

**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 B**

**FOR SUBMISSION TO THE DMR**

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

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**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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Joshua O'Brien	Environmental Scientist		23 April 2018

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## ACRONYMS AND ABBREVIATIONS

	<b>Definition</b>
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. DETAILS OF THE EAP

### 1.1 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

### 1.2 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

## **2. DESCRIPTION OF THE ASPECTS OF THE ACTIVITY**

**The requirement to describe the aspects of the activity that are covered by the draft environmental management programme are already included in PART A, Section 4, as required.**

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 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 3-1.

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.

### **3. COMPOSITE MAP**

**A map which superimposes the proposed activity, its associated structures, and infrastructure on the environmental sensitivities showing how areas are to be avoided is provided as Figure 3-1.**

**NOTE: NO ENVIRONMENTAL SENSITIVITIES ARE APPLICABLE TO THE FOOTPRINT AREA AS THE DMS UPGRADE PROJECT IS A BROWNFIELDS DEVELOPMENT TAKING PLACE WITHIN SISHEN MINE**

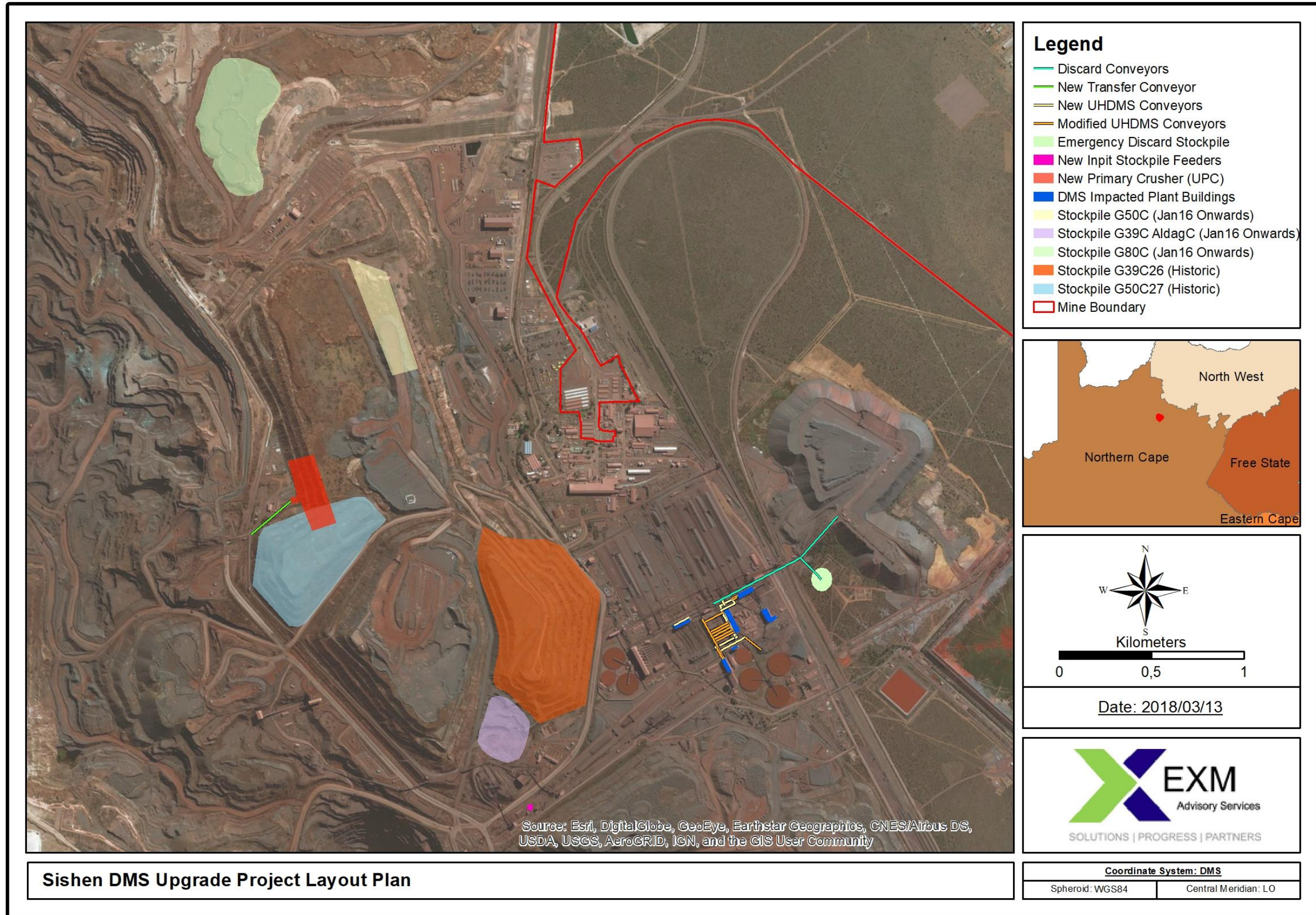


FIGURE 3-1: PROJECT LAYOUT: SISHEN DMS UPGRADE PROJECT WITHIN SISHEN MINE INFRASTRUCTURE AREAS

## **4. IMPACT MANAGEMENT OBJECTIVES**

### **4.1 Closure Objectives**

The DMS Upgrade Project will be incorporated into Sishen Mine. Rehabilitation and closure will be undertaken as part of the closure planning for the mine. A preliminary Closure Plan (Shangoni, February 2017) has been compiled and is included in Part C – Appendix 6.

As described in the Preliminary Closure Plan, the final land use at Sishen Mine is envisaged to include a combination of wilderness areas, agricultural and small industrial use.

The following are currently the overarching goals for the closure of Sishen Mine:

- A walk-away closure with limited / no significant long-term liabilities that require management;
- Rehabilitation must be of high quality and sustainable into the predictable future;
- Proposed post-closure land uses that are sustainable;
- Stakeholder engagement is to be undertaken and views taken into account in closure planning;
- Permanent Sishen employees have been successfully redeployed or re-skilled;
- Legal compliance is achieved;
- Authorities satisfied with the extent of rehabilitation and closure criteria;
- DMR satisfied to issue a closure certificate with limited / no significant conditions.

### **4.2 Process for Managing Environmental Damage, Pollution, Pumping and Treatment of Extraneous Water and Ecological Degradation**

The DMS Upgrade Project does not present any additional highly significant risks to the environment. The following measures will be put in place to ensure that pollution risks are minimised throughout the life of the project:

- 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.
- Run-off from the UPC and the UHDMS is to be accommodated by the stormwater management systems at Sishen Mine.
- 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.
- 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.

### **4.3 Potential Risk of Acid Mine Drainage**

#### **4.3.1 Steps taken to investigate, assess and evaluate the impact of acid mine drainage**

The DMS Upgrade Project will involve the processing of C-grade material from ROM and from mineral residue stockpiles at Sishen Mine. Two mineral waste streams are produced through the existing DMS and future UHDMS process, namely discard waste and slimes. The intention is for these wastes to be deposited at the existing Discard Dump and Tailings Storage Facility.

The various mineral waste streams to be produced as a result of the DMS Upgrade Project were assessed (Jones & Wagener, June 2017) 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 results are summarised in Table 4-1.

As shown in Table 4-1, the C-grade material from the ROM is slightly alkaline. It was assessed to be a Type 3 waste. However, due to the absence of leachable contaminants, 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. The water fraction of the slimes was assessed separately from the solid fraction. As shown in Table 4-1, 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.

**TABLE 4-1: 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, 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.

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<sup>3</sup>, 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<sup>3</sup> 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 installed at the new return water dam to be developed for the Tailings Storage Facility..

The absence of sulfates in waste streams and the alkaline nature of the ore and wastes mean that any risk of acid-mine drainage is not a relevant risk for Sishen Mine.

#### 4.3.2 Engineering/Mine design solution to be implemented to avoid or remedy acid mine drainage

Acid-mine drainage is not applicable to Sishen Mine. Furthermore, as indicated in Section 4.3.1, the C-grade material, discard and slimes are considered to be inert and do not present a significant risk of contamination of groundwater and no barriers are required to protect the groundwater.

However, the tailings water fractions on the other hand, have elevated nitrate concentrations. 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 in place for tailings water return water dam (see Figure 4-1).

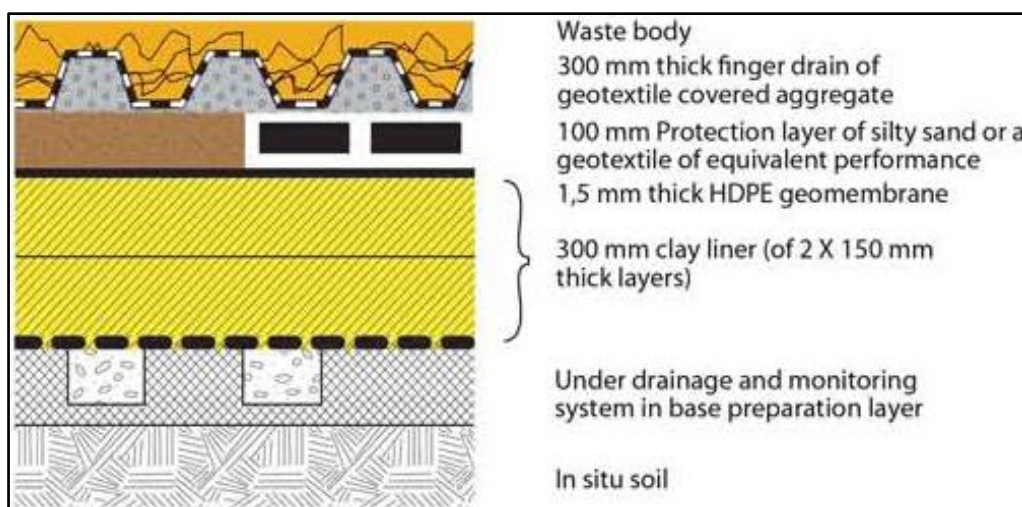


FIGURE 4-1: CLASS C BARRIER SYSTEM

Sishen Mine is in the process of planning for the development of a new Return Water Dam at the Tailings Storage Facility. Provision is being made for the lining of this dam to ensure pollution protection.

#### 4.3.3 Measures that will be put in place to remedy any residual or cumulative impact that may result from acid mine drainage

Not applicable.

#### **4.4 Volumes and rate of water use required for mining**

Additional water is required for the DMS Upgrade Project. The water will be used for additional dust extraction and suppression, washing and screening, spray water for floats and sinks, FeSi make-up water, wash water, fire water and potable water. The 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 however predicted to be below 100 m<sup>3</sup>/h and will be supplied predominantly by additional treated sewage effluent and recovered stormwater from the planned Eastern and Western Stormwater sumps, and the pollution control dams. 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<sup>3</sup> and one existing process water supply dam with a storage capacity of 25 000 m<sup>3</sup>. 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.

#### **4.5 Water use licence application**

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<sup>3</sup>/annum of water by the mine for processing and other activities. The processing of C-grade material will require and additional ~100 m<sup>3</sup>/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) of the National Water Act (No. 36 of 1998) 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 annual volumes to be disposed exceed the authorised volumes and the licence is to be amended to accommodate the additional volumes. The existing Integrated Water Use Licence at Sishen allows for the disposal of 3 045 370 m<sup>3</sup>/annum of slimes and 5 947 500 m<sup>3</sup>/annum. The discard volumes will exceed the licensed volumes from 2023 (6 052 638 m<sup>3</sup>) and be at a maximum in 2029 (10 080 360 m<sup>3</sup>).

## 5. ENVIRONMENTAL MANAGEMENT PROGRAMME

The DMS Upgrade Project will be integrated into the overall environmental management programme at Sishen Mine. The environmental actions provided in this section thus describe **additional measures** that are to be implemented at the mine as a result of the DMS Upgrade Project and serve to supplement the existing programme.

### 5.1 Planning and Design/Pre-Construction

Action No.	IMPACT MANAGEMENT ACTION	APPLICABLE STANDARD	Scheduling	APPLICABLE ACTIVITY				
				UPGRADE OF DMS TO UHDMS	DEVELOPMENT OF UPC	MINING OF C-GRADE MATERIAL	RECOVERY OF C-GRADE STOCKPILES	DISPOSAL OF PROCESS WASTE
<b>5.1.1</b>	<b>PROTECTION OF SOILS, BIODIVERISTY &amp; GROUNDWATER</b>							
5.1.1.1	Laydown areas to be located in existing disturbed areas at Sishen Mine.	-	Feasibility Layout Planning	Y	Y	-	-	-
5.1.1.2	The Discard Emergency Stockpile is to be developed within the authorised footprint of the Sishen Discard Dump	Sishen EMPr	Feasibility Layout Planning	Y	-	-	-	-
5.1.1.3	All areas where chemicals, hydrocarbons or other potential pollutants are stored or handled are to be provided with impervious surfaces and measures to contain spillages of such substances.	SANS 01131	Feasibility Design	Y	Y	-	-	-
5.1.1.4	Equipment which has the potential to leak oil or other chemicals are to be stored on impervious surfaces within bunded areas.		Feasibility Layout Planning Design	Y	Y	-	-	-
5.1.1.5	Provide sufficient storage of hazardous and general waste on site for incorporation into Sishen's waste management system.	-	Feasibility Layout Planning Design	Y	Y	-	-	-



5.1.1.6	Provide for implementation of a barrier system at new Return Water Dam at existing Tailings Storage Facility to ensure protection of groundwater.	GN. 636 of 2013	Pre-operation	-	-	-	-	Y
5.1.1.7	Amendment to the Sishen Integrated WUL to allow for increased discard disposal volumes.	Sishen IWUL	Pre-operation	-	-	-	-	Y
<b>5.1.2</b>	<b>PROTECTION OF SURFACE WATER RESOURCES</b>							
5.1.2.1	Integrate stormwater run-off into Sishen's upgraded stormwater management system.	Sishen IWUL	Feasibility Design	Y	Y	-	-	-
5.1.2.2	Provide for the separation of water potentially contaminated with hydrocarbons. This water is to report to the future Aldag PCD. Remaining run-off is to enter Sishen stormwater management canals.	Sishen Stormwater Management Plan	Feasibility Design	-	Y	-	-	-
5.1.2.3	Provide for sediment and oil interceptors for run-off water.		Feasibility Design	-	Y	-	-	-
5.1.2.4	Implement planned upgrade to stormwater and dirty water management systems at Sishen Mine	Sishen Stormwater Management Plan	Pre-operation	-	Y	-	-	-
<b>5.1.3</b>	<b>WATER BALANCE</b>							
5.1.3.1	Confirm water consumption requirements for project and integration into Sishen's water supply system. Maximise opportunities for re-use of water		Feasibility Design					
<b>5.1.4</b>	<b>AIR QUALITY</b>							
5.1.4.1	Include dust extraction and dust suppression at new crushing and transfer points.		Feasibility Design	-	Y	-	-	-
5.1.4.2	Ensure that existing dust management systems are operational and operating effectively		Pre-operation	Y	-	Y	-	Y
5.1.4.3	Provide for additional dust suppression at new site roads and work areas		Feasibility Design	-	Y	-	Y	-
<b>5.1.5</b>	<b>CLIMATE CHANGE</b>							

5.1.5.1	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.	-	Feasibility Design	-	-	-	-	-
5.1.5.2	Investigate opportunities for reducing fuel consumption at Sishen Mine.	-	Ongoing	Y	Y	Y	Y	Y
<b>5.1.6</b>	<b>PUBLIC AND LABOUR RELATIONS</b>							
5.1.6.1	Integrate Project into Sishen's Procurement Plan and objectives for maximising local procurement.		Feasibility	PROJECT				
5.1.6.2	Develop a Resourcing Plan for the project in line with Sishen's objectives for local recruitment both for construction an operation.		Feasibility	PROJECT				
5.1.6.3	Integrate the project into Sishen's Social Management Plan.		Feasibility	SISHEN				
5.1.6.4	Develop a Stakeholder Engagement Plan aimed at managing community expectations.		Feasibility	SISHEN				

## 5.2 Construction of Infrastructure

Action No.	IMPACT MANAGEMENT ACTION	APPLICABLE STANDARD	Scheduling	APPLICABLE ACTIVITY				
				UPGRADE OF DMS TO UHDMS	DEVELOPMENT OF UPC	MINING OF C-GRADE MATERIAL	RECOVERY OF C-GRADE STOCKPILES	DISPOSAL OF PROCESS WASTE
<b>5.2.1</b>	<b>PROTECTION OF SOILS, BIODIVERSITY &amp; GROUNDWATER</b>							
5.2.1.1	Hazardous substances are to be stored in bunded areas and handled on impervious surfaces.	SANS 01131	Throughout Construction	Y	Y	-	-	-
5.2.1.2	Topsoil (if present) is to be cleared from the footprint of the laydown and new infrastructure areas and used in rehabilitation.		Before Site Establishment	Y	-	-	-	-
5.2.1.3	Wastes are to be separated into hazardous and general waste. Receptacles for the temporary storage of waste are to be stored in bunded areas.		Throughout Construction	Y	Y	-	-	-
5.2.1.4	Wastes to be removed from laydown areas and disposed in accordance with legal requirements.		Throughout Construction	Y	Y	-	-	-
5.2.1.5	Additional temporary toilets and ablutions are to be provided in laydown areas and in areas of work where there are no existing facilities.		Throughout Construction	Y	Y	-	-	-
5.2.1.6	Equipment which has the potential to leak oil or other chemicals are to be stored on impervious surfaces within bunded areas.		Throughout Construction	Y	Y	-	-	-
5.2.1.7	Drip trays are to be provided where mobile equipment has the potential to drip oil.		Throughout Construction	Y	Y	-	-	-
5.2.1.8	Implement spill prevention and emergency response procedure.		Throughout Construction	Y	Y	-	-	-

<b>5.2.2</b>	<b>PROTECTION OF SURFACE WATER RESOURCES</b>							
5.2.2.1	Run-off from laydown areas and areas of work is to be directed and incorporated into the water management systems at Sishen Mine.	Sishen IWUL	Throughout Construction	Y	Y	-	-	-
5.2.2.2	Run-off from laydown areas to be free of hydrocarbons and sediment (sediment and oil interceptors to be installed where necessary).		Throughout Construction	Y	Y	-	-	-
<b>5.2.3</b>	<b>AIR QUALITY</b>							
5.2.3.1	Dust suppression to be implemented in areas of work where earth moving is to take place.		Throughout Construction	Y	Y	-	-	-
5.2.3.2	Dust suppression to be implemented at laydown areas and additional roads established to access laydown areas and work areas.		Throughout Construction	Y	Y	-	-	-
<b>5.2.4</b>	<b>PUBLIC AND LABOUR RELATIONS</b>							
5.2.4.1	Contractors to comply with preferential employment targets for the project and Sishen's Contractor Social Management Procedure.		Throughout Construction	PROJECT				
5.2.4.2	Implement Resourcing Plan for construction aimed at maximising local procurement		Throughout Construction	PROJECT				
5.2.4.3	Continued stakeholder engagement.		Throughout Construction	SISHEN				
5.2.6.4	Complaints regarding implementation of the DMS Upgrade Project to be managed through Sishen's External Complaints Procedure.		Throughout Construction	SISHEN				

### 5.3 Mine Operations

Action No.	IMPACT MANAGEMENT ACTION	APPLICABLE STANDARD	Scheduling	APPLICABLE ACTIVITY				
				UPGRADE OF DMS TO UHDMS	DEVELOPMENT OF UPC	MINING OF C-GRADE MATERIAL	RECOVERY OF C-GRADE STOCKPILES	DISPOSAL OF PROCESS WASTE
<b>5.3.1</b>	<b>PROTECTION OF SOILS AND GROUNDWATER</b>							
5.3.1.1	Hazardous chemical substances (such as hydrocarbons) are to be stored within bunded areas.	SANS 01131	Throughout Operation	Y	Y	-	-	-
5.3.1.2	Hazardous chemicals are handled over impervious surfaces.		Throughout Operation	Y	Y	-	-	-
5.3.1.3	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.		Throughout Operation	Y	Y	-	-	-
5.3.1.4	Drip trays are to be provided where mobile equipment has the potential to drip oil.		Throughout Operation	Y	Y	-	-	-
5.3.1.5	Wastes are to be separated at source and incorporated into Sishen's Waste Management System.		Throughout Operation	Y	Y	-	-	-
5.3.1.6	Implement spill prevention and emergency response procedure.		Throughout Operation	Y	Y	-	-	-
<b>5.3.2</b>	<b>PROTECTION OF SURFACE WATER RESOURCES</b>							
5.3.2.1	Run-off which is potentially contaminated with hydrocarbons is to be directed to an oil separator and then sent to the Aldag PCD for storage and recycling for use at the mine.	Sishen IWUL	Throughout Operation	-	Y	-	-	-
5.3.2.2	Sediment is to be removed from stormwater run-off before it reports to the Western Stormwater Canal.		Throughout Operation	-	Y	-	-	-
<b>5.3.3</b>	<b>AIR QUALITY</b>							

5.3.3.1	Dust management systems are to be maintained to ensure that they are working at maximum efficiency.		Throughout Operation	Y	Y	Y	Y	Y
5.3.3.2	Conduct local area visual checks to direct application of necessary dust controls.		Throughout Operation	Y	Y	-	-	-
5.3.3.3	Monitor the effectiveness of the mitigation measures implemented and feeding this information into regular reviews of dust management procedures.		Throughout Operation	Y	Y	Y	Y	Y
5.3.3.4	Ensuring staff are aware of and implement dust management procedures in day-to-day mining operations.		Throughout Operation	SISHEN				
<b>5.3.4</b>	<b>PUBLIC AND LABOUR RELATIONS</b>							
5.3.4.1	Implement Sishen's Procurement Plan and objectives for maximising local procurement	SLP	Throughout Operation	PROJECT				
5.3.4.2	Implement Resourcing Plan for the project in line with Sishen's objectives for local recruitment	SLP	Throughout Operation	PROJECT				
5.2.4.3	Implement Sishen's Social Management Plan		Throughout Operation	SISHEN				
5.3.4.4	Implement Stakeholder Engagement Plan aimed at managing community expectations		Throughout Operation	SISHEN				
5.3.4.5	Complaints regarding implementation of the DMS Upgrade Project to be managed through Sishen's External Complaints Procedure		Throughout Operation	SISHEN				

## 5.4 Decommissioning and Closure

Action No.	IMPACT MANAGEMENT ACTION	APPLICABLE STANDARD	Scheduling	APPLICABLE ACTIVITY				
				UPGRADE OF DMS TO UHDMS	DEVELOPMENT OF UPC	MINING OF C-GRADE MATERIAL	RECOVERY OF C-GRADE STOCKPILES	DISPOSAL OF PROCESS WASTE
<b>5.4.1</b>	<b>PROTECTION OF SOILS AND GROUNDWATER</b>							
5.4.1.1	Infrastructure not to be used in the future is to be demolished and disposed of in accordance with legal requirements.		During Decommissioning	Y	Y	-	-	-
5.4.1.2	Footprint areas are to be checked for signs of contamination and remediated as required.		During Decommissioning	Y	Y	-	-	-
5.4.1.3	Soils to be checked for fertility and augmented as required to promote the establishment of vegetation.		During Decommissioning	Y	Y	-	-	-
<b>5.4.2</b>	<b>PROTECTION OF SURFACE WATER RESOURCES</b>							
5.4.2.1	Stormwater run-off from potentially contaminated areas is to be contained and prevented from entering any clean water environment.	GNR. 704	Until Closure	Y	Y	-	-	-
5.4.2.2	Clean water is to be diverted around potentially contaminated areas.	GNR. 704	Until Closure					
<b>5.4.3</b>	<b>FINAL LAND USE</b>							
5.4.3.1	Platforms and ramps are to be reshaped to conform to the final land form required for the implementation of the end-use.		During Decommissioning	-	Y	-	-	-
5.4.3.2	Vegetate surfaces to achieve final cover required for implementation of desired end-use.		During Decommissioning	Y	Y	-	-	-
5.4.3.3	Monitor vegetation cover and augment as required until self-sustaining.							

## **6. FINANCIAL PROVISION**

### **6.1 Closure objectives and the extent to which they have been aligned with the baseline environment**

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.

### **6.2 Confirmation of consultation of closure objectives with landowners**

The Environmental Impact Assessment Report and the Environmental Management Programme will be subjected to a public participation process in accordance with Regulations 41 of the EIA Regulations (GNR. 982 of 4 December 2014, as amended). The annual rehabilitation compiled in terms of Appendix 3 of the Financial Provision Regulations (GNR. 1147 of 20 November 2015 as amended by GN. 1314 of 26 October 2016) will be compiled by Sishen Mine within 39 months after the coming into effect of the regulations and will be updated annually thereafter. This report will be made available for public review and comment on an annual basis.

### **6.3 Rehabilitation Plan**

The Preliminary Closure Plan is provided in Part C-Appendix 6. In line with the plan, the rehabilitation actions are required for the additional infrastructures at Sishen Mine as a result of the DMS Upgrade Project:

- 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.

#### **6.4 Explain how the rehabilitation plan is compatible with the closure objectives**

The final land use at Sishen Mine is currently envisaged to include a combination of wilderness areas, agricultural and small industrial use. The achievement of the rehabilitation objectives will allow for the successful implementation of agricultural (livestock grazing) or industrial use (should the process plant infrastructure be needed for some future agreed use).

#### **6.5 Quantum of Financial Provision required to manage and rehabilitate the environment**

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 6-1 and Table 16-2 and indicate the change in the liability at Sishen Mine.

**TABLE 6-1: ESTIMATE OF CHANGES- TO SISHEN IRON MINE PREMATURE CLOSURE COSTS AS A RESULT OF THE DMS UPGRADE PROJECT**

<b>SISHEN MINE PREMATURE CLOSURE AND REHABILITATION COST ESTIMATE 2018; INCLUDING DMS UPGRADE PROJECT</b>				
<b>No.</b>	<b>Area</b>	<b>PREMATURE COST (NOV 2017)</b>	<b>CHANGES DUE TO DMS UPGRADE PROJECT</b>	<b>TOTAL REVISED SISHEN PREMATURE CLOSURE COST; INCLUDING DMS UPGRADE PROJECT</b>
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
	<b>Total</b>	<b>R 2,372,981,876.00</b>	<b>R 4,720,509.98</b>	<b>R 2,377,702,385.98</b>
		<b>Difference</b>		<b>-R4,720,509.98</b>

**TABLE 6-2: ESTIMATE OF CHANGES- TO SISHEN IRON MINE LOM CLOSURE COSTS AS A RESULT OF THE DMS UPGRADE PROJECT**

<b>SISHEN MINE LOM CLOSURE AND REHABILITATION COST ESTIMATE 2018; INCLUDING DMS UPGRADE PROJECT</b>				
<b>No.</b>	<b>Area</b>	<b>LOM COST (NOV 2017)</b>	<b>CHANGES DUE TO DMS UPGRADE PROJECT</b>	<b>TOTAL REVISED SISHEN LOM CLOSURE COST; INCLUDING DMS UPGRADE PROJECT</b>
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
	<b>Total</b>	<b>R 20,181,553,946.45</b>	<b>R 4,720,509.98</b>	<b>R 20,186,274,456.43</b>
		<b>Difference</b>		<b>-R4,720,509.98</b>

## **6.6 Confirm how the financial provision will be provided**

The quantum of the financial provision for premature closure is updated on an annual basis. Sishen Mine undertakes to submit an annual update of the financial provision in accordance with the Financial Provision Regulations (GN. 1147 of 20 November 2015, as amended by GN. 1314 of 26 October 2016), within 39 months after the coming into effect of the regulations, and annually thereafter submit updated rehabilitation plan in support of an updated calculation of the financial provision.

The DMS Upgrade Project will result in an additional liability of ~ **R 4 720 510**. Should the current guarantees for Sishen Mine not be adequate to cover the additional liability, an additional guarantee is to be obtained to cover the premature closure liability.

## 7. MECHANISMS FOR MONITORING COMPLIANCE

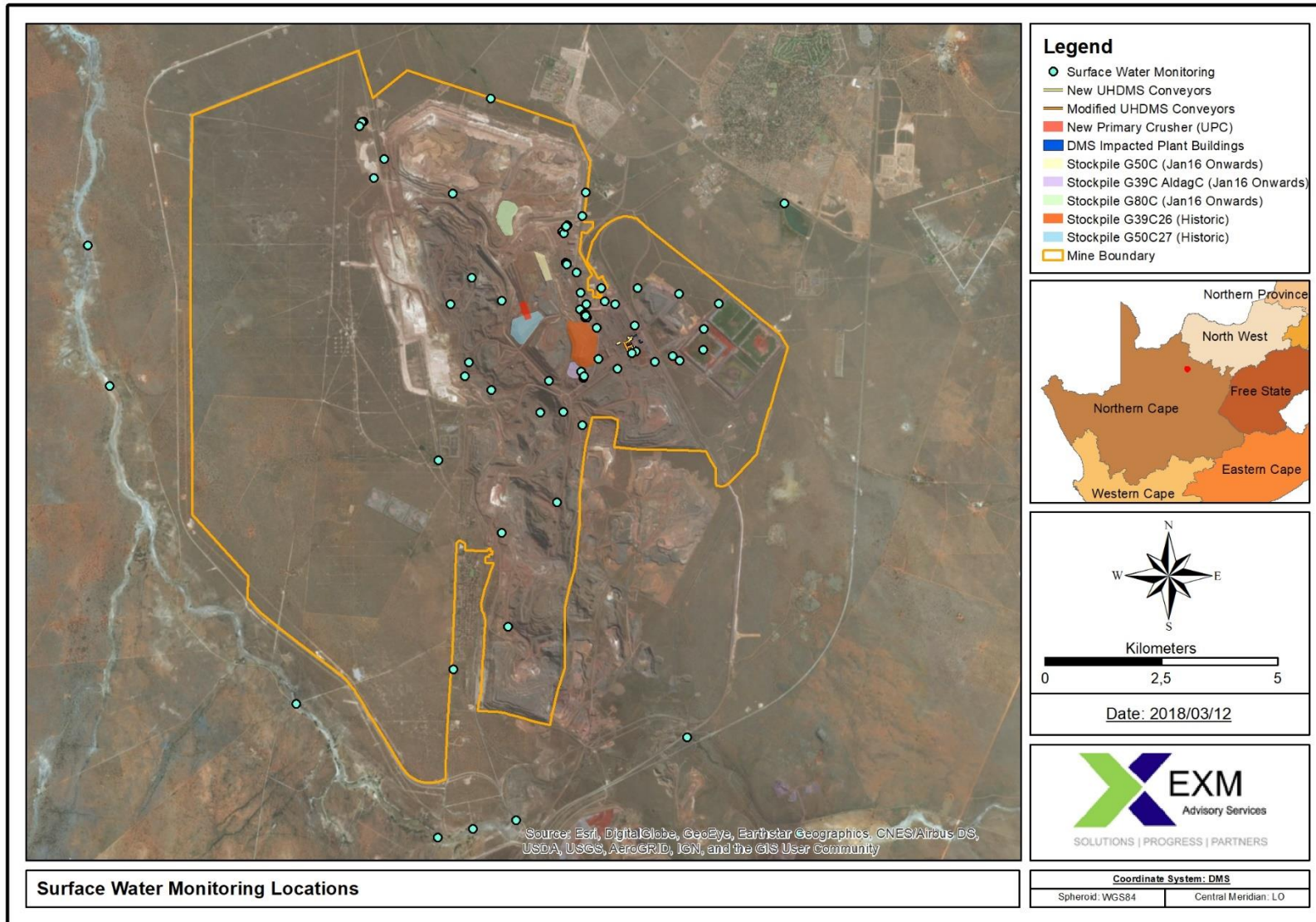
### 7.1 Surface Water Monitoring

Surface water monitoring points at Sishen Mine are indicated in Figure 7-1. The location of the DMS Upgrade Project is also indicated. The parameters analysed for are listed in Table 7-1. The monitoring schedule is re-assessed annually during the update of the Integrated Water and Waste Management Programme.

No additional monitoring is considered necessary for the implementation of the DMS Upgrade Project.

**TABLE 7-1: SURFACE WATER MONITORING PARAMETERS**

Monitoring	Variable
Sewage treatment plant (monthly)	EC, pH, total alkalinity, total suspended solids, COD, total coliform, total hardness, calcium, magnesium, E-coli, sodium, potassium, chloride, sulfate, fluoride, iron, manganese, aluminium, cobalt, lead, oil & grease, nitrate, orthophosphate and ammonium.
Process water (monthly)	EC, pH, TDS, total alkalinity, total suspended solids, COD, total coliform, total hardness, calcium, magnesium, E-coli, sodium, potassium, chloride, sulfate, fluoride, iron, manganese, aluminium, cobalt, lead, oil & grease, nitrate, orthophosphate and ammonium, Diesel Range Organics, Gasoline Range Organics, PAH, TPH
Receiving environment	EC, pH, TDS, total alkalinity, total suspended solids, COD, total coliform, total hardness, calcium, magnesium, E-coli, sodium, potassium, chloride, sulfate, fluoride, iron, manganese, aluminium, cobalt, lead, oil & grease, nitrate, orthophosphate and ammonium, Diesel Range Organics, Gasoline Range Organics, PAH, TPH



**FIGURE 7-1: EXISTING SURFACE WATER MONITORING POINTS AT SISHEN MINE**

## 7.2 Groundwater monitoring

There is an extensive groundwater monitoring network at Sishen Mine (see Figure 7-2).

No additional monitoring is considered necessary for the implementation of the DMS Upgrade Project.

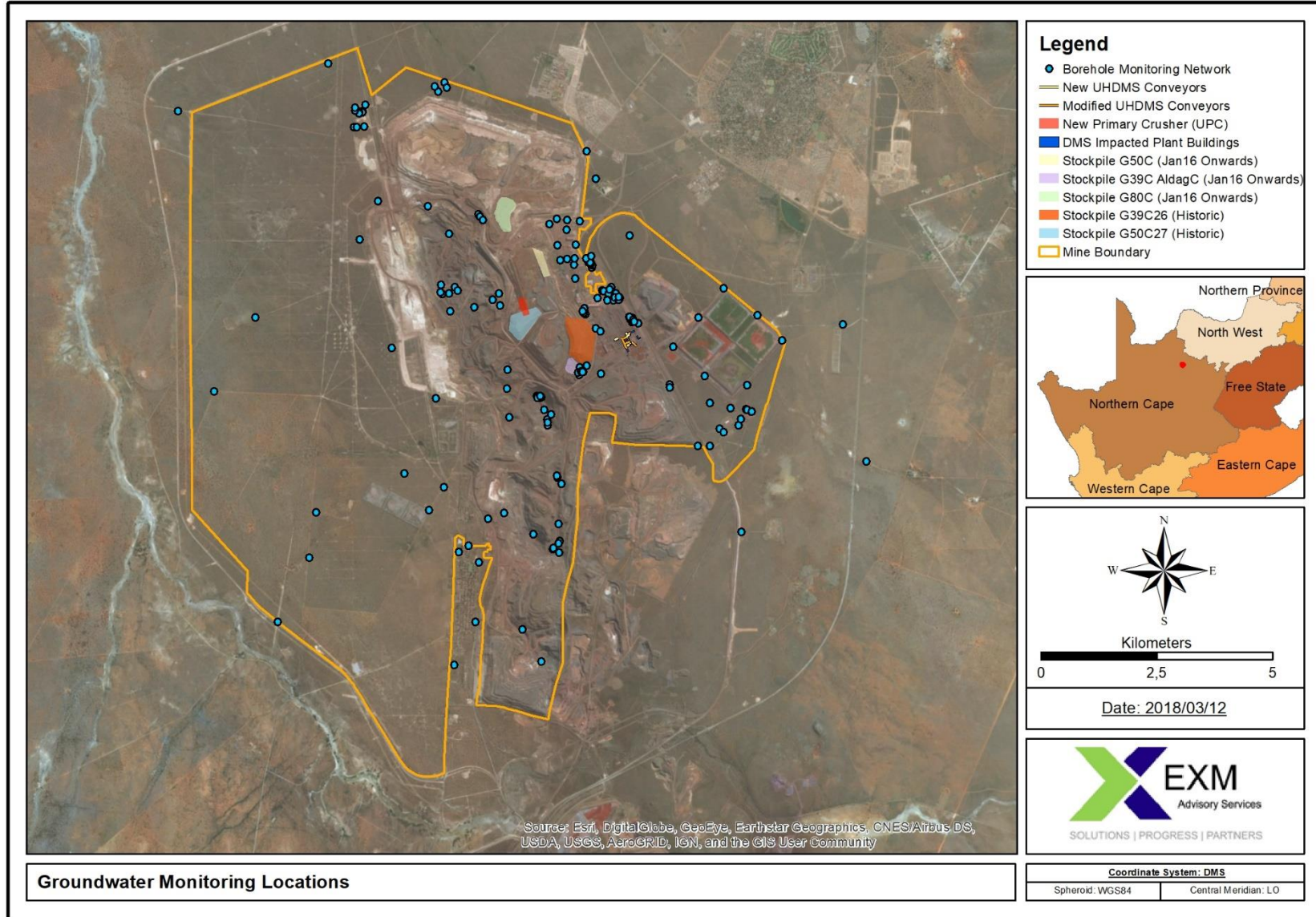
**TABLE 7-2: SURFACE WATER MONITORING PARAMETERS**

Monitoring	Variable
Groundwater monitoring points (monthly)	EC, pH, TDS, total alkalinity, total suspended solids, COD, total organic carbon, turbidity, total hardness, calcium, magnesium, sodium, potassium, chloride, sulfate, fluoride, iron, manganese, aluminium, cobalt, lead, oil & grease, nitrate, orthophosphate and ammonium, Diesel Range Organics, Gasoline Range Organics, PAH, TPH

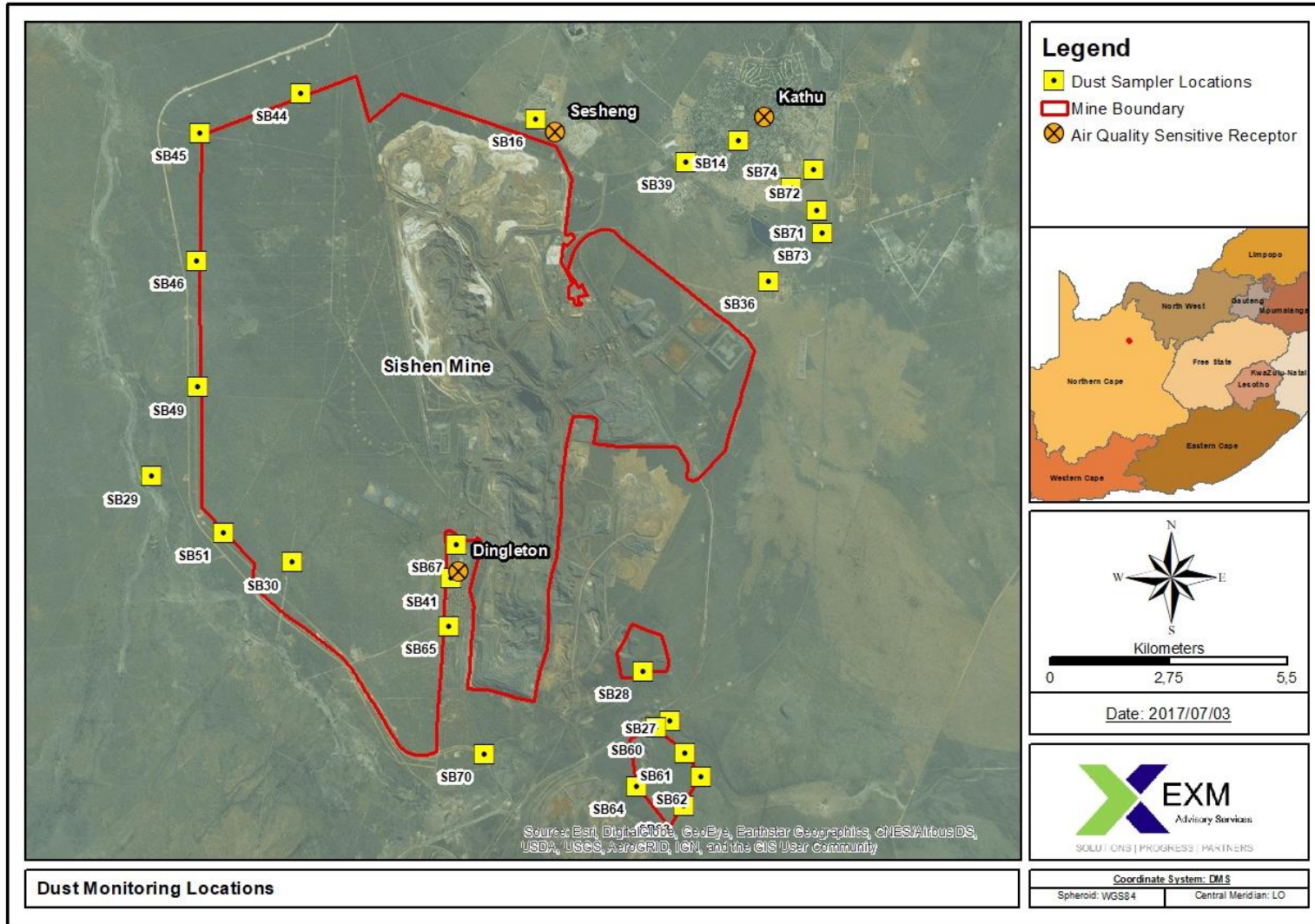
## 7.3 Air quality monitoring

Existing dust fallout monitoring points surrounding Sishen Mine are shown in Figure 7-3. PM<sub>10</sub> and PM<sub>2.5</sub> are monitored at Kathu, Sesheng and Dingleton. No additional monitoring points are required for the DMS Upgrade Project. Airshed Planning Professionals (January, 2018) has recommended the following be implemented to improve their dust management practices at Sishen Mine:

- Ongoing development and implementation of dust management plans. We recommend that a plan is developed for each specific residential area.
- 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.



**FIGURE 7-2: EXISTING GROUNDWATER MONITORING POINTS AT SISHEN MINE**



**FIGURE 7-3: LOCATION OF DUST MONITORING STATIONS AND KEY RECEPTORS AT SISHEN MINE .**



## 7.4 Noise monitoring

Sishen Mine undertakes summer and winter monitoring in neighbouring sensitive receptors: Sesheng, Kathu, Dingleton, and Kathu Agricultural Holdings and farmsteads to the west of Sishen Mine. No additional monitoring is required for the DMS Upgrade Project. dbAcoustics (February 2018) has recommended the following Noise Management Plan:

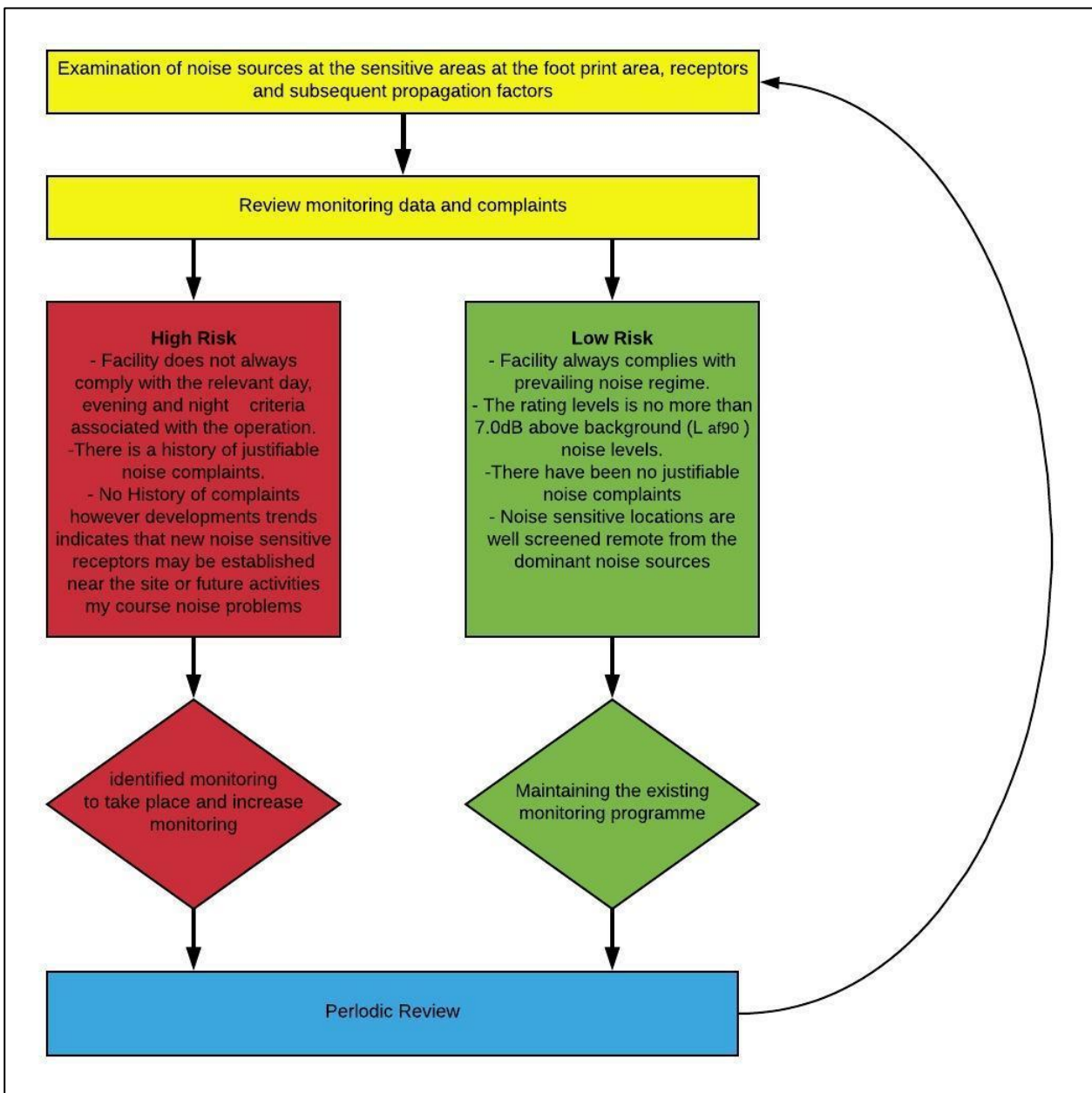


FIGURE 7-4: NOISE MANAGEMENT PLAN

## **8. SUBMISSION OF PERFORMANCE ASSESSMENTS**

Performance Assessments/Compliance Audits will be compiled in accordance with legislative requirements (as applicable at the time) including:

- (1) Regulation 34 of the EIA Regulations (GN. 982 of 4 December 2014, as amended);
- (2) Regulation 55 of the Minerals and Petroleum Resource Development Act.

The Performance Assessments/Compliance audits will be submitted annually or in accordance with the Environmental Authorisation.

## **9. ENVIRONMENTAL AWARENESS PLAN**

Sishen Mine developed an awareness and training programme describing the manner in which its employees may be exposed to environmental risk which may result from their work and the manner in which the risks must be dealt with in order to avoid safety incidents and pollution or the degradation of the environment. The operation also has awareness programmes aimed at educating its people and the community about the activities undertaken at the mine and the impacts of these activities on the environment. Shift workers are trained on a weekly basis on environmental focus topics of the month as well as significant environmental aspects on the mine.

All persons involved in the DMS Upgrade Project will be incorporated into the existing training and awareness programmes. No additional training is considered necessary.

## **10. SPECIFIC INFORMATION REQUIRED BY THE COMPETENT AUTHORITY**

None applicable.

## **11. UNDERTAKING**

I, **Kerry Colleen Fairley**, acting as independent environmental assessment practitioner hereby confirm:

- The correctness of the information provided in the reports;
- The inclusion of comments and inputs from stakeholders and I&APs;
- The inclusion of inputs and recommendations from specialist reports, where relevant; and
- The acceptability of the project in relation to the finding of the assessment and the level of mitigation proposed.