction	C	2	4	3	4	3.5	1	3.5	Local Procurement to be implemented in line with Sishen's Local Procurement Strategy aimed at achieving SLP commitments.	1	3.5
		Additional employment created during construction	C	2	4	3	4	3.5	1	3.5	Resourcing Plan to be developed and aligned with Sishen's commitments for preferential local procurement. Contractors to comply with preferential employment targets for the project in line with the Sishen's Contractor Social Management Procedure.	1	3.5
		Added value to the economy due to construction expenditure	C	2	4	3	5	4	1	4	Preferential procurement and employment to enhance benefits to local economy.	1	4
		Additional employment during operation	C	1	4	2.5	3	2.75	1	2.75	Employment in line with Sishen's targets for local employment. Project to be incorporated into capacity building initiatives with local communities to enhance skills and development.	1	2.75
		Added value to the economy due to operational expenditure.	O	2	4	3	4	3.5	1	3.5	Sishen's expenditure on LED and CSI to be increased in line with increased revenue associated with the project in accordance with SLP commitments.	1	3.5
		Increase in social pathologies (crime, prostitution, alcohol abuse, spread of HIV, poor living conditions) due to influx of persons	C	2	4	3	3	3	1	3	Develop a stakeholder engagement plan. Clear communication and engagement on public as to local procurement policies. Sishen's Social Management Plan to be updated to consider implications of the project. Sishen to continue to work together with local authorities and social services who are to be informed of the pending project in order that issues can be pre-empted and managed,	0.8	2.4
		Increase pressure on local services and infrastructure due to influx of persons.	C&O	3	5	4	2	3	0.8	2.4	Stakeholder engagement plan. Capacity building programme for municipal employees. Collaboration with local municipalities as to infrastructure development needs and priorities for LED requirements.	1	2.4
		Strained relationships with selected stakeholders due to unmet expectations of economic benefits from the mine	O	3	3	3	4	3.5	0.8	2.8	Engagement plan to ensure that stakeholders are being kept up to date with the project and the opportunities for local community members – management of expectations. Effective engagement with key stakeholders. Open door to listen to aggrieved groups. Communicate the mine's performance on socio-economic benefit delivery to the local community.	0.6	1.7

10. SUMMARY OF SPECIALIST REPORTS

LIST OF STUDIES UNDERTAKEN	RECOMMENDATIONS OF SPECIALIST REPORTS	SPECIALIST RECOMMENDATIONS THAT HAVE BEEN INCLUDED IN THE EIA REPORT	REFERENCE TO APPLICABLE SECTION OF REPORT WHERE SPECIALIST RECOMMENDATIONS HAVE BEEN INCLUDED.
Air Quality Specialist Study (Airshed Planning Professionals, February 2018)	• Ongoing development and implementation of dust management plans. We recommend that a plan is developed for each specific residential area. • Restricting or ceasing activities during unfavourable weather conditions. • Conducting local area visual checks to direct application of necessary dust controls. • Properly maintaining dust-control equipment to ensure mitigation measures are available and effective. • Monitoring the effectiveness of the mitigation measures implemented and feeding this information into regular reviews of dust management procedures. • Ensure that ambient dust-monitoring equipment is calibrated and maintained. • Ensuring staff are aware of – and implement – dust management procedures in day-to-day mining operations. • Limiting exposed areas throughout all stages of mine operations.	The project has a low contribution to dust emissions at Sishen Mine. The mitigation proposed here are generic for the mine and not specific for the project. For the purposes of the project the following recommendations were include: • Dust extraction to be in place at the UPC. • Dust suppression to be in place at all new transfer points, part of the project. • Current dust management systems at the DMS to be incorporated in the upgraded process are to be maintained and working efficiently. • Maintenance of dust-control equipment and visual inspections of effectiveness. • Regular reviews of dust management procedures. • Ensuring staff are aware of and implement dust management procedures in day-to-day mining operations	Included as mitigation in Table 9-10 and Section 11.4. Part B, Section 5 and 7.

LIST OF STUDIES UNDERTAKEN	RECOMMENDATIONS OF SPECIALIST REPORTS	SPECIALIST RECOMMENDATIONS THAT HAVE BEEN INCLUDED IN THE EIA REPORT	REFERENCE TO APPLICABLE SECTION OF REPORT WHERE SPECIALIST RECOMMENDATIONS HAVE BEEN INCLUDED.
Noise Specialist Study (dBAcoustics, February 2018)	The noise impact assessment revealed that the noise increase will be insignificant at the abutting noise receptors to the Sishen Mine as the prevailing ambient noise will not be exceeded. The activities, during the operational phases of proposed DMS Upgrade project, will comply with the relevant Noise Control Regulations, 1994, IFC Health and safety Guideline and SANS 10103 of 2008, provided that the prevailing ambient noise level will not be exceeded and that the **noise management plan be adhered to at all times.**	The recommended noise management plan will be implemented.).	Included as mitigation in Table 9-10. Part B, Section 5 and 7.
Social Impact Assessment (Atlegang Social Intelligence, January 2018).	• Recruit locally, where possible and especially at unskilled and semi-skilled level, and make it clear that where skills are available, locals will be given first preference. This applies to both Sishen Mine and its contractors. • Each position should be advertised with the relevant minimum requirements stated. Information regarding employment needs should be communicated well in advance of each phase of the project in which employees will be required. • UHDMS Project employees will be incorporated into Sishen Mine's affordable housing project. • Hiring at both construction and operation phase should take place formally in accordance to with relevant legislative requirements and nationally acceptable methods. No recruitment should take place 'at the gate'. • Communicate with Gamagara LM and relevant government departments regarding existing infrastructural needs and how the UHDMS project could potentially directly and indirectly increase the pressure on the infrastructure. The needs should be discussed in the context of the constraints the municipality has and will have in providing services and infrastructure. • Project information should be effectively communicated throughout all stages of the project to ensure that expectations of all stakeholders are managed. • Contractor camps will be avoided where possible and feasible.	Note that the project will be incorporated into Sishen Mine which has existing policies, procedures and systems in place for recruitment, procurement, LED, staff awareness and training. It is thus not necessary to develop new structures but to make sure that the project is included in existing structures and future planning and updates. Mitigation proposed in the EIA include: • Local Procurement to be implemented in line with Sishen's Local Procurement Strategy aimed at achieving SLP commitments. • Resourcing Plan to be developed and aligned with Sishen's commitments for preferential local procurement. • Develop a stakeholder engagement plan.	Included as mitigation in Table 9-10 and Section 11.4. Part B, Section 5.

LIST OF STUDIES UNDERTAKEN	RECOMMENDATIONS OF SPECIALIST REPORTS	SPECIALIST RECOMMENDATIONS THAT HAVE BEEN INCLUDED IN THE EIA REPORT	REFERENCE TO APPLICABLE SECTION OF REPORT WHERE SPECIALIST RECOMMENDATIONS HAVE BEEN INCLUDED.

	• To mitigate the potential increase in HIV/AIDS prevalence and the spread of sexually transmitted diseases, the following steps will be taken:
	  o UHDMS Project employees and contractor employees should be included in Sishen Mine's HIV/AIDS management strategy. As part of this, workers will be trained on HIV/AIDS and STI prevention and management. Workers should also have access to counselling and testing.
	  o If no HIV/AIDS committee has been formed, an HIV/AIDS committee which include management, union representatives and local community members should be formed.
	• To mitigate the potential increase in drug and alcohol abuse, the following steps will be taken:
	  o UHDMS Project employees and contractor employees will be subject to the Drug and Alcohol Abuse Policy implemented by Sishen Mine.
	  o UHDMS Project employees and contractor employees will be trained on the adverse impacts of drug and alcohol abuse.
	• UHDMS Project employees will be subject to regular testing on site for alcohol and drug abuse as other Sishen Mine employees.
	• To mitigate the potential increase in crime, the Code of Conduct that addresses the illegal activities by workers (including prostitution; illegal sale or purchase of alcohol; sale, purchase or consumption of drugs; illegal gambling or fighting) must apply to UHDMS Project employees and contractor employees.
	• On the job training will be encouraged and be a prerequisite, where possible, for contractors and/or service providers
	• Sishen Mine will continue the inclusion of the human resource development programme in its Social and Labour Plan.
	• The human resource development programme will take cognizance of the local economy's present and future skills needs to ensure that
		• Engagement plan to ensure that stakeholders are being kept up to date with the project and the opportunities for local community members – management of expectations.
		• Sishen's expenditure on LED and CSI to be increased in line with increased revenue associated with the project in accordance with SLP commitments	

LIST OF STUDIES UNDERTAKEN	RECOMMENDATIONS OF SPECIALIST REPORTS	SPECIALIST RECOMMENDATIONS THAT HAVE BEEN INCLUDED IN THE EIA REPORT	REFERENCE TO APPLICABLE SECTION OF REPORT WHERE SPECIALIST RECOMMENDATIONS HAVE BEEN INCLUDED.
	the skills provided to community members and employees are relevant to the economy. • Where possible, labour should be sourced from the local area (John Taolo Gaetsewe DM) • If a skills database exists within the local area, it should be made available to contractors to enhance the procurement of labour from the local area. • If a skills database does not exist, Sishen Mine will establish a skills desk where local potential employees can submit their CVs. • Information regarding job requirements should be clearly stated to enable those with suitable skills to make their skills available for the project. • The recruitment process should promote gender equality. • Where possible, Sishen Mine will continue procuring as much as possible from local small businesses; this will stimulate indirect job creation. • In implementing socio-economic development projects and to enhance socio-economic development potential, Sishen Mine will assess community needs in consultation with the relevant stakeholders including the relevant municipalities, other relevant state organs, communities and non-profit organisations.		
Socio-economic Impact Assessment (Demacon Market Studies, October 2017)	None.		
Waste Assessment (Jones & Wagener, January 2018)	• The C-Grade ROM material as well as the various C-Grade waste streams being generated by the processing of C-grade material should be considered a Type 4 (inert waste) and may be disposed of on a dump with barrier systems of which the performance complies with that of a Class D landfill.	The following mitigation has been included in the project: • Use will be made of existing mineral residue disposal facilities for the disposal of discard and slimes.	Included as mitigation in Table 9-10 and Section 11.4 Part B, Section 5.

LIST OF STUDIES UNDERTAKEN	RECOMMENDATIONS OF SPECIALIST REPORTS	SPECIALIST RECOMMENDATIONS THAT HAVE BEEN INCLUDED IN THE EIA REPORT	REFERENCE TO APPLICABLE SECTION OF REPORT WHERE SPECIALIST RECOMMENDATIONS HAVE BEEN INCLUDED.
	• All associated water management infrastructure should be provided with barrier systems of which the performance complies with that of a Class C barrier system. • Alternatively, source-pathway-receptor modelling can be conducted to demonstrate that an alternative, less conservative barrier system, will protect the receiving environment against the impacts of the tailings and tailings water; and • All designs must be approved by the DWS.	• The proposed new tailings return water dam is to be lined to ensure protection of groundwater.	

11. ENVIRONMENTAL IMPACT STATEMENT

11.1 SUMMARY OF KEY FINDINGS OF THE ENVIRONMENTAL IMPACT ASSESSMENT

The following have been identified as the key findings of the impact assessment:

11.1.1 Employment, Local Procurement and Economic Development

- The construction phase of the project will provide for ~495 jobs. The predicted indirect job opportunities that could be created due to the capital input will be 2 075.
- The operational phase of the project will provide ~128 additional job opportunities at Sishen Mine. However, due to the additional annual operational expenditure associated with the project, a total of 1 059 employment positions could be created.
- The project will have a significant impact on the local and regional economy both during construction (~additional GGP of R1.9 billion) and during the life of the operations (~R485 million per annum).
- An increase in production will be associated with an increase in expenditure by Sishen Mine on CSI and LED, in line with the SLP commitments.

11.1.2 Influx of Persons

- The construction and increased production at Sishen Mine may result in an influx of persons into the area.
- Influx of persons places additional pressure on municipal infrastructure and community services including: health care, poverty alleviation, and education.
- Sishen is to incorporate the project into its Social Management Plan.

11.1.3 Community Expectations

- Possible strained relationships with surrounding communities may result due to the failure to meet expectations in terms of employment and socio-economic development initiatives associated with the project and increased production.
- Sishen is to include the project in a Stakeholder Engagement Plan which gives consideration to all development taking place at the mine.

11.1.4 Soil and Groundwater Contamination

- The risks of contamination of soils and groundwater result due to the storage of hazardous chemical substances such as hydrocarbons. The impact significance is low and can be managed through the implementation of measures to contain and manage spills and leaks.

- Discard and slimes originating from the processing of C-grade material is not expected to result in a contamination risk for groundwater. This material will be placed on existing waste management facilities at Sishen Mine. There is no need to expand the discard dump or tailings storage facility.
- Of importance is the potential of the water fraction from slimes to contaminate groundwater resources due to high nitrate levels. The return water management at Sishen's tailings storage facility is in the process of being upgraded. Provision is to be made for the lining of the return water dam.

11.1.5 Water Consumption

- The processing of C-grade material will result in additional water consumption of ~100m^3/hr. This water will be supplied largely through initiatives for the recycling of water at the mine.

11.1.6 Surface Water Management

- The DMS Upgrade Project will be incorporated into existing stormwater management systems at Sishen Mine.
- Sishen is in the process of upgrading existing stormwater management systems which includes provision for containment and recycling of water.
- The existing systems will be able to accommodate the project and the surface water resource risks are expected to be low.
- The upgraded stormwater management infrastructure is to be in place prior to the commencement of construction of the project.

11.1.7 Increased Dust Levels

- The project is expected to result in a 2.5 - 5% increase in dust emissions as a result of the processing of C-grade material.
- Although the increase in dust emissions is of low significance, the cumulative impact of Sishen Mine is high and exceeds legislative requirement at some sensitive receptors.
- Sishen Mine is to implement dust management actions to address dust levels as a matter of urgency.

11.1.8 Climate Change

- The mining and processing of C-grade material will result in an increase in electricity consumption and diesel consumption.
- The contribution of these increases is considered to be low.

11.1.9 Increased Noise Levels

- The project is to result in an increase in noise levels at sources such as the UPC, UHDMS and conveyors.
- The increase will not result in any change in noise levels in the ambient environment.

11.1.10 Change of Landforms and Rehabilitation Requirements

- The processing of C-grade material will result in less material being placed on residue stockpiles/waste rock dumps during the remaining life of Sishen Mine.
- The project will result in the removal of surface material from residue stockpiles and waste rock dumps at the mine.
- The cumulative positive impact on the change in landforms and rehabilitation at Sishen Mine will however be low.
- Opportunities for the processing of additional low-grade material and enhancing the benefits to existing landform impacts and rehabilitation requirements are to be investigated.

11.1.11 Disturbance Footprint

- The DMS Upgrade Project is a brownfields project. The development of the Discard Emergency stockpile will require clearing of soils and vegetation, but this will take place within the existing authorised footprint area of the Discard Dump

11.2 Final site map

The final site layout map is provided in Figure 3-1 and also here as Figure 11-1. There has been no need to alter the site layout as an outcome of the findings of the EIA.

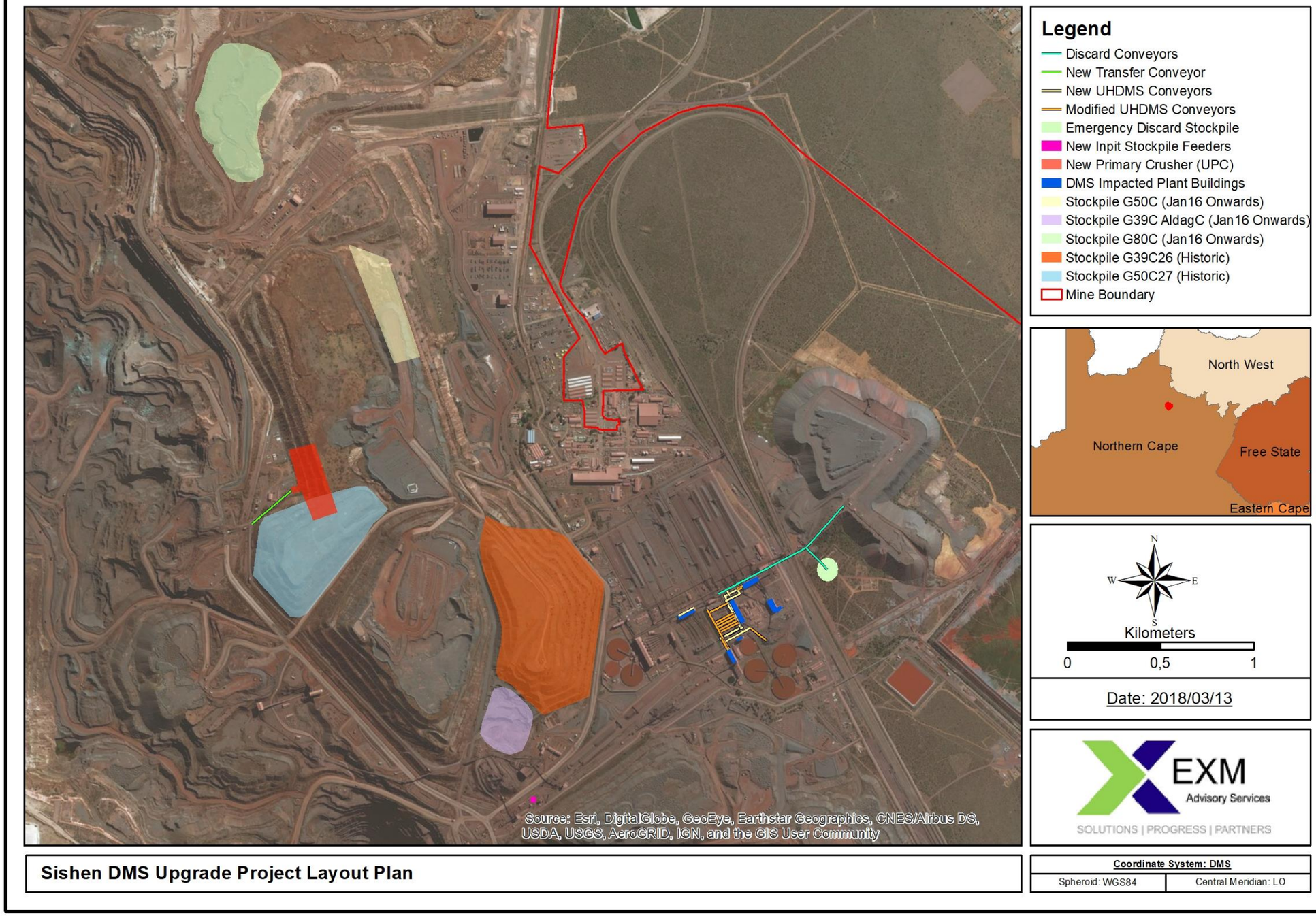


FIGURE 11-1: PROPOSED PROJECT LAYOUT OF THE DMS UPGRADE PROJECT

11.3 Summary of the positive and negative implications and risks of the proposed activity and identified alternatives

TABLE 11-1: SUMMARY OF KEY POSITIVE AND NEGATIVE IMPACTS IDENTIFIED FOR THE MITIGATED AND UNMITIGATED SCENARIOS

(NOTE THAT THE PROJECT WILL NOT RESULT IN VERY HIGH OR HIGH IMPACTS, THUS MODERATE IMPACTS ARE SHOWN)

ACTIVITY	ASPECT	IMPACT DESCRIPTION	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION	SIGNIFICANCE WITH MITIGATION
UPGRADE OF DMS TO UHDMS INCLUDING NEW CONVEYORS	Water Consumption	Consumption of additional water as a result of UHDMS process	Moderate	Sishen is to maximise the opportunity for the recycling of water to accommodate additional water requirements at the mine.	Low
	Surface Water Resources	Contamination of surface water resources due to contaminated run-off originating from upgraded components of the UHDMS.	Moderate	Run-off to be managed through the stormwater management systems at Sishen Mine (in the process of being upgraded). The upgraded stormwater management infrastructure is to be in place prior to the commencement of construction.	Low
	Air Quality	Increase in dust emissions as a result of the UHDMS.	Moderate	Ensure that current systems at Sishen Mine to be used by UHDMS for dust extraction are working efficiently. Implement measures for dust suppression at additional handling points. Maintenance of dust-control equipment and visual inspections of effectiveness.	Low
	Soils	Loss of available soils within the footprint area of the Discard Emergency Stockpile and Laydown areas.	Moderate	Topsoil to be removed from footprint areas and stockpiled for use in rehabilitation.	Low

ACTIVITY	ASPECT	IMPACT DESCRIPTION	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION	SIGNIFICANCE WITH MITIGATION
DEVELOPMENT OF UPC, RAMPS, STOCKPILES AND CONVEYOR	Water Consumption	Consumption of additional water as a result of additional dust suppression required at the crusher.	Moderate	Sishen is to maximise the opportunity for the recycling of water to accommodate additional water requirements at the mine.	Low
	Surface Water Resources	Contamination of surface water resources due to contaminated run-off originating from the UPC and associated infrastructure.	Moderate	Run-off from the UPC is to be integrated into the upgraded stormwater management system at Sishen Mine. The upgraded stormwater infrastructure is to be in place prior to the commencement of construction. Run-off that could be potentially contaminated with hydrocarbons is to be separated at the UPC. This water is to be contained and prevented from entering stormwater canals. The water is to report to the future Aldag PCD which is designed for the management of hydrocarbons and water is recycled for use at the mine. The remaining run-off is to pass through a sediment trap before entering the stormwater management canals.	Low
	Air Quality	Increased dust emissions due to entrainment from construction activities associated with the development of the UPC.	Moderate	Dust suppression to be implemented in areas of work where earth moving is to take place. Dust suppression to be implemented at laydown areas and additional roads established to access laydown areas and work areas.	Low

ACTIVITY	ASPECT	IMPACT DESCRIPTION	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION	SIGNIFICANCE WITH MITIGATION
		Increase in dust emissions as a result of the additional handling, stockpiling and crushing at the UPC.	Moderate	Dust extraction to be implemented at the UPC. Dust suppression to be in place at new handling points. Dust aside to be in place at all new roads leading to the UPC and associated infrastructure. Maintenance of dust-control equipment and visual inspections of effectiveness.	Low
	Topography	Change in landforms for the development of new infrastructure	Moderate	Platforms and ramps associated with the development of the UPC are to be included in the final landscape planning (if not to be used in future) Infrastructure to be removed at the end of the LOM. Financial provision to be updated to provide for the removal of additional infrastructure.	Moderate
DMS UPGRADE PROJECT	Socio-Economics	Additional procurement for construction	High Positive	Local Procurement to be implemented in line with Sishen's Local Procurement Strategy aimed at achieving SLP commitments.	High Positive
		Additional employment created during construction	High Positive	Resourcing Plan to be developed and aligned with Sishen's commitments for preferential local procurement. Contractors to comply with preferential employment targets for the project in line with the Sishen's Contractor Social Management Procedure.	High Positive

ACTIVITY	ASPECT	IMPACT DESCRIPTION	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION	SIGNIFICANCE WITH MITIGATION
		Added value to the economy due to construction expenditure	High Positive	Preferential procurement and employment to enhance benefits to the local economy.	High Positive
		Added value to the economy due to operational expenditure.	High Positive	Sishen's expenditure on LED and CSI to be increased in line with increased revenue associated with the project in accordance with SLP commitments.	High Positive
		Increase in social pathologies (crime, prostitution, alcohol abuse, spread of HIV, poor living conditions) due to influx of persons	Moderate	Develop a stakeholder engagement plan. Clear communication and engagement on public as to local procurement policies. Sishen's Social Management Plan to be updated to consider implications of the project. Sishen to continue to work together with local authorities and social services who are to be informed of the pending project in order that issues can be pre-empted and managed,	Moderate
		Increase pressure on local services and infrastructure due to influx of persons.	Moderate	Stakeholder engagement plan. Capacity building programme for municipal employees. Collaboration with local municipalities as to infrastructure development needs and priorities for LED requirements. Collaboration with community forums	Moderate

ACTIVITY	ASPECT	IMPACT DESCRIPTION	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION	SIGNIFICANCE WITH MITIGATION
		Strained relationships with selected stakeholders due to unmet expectations of economic benefits from the mine	Moderate	Engagement plan to ensure that stakeholders are being kept up to date with the project and the opportunities for local community members – management of expectations. Effective engagement with key stakeholders. Open door to listen to aggrieved groups. Communicate the mine's performance on socio-economic benefit delivery to the local community.	Moderate

11.4 Proposed management objectives and the impact management outcomes for inclusion in the EMPr

The key mitigation measures to be included in the EMPr are as follows:

- Hazardous chemicals are to be stored in bunded areas designed according to SANS.
- Areas where hazardous chemicals are stored or handled are to be provided with impervious surfaces to prevent the contamination of soils and seepage to groundwater.
- Sishen is to maximise the opportunity for recycling of water from existing processes and facilities to accommodate additional water requirements.
- Run-off from the UPC and the UHDMS is to be accommodated by the upgraded stormwater management systems at Sishen Mine.
- The upgraded stormwater management infrastructure is to be in place prior to the commencement of construction.
- Run-off potentially contaminated with hydrocarbons is to be prevented from entering stormwater canals. Such water originating at the UPC is to report to the Aldag PCD, which will be a lined facility.
- The new return water management infrastructure at the Tailings Storage Facility is to be lined to prevent contamination of groundwater.
- Increased discard volumes to be included in update of Sishen Mine Integrated Water Use Licence.
- Dust extraction systems to be in place at all crushers and dust suppression to be carried out at all new transfer points.
- Current dust management systems at the DMS to be incorporated in the upgraded process are to be maintained and working efficiently.
- Resourcing plan to be developed in line with Sishen's commitments to local employment.
- Contractors to comply with local employment targets.
- Preferential local procurement plan to be implemented.
- Opportunities for the processing of additional low-grade ore to be investigated.

11.5 Final proposed alternatives

The proposed final layout alternative is depicted in Section 11.2 (see Figure 3-1 & Figure 11-1).

11.6 Aspects for inclusion as conditions in the authorisation

Sishen Mine is to prioritise the implementation of the planned stormwater management systems and water recycling initiatives in accordance with the requirements of the Department of Water & Sanitation. Such systems are required to ensure the protection of water resources at the mine including the incorporation of the DMS Upgrade Project. The upgraded stormwater infrastructure is to be in place prior to the implementation of the project.

11.7 Description of any assumptions, uncertainties and gaps in knowledge

The outcomes of this EIA Report are based on the following assumptions, uncertainties and knowledge gaps:

- The impacts are as for the project description as available at the end of the Prefeasibility Study undertaken by the Sishen Iron Ore Company and as described in Section 4. This is based on the 2016 mine plan.
- Impacts on air quality and noise have been based on a proposed ROM of 12.3 Mtpa. The actual production rates will be confirmed in the feasibility study. However, given that the impacts are low, it is not anticipated that the possible increased in production to 16 Mtpa ROM, to be confirmed in the Feasibility Study will result in a change in impacts that will affect the outcome of the project.
- Impacts on the economy have also been based on a production of 3.2 Mtpa of ore. Should the project produce more based on the outcomes of the Feasibility Study the benefits of the project to the economy will be enhanced.
- It is assumed that the upgraded stormwater management systems at Sishen will be able to accommodate the DMS Upgrade Project.
- It is assumed that the capacity of the Discard Dump and Tailings Storage Facility will be sufficient to accommodate the disposal of waste from the processing of C-grade material throughout the LOM. However significant increases in production may mean that additional storage capacity is required. The expansion of such facilities outside of the scope of this assessment will have to be addressed in additional applications for environmental authorisation.

11.8 Reasoned opinion as to whether the proposed activity should or should not be authorised

It is the opinion of the EAP that the DMS Upgrade Project should be authorised based on the following reasons:

- The project is a brownfields development within Sishen Mine with low to moderate risks to the environment.

- The projects will result in significant socio-economic benefit in terms of capital projection into the local economy as well as ongoing benefits due to the increased production at Sishen Mine.
- Low grade iron ore material is currently being placed on residue stockpile areas and is regarded as "waste" due to the absence of suitable technology for the processing of the material. UHDMS presents the technology for the processing of this low grade material from ROM and from current stockpile/waste areas reducing the amount of waste produced at Sishen Mine.
- The project presents an opportunity for Sishen Mine to investigate opportunity for the processing of additional low grade material at the mine and the possible extension of the life of mine.

11.9 Rehabilitation Objectives

The DMS Upgrade Project will be incorporated into Sishen Mine. Rehabilitation will be undertaken in accordance with the overall rehabilitation objectives for the mine. A Preliminary Closure Plan has been developed for Sishen Mine (Shangoni Management Services. February 2017) and presented to the DMR (currently pending authorisation). The Preliminary Closure Plan is included in Part C, Appendix 6. The final land use at Sishen Mine is envisaged to include a combination of wilderness areas, agricultural and small industrial use. In order to achieve the final land-use plan the following rehabilitation objectives have been set for the mine:

- All rehabilitated land is to be safe and useable, excluding the open pits and potentially the pit-facing slopes of waste rock dumps which will be wilderness;
- All rubble from plant decommissioning and related areas must not cause long term degradation or safety hazards;
- All waste dumps must be closed and rehabilitated as per legislative requirements;
- Land is to be physically and chemically stable;
- Rehabilitated areas must be used in a sustainable manner;
- Ground and surface water will not be polluted once the mine is closed; and
- Stakeholders will be engaged on final land use planning.

In order to meet the above objectives, provision has been made for:

- Removal of infrastructure associated with the DMS Upgrade Project (unless there is an identified and agreed future use);
- Remediation of landforms in line with final land use;

- Ripping of roads to allow for the establishment of vegetation;
- Removal or rubble and disposal of waste in accordance with legislative requirements;
- Remediation of the footprint area to a state that is free of contaminants and suitable for the establishment of sustainable vegetation;
- Implementation of stormwater management at contaminated areas (if required);
- Establishment of suitable indigenous vegetation on rehabilitated footprint areas;
- Maintenance and monitoring of revegetated areas to self-sustaining state.

11.10 Period for which the environmental authorisation is required

Construction is planned to commence in 2020. Production is planned for 2022 and will continue for the life of Sishen Mine (currently 2031).

12. FINANCIAL PROVISION

12.1 Derivation of quantum

EXM Advisory Services has estimated the cost of rehabilitating the additional infrastructure required for the DMS Upgrade Project. The detailed costing is provided in Part C, Appendix 7. The costs were based on the closure cost plan for Sishen (Shangoni Consulting, 2015). The rates were adjusted with CPI for 2016 and 2017.

Note that the premature closure cost is the same as the LOM closure cost as the infrastructure is in place after implementation and remains unchanged to the end of LOM. The closure liability associated with the DMS Upgrade Project is: R4 720 510.

The breakdown of the liability costs for premature closure and LOM closure are provided in Table 12-1 and Table 12-2 and indicate the change in the liability at Sishen Mine.

TABLE 12-1: ESTIMATE OF CHANGES- TO SISHEN IRON MINE PREMATURE CLOSURE COSTS AS A RESULT OF THE DMS UPGRADE PROJECT

SISHEN MINE PREMATURE CLOSURE AND REHABILITATION COST ESTIMATE 2018; INCLUDING DMS UPGRADE PROJECT				
No.	**Area**	**PREMATURE COST (NOV 2017)**	**CHANGES DUE TO DMS UPGRADE PROJECT**	**TOTAL REVISED SISHEN PREMATURE CLOSURE COST; INCLUDING DMS UPGRADE PROJECT**
1	Rehabilitation / Restoration provisions Total	R 1,406,830,183.00	R 0.00	R 1,406,830,183.00
2	Decommission provisions (Sishen excl. SEP)	R 276,323,084.00	R 3,654,324.62	R 279,977,408.62
3	Decommission provisions (Total only SEP)	R 43,179,454.00	R 0.00	R 43,179,454.00
4	Contingencies and consultation fees	R 646,649,155.00	R 1,066,185.36	R 647,715,340.36
	Total	**R 2,372,981,876.00**	**R 4,720,509.98**	**R 2,377,702,385.98**
		Difference		**-R4,720,509.98**

TABLE 12-2: ESTIMATE OF CHANGES- TO SISHEN IRON MINE LOM CLOSURE COSTS AS A RESULT OF THE DMS UPGRADE PROJECT

SISHEN MINE LOM CLOSURE AND REHABILITATION COST ESTIMATE 2018; INCLUDING DMS UPGRADE PROJECT				
No.	**Area**	**LOM COST (NOV 2017)**	**CHANGES DUE TO DMS UPGRADE PROJECT**	**TOTAL REVISED SISHEN LOM CLOSURE COST; INCLUDING DMS UPGRADE PROJECT**
1	Rehabilitation / Restoration provisions Total	R 18,671,246,895.43	R 0.00	R 18,671,246,895.43
2	Rehabilitation / Restoration provision Total	R 285,007,172.31	R 3,654,324.62	R 288,661,496.93
3	Decommission provisions (Total only SEP	R 43,179,454.00	R 0.00	R 43,179,454.00
4	Contingencies and consultation fees	R 1,182,120,424.72	R 1,066,185.36	R 1,183,186,610.08
	Total	**R 20,181,553,946.45**	**R 4,720,509.98**	**R 20,186,274,456.43**
		Difference		**-R4,720,509.98**

12.2 Amount to be provided for from operating expenditure

No ongoing rehabilitation is required for the project and no additional environmental operating expenditure is required. The costs of dust management are incorporated into the running costs of the mine.

13. DEVIATIONS FROM THE APPROVED SCOPING REPORT AND PLAN OF STUDY

13.1 Deviations from the methodology used in determining the significance of the potential environmental impacts and risks

Not applicable

13.2 Motivation for deviation

Not applicable

14. OTHER INFORMATION REQUIRED BY COMPETENT AUTHORITY

Not applicable

15. OTHER MATTERS REQUIRED IN TERMS OF SECTIONS 24(4)(A) AND (B) ON NEMA

Not applicable

16. UNDERTAKING

I, Kerry Colleen Fairley, the Environmental Assessment Practitioner responsible for compiling this report, undertake that:

- the information provided herein is correct;
- the comments and inputs from stakeholders and I&APs has been correctly recorded;
- information and responses provided to stakeholders and I&APs by the EAP is correct; and

the level of agreement with I&APs and stakeholders has been correctly recorded and reported.

17.REFERENCES

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