ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED DEVELOPMENT OF THE OKANJANDE GRAPHITE MINE AND EXPLORATION ACTIVITIES

ENVIRONMENTAL MANAGEMENT PLAN

PREPARED BY: ENVIRO DYNAMICS

DATE: September 2014

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PROJECT NAME	Environmental Impact Assessment for the proposed Okanjande graphite mine and exploration activities.
STAGE OF REPORT	Draft report for client review
CLIENT	Gecko Graphite P O Box 81307 Windhoek Namibia
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DATE OF RELEASE	September 2014
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DECLARATION

I hereby declare that I do:

(a) have knowledge of and experience in conducting EIA assessments, including knowledge of the Environmental Management Act (Act 7 of 2007)and the Regulations and Guidelines that have relevance to the proposed activity;

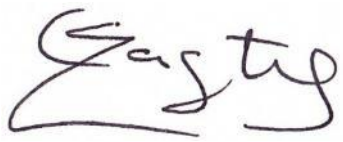
(b) perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;

(c) comply with the abovementioned Act, its Regulations, Guidelines and other applicable laws.

I also declare that there is, to my knowledge, no information in my possession that reasonably has or may have the potential of influencing –

(i) any decision to be taken with respect to the application in terms of the Act and its Regulations; or

(ii) the objectivity of this report, plan or document prepared in terms of the Act and its Regulations.



Eloise Carstens

Environmental Assessment Practitioner (EAP)

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Abbreviations and Acronyms

ABBREVIATION/ ACRONYM	DESCRIPTION
ACGIH	American Conference of Governmental Industrial Hygienists
AMD	Acid Mine Drainage
AQG	Air Quality Guidelines
BAT	Best Available Technology
CO	Carbon Monoxide
DEA	Directorate of Environmental Affairs
EA	Environmental Assessment
EIA	Environmental Impact Assessment
EC	European Commission
ECO	Environmental Control Officer
EMP	Environmental Management Plan
EPL	Exclusive Prospecting Licence
FEL	Front End Loader
GIS	Geographic Information System
GN	Government Notice
GG	Government Gazette
HIV	Human Immunodeficiency Virus
IFC	International Financing Corporation
LOM	Life of mine
MAWF	Ministry of Agriculture, Water and Forestry

ABBREVIATION/ ACRONYM	DESCRIPTION
MME	Ministry of Mines and Energy
NHC	National Heritage Council
NO_2	Nitrogen Dioxide
OEHHA	Office of Environmental Health Hazard Assessment
PPE	Personal Protective Equipment
PM	Particulate Matter
PPE	Personal Protective Equipment
RFC	Reference Concentrations
ROM	Run of Mine
RWD	Return Water Dam
SHE	Safety, Health and Environment
SME	Small and Medium Enterprises
SO_2	Sulphur Dioxide
TLV	Threshold Limit Value
TSF	Tailings Storage Facility
NAAQS	National Ambient Air Quality Standards
WHO	World Health Organization

1 Project Overview

1.1 Introduction

The Okajande graphite deposit is situated approximately 14 km south of Otjiwarongo in the Otjozondjupa region (see **Figure 1**). The reserve comprises an ore body extending to a depth of at least 70 m and has been determined to contain 34 million tons of graphite, contained mainly in flake form with an average carbon content of 5.14%.

Gecko Graphite has obtained the mineral rights over the deposit, and is now in the process of updating the previous studies done by Rössing Uranium Limited (the former owner) in the 1990's. Gecko Graphite, a Namibian-owned and operated company, proposes to develop a graphite mine and processing operations at the site.

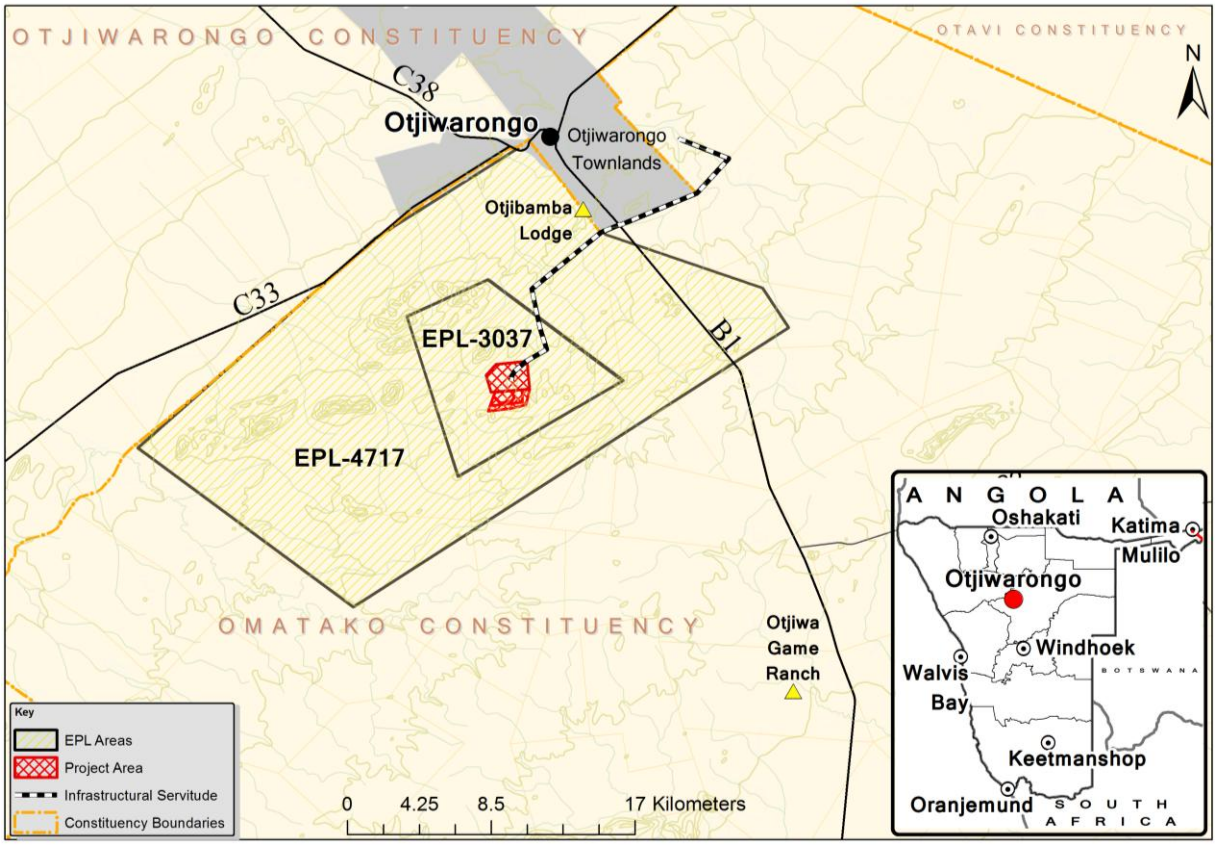


Figure 1: Location of the Okanjande graphite mine as well as the associated EPLs.

An Environmental Assessment (EA) process was followed to assess the expected impacts of the proposed mine on the natural and social environment. This document details the Environmental Management Plan (EMP) or the management actions needed to avoid or lessen the impacts to acceptable standards as informed by the EA.

1.2 Project Components

The project activities covered by this EMP consist of construction and operation of the following main components. These are presented in below (**Figure 2**):

- Mining operations – comprising of open pit mining by drill and blasting, ore stockpiles, waste dump area, transportation infrastructure and crusher and ore conditioning facilities.
- Processing operations – comprising of the milling, ore conditioning facilities of the processing plant adjacent to the mine pit and associated pipeline and other infrastructure routings, product packaging and storage facilities.
- Tailings disposal – Tailings Storage Facility (TSF) with associated disposal and drainage infrastructure, monitoring and pipe infrastructure.
- Product transport and shipping – including the main access points to and from the site, main transportation routes to either Otjiwarongo or Windhoek and railway access.
- Small-scale mining of marble rock for pH control

The project has a projected life of mine of minimum 70 years during which mining will be taken on a phased approach:

- Phase 1 - first four to ten years of mining. Initially the mine will operate at a maximum depth of 18 m. Only the weathered or oxidized zone of material will be utilized during this phase. Therefore there will be a low risk of generating Acid Mine Drainage (AMD). The mining rate during this initial period is estimated at 210,072 tons per annum excluding approximately 17% of waste rock.
- Phase 2 –mine pit will be extended to potentially 85 m (maximum depth after 70 years). The mining rate during this period will remain at 420,143 tons per annum excluding the 17% waste (unmineralized rock).

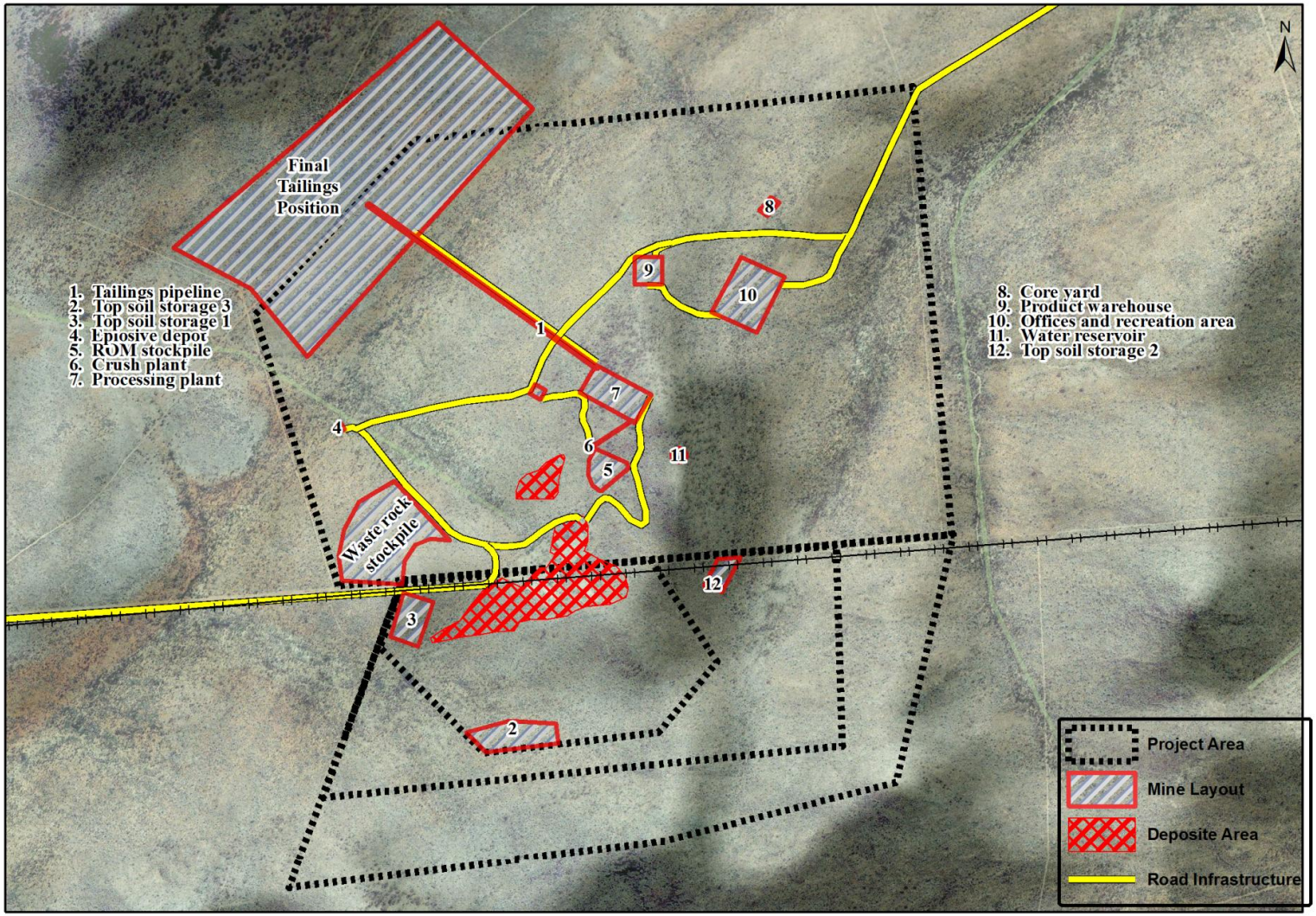


Figure 2: Lay out of the mine site.

1.3 Stakeholders engagement

1.3.1 Objectives

Community consultation and stakeholder engagement was undertaken as part of the Environmental Assessment (EA) process and are detailed in the Community Consultation (2013) and EIA report (2014) of the project.

Since this component of the EA process (i.e. public consultation) is indispensable for the building of strong, constructive and responsive relationships, stakeholder engagement should be a continuing process. This is essential for the successful management of the project's social and environmental impacts. An ongoing process of public participation shall therefore be maintained to ensure the continued involvement of the communities and stakeholders in a meaningful way. The objectives of this consultation are:

- To facilitate two-way engagement with stakeholders whereby relevant information on the project are provided in an accurate and timely manner;
- To identify and address issues that stakeholders may have with the project;
- To explore areas within the community where the project proponent can make a positive contribution that would lead to the upliftment of the community.

1.3.2 Project stakeholders

During the Public Consultation process various stakeholders have been identified that are likely to be adversely or positively affected by the project. The relevant stakeholders for the project have been identified as (**Table 1**):

Table 1: I&AP categories related to this project

LEVEL	DESCRIPTION	
NATIONAL	Ministry of Environment and Tourism	Ministry of Works and Transport
	Ministry of Health and Social Services	Chamber of Mines
	Ministry of Mines and Energy	NamWater
	Ministry of Water, Agriculture and Forestry	NamPower
	Ministry of Regional, Local Government Housing and Rural Development	NGOs
REGIONAL	Ministry of Environment and Tourism	Otjozondjupa Regional Council
	Ministry of Water, Agriculture and Forestry: Dept. of Water Affairs	Chamber of Commerce
	Ministry of Works and Transport	Transnamib
		Okorusu Fluorspar

LEVEL	DESCRIPTION	
	CENORED	B2Gold
	Roads Authority	Ohorongo Cement
LOCAL	Otjiwarongo Town Council	Farm Owners
	EPL Holders	Other registered I&APs

1.3.3 Continued engagement

The consultation and engagement process will continue to actively involve the identified stakeholders as required by IFC (2012). This involvement includes:

- The implementation of the Stakeholder Engagement Plan (provided in ***APPENDIX A***) which allows for the effective participation of those people identified as interested or affected;
- The establishment of a Grievance Mechanism (guidelines provided in ***APPENDIX B***) which allows for the receiving and facilitation of affected parties' concerns and grievances about the proponent's environmental and social performance, and
- The annual reporting to the affected community regarding 1) progress with implementation of the project, 2) available action plans on issues that pose a risk to or could potentially have an impact on the community and 3) issues identified during the consultation process or grievance mechanism as a concern to the community.

1.4 Environmental policy

Based on the criteria provided in this EMP, Gecko Namibia is to establish an overarching, project specific policy that defines the objectives of the project that will ensure sound environmental and social performance (IFC, 2012). This policy obligates the proponent to comply with the applicable laws and regulations related to environmental and social assessment and management processes.

2 The Environmental Management Plan (EMP)

2.1 Introduction

This EMP has been prepared for Gecko Graphite to serve as a standalone plan for managing the potential impacts associated with the construction, operation and decommissioning of the Okanjande Graphite Mine. Mitigation measures are based on the assessments and findings of the EIA and should be read in the context of what is written in the EIA report. As the EMP is a working document, changes may be made with regards to future extensions of the project as well as the consideration of Best Available Technology (BAT).

2.2 Environmental management objectives

The implementation of this EMP is a cyclical process that converts mitigation measures into actions and through monitoring, auditing, review and corrective action, ensures conformance with the overall aims and objectives. These objectives are provided below:

- Ensure compliance with the conditions of the Environmental Certificate granted by the Directorate of Environmental Affairs (DEA);
- Propose practical measures to prevent, minimise, mitigate or rehabilitate adverse impacts;
- Conserve significant aspects of the biophysical and social environments;
- Protect human health and ensure safety of workers and the public;
- Propose a plan to monitor and manage project implementation, in such a way that the project is environmentally sustainable.

2.3 Roles and responsibilities

The implementation of this EMP requires the involvement of several stakeholders, each fulfilling a different but vital role to ensure sound environmental management during each phase.

2.3.1 Construction/project Manager, Mine Manager

The mine manager and construction/project manager during the construction and operation phase will be responsible for the following:

- Ensure that responsibilities are executed in compliance with relevant legislation and the EMP.
- Ensuring that the necessary environmental authorizations and permits have been obtained.

- Maintain general communications with stakeholders and authorities to inform them of planned activities where relevant.
- Report significant environmental incidents or emergencies to the relevant local authority.
- Oversee and initiate strategies to improve the measures of and implementation of the EMP and environmental policy of the mine.

2.3.2 Environmental Team

The Environmental Team will consist of a Safety, Health and Environmental Manager (SHE), SHE Officers and a Community Liaison Officer. The team will be responsible for the following:

- Review of EMP during detailed design to ensure that the design specifications recommended in the EMP are incorporated.
- Undertake induction training for all personnel to ensure that the environmental values, potential impacts, management measures and emergency responses are understood and implemented.
- Undertake weekly inspections to ensure onsite implementation and to check the effectiveness of the prescribed mitigation measures.
- Undertake or coordinate monitoring activities such as water or air quality data collection.
- Investigate environmental incidents and report to the mine manager the corrective actions taken and the results of ongoing monitoring activities.
- Bi-annual internal audits of EMP implementation.
- Annual internal review and update of the EMP.
- Liaison with stakeholders and authorities.

External consultants will also form part of the environmental team. These consultants will specifically review monitoring data for SO_2 releases and from monitoring boreholes. Any exceedance of the prescribed standards will immediately be reported to the mine manager so that appropriate action can be taken (e.g. emergency procedures followed).

2.3.3 Site Supervisors

The site supervisors will be responsible for the following:

- Ensure that the mitigation measures detailed in the EMP are implemented correctly and are effective and appropriate for the site and activities.
- Review and sign off on area specific plans and drawings prior to construction or implementation.

- Conduct daily inspections of activities and mitigation measures with corrective actions taken and recorded where applicable.
- Report all environmental incidents to the Construction/Project Manager and Environmental Team.
- Hold weekly meetings with personnel to discuss the current project activities and the health, safety and environmental issues associated with these activities.

2.3.4 Project Personnel

All personnel will have a general duty of taking any reasonable and practical measures to ensure that no harm is caused to the environment. This will include the following:

- All project personnel will receive an induction presentation on the importance and implications of the EMP. The presentation shall be conducted, as far as is possible, in the employees' language of choice. As a minimum, training should include:
  - Explanation of the importance of complying with the EMP.
  - Discussion of the potential environmental impacts of construction activities.
  - The benefits of improved personal performance.
  - Employees' roles and responsibilities, including emergency preparedness.
  - Explanation of the mitigation measures that must be implemented when carrying out their activities.
  - Explanation of the specifics of this EMP and its specification (no-go areas, etc.)
  - Explanation of the management structure of individuals responsible for matters pertaining to the EMP.
  - Health and Safety Training
- Daily pre-start checks will be undertaken by personnel in charge of vehicles to ensure that equipment is in good working condition, i.e. no repairs/maintenance is needed, does not have signs of oil or other leakages and contains necessary emergency equipments, e.g. spill kits and fire extinguishers. A checklist will be kept in the vehicle to record daily pre-start checks.

2.4 Environmental legislation and standards

2.4.1 Legislation

Summarized below (**Table 2**) are the activities associated with the construction and operation of the mine that have specific requirements in terms of national legislation (such as permits).

Table 2: Activities requiring permits in terms of National Legislation

THEME	LEGISLATION	REQUIREMENT
LABOUR	Labour Act 11 Of 2007	• Regulations relating to the health and safety of employees at work are contained in GN 156/1997 (GG 1617). Must be complied with on this project.
NATURE CONSERVATION	Forestry Act No 27 Of 2004	• Provision for the protection of various plant species. • A **permit** will be needed for removal or destruction of protected species such as *Boscia albutrunca*. The forms can be obtained from **Mr T. Uahengo in the permit office at the Ministry of Environment and Tourism, Windhoek**. A period of three months should be allowed for obtaining this permit. Species and numbers/quantities involved will need to be specified.
	Nature Conservation Ordinance 4 0f 1975	• Permit needed for the removal or destruction of protected species such as *Boscia albutrunca*.
HERITAGE	National Heritage Act No 27 Of 2004	• No archaeological/heritage site or cultural remains may be removed, damaged, altered or excavated. • Section 48 sets out the procedure for application and granting of **permits,** such as the permit required in the event of damage to a protected site occurring as an inevitable result of development. Section 51 (3) sets out the requirements for impact assessment. • Part VI Section 55 Paragraphs 3 and 4 require that any person who discovers an archaeological site should notify the National Heritage Council. Contact: **Karl Aribeb (061-244 375)**
WATER	Water Resources Management Act (2004) Enforced By The Water Act No 54 Of 1956	The following permits are required in terms of the Water Act: • water abstraction permits; • domestic effluent discharge permits (site offices, construction camp); industrial effluent discharge permits; • water use for dust suppression; and water reticulation permits (pipelines). Will be superseded by Water Resources Management Act 2013 once the regulations are implemented in the future.

THEME	LEGISLATION	REQUIREMENT
EXPLOSIVES AND PETROLEUM	Explosives Act No 26 Of 1956	A licensed inspector is required to visit the site to assess its safety and to issue a permit.
	Petroleum Products And Energy Act, No 13 Of 1990	Storage of petroleum products Proponent needs to apply at MME for a ***consumer installation certificate***.

2.4.2 Standards and Guidelines

❖ *Air Quality Standards*

The Namibian Atmospheric Pollution Prevention Ordinance (No. 11 of 1976) does not include any ambient air standards to comply with. Typically, when no such local criteria exists, or are in the process of being developed, reference is made to international criteria (**Table 3**).

Table 3: Ambient Air Quality Guidelines for various international organisations as accepted by the World Bank (Airshed Planning Professionals, 2014).

POLLUTANT	AVERAGING PERIOD	WHO GUIDELINE VALUE (µG/M³)	EC DIRECTIVE LIMITS (µG/M³)	US NAAQS (µG/M³)	SOUTH AFRICA NAAQS (µG/M³)
SULPHUR DIOXIDE (SO_2)	1-year 24-hour 1-hour 10-minute	- 125 (IT-1) 50 (IT-2) 20 (guideline) - 500 (guideline)	20 125 350 -	- - 196 -	50 125 350 500
CARBON MONOXIDE (CO)	1-hour	30 000 (guideline)	-	40 000	30 000
NITROGEN DIOXIDE (NO_2)	1-year 1-hour	40 (guideline) 200 (guideline)	40 200	100 188	40 200
PARTICULATE MATTER (PM10)	1-year	70 (IT-1) 50 (IT-2) 30 (IT-3)	20	-	50 40

POLLUTANT	AVERAGING PERIOD	WHO GUIDELINE VALUE (µG/M³)	EC DIRECTIVE LIMITS (µG/M³)	US NAAQS (µG/M³)	SOUTH AFRICA NAAQS (µG/M³)
	24-hour	20 (guideline) 150 (IT-1) 100 (IT-2) 75 (IT-3) 50 (guideline)	50	150	120 75
PARTICULATE MATTER (PM2.5)	1-year	35 (IT-1) 25 (IT-2) 15 (IT-3) 10 (guideline)	-	15	25 20 15
	24-hour	75 (IT-1) 50 (IT-2) 37.5 (IT-3) 25 (guideline)	-	35	65 40 25 (s)

❖ *Health Screening Criteria*

For the purpose of the health risk assessment, proposed evaluation criteria taken from the various international criteria are provided in **Table 4**.

Table 4: Reference exposure levels for SO2, NO2, PM10 and graphite dust (Airshed Planning Professionals , 2014a).

POLLUTANT	AVERAGING PERIOD	SELECTED CRITERIA (µG/M³)	SOURCE
SO_2	1-hour Mean	350(a) 660	EC Limit & SA Standard California OEHHA RfC
	8-hour TWA	5 640 1 410	Namibian occupational exposure limit European Community (EC)
	24-hour Mean	125 20	WHO IT1, SA Standard, Botswana and EC Limit WHO AQG
	Annual Mean	50	SA Standard
NO_2	1-hour Mean	200(a) 470	EC Limit & SA Standard California OEHHA RfC

POLLUTANT	AVERAGING PERIOD	SELECTED CRITERIA (µG/M³)	SOURCE
	Annual Mean	40	WHO AQG
PM_{10}	8-hour TWA	10 000	Namibian occupational exposure limit
	24-hour Mean	75(b) 50	WHO IT3 & SA Standard WHO AQG
	Annual Mean	30	WHO IT3
GRAPHITE DUST	8-hour TLV	2	ACGIH TLV

Notes:
(a) Not to be exceeded more than 88 times per calendar year (SA Standard).
(b) Not to be exceeded more than 4 times per calendar year (SA Standard).

❖ *Water Quality Guidelines*

The Water Quality Guidelines of Namibia (MAWF 1988) are applicable for drinking water, livestock watering and discharge of waste water (**Table 5**).

Table 5: Water quality guidelines (Namib Hydrosearch, 2014).

RECOMMENDED MAXIMUM LIMITS	HUMAN CONSUMPTION			LIVESTOCK WATERING
PARAMETER	GROUP A	GROUP B	GROUP C	
pH	6-9	5.5-9.5	4-11	4-11
ELECTRICAL CONDUCTIVITY (mS/M)	150	300	400	
TURBIDITY (NTU)	1	5	10	
TOTAL DISSOLVED SOLIDS (mg/l)				6000
TOTAL HARDNESS AS mg/l $CaCO_3$	300	650	1300	
CA-HARDNESS AS mg/l $CaCO_3$	375	500	1000	2500
MG-HARDNESS AS mg/l $CaCO_3$	290	420	840	2057
CHLORIDE AS Cl mg/l	250	600	1200	3000
FLUORIDE AS F mg/l	1.5	2.0	3.0	6
SULPHATE AS SO_4 mg/l	200	600	1200	1500
NITRATE AS N mg/l	10	20	40	100
NITRITE AS N mg/l				10

RECOMMENDED MAXIMUM LIMITS	HUMAN CONSUMPTION			LIVESTOCK WATERING
PARAMETER	GROUP A	GROUP B	GROUP C	
SODIUM AS Na mg/l	100	400	800	2000
POTASSIUM AS K mg/l	200	400	800	
MAGNESIUM AS Mg mg/l	70	100	200	500
CALCIUM AS Ca mg/l	150	200	400	1000
MANGANESE AS Mn mg/l	0.05	1.0	2.0	10
IRON AS Fe mg/l	0.1	1.0	2.0	10

2.5 Inspections

The table below provides a list of inspections that should be undertaken as part of the EMP:

INSPECTIONS	FREQUENCY	RESPONSIBILITY
• Erosion control measures • Effectiveness of surface water control measures (during rainy season only) (e.g. storm water pond overflow) • Effectiveness of dust extraction methods at the crusher and other reduction methods employed on the road and dusty areas • All work areas for signs of AMD • Protection of large trees during bush clearing • Establishment of invader species on cleared or damaged areas • Condition of the access roads • Littering on site • Waste disposal • Any hazardous spills	Daily	Site supervisor/environmental officer
• Work areas and implemented management measures.	Weekly	Environmental officer
• Occupational PM_{10}, SO_2 and NO_2 exposure • Effectiveness of vegetation cover on the TSF to	Monthly	Environmental officer to construction/ project manager

INSPECTIONS	FREQUENCY	RESPONSIBILITY
minimize wind erosion • Internal environmental reporting on issues recurring on inspection records. • Summary of monitoring and inspection results.		

2.6 Environmental Monitoring, Auditing and Review

Environmental monitoring is essential to assess the effectiveness of the recommended management strategies. According to IFC (2012) monitoring should include keeping record of specific outcomes (e.g. groundwater quality) and then comparing it to the benchmarks established during the onset of the EIA. Should corrective actions be required, it need to be documented to reflect not only the corrections that were made, but also preventative measures to avoid future recurrence. This should be followed up on in all future monitoring endeavours to ensure the effectiveness. Monitoring actions required during normal operations of the mine are indicated as such in the tables contained in the following sections. The specific programs for monitoring ground and surface water and air quality on the mine site, is contained in *Section 4*.

In addition to keeping record of monitoring actions and outcomes, the implementation of this EMP will be internally audited on a biannual basis after which the document will be updated or revised (as required) to address the issues and mitigation measures identified during the audit. During this audit, the appropriateness of the EMP to current activities, monitoring studies and legislation will be reviewed. This will enhance the relevance of the document and verify compliance and progress towards the desired outcomes.

The environmental manager will provide monthly updates to the construction/project manager on routine monitoring and auditing results.

3 Impact Mitigation and resource management

3.1 Structure of the EMP

This EMP has been developed based on the findings and recommendations of the individual specialist studies undertaken as part of the Environmental Impact Assessment (EIA) report. The specialist studies assessed the vulnerability of the specific feature of their specialist field and provided a significance rating for each of the potential impacts associated with the implementation of the proposed project. Management measures/strategies have thus been proposed with the aim of reducing the risks associated with the identified impacts.

For each of the environmental elements listed in this report, the following are described:

- Management objectives – main outcomes to be achieved by the prescribed management strategies;
- Management strategies – in table format, including for each aspect:
  - The project phase - i.e. planning and design phase, construction phase, operation phase, monitoring during normal operations and decommissioning or mine closure;
  - The project component – i.e. the specific component of the mine site e.g. mine pit or waste rock stockpile;
  - Mitigation measures – i.e. individual tasks or actions that need to be undertaken at the mine component during the specific phase.
- Management strategies for decommissioning, rehabilitation and final mine closure.

3.2 Land and soils

3.2.1 Objectives

- Disturbed land areas and slopes are progressively restored, as close as practically possible, to pre-mining conditions;
- Reasonable and practical measures are taken to minimise short and long term soil erosion and the adverse effects of sediment transport.

3.2.2 Management strategies

The clearing of land for mining and other construction activities will inevitably involve earthworks and lead to an increased risk of erosion. The following measures should be adopted to minimize the impact of erosion during the various phases of the project:

ASPECT	PROJECT COMPONENT	MITIGATION MEASURE
PLANNING AND DESIGN PHASE		
TENDER PROCESS	All components	Include provision for management of topsoil (in the form of a topsoil management plan) and the rehabilitation of borrow pits in tender documents, as well as all other measures prescribed emanating from the borrow-pit investigation and the design for excavations and storage of spoil material.
TOPSOIL	All components	The top 200-300mm of topsoil should be saved for use in rehabilitation. The soil should be stripped and stockpiled not exceeding 1m in height.
	Topsoil stockpiles	If not used within 1 year, the stockpile should be levelled and contoured and natural grass allowed to grow over the area. This will keep the soil biologically active.
VEGETATION CLEARING	All components	Vegetation clearing should be restricted to areas essential for the envisaged development to minimise the length of time soil is exposed.
	Borrow pits	The ECO shall visit all proposed areas for clearing and indicate where and how material may be removed, before works commence. If material is only available around significant mature trees, a radius of soil of at least 3m shall be kept around the base of the trunk, and it shall be endeavoured not to expose the roots of such trees.
AESTHETICS AND EROSION	All disturbed components	Areas temporarily disturbed during construction that will not be required for operations (e.g. lay down areas) will be identified, graded and rehabilitated to improve aesthetics and reduce erosion.
STORM WATER AND RUNOFF	Disturbed components	Storm water and runoff should be diverted away from active mining and disturbed areas.
MONITORING ACTIONS DURING NORMAL OPERATIONS		
MONITORING	Disturbed components	Cleared areas and removed soil shall be left at as gentle a slope angle as possible, to minimise the risk of erosion and to enable revegetation.

ASPECT	PROJECT COMPONENT	MITIGATION MEASURE
MONITORING	Disturbed components	Disturbed areas around construction sites should be rehabilitated promptly and not left un-rehabilitated for long periods at end.
MONITORING	Disturbed components	Areas disturbed by mining activities and infrastructure are to be rehabilitated to a stable landform with self sustaining vegetation cover.
CONTINUOUS REHABILITATION		
MONITORING	Eroded areas	An erosion monitoring procedure should be developed whereby mined areas and other potential erosion sites are visually monitored at the end of the wet season every year to identify erosion gullies. Areas where erosion was remediated previously should also be monitored.

3.3 Water quality and flow

3.3.1 Objectives

- Spills are contained and remediated with no adverse impacts to surface or ground water resources.
- Acid mine drainage is monitored and controlled.
- Minimise impacts to groundwater quality and flow from the project.
- Maintain community water supply throughout the life of the project.

3.3.2 Management strategies

Proposed actions for managing potential impacts to surface and groundwater quality and flow, monitoring and corrective actions are provided below:

ASPECT	PROJECT COMPONENT	MITIGATION MEASURE
PLANNING AND DESIGN PHASE		
TENDER PROCESS	All project components	An Emergency Response Plan will be prepared prior to the construction phase to address the responses during an emergency situation (e.g. failure of retaining walls of RWD) and the clean-up procedures after the occurrence. The plan will

ASPECT	PROJECT COMPONENT	MITIGATION MEASURE
		include roles in disaster preparedness and response such as training, notification, evacuation and first aid.
SURFACE WATER RUNOFF	Mine pit Stockpiles	• The suitability of the water accumulated in the mine pit for use in the plant is to be evaluated. • Berms should be considered to channel runoff away from the entire north-western boundary of the Tailings Storage Facility (TSF) to avoid erosion and damage to embankments and possible mixing with effluent in TSF perimeter trenches. The berms should direct flow away from the high point about mid-way along this boundary to alternately the south-west and the north-east following the natural gradient. The runoff should be discharged to the natural drainage channel in these directions. No runoff should enter the perimeter trench or reach the embankment of the TSF. • Runoff is to be diverted away from the stockpiles towards the southwest flowing natural drainage. Contact or mixing of runoff with the stockpile material or effluent is to be avoided.
PERIMETER TRENCH	Around the TSF	Trenches should be lined and any effluent collected should be directed to the RWD. It should be of sufficient depth to intercept any lateral flow along the soil zone.
STORMWATER	RWD	• The Return Water Dam (RWD) needs to be lined with strip drains to prevent seepage. • Retention time should be limited in the RWD by pumping this water as a priority for use in the plant. • The RWD should be designed to accommodate storm water (1:100 rainfall event) and to contain surface runoff from the TSF.
STORM WATER	ROM stockpile	Berms and peripheral trenches should be used to collect storm water drainage with seepage water and close monitoring is recommended.

ASPECT	PROJECT COMPONENT	MITIGATION MEASURE
PH OF WASTE ROCK STOCKPILE	Waste rock stockpile	The addition of pulverized limestone (marble) to the stockpile to raise the pH in the long term is recommended.
WASTE WATER AT MINE SITE	Water treatment facility	Waste water is not to be disposed in the natural environment unless effluent quality guidelines (MAWF, 1988) are met. A Waste Water Discharge Permit will be required from the DWAF for such disposal.
MONITORING ACTIONS DURING NORMAL OPERATIONS		
SEEPAGE AND STABILITY OF TSF	TSF	Performance of the seepage control measures are to be evaluated with monitoring of water levels and water balance of the operations. The indication of higher seepage rates than expected would require the following: • Measures to contain and recovery of water from the TSF cells during the start-up stages. • Installation of recovery boreholes for retrieval of the effluent without affecting downstream groundwater users. Recovery boreholes may be required if seepage through or below the embankments is recorded. • If early phased monitoring of water levels and seepage quality indicates leakage through the bedrock underlying the TSF, the possibility of changing to dry tailing disposal has to be considered.
LOCAL WATER SUPPLY		Monitoring points and parameters are recommended for providing an early warning system and mitigation measures are discussed under *Section 4*.
GROUNDWATER INFLOW	Mine Pit	• Monitoring of groundwater levels surrounding the pit from the beginning of operations is recommended for an understanding of the expected seasonal fluctuations and recharge. • Monitoring of water levels and pumping from the pit when inflow of water to the pit is encountered with depth. • The chemistry of the groundwater inflow to the pit to be monitored and recorded during the operation phase so that strategies for neutralisation of acid water can be

ASPECT	PROJECT COMPONENT	MITIGATION MEASURE
		made. The mine pit could be dosed with acid neutralisation material such as marble or limestone. Reaction may be hindered by formation of 'armour' of Fe(OH)3 and has to be ground to sand size particles for effective neutralisation in the long-term (The Global Acid Rock Drainage Guide.

3.4 Ecology

3.4.1 Objectives

- Removal, modification and fragmentation of habitats are minimized.
- Fauna and flora are managed at the mine site and the risks to flora and fauna outside the immediate mine area are minimized.
- Indirect impacts from construction and operation activities are minimized.
- Progressive restoration to restore ecosystem functions where possible.

3.4.2 Management strategies

The mitigation measures for reducing the loss of flora and fauna habitat during the various phases of the project include:

ASPECT	PROJECT COMPONENT	MITIGATION MEASURE
PLANNING AND DESIGN PHASE		
REMOVAL OF LARGE TREES	Entire mine site	• Unnecessary land clearing should be prevented. Trees to be left in place, undisturbed, should be clearly marked (such as with hazard tape) so that they are not accidentally destroyed. • Where possible, removal of taller and rarer species should be avoided. The species of trees that are relatively more valuable, and which should preferably not be taken down, are listed in ***APPENDIXC***. • Careful landscaping during the plant layout process should aim to retain large trees wherever possible in the mine plant, administration and parking areas.

ASPECT	PROJECT COMPONENT	MITIGATION MEASURE
CONSTRUCTION PHASE		
LAND CLEARING	Entire mine site	• The operators of all earth working machines and bulldozers should be thoroughly instructed about where land clearing should happen and where not. • Wherever possible, the mine should plant and encourage indigenous trees to replace the ones lost in the land clearing, and to enhance the working environment with pleasant surroundings.
STEEP SIDED RESERVOIRS	Reservoirs	All reservoirs should be covered with a roof of solid sheeting. If the reservoir must be left open, steps down the inside, or a log left floating on the surface but attached to the side, will assist any bird or other animal get itself out of the water.
ILLEGAL HARVESTING/ POACHING	All employees	Illegal harvesting and poaching is prohibited. Thorough security around the mine site and construction activities is required, and the mine should promote its green principles to encourage people to take pride in their surrounding natural heritage, rather than to illegally exploit it.
OPERATIONS		
REHABILITATION	Disturbed areas	Progressive rehabilitation in the form of backfilling of overburden, topsoil management and revegetation activities should be conducted as the mine progresses.

3.5 Air quality

3.5.1 Objectives

- Minimize the impacts of particulates and gaseous emissions on the surrounding environment.
- Reduce dust and gaseous emissions within specific target ranges, by employing appropriate suppression strategies.
- Control and reduce sulphur dioxide emissions.

3.5.2 Management strategies

Proposed actions for managing potential impacts to air quality and associated facilities with monitoring and corrective actions are provided below:

ASPECT	PROJECT COMPONENT	MITIGATION MEASURE
PLANNING AND DESIGN PHASE		
INSTALLATION/ PRE-CONSTRUCTION REQUIREMENTS	All roads TSF Crusher Drier	• All haul roads as well as the access road should be treated with chemical surfactants to minimize dust emissions. The temporary roads should be sprayed with water in combination with a chemical stabilizer. • The tailings storage facility should be constructed according to the wet design specifications where the toe-wall or starter wall would serve as a windbreak on the windward side of the TSF. The dormant and dried out areas should be vegetated and continually re-vegetated to minimize windblown dust emissions from the surface areas. The beach areas should be kept moist to minimise the wind erosion potential. • The crusher should be fitted with an extraction system as per the design specifications. • Water sprays should be applied at all material handling operations should these result in visual dust plumes. • The vehicle fleet should comprise of new technology engines (tier-2 or tier-3 compliant engines) to ensure low combustion emissions. Vehicles should be maintained and serviced regularly and vehicle idling times should be limited to minimize NO_2 emissions and impacts. • Low sulphur fuels should be used for the drier and mine vehicle fleet and equipment.
SO_2 CONCENTRATIONS	All mining components	• Sampling of ambient SO_2 emissions before construction as well as for the duration of operational phase. Results are to be analysed by an external consultant and if found necessary to map high risk areas where personnel are required to wear safety gear.

ASPECT	PROJECT COMPONENT	MITIGATION MEASURE
CONSTRUCTION PHASE		
PM_{10} CONCENTRATIONS	Processing plant	• Measures must be taken to reduce emissions from unpaved roads: (a) measures aimed at reducing the extent of unpaved roads, e.g. paving, (b) traffic control measures aimed at reducing the entrainment of material by restricting traffic volumes and reducing vehicle speeds, and (c) measures aimed at binding the surface material or enhancing moisture retention, such as wet suppression and chemical stabilization • Water sprays on roads, material handling points and cleared areas. • Speed limits need to be adhered to: On the mine site (40km/h) and access road (60km/h).
OPERATIONS		

PM_{10} AND $_{2.5}$ CONCENTRATIONS	Processing plant
	TSF
	Opencast pit
		• Water sprays and/or chemical suppressants should be used on:
		  • the roads
		  • the crusher and screen, and
		  • materials handling points.
		• Partial vegetation cover should be established on the TSF as soon as practically possible.

DUST SUPPRESSION	Crushing and screening	• Dust extraction (hooding with cyclone) (65% control) • Water sprays to keep ore wet (50% control) • Wind screens on the windward side of the crusher (30% control) • Dust deposition rates less than 1200 mg/m^2.day at downwind dust bucket. • Maintenance of water spray system to maximise control efficiency. • Addition of chemical surfactants to water sprays to lower water surface tension and increase binding properties. • Spillage clean up, at least once a week

ASPECT	PROJECT COMPONENT	MITIGATION MEASURE
		• Water spraying road surface in loading area.
MATERIALS HANDLING	• Loading to trucks in the pit • Unloading at ROM pad • FEL loading at ROM pad • FEL unloading at the crusher	• Water-sprays on dry material at off-loading points. • Wetting of material on ROM pad (if practical) • Ensuring tip distance is minimal i.e. drop height into truck and onto stockpiles • Keep material being handled by dozers and wheeled loader moist to achieve a control efficiency of 50%. • Regular clean-up at loading areas
WIND EROSION	• Tailings storage facility • ROM stockpile	• Vegetation of dormant TSF surface to be continuously re-vegetated in areas where vegetation has died/ exposed areas • Ensure toe-wall to be constructed before tailings are deposited • Beach areas (wet option) should be kept moist • Water sprays on ROM stockpile under conditions of high wind speed

GASEOUS EMISSIONS	• Vehicle tailpipe
	• Drier off-gas emissions
		• Preventative controls for vehicle NO_x emissions:
		  • minimization of vehicle idling times,
		  • regular maintenance of vehicles according to manufacturer's guidance,
		  • use of best available technologies such as exhaust gas recirculation and installation of selective catalytic reducers to reduce NO_x emissions.
		• Vehicle fleet should be carefully selected to include the latest technology that would ensure low tailpipe emissions.
		• Preventative controls for vehicle tailpipe PM_{10} emissions:
		  • minimization of vehicle idling times,
		  • regular maintenance of vehicles according to manufacturer's guidance

ASPECT	PROJECT COMPONENT	MITIGATION MEASURE
		• use of best available technologies such as the installation of selective catalytic reducers, oxidation catalysts and diesel particulate filters to reduce PM_{10} emissions. • Uses of low sulfur content fuels are recommended to minimise SO_2 emissions from both vehicle tailpipe emissions as well as generator emissions.
MONITORING ACTIONS DURING NORMAL OPERATIONS		
MONITORING	All mining operations	• A dust monitoring network comprising at least six single dust fallout units should be established to collect dust fallout due to routine operations, as well as the dust fallout during high wind periods. • Occupational PM_{10}, SO_2 and NO_2 exposure should be measured monthly. Personal samplers should be issued to selected employees covering various mining activities and areas over the 8-hour working shift. The sampled PM_{10} filters should be analyzed for graphite content to determine exposure to inhalable graphite dust. This is useful to obtain a data record of exposure levels at the mine. • One PM_{10} monitor should be installed downwind from the mining operations and downwind from the TSF. • A passive SO_2 and NO_2 sampling campaign should be conducted bi-annually (summer and winter) at the same locations used for dust fallout monitoring. • The passive samplers should be exposed for a period of at least one month during each campaign. • Personal samplers can be issued to selected employees covering various mining activities and areas over the 8-hour working shift. • See *Section 4* for the detailed monitoring plan.
QUANITIFICATION OF SO_2 CONCENTRATIONS		• SO_2 concentrations should be sampled to: • Determine the impact of vehicle exhaust emissions and sulphide oxidation on the surrounding environment.

ASPECT	PROJECT COMPONENT	MITIGATION MEASURE
		• Determine the impact of sulphide oxidation on employee health. • Determine the rate of sulphide oxidation.
DUST DEPOSITION		• A dust deposition monitoring network is to be established to monitor the dust deposition due to routine operations, as well as the dust deposition during high-wind periods. • Dust monitoring should be established before operations commence to measure baseline conditions. It should remain active throughout the life of the mine as well as for a few years post closure to determine the effectiveness of tailing storage facility mitigation measures.

3.6 Noise

3.6.1 Objectives

❖ Minimizing noise nuisances to sensitive receptors beyond the boundaries of the project.

3.6.2 Management strategies

The noise impact associated with the construction and operation of the mine is expected to be limited due to the distance to the nearest sensitive receptors and also due to the surrounding landforms which is expected to limit the way the noise will travel. Nonetheless, the following management measures are prescribed to further reduce any potential noise from the mine:

ASPECT	PROJECT COMPONENT	MITIGATION MEASURE
PLANNING AND DESIGN PHASE		
EQUIPMENT AND VEHICLES	All project components	All vehicles and mobile equipment should be fitted with appropriate exhaust and muffler devices where possible in compliance with international environmental and occupation health standards.
CONSTRUCTION PHASE		
BLASTING	All project components	Consult with nearby sensitive receptors (i.e. neighbouring farmers, town residents) about the potential for noise nuisance

ASPECT	PROJECT COMPONENT	MITIGATION MEASURE
		from blasting operations including schedule, duration and repetitions.
EQUIPMENT AND VEHICLES	All project components	Regularly maintain equipment and vehicles to minimize noise.
OPERATIONS		
TRANSPORT OF PRODUCT AND MATERIALS	All project components	Transport of product and materials to and from the railway station should preferably occur during daylight hours only.

3.7 Cultural heritage

3.7.1 Objective

- Ensure due consideration is given to matters regarding the cultural and general wellbeing of the affected community and matters incidental thereto.

3.7.2 Management strategies

The following mitigation measures are prescribed to avoid or limit any potential impact on culturally significant sites that may occur in the project area:

ASPECT	PROJECT COMPONENT	MITIGATION MEASURE
PLANNING AND DESIGN PHASE		
ARCHAEOLOGY	All project components	A site walk over should be undertaken by an archaeologist at the time of bush clearance to check for the presence of artefacts.
CONSTRUCTION AND OPERATION PHASES		
ARCHAEOLOGY	All project components	Should a heritage site or archaeological site be uncovered or discovered during the construction phase of the project, a "chance find" procedure should be applied in an order as follows: • If operating machinery or equipment → stop work; • Demarcate the site with plastic warning tape; • Determine GPS position if possible; • Report findings to foreman; • Report findings, site location and actions taken to

ASPECT	PROJECT COMPONENT	MITIGATION MEASURE
		superintendent; • Cease any works in immediate vicinity; • Visit site and determine whether work can proceed without damage to findings; • Determine and demarcate exclusion boundary; • Site location and details to be added to the project's Geographic Information System (GIS) for field confirmation by archaeologist; • Inspect site and confirm addition to project GIS; • Advise the National Heritage Council (NHC) and request written permission to remove findings from work area; and • Recovery, packaging and labelling of findings for transfer to National Museum.
ARCHAEOLOGY	All project components	Should human remains be found, the following actions will be required: • Apply the chance find procedure as described above; • Schedule a field inspection with an archaeologist to confirm that remains are human; • Advise and liaise with the NHC and Police; and • Remains will be recovered and removed either to the National Museum or the National Forensic Laboratory.

3.8 Waste management

3.8.1 Objectives

- ❖ Waste is managed according to the waste management hierarchy (prevention, reduction, re-use, recycling, disposal);
- ❖ All waste is properly handled, stored, transported and disposed of;
- ❖ Contaminant spills are avoided or immediately contained;

3.8.2 Management strategies

Proposed actions for managing potential impacts associated with waste are provided below:

ASPECT	PROJECT COMPONENT	MITIGATION MEASURE
PLANNING AND DESIGN PHASE		
WASTE MANAGEMENT PLAN	All project components	A Waste Management Plan should be developed and implemented and should include project and site-specific details on waste types, procedures and facilities where it will be disposed of.
INDUCTION AND TRAINING	All project components	Implement a training program and inductions for waste management for all project personnel.
WASTE PREVENTION	All project components	Encourage careful project planning in the purchasing policy to minimize unnecessary materials brought onto site. Rather return surplus materials to the supplier.
WASTE REUSE	All project components	Reuse or recycle solvents, metals and oils.
CONSTRUCTION AND OPERATION PHASE		
HAZARDOUS WASTE	All project components	All heavy construction vehicles and equipment on site should be provided with a drip tray. • Drip trays are to be transported with vehicles wherever they go. • Drip trays should be cleaned daily and spillage handled, stored and disposed of as hazardous waste.
	All project components	All heavy construction vehicles should be inspected regularly to prevent oil leakages.
	Workshop and wash bay	Maintenance and washing of construction vehicles should take place only at a designated workshop area. • The workshop area should be lined with concrete. • The workshop should have an oil-water separator for collection of run-off from washing. • Oil filters should be stored in marked containers that allow oil to drain but not escape from storage.
	All project components	Spilled concrete (wet or dry) should be treated as hazardous waste and disposed of in the appropriate hazardous waste containers.

ASPECT	PROJECT COMPONENT	MITIGATION MEASURE
	All project components	All hazardous substances (e.g. fuel etc) or chemicals should be stored in a specific location on an impermeable, bunded surface.
	All project components	Hazardous waste to be handled by trained personnel only and disposed of at an appropriately licensed facility off-site.
	All project components	Spill management kits, Personal Protective Equipment (PPE) and relevant emergency procedures should be available at the workshop and storage facilities.
	All project components	Any spills should immediately be contained and cleaned up and the contaminated soil appropriately disposed of. The receiving environment should then be remedied where necessary to prevent the spill from entering the storm water drainage system.

SEWAGE AND GREY WATER	Waste water treatment facility	The trickling filter system proposed in the project design will be used to treat onsite sewage:
		• Sewage (black water) may not be discharged directly into the environment;
		• Grey water should be recycled by:
		  o Using it for dust suppression;
		  o Sustaining a vegetable garden, or to support a small nursery;
		  o Used to clean equipment.

GENERAL WASTE	All project components	• The construction site should be kept tidy at all times. All domestic and general construction waste produced on a daily basis should be cleaned and contained daily. • No waste may be buried, burned or disposed to land on site, outside of the approved waste disposal facility. • Waste containers (bins) should be emptied regularly and removed from site to a recognized (municipal) waste disposal site. All recyclable waste needs to be taken to the nearest recycling depot. • A sufficient number of separate waste containers (bins) for hazardous and domestic/general waste must be provided on site. These should be clearly marked as such.

ASPECT	PROJECT COMPONENT	MITIGATION MEASURE
		• Construction laborers should be sensitized to dispose of waste in a responsible manner and not to litter. • No waste may remain on site after the completion of the project

3.9 Social and community values

3.9.1 Objectives

- ❖ Minimize the impact on social services, infrastructure and social or cultural values due to the operations of the mine.
- ❖ Minimize negative visual amenity changes or changes in the sense of place resulting from the construction and operation of the mine.
- ❖ Minimize any adverse impacts on the surrounding land uses.
- ❖ Minimize any potential health impacts that may result from the project.
- ❖ Optimize the advantages of the project by engaging in social projects and providing local employment opportunities as far as possible.

3.9.2 Management strategies

Proposed actions for managing potential impacts impacting on social and community values are provided below:

ASPECT	PROJECT COMPONENT	MITIGATION MEASURE
PLANNING AND DESIGN PHASE		
CONTRIBUTION TO LOCAL ECONOMY	All project components	• Source goods and services locally as far as possible.
ACCOMMODATION OF WORKFORCE	Workforce	• Okanjande Mine should communicate their accommodation, waste management, and sewerage disposal needs to the Municipality of Otjiwarongo to identify a mutually acceptable accommodation site, which should be within townland and preferably already disturbed. Should such a site not be available, negotiations on

ASPECT	PROJECT COMPONENT	MITIGATION MEASURE
		alternative sites with the municipality should include concerns and considerations of adjacent land users and land owners. Such negotiations are to be conducted prior to the construction phase. Where possible, the Okanjande Mine should work with the municipality in efforts to alleviate pressure on the services infrastructure of the town.
TRANSPORT	Private road Municipal roads railway	• The mine should enter into an agreement with the farmers regarding the use of the private road to the site. • Consult with TransNamib on services needed from them during the operational phase. • Should the product be transported via railway, the traffic department in town should be informed of the intended road use to TransNamib
HIV/AIDS	Workforce	• An HIV/AIDS policy should be adopted by the contractors and the Okanjande mine for both the construction and operational phases. Initiatives should be implemented with regards to raising awareness on HIV/AIDS. See ***APPENDIX D*** for the HIV Action Plan.
OPERATIONS		
TRAFFIC	Roads	• Transport of shift workers should take place outside of peak traffic hours such as 07h00-08h30 and 16h00-17h30.
PUBLIC COMMUNICATION	All project components	• All the neighboring land users should be informed regarding the dates and times for blasting.
MONITORING ACTIONS DURING NORMAL OPERATIONS		
CONTRIBUTION TO ECONOMY	All project components	• Contribution of the mine to the Namibian economy should be monitored and reported on through annual reviews. Such reports should be produced by the mine as part of its management, as well as the Chamber of Mines.
CORPORATE SOCIAL RESPONSIBILITY	All project components	• The Human Resources Department should report to the Executive Management on Corporate Social Responsibility initiatives. They should indicate their aim of serving the community and meeting development needs for example,

ASPECT	PROJECT COMPONENT	MITIGATION MEASURE
		the health or education sector.
TRAFFIC	Private road	• A logbook should be kept at the gate of the access road indicating the time of entrance or exit, the type of vehicle, and its destination. By doing so, traffic to and from the town during peak hours can be monitored. It will also indicate whether traffic predictions were accurate or not, and whether traffic forecasts should be revisited.

3.10 Labour and Working Conditions

3.10.1 Objectives

- ❖ To equal opportunity of workers.
- ❖ To promote compliance with national employment and labor laws.
- ❖ To promote safe and healthy working conditions, and the health of workers.

3.10.2 Management strategies

Proposed actions for managing potential impacts associated with labour and working conditions are provided below:

ASPECT	PROJECT COMPONENT	MITIGATION MEASURE
PLANNING AND DESIGN PHASE		

HEALTH AND SAFETY	Personnel	• Ensure the health and safety of labourers (construction and operation) and those potentially affected from the public.
		• Ensure the Health and Safety Regulations adhere to all legal requirements as laid out in legal section of the EIA report.
		• Compile a **Health And Safety Plan**: The basic principles to include in this plan are:
		  • Awareness raising
		  • Information sharing
		  • Access to health care services i.e. counselling and testing.
		• Develop an **Emergency Response and Procedures**

ASPECT	PROJECT COMPONENT	MITIGATION MEASURE
		framework: Any safety incidents occurring on site that covers: • Accidental spills of hazardous materials, • Accidents involving personnel on the work sites, and • Major failures such as landslides, mine failures, structural collapse etc. The basic principles to include are: • Consider preventive and responsive actions • Who should be responsible to coordinate such actions • Reporting on incidents on site • Corrective measures to flawed methods of response • Compile a **Health and Safety report** that identifies PPE – specifically for inhalation protection – for the various mining activities. Supervisors and contractors are responsible for maintaining the health of all employees and labourers during the period of employment. All necessary PPE as required for doing work will be provided to the employees.
EMPLOYMENT/ RECRUITMENT	Personnel	• The Company and its Contractors will make their best efforts to employ local labour where practicable. The written agreement between Okanjande Mine and the main contractor should contain the 'Locals First' clause stipulating the commitment to employ local Namibians where possible. The project team and its tender board will be responsible to see to this. • A fair and transparent employment scheme should be established in consultation with the Regional Council. Once the unskilled or semi skilled labour needs have been identified, it will be passed on to the Community Liaison Officer who will then make an initial approach for local labour. • Ensure that recruitment takes place in a legal and fair manner so as to minimise conflict. • The recruitment process should be gender inclusive, i.e.

ASPECT	PROJECT COMPONENT	MITIGATION MEASURE
		qualified women should be given an equal opportunity where possible. See ***APPENDIX E*** for the **Equal Opportunities Plan**. Remuneration should also meet Namibian set standards. • Adhere to the legal provisions for the recruitment of labour (target percentages for gender balance, optimal use of local labour and SME's, etc.) in the contract. • The recruitment process must be formal and organised. • Preference should be given to recruit those who live closest to the project area. • Recruitment should not take place at construction site. • Ensure that all sub-contractors are aware of recommended recruitment procedures and discourage any recruitment of labour outside the agreed upon process. • Contractors should give preference in terms of recruitment of sub-contractors and individual labourers to those from the local community. • Clearly explain to all job seekers the terms and conditions of their respective employment contract (e.g. period of employment etc.) – make use of interpreters when necessary. • Secure accreditation for in-house skills transfer which recognizes and certifies any training courses.
OPERATIONAL PHASE		
AIR QUALITY SAFETY MEASURES	Personnel	• Maintain levels of contaminant dusts, vapors and gases in the work environment at concentrations below the recommended ACGIH TWA-TLV (8 hrs/day, 40 hrs/week, week-after-week). Specific limits for Okanjande Graphite mine will include: o PM_{10} < 10 mg/m³ (Namibian); o Graphite dust < 2 mg/m³ (ACGIH); o SO_2 < 5.64 mg/m³(Namibian). • Develop and implement work practices to minimize the

ASPECT	PROJECT COMPONENT	MITIGATION MEASURE
		release of contaminants into the work environment: o Provide appropriate PPE to mine personnel in conjunction with training, use, and maintenance of the PPE; o Enclose operations which may result in direct release of dust into areas where people work such as the crusher; o Ensure all areas in the processing plant are well ventilated; and o Ensure enclosed climate controlled cabins for mine vehicles and equipment (i.e. haul trucks, excavators, drill rigs, etc.).
MONITORING ACTIONS		
RECORD KEEPING	Project personnel	• During the construction phase, the project team should compile an annual report indicating the number of contractors used, the amounts paid to them, as well as their country of origin. Each contractor should supply information on the number of Namibians they employ. Such reports will provide an indication of the number of Namibian contractors and employees used during the construction phase. The same should be true for products procured.
		• During the operational phase, the Human Resources Department will keep record on the number of employees, as well as their salary scales. The amount spent on salaries will be an indication of the amount of money that will be spent in the local, regional and national economy by the employees. Reports should also be compiled on how and where operational costs were spent indicating the local, regional and national goods and services used.

4 Specific Monitoring Plans and Reporting

4.1 Air quality Monitoring

Ambient air quality should be monitored by implementing the recommendations provided by Airshed Planning Professionals (2014):

4.1.1 Dust Deposition

Dustfall should be collected in order to:

- Track progress of air pollution control measures being implemented at the material handling points, at the crusher and most importantly at windblown dust sources.
- Quantify the nuisance risk to the surrounding environment.

A dust deposition monitoring network should be established that consists of six single dust fallout units, installed at the following locations (as proposed with **Figure 3**):

- One dust bucket downwind of the TSF
- One dust bucket downwind of the processing plant
- One dust bucket downwind of the ROM stockpile
- One dust bucket downwind of opencast pit
- One dust bucket downwind of the plant, for the southerly winds recorded in spring.
- One dust bucket upwind of the mining operations.

The buckets should be exposed for a period of one month (30 days ±2 days). The exposed buckets are rinsed out with de-ionised water and poured into plastic bottles that get couriered to a nearby laboratory for analysis. The results are reported to the mine on a monthly basis.

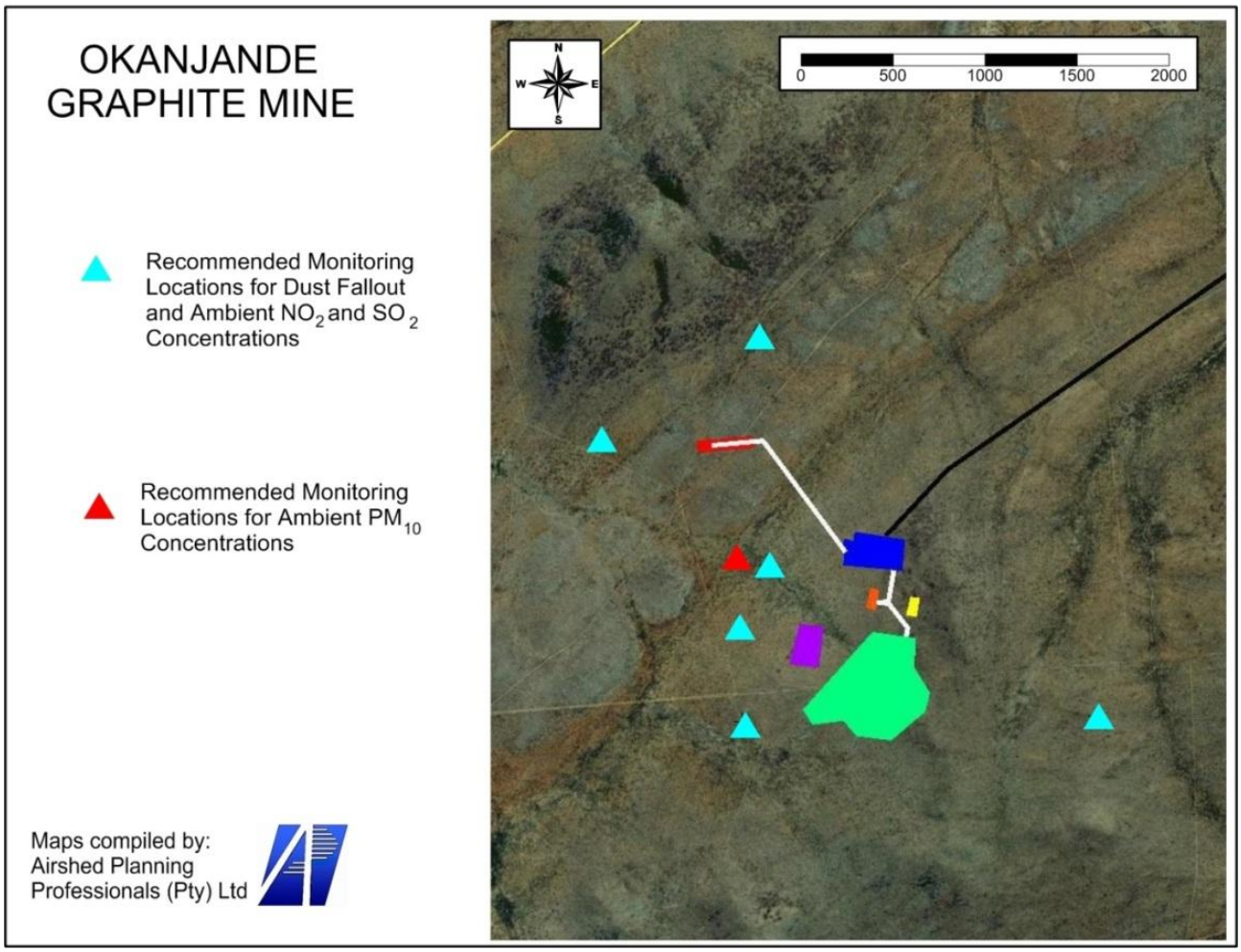


Figure 3: Recommended Monitoring Network for the Okanjande Graphite Mine.

4.1.2 PM_{10} concentrations

PM_{10} concentration should be sampled in order to:

- Track progress of air pollution control measures on the impact on the surrounding environment.
- Quantify the health risk to the surrounding environment, beyond the premises of the Okanjande Graphite Mine.

It is recommended that the PM_{10} monitor be installed downwind from the mining operations and the TSF.

4.1.3 NO_2 concentrations

NO_2 concentrations should be sampled to determine the impact of vehicle exhaust emissions on the surrounding environment.

NO_2 should be sampled with passive diffusive samplers that can be attached to dust bucket stands (**Figure 3**). SO_2 and NO_2 sampling campaigns should be done bi-annually – one during winter and one during summer. It would be useful to conduct one sampling campaign before the mine operations commence in order to determine baseline conditions.

4.1.4 SO_2 concentrations

SO_2 concentrations should be sampled to:

- Determine the impact of vehicle exhaust emissions and sulphide oxidation on the surrounding environment.
- Determine the impact of sulphide oxidation on employee health.
- Determine the rate of sulphide oxidation.

The following methods are recommended to quantify the impact of SO_2 on the surrounding environment and employee health:

- Determination of SO_2 emissions from ore oxidation.
- Sampling of ambient SO_2 emissions before construction as well as for the duration of operational phase. The same locations (**Figure 3**) recommended for dust fallout monitoring are recommended for SO_2 monitoring.

4.2 Surface and groundwater monitoring

The following measures are provided by Namib Hydrosearch (2014) for the monitoring of surface and groundwater.

4.2.1 Water level and discharge monitoring points

The recommended groundwater levels monitoring points are shown in **Figure 4** in existing and proposed new boreholes. In addition, water levels in the TSF and embankment are needed to check saturation and water quality. The position of these could be decided on completion of the detailed tailings designs. Overall water balance of the mine is to be monitored particularly on the following main components:

- Water disposal in tailings
- Recovered water and decrease in recovered water volumes
- Inflow to the perimeter drain,
- Inflow and outflow from the central decant pond and RWD,
- Intake of freshwater to the mine and plant from the water supply wellfield.

4.2.2 Water quality monitoring

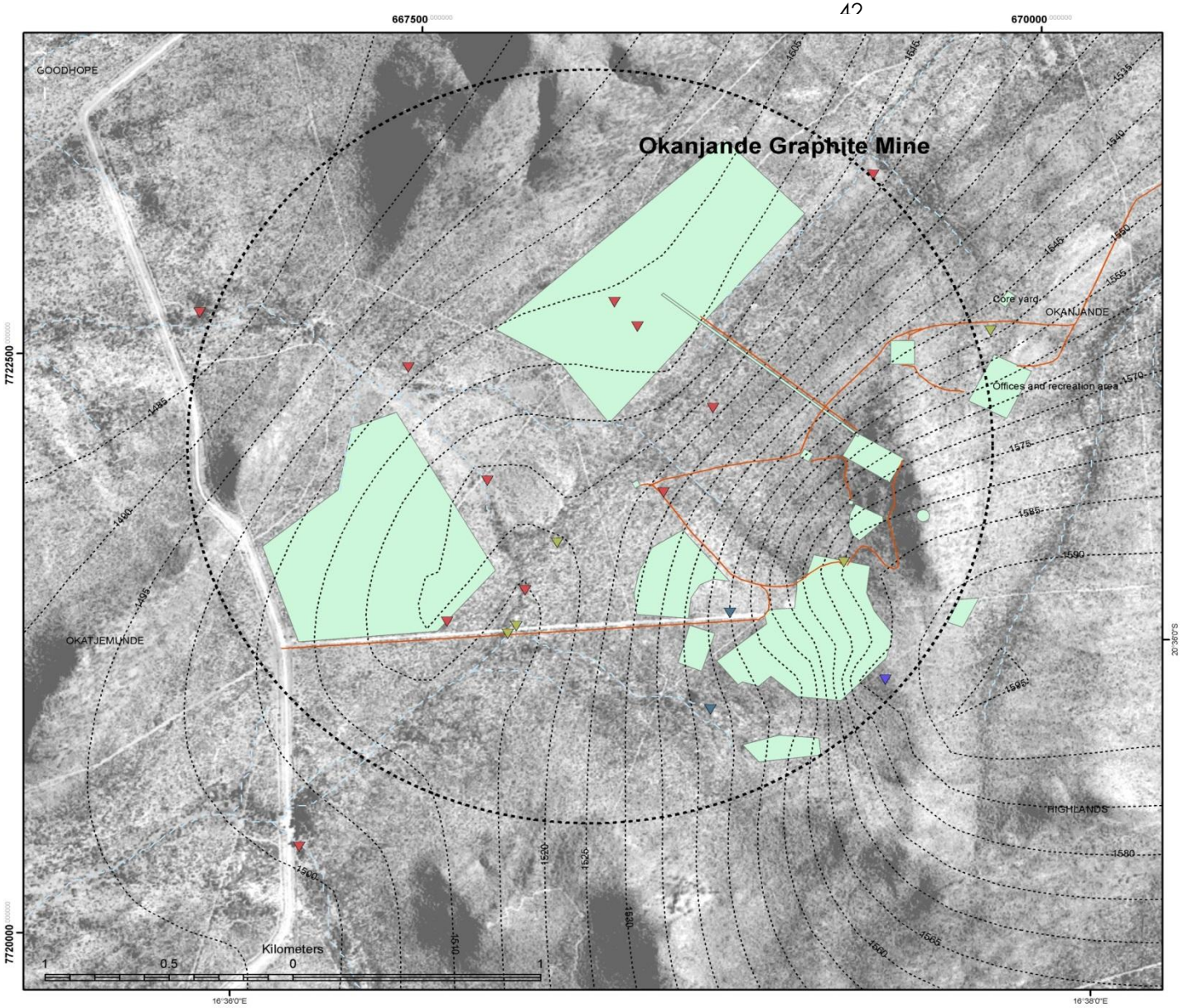
The following recommendations are made for the water quality monitoring:

- Water quality monitoring will include the following parameters for boreholes indicated in **Figure 4**. Water well head chemistry parameters would include pH, electrical conductivity, temperature, and alkalinity. Monitoring needs to be carried out on monthly basis.
- The above parameters will be monitored also on the ponding in the TSF, perimeter trench drainage and RWD on a monthly basis or when change in flow is noted.
- Quarterly sampling and analyses of water chemistry is to be done from boreholes indicated in **Figure 4**, ponding on the TSF and RWD. The parameters will include major ions, minor and trace ions analysed during the project together with zinc, cadmium, manganese, antimony, arsenic and selenium.
- The monitoring of wellhead parameters of selected points is to begin before start of operation in order to establish background levels and seasonal fluctuations if any.
- Reassessment of sampling parameters and frequency of the sampling is recommended after each 2 years of operation.

Table 6: Summary of monitoring recommendations

RISK ITEM	MONITORING
SEEPAGE FROM TSF	• Monitoring and accounting of water inflow, outflow and from the TSF. Water quality monitoring. • Water recovery rates from decant pond and RWD • Inspection and estimate of outflow from under drains
QUALITY OF SEEPAGE FROM TSF	• Monitoring boreholes in the active TSF cell, embankments and base. • Monthly field water quality parameter measurements • Quarterly water quality analyses
STRUCTURAL INTEGRITY OF THE TSF	• Monthly inspection of embankment walls for erosion and ponding of water along embankments • Water level monitoring within embankments.
CONTAMINATION AFTER CLOSURE OF TSF	• Water level within TSF • Groundwater level • Inspection of TSF walls
CONTAMINATION	• Monitor water levels

RISK ITEM	MONITORING
AND RISK AFTER CLOSURE FROM MINE PIT	• Monitor water quality
WASTE WATER DISPOSAL	• Volume and quality



Environmental Impact Assessment
Okanjande Graphite Project

Hydrology and Hydrogeology

Figure 16: Proposed groundwater monitoring points

Legend

Groundwater monitoring points

Monitoring parameter

- Water level - existing
- Water level - proposed
- Water level and water quality - existing
- Water level and water quality - proposed
- Mine roads
- Main road
- **Surface drainage**
- Water table elevation (mamsl)
- Okanjande Graphite Mine

Digital aerail photo data from
Directorate of Survey and Mapping

1:15 000
Projection: UTM Zone 33 south (WGS84 spheroid)

Namib Hydrosearch
PO Box 11546
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Figure 4 : Recommended groundwater monitoring points

5 Conceptual Closure Framework: Mine closure, decommissioning and rehabilitation management

5.1 Introduction

IFC (2007) requires a mine closure plan to incorporate both socio-economic considerations and physical rehabilitation to be an integral part of the project life cycle. The objectives of such a plan should be structured so that:

- *"Future public health and safety are not compromised*
- *The after use of the site is beneficial and sustainable to the affected communities in the long term;*
- *Adverse socio-economic impacts are minimized and socio-economic benefits are maximized."*

5.2 Objectives

The objectives for mine closure and the rehabilitation of disturbed areas are to:

- Ensure that the objectives set by IFC (2007) are met as a minimum, i.e.:
    - The site is safe for both humans and animals,
    - The residual impacts are managed to acceptable levels and will not deteriorate over time, and
    - Closure is achieved with minimal socio-economic upheaval.
- Ensure that the biodiversity and environment on the site is protected.
- Provide sufficient funds at the end of life of mine, to properly implement the closure plan
- Establish a self sustaining vegetation community using appropriate native tree, shrub and grass species and
- Ensure land is made stable, both in terms of geotechnical parameters and erosion so that post mine land use is not compromised by site instability.

5.3 Closure Planning

The planning for closure and rehabilitation is an on-going process, which should be adapted and updated during the operational phase of the project, refining the closure criteria and associated costing to develop a preliminary closure and rehabilitation plan. This plan should reflect changes in mine development, operational planning and environmental and social conditions.

Gecko Graphite will be required to undertake a detailed closure and rehabilitation process at the feasibility phase of an operation, based on a thoroughly developed closure strategy, which should be reviewed and improved throughout the life cycle of the mine. The final closure plan should include:

For continuous rehabilitation:

- Progressive rehabilitation plan
- Monitoring plan

For final closure:

- A structured risk/opportunity assessment that considers risks associated with health and safety and the natural and social environment, legal risks and financial risks.
- Social plan (employees and communities)
- Decommissioning plan
- Final rehabilitation plan
- Monitoring plan
- Updated financial breakdown for closure
- Approved suggestions for post mining land use based on further engagement with surrounding landowners and key stakeholders.

The closure plan should make provision for all possible closure scenarios including:

- Life of mine closure (i.e. planning closure at the completion of mining operations), and
- Immediate closure (i.e. a sudden closure of operations e.g. due to a drop in the price of graphite).

Although planning for the latter cannot be done in much detail, being prepared for such unforeseen circumstances rely on having an updated detailed closure plan, which gives the planner the ability to rapidly evaluate the remaining unknowns and risks associated with closure and to develop an appropriate decommissioning plan.

The purpose of this Section in the EMP is to provide a conceptual closure plan, including closure and rehabilitation objectives, financial provisioning and potential suggestions for post mining land use. The structure of this plan is in accordance to the Namibian Mine Closure Framework (The Chamber of Mines of Namibia, 2010).

5.4 Socio-economic considerations

5.4.1 Stakeholder engagement

The identification and engagement of key stakeholders is fundamental to the development of a successful Mine Closure Plan since closure can often be responsible for substantial changes in both the community and the environment in which it operates (The Chamber of Mines of Namibia, 2010). Engagement enables stakeholders to have their interests considered as part of the mine closure planning process, whilst creating an understanding for their views and expectations and formulating a balanced, realistic and achievable closure outcome.

Stakeholder engagement is an ongoing process that should start in the planning phase, and continue throughout the operation and mine closure phases. It should include consultation, listing and feedback, as well as distribution of information.

The parties that should be consulted are divided into those that are directly affected e.g.:

- mine employees;
- Contractors; and
- Land owners.

and those that have an interest in the process e.g.:

- Adjacent landowners,
- local businesses and
- government institutions (e.g. local and regional councils and ministries).

5.4.2 Mechanisms to manage socio-economic effects

Various mechanisms are available to manage post closure social issues. The following mechanisms are however recommended:

- Establishment of a Future Forum;
- Mechanisms to Save Jobs and avoid Job Losses and a Decline in Employment;
- Mechanisms to Provide Alternative Solutions and Procedures for Creating Job Security where Job Losses cannot be avoided; and
- Mechanisms to improve the social and economic impact on individuals, regions and economies when retrenchment or closure of the mine is certain.

At this stage, no financial provision is made for the above mentioned mechanisms and Gecko Graphite will need to ensure that sufficient provision is made for the management of these issues within future iterations of the Mine Closure Plan.

Financial provision for socio-economic effects should be structured to include:

- Employee costs:
    - Retrenchment provision (e.g severance or retention packages)
    - New employment opportunities
    - Retraining costs
- Social aspects (sustainability of associated communities):
    - Exit strategy (i.e. process by which the mine will cease to support local initiatives)
    - Social transition (i.e. support that will be provided to the community to transition to new economic activities).

5.5 Physical rehabilitation

The key mine infrastructure components that will be decommissioned and rehabilitation are:

- Processing plant
- TSF
- Mine pit
- Rom stockpile
- Waste rock dumps
- RWD
- Transmission line
- Water supply boreholes, pipelines and reservoirs
- Access roads
- Administration and ancillary support facilities
- Sewage treatment facility
- Borrow pits

The following methods and management strategies are recommended for the decommissioning and rehabilitation of these components during final closure.

ASPECT	METHODS/STRATEGIES
GENERAL	• All rubbish/wastes will be removed from site and disposed of at the Otjiwarongo municipal waste dump site • All decommissioned areas should be stabilized to prevent slope failure and erosion post mine closure. • Prior to decommissioning unused chemicals, hydrocarbons and explosives are to be removed from site.
PROCESSING PLANT	• Prior to decommissioning the processing circuit will be emptied of any reagents and fluids. • The processing plant and associated steel work should be dismantled and sold, recycled or removed from the site to the Otjiwarongo waste dump site. • The disturbed footprint area should then be graded and re-contoured to match the surrounding landscape. • The surface should be ripped and covered with topsoil to ensure water infiltration and the re-establishment of vegetation.
TSF	• At decommissioning the tailings pipelines will either be rolled up for removal off site or cut into sections to be shredded for recycling. • Upon closure of the mine the surface of the TSF should be graded to avoid ponding and encourage surface runoff, and limiting the infiltration of water into the tailings. • Low permeability seal should be placed on the TSF. This limits the possibility of rainwater infiltration and salt accumulation at surface by capillary action. For the cover clay-rich material or other material such as compacted calcrete is to be evaluated. This seal will minimize moisture influx by maximizing near surface moisture storage allowing for subsequent release by evapotranspiration • During this period groundwater monitoring will continue to assess the level of seepage from the TSF and the associated water quality along the most likely seepage pathways. • Monitoring boreholes should be designed with the capacity to extract potential seepage. • The following approach should be taken in terms of revegetation: o Compacted areas on the mine site should be ripped;

ASPECT	METHODS/STRATEGIES
	○ Freshly stripped or stockpiled topsoil should be spread over the area; ○ Soil surface should be broken up along contours before seeding to increase water infiltration and root penetration; ○ Seed with a mix of locally occurring species to facilitate a self sustaining ecosystem. • Apply a standard phosphate fertilizer.
MINE PIT*	• On closure the mine pit should be cordoned off (with a game-prove fence and clear warning signs) to avoid access and use by animals and humans. • Secure the pit against inflow of surface runoff water and discharge. • As soon as the groundwater table is intersected by mining, monitoring of the flow rate and quality of water should start and continue for at least 6 months. • In the last three years of the LOM, Gecko Graphite should undertake a groundwater study to determine what the water inflow rate will be into the pit. The expected volume of water in the end will determine the amount of neutralizing material required. • Potential backfilling of the pit should be evaluated by Gecko Graphite to reduce the operations footprint and manage waste rock and/or tailings. If pits are backfilled fully or partially the infill will be contoured to blend in with the surrounds. However backfilling will not be undertaken if: • it makes the operation unviable. • it sterilises a potentially viable mineral resource in the future. • there is a possibility that the safety of future mining operations will be jeopardised.
ROM STOCKPILE	• Once all stockpiles have been removed any residual ore material should be graded into windrows and placed in the tailings dam. • On closure of the mine the stock piles are to be graded to encourage runoff and limit infiltration. The surface is to be covered with topsoil and vegetated. The protective berms diverting surface flow are to remain to avoid any erosion of the soil cover
WASTE ROCK STOCKPILE	• On closure of the mine the stock piles are to be graded to

ASPECT	METHODS/STRATEGIES
	encourage runoff and limit infiltration. The surface is to be covered with soil and vegetated. The protective berms diverting surface flow are to remain to avoid any erosion of the soil cover.
TRANSMISSION LINE	• Dismantle and remove transmission lines and all associated infrastructure from site for sale. • Remove scrap metal from site for recycling. • Rip surface to alleviate compaction and encourage re-growth of local vegetation
WATER SUPPLY BOREHOLES AND PIPELINES	• Consult with landowner or local stakeholders about possible take-over agreements of the boreholes on farm Doornlaagte. • Pipelines and pumps should be flushed and removed from site. • Disturbed areas around the boreholes and the pipeline should be contoured and ripped to encourage the re-growth of local vegetation.
ACCESS ROADS	• Consult with landowner to determine future post operation use for access roads and tracks constructed by Gecko Graphite. • In the short term the access road and a number of internal roads will be kept open to allow access for closure monitoring. • Access roads not required by landowner will be rehabilitated. • The road corridor will be contoured to restore natural drainage. • Re-spread stockpiled topsoil. • Deep rip surface to alleviate compaction and encourage re-growth of local vegetation. • Use seeds of local vegetation to help re-establish vegetation. • Access to the rehabilitated area should be restricted.
ADMINISTRATION AND ANCILLARY SUPPORT FACILITIES	• Power, water and drainage systems to be shut off and the buildings removed from site. • Any scrap metal should be recycled. • Hydrocarbon contaminated soil should be removed. • Contour the area to restore natural drainage. • Rip the surface to alleviate compaction and encourage re-growth of local vegetation.

ASPECT	METHODS/STRATEGIES
SEWAGE TREATMENT FACILITY	• Empty any sewage from the treatment facility and transfer to Otjiwarongo for emptying at the town's sewage works. • Dismantle and remove the sewage treatment facilities from the site. • Recycle any scrap metal. • Contour the area to restore natural drainage. • Rip the surface to alleviate compaction and encourage re-growth of local vegetation.
BORROW PITS	• Consult with stakeholders about the post operation use of the borrow pits. • If stakeholders require the pits to be closed, it will be backfilled where sufficient material is available. • The sides will be sloped to less than 20˚ to resemble surrounding topography where practicable. • The disturbed area should be ripped to relieve compaction and assist the infiltration of water.
REMAINING MATERIALS	• All other remaining materials, which are anticipated to be small quantities of non-recyclable items and rubbish, should be disposed of at the Otjiwarongo municipal waste site.
*When the mine closes the pit will be left. During seasonal rainfall events the pit will partially fill with direct rainfall and limited surface water flows. Evaporation during the dry months will minimise the amount of water remaining in the pit prior to the next wet season as the pits will remain above the water table. The open pit walls will contain minor veins of partially oxidized sulphides. The presence of small quantities of sulphides will have little effect on water quality. In the long term the quality of the water will be affected by evaporation leading to an increase in salinity.	

5.6 Post closure monitoring

Post-Closure monitoring and management is also accounted for and it is recommended that this involve:

- ❖ Vegetation succession monitoring and management
- ❖ Erosion monitoring and management
- ❖ Groundwater quality monitoring
- ❖ Surface run-off monitoring

- Monitoring and management of pollution control facilities, i.e. the tailings dam trenches and RWD, cut-off trenches etc

Post closure monitoring should continue for a minimum period of five years depending on the risks.

5.7 Post closure use of land

According to The Chamber of Mines of Namibia (2010) rehabilitation is not just about making an area neat but also about setting a disturbed ecosystem on a trajectory back to recovery so that it can be sustainably used in the future. Mining is seen as a temporary land use which should be integrated with, or followed by, other forms of land use. Rehabilitation of the mine will be aimed towards a clearly defined future land use for the area. This use will be determined in consultation with relevant interest groups including surrounding landowners, local authorities and other stakeholders. Since the mine site is located in an area that is almost exclusively used for agricultural activities, it is recommended that the site is restored with the aim of re-establishing the vegetation so that it again can be used for agricultural farmland (i.e. sustaining wildlife and livestock).

5.8 Financial Provision for closure

The Minerals Policy of Namibia (1999) endorses the 'polluter pays' principle which places responsibility for pollution mitigation on the party that caused the pollution. This principle is strengthened by the Mine Closure Framework (The Chamber of Mines of Namibia, 2010) and IFC (IFC, 2007). It aims to ensure that environmental liabilities do not remain with the government but that mechanisms are put in place by mining industries to make sure that adequate financial resources have accrued at the time of closure to cover these costs at a time when revenue is no longer being generated.

Gecko Graphite should review the closure provision on an annual basis to ensure that provisions are correct and up to date.

The costs associated with the decommissioning strategies and the monitoring and management program up to a period of five years post-closure (as prescribed by IFC (2007)) have been included in the closure cost estimate presented in Table below.

REF	ITEM	UNIT OF MEASURE	AMOUNT	N$ (2014)	
				COST PER UNIT	TOTAL
1	Demolition of buildings and structures:				
	• Mine offices	m^2	60,000	8.25	495,000.00
	• Core yard	m^2	3,500	4.2	14,700.00
	• Product storage warehouse	m^2	10,000	8.25	82,500.00
	• Explosive depot	m^2	400	4.2	1,680.00
	• Workshops	m^2	2,500	8.25	20,625.00
	• Processing plant	m^2	20,000	11.25	225,000.00
	• Fencing	m^2	4,800	180	864,000.00
	SUB TOTAL				**1,703,505.00**
2	Operational:				
	• ROM Stockpile Area	m^3	10,000	8.25	82,500.00
	• Tailings Dump (Top and sides)	m^3	512,000	7.02	3,594,240.00
	• Topsoil levelling	m^3	329,600	8.25	2,719,200.00
	• Rehab of Quarry	m^3	40,000	7.02	280,800.00
	• Final Void shaping	m^3	560,000	7.02	3,931,200.00

REF	ITEM	UNIT OF MEASURE	AMOUNT	N$ (2014)	
				COST PER UNIT	TOTAL
	Removal of Pipeline	m³	510	4.92	2,509.20
	Removal of Reservoir and Booster pump	m³	3000	11.25	33,750.00
	Removal of powerline	m³	437.5	11.25	4,921.88
	Transport of waste	m³	100,347.5	2.4	240,834.00
	Final disposal and rehabilitation of land fill	m³	100,347.5	4.2	421,459.50
	SUB TOTAL				**11,311,414.58**
	COST ESTIMATE FOR MINE REHABILITATION - TOTAL				**13,014,919.58**

5.9 Conclusion

This Closure Plan cannot anticipate all of the issues that will arise during the projected life of the operation and therefore, is not intended to be a definitive closure prescription. This document does, however, provide an outline of the closure process that may be undertaken. A detailed closure plan will be prepared closer to the actual closure date, when the date of closure has been confirmed.

6 Final conclusion

This EMP becomes a legally binding document once approval is granted and written confirmation to this effect through an environmental clearance certificate by the Ministry of Environment and Tourism is obtained. The provisions and mitigation details given in this EMP must be strictly adhered to and applied by the user of it.

7 Bibliography

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