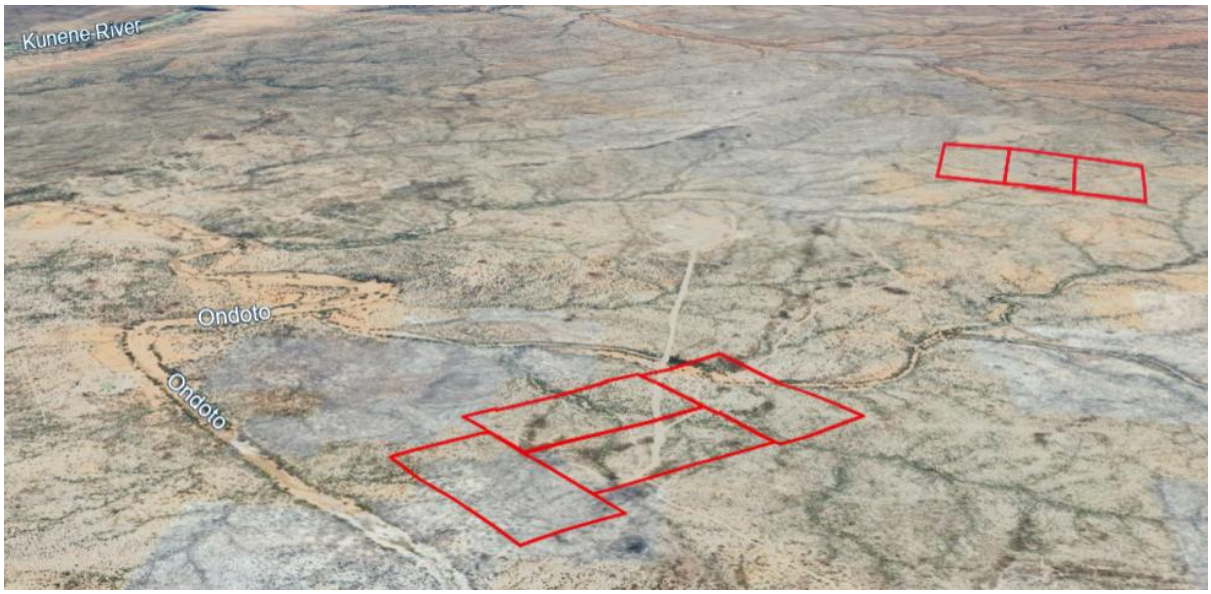
DRAFT ENVIRONMENTAL MANAGEMENT PLAN

FOR MINING OF BASE & RARE METALS, INDUSTRIAL MINERALS, PRECIOUS METALS AND SEMI-PRECIOUS STONES WITHIN MINING claims 75160, 75161 & 75162 - NEAR OTJIMUHAKA, EPUPA CONSTITUENCY, KUNENE REGION



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Prepared For:

Nina Smit

Prepared By:

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ABREVIATIONS

EAP	Environmental Assessment Practitioner
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ERA	Environmental Risk Assessment
HSE	Health Safety Environment Officer
I&AP	Interested and Affected Parties
MEFT	Ministry of Environment Forestry & Tourism
MC	Mining Claims
MSDS	Materials Safety Data Sheet
PBS	Performance Based Standard
PPP	Public Participation Process

1 INTRODUCTION

Nina Smit (hereafter referred to as the Proponent) is a Namibian citizen, who applied for mineral rights within MCs 75160, 75161 and 75162 for the following commodities, Base and Rare Metals, Industrial Minerals, Precious Metals and Semi-Precious Stones. The mining claims are all located within the Exclusive Prospecting License (EPL) 5885, situated at the northern border of Namibia, near Otjimuhaka (previously Swartbooisdrif) in the Kunene Region.

2 PROJECT OVERVIEW

Nina Smit's MCs lie approximately 130 km northwest from Opuwo and are located about 3.5 km southwest of the Namibian Angolan border, marked by the river Kunene, and 6 km south-west of Otjimuhaka settlement (previously Swartbooisdrif). The mining area is situated on the foothills of the NE-striking ridges of the Zebra Mountains in the north-west.

The MCs area is located within the Kunene Region and in the northern Epupa Constituency. The MCs is about 125km north of Opuwo travelling along the C43 and D3701 roads and about 80 kilometres west of Ruacana along the D3700 road.

Operations at the site use open cast mining methods. Mining techniques make use of modern equipment such as excavators, diamond wire saw, circular diamond cutting machines, compressor driven drill rigs, jack hammers and dump trucks. Such open cast mining operations will be established according to good practice procedure. The mining operations comprise of consecutive phases including site clearing, excavations – by means of drilling and blasting, digging, block cutting, removing and haulage of rock to processing plant and storage yard.

Multiple quarries (i.e., wedge, terrace or trench shaped) will be mined at various places within the mining claims. Quarry depth will also be to a maximum of about 50 m. Up to approximately 1,000 t of rock is expected to be removed from the ground and processed monthly. For all types of material from the ground the excavations are planned to a maximum stripping ratio of 1: 10. Overall the maximum or total estimate of waste rock produced will be up to 60 000 tons annually. Mineral waste will be deposited in waste rock dumps and in a tailings' storage facility.

The Ondoto Mining project has already established a central processing facility for sodalite dimension stone blocks at the Oroutumba settlement and a mineral processing facility for rare earth minerals at an approved accessory works area northwest of the MCs. Both processing facilities are situated within ML40.

3 EMP OBJECTIVES

The main purpose of the Environmental Management Plan ("EMP") is to provide a strategy for the identified socio-economic and biophysical impacts to provide measures that mitigate, as far as practicably possible, the effects of significant adverse impacts while providing strategies for maintaining or enhancing positive impact effects.

This mode of environmental protection is implemented in all the activities associated with the Proponent operations on the MCs, ensuring that time and national resources are not wasted and that problems occurring during all operations are identified and rectified to prevent damage to the environment.

The overall environmental objectives have been set for the management of the following main activities:

- Mining sodalite lumps, dimension stone, and rare earth minerals within the MCs.

- Transporting product along the national road network
- Storage and export at Walvis Bay port

If any issues were overlooked, the plan must be amended in consultation with the Proponent and regulatory authorities. The EMP objectives are:

- To comply with national legislation and standards for the protection of the environment.
- To limit potential impacts on biodiversity through the minimisation of the footprint and the conservation of residual habitat within the mining claim area.
- To ensure the Proponents operations are managed efficiently and effectively to reduce or avoid negative impacts and enhance positive impacts of the operations
- To keep surrounding communities informed of the mining activities through the implementation of forums for communication and constructive dialogue between the Proponent and all those affected
- To conserve soil resources by stripping, stockpiling and managing topsoil where practicably possible.
- To minimise the potential for dust emissions through the implementation of dust control measures.
- To minimise the potential for noise and vibration disturbance in surrounding areas.
- To undertake rehabilitation wherever possible during the life of the mine.
- Prevent and minimise all forms of pollution.
- To include all components of the operations of the project.
- To prescribe the best practice control methods to lessen the environmental impacts associated with the operations of the project.
- To monitor and audit the performance of operational personnel in applying such controls.
- To ensure that appropriate environmental training is provided to responsible operational personnel.

The Environmental Management Act and Regulations require that an EMP for the proposed project be developed (see Legal Section of EIA Scoping Report). The Management Programmes within this EMP have therefore been compiled to satisfy requirements based on the regulations for all developmental projects in Namibia.

3.1 Environmental Management Roles and Responsibilities

The main parties that are responsible for specific aspects of the EMP's implementation or to whom the responsibility reports are:

- The **Proponent**
- **Project Manager** (PM);
- The **Environmental Assessment Practitioner** (EAP)
- The **Environmental Control Officer** (ECO)

3.1.1 Proponent

Bears the ultimate responsibility for the mining and processing operations and is thus responsible for environmental performance. Must be informed of environmental issues and impacts of all operations (existing and future) and the resultant effect that such activities have on the environment.

3.1.2 Environmental Assessment Practitioner

Undertakes Environmental Impact Assessment ("EIA") and generates a draft Environmental Management Plan, completes EIA and EMP reports, ensures overall compliance of the EMP and undertakes periodic external environmental audits.

3.1.3 Environmental Control Officer

Monitors the implementation of the EMP as well as identifies potentially detrimental impacts not identified in the EMP so that the EMP can be reviewed and updated. The following list outlines the ECO's responsibilities:

- Responsible for maintaining compliance to the EMP and any other relevant legal requirements e.g., permits and authorisations.
- Implementation of the Environmental Management System ("EMS").
- Coordination, monitoring and consultation with stakeholders and personnel, including the promotion of environmental management competence and providing risk assessment expertise.
- Undertake Environmental Risk Assessments (ERAs).
- Set environmental objectives and targets.
- Monitoring of systems to ensure compliance to legislation and company policies.
- To facilitate updating of the environmental management process and ascertaining the state of environmental risk and performance.
- Compile biannual reports for MEFT.
- Ensuring that all personnel undergo environmental awareness training as per company environmental standards on an ad hoc basis.
- Coordinate internal and external environmental audits.
- Submit required information to relevant authorities such as reporting related to monitoring and with regard to compliance with the EMP, permit and relevant authorisations.
- Liaise with the Proponent's management team and various external stakeholders such as authorities and interested and affected parties on environmental management

3.2 Environmental Training and Capacity Building

The Proponent is responsible to ensure all personnel working on the Mining Claims are trained on aspects of health, safety and environment (HSE) relevant to the site. The plant equipment technical team must be trained to maintain the plant. Equipment manuals and data sheets must be supplied. HSE manuals must be available on site at all times. Material Safety Data Sheets ("MSDS"), where required, are to be available.

Where the capacity of the personnel is insufficient the Proponent must take up the responsibility to build capacity especially where compliance to HSE issues is lacking. For this EMP to be successful, compliance monitoring is essential. Reporting the data from the monitoring to the environmental authority will be necessary in order to show that capacity building and training are carried out.

4 ENVIRONMENTAL IMPACTS

The key environmental impacts described and discussed in the scoping report for construction and operations were identified by site visits, consultation with the Proponent and an impact assessment.

Key Positive Environmental impacts

The following key issues and potential positive impacts associated with the proposed operations are:

- The operations help to create jobs and long term employment.
- The local economy benefits; through direct contribution to Gross Namibian Income (GNI) of the mine.
- Reducing income inequality, increasing job creation and economic growth.
- Implementation of environmental management measures to mitigate negative impacts.
- Environmental awareness created for all the mine personnel through training.
- Improve the standard of living of the Proponent's employees.

Key Negative Environmental Impacts

- Potential decrease in the road surface integrity due to increased haulage frequency could incur more frequent spending on road repairs.
- Potential air pollution from vehicle fumes and during windy conditions from dust generating activities.
- Potential decrease in aesthetic value of the area earmarked for mining as vegetation and topsoil will be cleared as it is prepared for mining expansion and operations.
- Potential increases in waste and sewerage generation.
- Potential increase of soil erosion because of stripping of topsoil during the mining operations.
- Natural resource depletion, loss of land (habitat), change in land-use potential.
- Potential impact on health and safety (security) of personnel and public.
- Potential water pollution and poor water quality.
- Public safety on National Roads and at the Port of Walvis Bay.

5 EMP IMPLEMENTATION GUIDELINES

The potential impacts resulting from the proposed operations were evaluated in the scoping report with assessment for the overall Ondoto Project. The suggested mitigations for potentially negative impacts if implemented, will reduce the impacts on the biophysical and socio-economic environment so that their significance is negligible. The mitigation measures are included in the EMP implementation guidelines below. **Table 1** to **Table 16** describe the management programmes for the Mining Claims regarding the main potential impacts to mitigate and/or enhance the potentially significant environmental and socio-economic impacts.

This document may need to be periodically reviewed and updated due to new insights or operational changes to ensure that all the environmental impact aspects are included. It categorises aspects into loosely defined phases of planning, construction, operational, and decommissioning phases. These phases are applicable in the following ways:

- elements of the **Planning Phase** apply to the current scoping report preparation, the review process, permit and certificate renewal periods;
- the establishment of new activities on site and the upgrading of infrastructure or equipment is covered under the **Construction Phase**;
- extraction, blasting, crushing, milling and haulage of the resource and supplies and transport of product to port and various accessory components falls under the **Operational Phase**;
- should any of the activities discussed ever end then the **Decommissioning Phase** section will be applicable in particular the application of the fund to the rehabilitation of the mine.

The following programmes are discussed in detail in the tables that follow:

- Air quality Management Programme (includes Radiation aspects)
- Noise Management Programme
- Health & safety Management Programme (includes Security and Radiation aspects)
- Visual Management Programme
- Stakeholder Communication Management Programme (include socio-economic and cultural heritage aspects)
- Waste Management Programme (includes radiation aspects)
- Ecology Management Programme
- Water Resource Management Programme: a. Water Resource Management (Utilisation) b. Water Quality Management (Contamination)
- Traffic Management Programme
- Port Handling and Storage Management Programme
- Mine Closure & Rehabilitation Management Programme

The Radiation Management Plan is a supplementary document to be used in conjunction with this EMP.

Table 1. Air Quality Management Programme

<table>
<tr><th>Impact Event</th><th colspan="3">Disturbances to soil, rock and ore resulting in excessive dust in the atmosphere</th></tr>
<tr><td>Description</td><td colspan="3">Dusty atmospheric conditions do prevail in the arid northwest of Namibia particularly during the winter months when dry easterly winds blow and during early summer months when south westerly winds blow. Mining activities will generate dust as follows:
Movement of vehicles along road network hauling ore to the plant on site are likely to lift dust into the air
Trucks transporting product along the dirt roads create dust trails as they travel south to the port along the preferred route as per the EIA and the project description above.
Drilling and blasting will most definitely cause dusty conditions.
Crusher, sizing screens and conveyor functioning will result in dusty conditions.
The TSF and waste rock dump (WRD).
Product handling & storage areas
The surrounding habitats receive the dust that emanates from the mining activities and may potentially be affected. Fauna and flora alike could be impacted as ecosystem functioning is possibly affected.

Negative effects of dust on personnel working at the quarry site are likely to occur if dust suppression techniques are not employed and personal protection equipment is not used to safeguard the health of personnel.

It is not known how many people lived at Oroutumba before the existing sodalite quarry work started decades ago but currently there are at least 50 residences within 500m of the main quarry site which is in app 2.5km distance. Nearby residents may be affected by these dust sources.</td></tr>
<tr><td>Nature</td><td colspan="3">Negative</td></tr>
<tr><td>Phases</td><td colspan="3">Phases during which sources of dust apply are highlighted below;
Significance assessment was carried out on the operational phase which presents a long-term risk.</td></tr>
<tr><td>Construction Phase</td><td>Operational Phase</td><td>Decommissioning Phase</td><td>Post Closure</td></tr>
<tr><td>Crushers & screens</td><td>Crushers & screens</td><td>Dismantling crushers & screens</td><td rowspan="4">Background levels will most likely resume soon after closure.</td></tr>
<tr><td>Conveyor construction</td><td>Conveyor functioning</td><td>Dismantling conveyors</td></tr>
<tr><td>Road network establishment</td><td>Road use and maintenance</td><td>Demolishing buildings</td></tr>
</table>

Building construction	Drilling & blasting	Rehabilitation of slopes	
	Ore haulage from quarry pit	Constructing fences	
	Product handling & storage		

Severity	Moderate / measurable deterioration (discomfort). Recommended level will occasionally be violated.
Duration	Reversible over time. Life of the project. Medium term
Spatial Scale	Fairly widespread – Beyond the site boundary. Localised at best. Though this does depend on mobility of particles and prevailing weather conditions. Dust trails are also created outside the local area along the gravel road between the mine and Opuwo or Ruacana and then again between Kamanjab and Henties Bay via Khorixas.
Probability	Definite and continuous

Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Unmitigated	**M**	**M**	**M**	**M**	**H**	**M**

Significance of Consequence	Unless it is mitigated the generation of dust should have an influence on the decision to carry out the activity or not. Natural weather conditions can create very dusty atmospheric conditions regardless of the existence of the mine. However, mining and processing activities on site will contribute significantly to local atmospheric dust levels and could potentially affect the ecosystem functioning. Company personnel could be affected depending on the content of the atmospheric dust and how great the exposure is.
Prevention	Dust creation cannot be prevented completely. Water is normally used to suppress dust on the roads. However, this scarce resource cannot be applied continuously and indiscriminately without impacting the groundwater resource.
Mitigation Action	➢ Dust suppression techniques will be necessary when dust becomes an issue during the dry winter months. The following can be done to reduce exposure of the environment and personnel to continuous and excessive dust plumes: ➢ Avoid dust generating activities that create excessive dust during windy conditions. ➢ The new and refurbished roads should have a hard surface whose integrity will not be easily compromised. ➢ Personnel are required to wear personal protection equipment if excessive dust should be created.

	➢ All vehicles transporting product material off site should be covered with a tarpaulin when travelling on the national road network of tar and gravel roads. ➢ Windbreaks and covers can be used to reduce lifting of dust from crushers, screens and conveyors. ➢ Water spays at the various plant components will effectively keep dust from blowing into the atmosphere (only if water sources are sustainably used) ➢ The road network within the mine site can be sprayed with water and other dust suppressants during dry dusty conditions (only if water sources are sustainably used) ➢ Waste rock dumps (WRDs) and the TSF should be landscaped and compacted where necessary to supress erosion of soil and dust emission on windy days. ➢ Natural revegetation of the WRDs and the TSF side walls would mitigate the amount of dust that these sources could generate. ➢ To mitigate gaseous pollutants released from the combustion of hydrocarbons, use of high-quality fuels will ensure quantities released per unit weight of product are at levels within environmental limits. ➢ In order to know for sure whether the dusty conditions created by mining activities will exceed the limits or standards set for the southern African context it would be necessary to set up a monitoring network of dust fallout buckets. The merits of such monitoring could be motivated by local authorities should complaints be received by nearby residents. The results of any monitoring would confirm the ambient air quality during baseline pre-construction conditions, and this would provide a gauge by which the site-specific conditions compare to the industry standards used. ➢ Refer to the **Radiation Management Plan** for aspects related to dust inhalation and radiation dose and the effects of exposure.

Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Mitigated	**L**	**L**	**M**	**L**	**L**	**L**

Significance of Consequence	The dust suppression techniques if applied diligently and consistently will result in a low significance impact for both the biophysical and social environment.
Confidence Level	High, provided management implements the mitigation action and the company provides the necessary financial support to implement the measures required
Monitoring	A dust bucket network is recommended so that **monthly dust fallout** can be documented. However, the setting up of a monitoring network could be delayed if the conditions are perceived to be excessive and complaints from residents are received. Acceptable limits as proposed by the Ministry of Environment Forestry & Tourism must be complied with. In the absence of such guidelines, typical ambient conditions prior to operations can be compared to guidelines used by RSA and Botswana and limits can be set for this project. Comparisons can be made with baseline conditions recorded by

	the Celsius Cobalt project should a network be set up later during operations. A **complaints register** must be kept. See monitoring requirement in the **Radiation Management Plan**.

Table 2. Noise Management Programme

Impact Event	**Disturbance of sense of place and the effect on tranquil ambient noise levels**		
Description	Potential noise sources during the mining and processing activities could originate from vehicles, earthmoving equipment like excavators and graders, generators, drilling and blasting, crushers, screens, and conveyors. The irritation issue of these noise sources will depend on the closeness of the mining activities to various receptors. The nearest residences are between 250m and 2km from any mining activity. It is not known how many people lived at Oroutumba before the existing sodalite quarry work started decades ago but currently there are at least 50 residences within 500m of the main quarry site. At the planned new processing site there are 26 people living in 10 residences from 250m to 750m away from the boundary of the new accessory works area. For rural districts the day-time ambient noise level requirement outlined in SANS 10103 (2008) between 6am and 10pm is 45dBA (**A-weighted decibel**). This is in line with the guidelines published by the World Health Organisation (WHO). The noise levels should not exceed the ambient noise levels for rural settings. The residences mentioned above would fall into the rural category.		
Nature	Negative		
Phases	Phases during which sources of noise will apply are highlighted below; Significance assessment was carried out on the operational phase which presents a long-term risk.		
Construction Phase	**Operational Phase**	**Decommissioning Phase**	**Post Closure**
Crushers & screens	Rock Cutters, crushers & screens	Dismantling crushers & screens	Background or baseline levels will most likely become prevalent again immediately after closure.
Conveyor construction	Conveyor functioning	Dismantling conveyors	
Vehicles on road network	Vehicles on road network	Demolishing buildings	

Building construction		Drilling & blasting	Rehabilitation of slopes			
		Ore and blocks haulage from quarry pit	Constructing fences			
Severity		Moderate / measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints.				
Duration		Reversible over time. Life of the project. Medium term				
Spatial Scale		Fairly widespread – Beyond the site boundary. Localised at best. Though this does depend on prevailing wind conditions proximity of residents.				
Probability		Definite and continuous				
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Unmitigated	**M**	**M**	**M**	**M**	**H**	**M**
Significance of Consequence		Mitigations to reduce noise levels measured at receptors will be necessary.				
Prevention		Noise creation cannot be prevented and will occur and should be mitigated. Additional traffic planned on the road for hauling product cannot be avoided.				
Mitigation Action		There are industrial standards to which the noise sources (i.e. machinery) must comply. Regular maintenance of machinery should ensure the acceptable noise levels for operators working with the machines. It is not clear whether this will produce the accepted rural standard at the homesteads. It is recommended that any complaints regarding noise be recorded and included in the environmental reports. Should complaints persist then a survey by a suitably qualified and independent occupational hygienist will be required. Shields which deflect the noise away from receptors may reduce the decibels to within the rural standards. The placement of stockpiles and buildings will also play a role to ensure sources of noise are not directly in line with the farm homestead. Transportation routes should be planned for trucks such that they pass noise sensitive receivers at appropriate times. A restriction of the hours of movement, e.g. not allowing the transport of material during the noise sensitive hours of the night can mitigate noise impacts. The frequency (distance between trucks can also be planned to fall within a limited period.					

Mitigation	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Mitigated	**L**	**M**	**M**	**L**	**L**	**L**
Significance of Consequence		The normal maintenance may reduce the probability of noise marginally. Should the shielding of noise sources keep the noise measured at the receptors to within the limits then the significance could drop to low.				
Confidence Level		The EAP is confident that the mitigations will result in lowering the impact significance. A good monitoring system will enable the mine to document the facts and respond accordingly by enhancing any noise reduction strategies.				
Monitoring		A mechanism to monitor noise levels, record and respond to complaints and mitigate impacts should be developed. **Monitoring:** ➢ Keep a register of all complaints received and remediation action taken. ➢ Survey noise levels annually **Performance Indicator:** ➢ Number of registered complaints ➢ Noise monitoring plan is on file. ➢ Record all information in a biannual report.				

Table 3. Health & Safety Management Programme – a. Noise and Vibration Effects on Personnel

<table>
<tr><th>Impact Event</th><th colspan="3">The effects of excessive noise and vibration on the health and safety of personnel.</th></tr>
<tr><td>Description</td><td colspan="3">Noise:
Long term exposure to high levels of noise can cause permanent hearing loss. Neither surgery nor a hearing aid can help correct this type of hearing loss.
Short term exposure to loud noise can also cause a temporary change in hearing (your ears may feel stuffed-up) or ringing in your ears (tinnitus). These short-term problems may go away within a few minutes or hours after leaving the noisy area.
Vibration:
Different vibration types are defined as:
Hand-Arm Vibration is defined as mechanical vibration that, when transmitted to the human hand-arm system, entails risks to the health and safety of workers, vascular, bone or joint, neurological or muscular disorders. Whole-Body Vibration is defined as the mechanical vibration that, when transmitted to the whole body, entails risks to the health and safety of workers lower back morbidity and trauma to the spine.</td></tr>
<tr><td>Nature</td><td colspan="3">Negative</td></tr>
<tr><td>Phases</td><td colspan="3">Phases during which sources of noise and vibration could apply are highlighted below; Significance assessment was carried out on the operational phase which presents a long-term risk.</td></tr>
<tr><td>Construction Phase</td><td>Operational Phase</td><td>Decommissioning Phase</td><td>Post Closure</td></tr>
<tr><td>Crushers & screens</td><td>Rock Cutters, Crushers & screens</td><td>Dismantling crushers & screens</td><td rowspan="5">Background or baseline levels will most likely become prevalent again immediately after closure. Personnel no longer on site.</td></tr>
<tr><td>Conveyor construction</td><td>Conveyor functioning</td><td>Dismantling conveyors</td></tr>
<tr><td>Vehicles on road network</td><td>Vehicles on road network</td><td rowspan="2">Demolishing buildings</td></tr>
<tr><td rowspan="2">Building construction</td><td>Drilling & blasting</td></tr>
<tr><td>Ore haulage from quarry pit</td><td>Constructing fences</td></tr>
<tr><td>Severity</td><td colspan="3">Substantial deterioration (permanent damage to spine from vibration or hearing). Recommended level will often be violated. Personnel potentially unable to work any longer.</td></tr>
</table>

Duration		Permanent. Beyond closure. Long term.				
Spatial Scale		Localised - Within the site boundary.				
Probability		Definite and continuous				
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Unmitigated	**M**	**M**	**L**	**M**	**M**	**M**
Significance of Consequence		Mitigations to reduce noise levels and exposure to vibrations for personnel are imperative.				
Prevention		Engineering controls that reduce sound exposure levels are available and technologically feasible for most noise sources. Engineering controls involve modifying or replacing equipment or making related physical changes at the noise source or along the transmission path to reduce the noise level at the worker's ear. The same goes for vibration. The following should be considered: ➢ Choose low-noise tools and machinery. ➢ Maintain and lubricate machinery and equipment (e.g. oil bearings). ➢ Enclose or isolate the noise source.				
Mitigation Action		**Noise:** The **Occupational Safety and Health Administration** (OSHA) guidelines set legal limits on noise exposure in the workplace. These limits are based on a worker's time weighted average over an 8 hour day. With noise, OSHA's **permissible exposure limit** (PEL) is 90dBA for all workers for an 8 hour day. The OSHA standard uses a 5dBA exchange rate. This means that when the noise level is increased by 5dBA, the amount of time a person can be exposed to a certain noise level to receive the same dose is cut in half. The WHO guideline on maximum noise levels to prevent hearing impairment set noise level limits at an average of 70 da over a 24-hour period with maximum noise levels not exceeding 110 dBA during the period. These limits would apply if the day-time shift is prolonged beyond the 8-hour day. **Mitigation actions include:** ➢ Limiting the amount of time, a person spends at a noise source. ➢ Providing quiet areas where workers can gain relief from noise sources. ➢ Where possible, restricting worker presence to a suitable distance away from noisy equipment. (Controlling noise exposure through distance is often an effective, yet simple and inexpensive administrative control.)				

		➢ In open space, the further the distance from the source of noise, the worker may experience a decrease in noise levels to be about 6dBA less for every doubling of the distance (nonlinear relationship). ➢ Hearing protection devices, specifically earmuffs for long periods of exposure near sources and always use plugs for all places outside offices within the claims not near noise sources for extended periods ➢ PPE is considered an acceptable mitigation, but a less desirable option to control exposures to noise. ➢ Entrance and exit medicals to test hearing should be carried out as a minimum requirement. **Vibration:** Meet industry vibration regulations; set daily exposure limit values and action values for both hand-arm and whole-body vibration for eight-hour shifts. Personnel can work shorter shifts where excessive vibration conditions exist.				
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Mitigated	**L**	**M**	**L**	**L**	**L**	**L**
Significance of Consequence		If all the mitigations listed are used then the significance of the impact will be maintained at low.				
Confidence Level		The EAP is confident that the mitigations will result in low significance. A good monitoring system will enable the mine to document the facts and respond accordingly by enhancing any noise and vibration reduction strategies. Continuous training of personnel is imperative				
Monitoring		A mechanism to monitor noise levels, record and respond to health-related complaints of personnel and mitigate impacts appropriately. **Monitoring:** ➢ Record all health-related incidents ➢ Survey noise and vibration levels annually **Performance Indicator:** ➢ Number of registered health complaints/incidences ➢ Occupational health policy is on file ➢ Monitoring plan is on file. Record all information in a biannual report.				

Table 4. Health & Safety Management Programme – b. General Hazards and Potential Risk of Injury

<table>
<tr><th>Impact Event</th><th colspan="3">Injury risks due to normal working conditions</th></tr>
<tr><td>Description</td><td colspan="3">The potential impacts on human health and safety resulting from activities in any phase could include occupational accidents and injuries, vehicle accidents, exposure to weather extremes, trips and fall on uneven terrain, adverse health effects from dust generation and emissions, and contact with hazardous materials. The potential for these impacts to occur would be low because of the limited range of activities and number of workers required during operations. KNL follows a set of industry-specific safety and health policies in the work place.

Typical operational procedures that pose risks to operational personnel are:
➢ Operating heavy machinery such as, front-end loaders, excavators, and stationary processing equipment.
➢ Operating haulage trucks</td></tr>
<tr><td>Nature</td><td colspan="3">Negative</td></tr>
<tr><td>Phases</td><td colspan="3">Phases and specific activities or equipment during which personnel are exposed to health and safety risks are highlighted below; Significance assessment was carried out on the operational phase which presents a long-term exposure risk.</td></tr>
<tr><td>Construction Phase</td><td>Operational Phase</td><td>Decommissioning Phase</td><td>Post Closure</td></tr>
<tr><td>Rock falls from steep and high cliff faces of quarry pit</td><td>Rock falls from steep and high cliff faces of quarry pit</td><td>Rehabilitation of slopes</td><td rowspan="5">Personnel no longer on site. Public safety ensured through restricted access though quarry pit will remain.</td></tr>
<tr><td>Large mobile plant equipment</td><td>Large mobile plant equipment and product haulage</td><td>Demolishing buildings</td></tr>
<tr><td rowspan="2">Working at heights</td><td>Drilling & blasting</td><td rowspan="2">Constructing fences</td></tr>
<tr><td>Fire and explosion hazards</td></tr>
<tr><td>Severity</td><td colspan="3">Substantial deterioration. Accidents can happen and injuries to personnel may potentially lead to early retirements.</td></tr>
<tr><td>Duration</td><td colspan="3">Permanent. Beyond closure. Long term.</td></tr>
<tr><td>Spatial Scale</td><td colspan="3">Localised - Within the site boundary.</td></tr>
<tr><td>Probability</td><td colspan="3">Definite and continuous</td></tr>
</table>

Mitigation	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Unmitigated	**H**	**H**	**L**	**H**	**H**	**H**
Significance of Consequence		Mitigations to reduce exposure to health and safety risks for personnel are imperative.				
Prevention		The removal of hazards or risks will possibly prevent accidents from occurring. However, it is not possible to remove all risks.				
Mitigation Action		It is not possible to prevent all incidents from occurring completely. An accident is an unplanned incident though it could have been foreseen if the necessary precautions had been taken. Not all hazards can be removed but the risk it presents can be lowered. An integrated health and safety management system acts as a monitoring tool and mitigating tool to reduce the risks. Typical mitigating measures within the health and safety management systems are:- ➢ Draw up operational procedure manuals ➢ Provide health and safety awareness training ➢ Establish practical standard housekeeping rules ➢ Colour code certain areas, equipment and substances to thereby classifying the risks. ➢ Provide signage for personal protective equipment (e.g. protective clothing like safety boots and hard hats) ➢ Institute safe working procedures and require permits to work ➢ Devise and implement emergency response plans ➢ Close coordination with the traffic authorities to ensure road safety signs are strategically placed and ensure all employee drivers are well trained ➢ Provide easy access to Material Safety Data Sheets (MSDS) ➢ Provide first aid treatment and training ➢ Devise emergency medical procedures for all eventualities ➢ Undertake daily safety reminders and/or drills ➢ Establish regulations for handling fuel The MSDS gives health related medical responses for personnel assisting staff who are exposed to the products, i.e. fuels, chemicals, etc. Procedures for dealing with injuries or accidents must be in place and all contact details for emergency personnel must be available. This list is not comprehensive and could be supplemented substantially by the Health & Safety Manager				

Mitigation	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Mitigated	**L**	**L**	**L**	**L**	**L**	**L**
Significance of Consequence		If all the mitigations listed are implemented, then the significance will be maintained at low.				
Confidence Level		The EAP is quite confident that the mitigations will result in low significance. Continuous training of personnel is imperative.				
Monitoring		**Planning:** ➢ A register of all incidents must be maintained on a daily basis. This should include measures taken to ensure that incidents do not repeat themselves. ➢ An Emergency Response Plan should be developed. **Construction and Operations:** ➢ Monitoring reports on file ➢ Non-compliances reported and on file ➢ Operators certificates on file ➢ Schedule of road maintenance on file ➢ A register must be maintained of all training provided to staff. ➢ A register must be maintained for all safety equipment and medical supplies kept on site. This should include date of purchase and date of service/replacement for items that can expire or deteriorate with age. ➢ A register of all incidents must be maintained on a daily basis. This should include measures taken to ensure that incidents do not repeat themselves. ➢ File any incident reports. ➢ Include all monitoring information in the biannual environmental report. **Mine Closure:** At the time of mine closure and abandonment the contractor must rehabilitate the mine site to the state agreed upon at the start of the agreement. Comparisons with the baseline report drafted at the start of the relationship must be made. ➢ Removal of **contractor's** movable assets i.e., plant equipment ➢ Demolishment of **contractor's** fixed immovable assets ➢ Removal of this demolished plant and building rubble by **contractor**				

	➢ **contractor** to fence off dangerously deep pits or holes in the ground that poses a threat to the public safety ➢ In accordance with the rehabilitation plan the steep side slopes may need to be blasted to change angle of repose. ➢ The **proponent** is to fulfil the same rehabilitation tasks as above for all the accessory works area, including infrastructure, pits and holes etc.

Table 5. Health impact due to exposure to radioactive particulates + normal working conditions

Impact Event	**Disease or normal health risks due to normal working conditions and in particular to exposure to radioactive particulates**
Description	The potential impacts on human health and safety resulting from activities in any phase could include occupational accidents and injuries, vehicle accidents, exposure to weather extremes, trips and fall on uneven terrain, adverse health effects from dust generation and emissions, and contact with hazardous materials. The potential for these impacts to occur would be low because of the limited range of activities and number of workers required during operations. The proponent and his operational mining company follows a set of industry-specific safety and health policies in the workplace. Typical operational procedures that pose risks to operational personnel are: ➢ Operating heavy machinery such as, front-end loaders, excavators, conveyors, crushers and sieves ➢ Operating haulage trucks ➢ Prolonged proximity to and exposure to radioactive particulates The REE ore and REE product concentrate is potentially hazardous because of the radioactive nature of the thorium at higher concentrations. Through the processing of the REE ore the thorium element is expected to concentrate and as a result increase the risk of radioactive emissions. Working at the mine's quarries and processing plant could increase the exposure to this risk. The risks associated with exposure to radioactive materials is increased by three factors. Namely, the proximity to the source, the period spent on any one occasion near to the source and thirdly the frequency with which you are exposed over a long period of time. These factors affect the potential with which the radiation can cause sickness and or death. Radioactive exposure can be through inhalation, oral, dermal contact or close to the source without contact. The effects can be carcinogenic in nature and can eventually lead to death.
Nature	Negative
Phases	Phases and specific activities or equipment during which personnel are exposed to health and safety risks will apply are highlighted below; Significance assessment was carried out on the operational phase which represents the period personnel are exposed to the hazard.

<table>
<tr><th colspan="2">Construction Phase</th><th colspan="2">Operational Phase</th><th colspan="2">Decommissioning Phase</th><th colspan="2">Post Closure</th></tr>
<tr><td colspan="2">Processing plant construction site</td><td colspan="2">Processing plant operations, product storage and handling, and transport of concentrate</td><td colspan="2">Dismantling processing plant and handling ‘radioactive contaminated materials’</td><td colspan="2" rowspan="5">Personnel no longer on site. Public safety ensured through restricted access though quarry pit will remain.</td></tr>
<tr><td colspan="2">Rock falls from steep and high cliff faces of quarry pit</td><td colspan="2">Rock falls from steep and high cliff faces of quarry pit</td><td colspan="2">Rehabilitation of slopes</td></tr>
<tr><td colspan="2">Large mobile plant equipment</td><td colspan="2">Large mobile plant equipment and product haulage</td><td colspan="2">Demolishing buildings</td></tr>
<tr><td colspan="2" rowspan="2">Working at heights</td><td colspan="2">Drilling & blasting</td><td colspan="2" rowspan="2">Constructing fences</td></tr>
<tr><td colspan="2">Fire and explosion hazards</td></tr>
<tr><td colspan="2">Severity</td><td colspan="6">Substantial deterioration. Recommended level will often be violated. Personnel potentially unable to work because the maximum exposures for the month or or year have been met. Some personnel may need to work at less risky sites at the mine for the remainder of the period (a month or a year)</td></tr>
<tr><td colspan="2">Duration</td><td colspan="6">Permanent. Beyond closure. Long term.</td></tr>
<tr><td colspan="2">Spatial Scale</td><td colspan="6">Localised - Within the site boundary. During transportation (lowest risk to public) and temporary storage at Walvis Bay Harbour</td></tr>
<tr><td colspan="2">Probability</td><td colspan="6">Definite and continuous</td></tr>
<tr><th>Mitigation</th><th>Severity</th><th>Duration</th><th>Spatial Scale</th><th>Consequence</th><th>Probability of Occurrence</th><th>Significance</th></tr>
<tr><td>Unmitigated</td><td>H</td><td>H</td><td>L</td><td>H</td><td>H</td><td>H</td></tr>
<tr><td colspan="2">Significance of Consequence</td><td colspan="6">Mitigations to reduce exposure to health and safety risks for personnel are imperative.</td></tr>
<tr><td colspan="2">Prevention</td><td colspan="6">The removal of all hazards or risks will not be possible.</td></tr>
<tr><td colspan="2">Mitigation Action</td><td colspan="6">It is not possible to prevent all incidents from occurring completely. An accident is an unplanned incident though it could have been foreseen if the necessary precautions had been taken. Not all hazards can be removed but the risk it presents can be lowered. An integrated health and safety management system acts as a monitoring tool and mitigating tool to reduce the risks. This section should be read in conjunction with and supplemented</td></tr>
</table>

	by the **Radiation Management Plan**. Typical mitigating measures within the health and safety management systems are- ➢ Draw up operational procedure manuals ➢ Provide health and safety awareness and radiation training ➢ Establish practical standard housekeeping rules ➢ Colour code certain areas, equipment and substances to thereby classifying the risks. ➢ Provide signage for personal protective equipment (e.g. protective clothing like safety boots and hard hats) ➢ Institute safe working procedures and require permits to work ➢ Devise and implement emergency response plans ➢ Close coordination with the traffic authorities to ensure road safety signs are strategically placed and ensure all employee drivers are well trained ➢ Provide easy access to Material Safety Data Sheets (MSDS) ➢ Provide first aid treatment and training ➢ Devise emergency medical procedures for all eventualities ➢ Undertake daily safety reminders and/or drills ➢ Establish regulations for handling fuel The Fuel storage and handling MSDS gives health related medical responses for personnel assisting staff who are exposed to the fuels. Procedures for dealing with injuries or accidents must be in place and all contact details for emergency personnel must be available. This list is not comprehensive and could be supplemented substantially by the Health & Safety Manager With respect to radiation exposure the following mitigations and monitoring are either mandatory by law or recommended: ➢ Annual medical assessment – apart from the normal checks, employees' white blood cell count could be tested to assess the potential effect of radiation exposure. ➢ Personnel working in the higher risk area should wear a passive sensor that can be analysed at the laboratory to provide monthly records of radiation exposure; ➢ PPE – dust masks are worn by all employees exposed to dust. The type used is FFP3; ➢ Ideally the higher risk ground surfaces should be watered or chemically bound to supress dust billowing; ➢ Ideally at transfer points on conveyor belts and at crusher bins mist sprays should be installed; ➢ The networks of dust fall-out sampling points should be in place and monitoring results direct further decisions for planning

		mitigation depending on the spatial extent of any high levels of atmospheric radioactive particulates. ➢ Devices for monitoring the radiation emitted from all potential sources must be purchased and a regular monitoring programme be carried out and records kept for reporting purposes. A procedure manual must be drafted that is based on the industry standards and laws and regulations that are implemented by the MME and Ministry of Labour.				
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Mitigated	**L**	**L**	**L**	**L**	**L**	**L**
Significance of Consequence		If all the mitigations listed are implemented, then the significance will be maintained at low.				
Confidence Level		The EAP is quite confident that the mitigations will result in low significance. It is imperative that continuous training and medical monitoring of personnel at the regionally (SADC region) recommended frequency. The regionally (SADC region) accepted levels of radiation exposure must be monitored and maintained. The only point where mitigation may be insufficient is with dust suppression due to the measures in place for limiting water use				
Monitoring		With respect to radiation exposure the following monitoring are either mandatory by law or recommended: ➢ Annual medical assessment – apart from the normal checks, employees' white blood cell count could be tested to assess the potential effect of radiation exposure. ➢ Personnel working in the higher risk area should wear a passive sensor that can be analysed at the laboratory to provide monthly records of radiation exposure; ➢ PPE – dust masks are worn by all employees exposed to dust. The type used is FFP3; ➢ Ideally the higher risk ground surfaces should be watered or chemically bound to supress dust billowing; ➢ Ideally at transfer points on conveyor belts and at crusher bins mist sprays should be installed; ➢ The networks of dust fall-out sampling points should be in place and monitoring results direct further decisions for planning mitigation depending on the spatial extent of any high levels of atmospheric radioactive particulates. Devices for monitoring the radiation emitted from all potential sources must be purchased and a regular monitoring programme be carried out and records kept for reporting purposes. A procedure manual must be				

	drafted that is based on the industry standards and laws and regulations that are implemented by the MIME and Ministry of Labour

Table 6. Visual Impact Management Programme

Impact Event	**Changes to the aesthetic appeal of the area due to presence of people, vehicles and machinery. Visible changes to habitats due to human activities.**		
Description	The experience of enjoying the landscape free of human activities is considered highly desirable. Intrusions into the current scenery may be unwelcomed. The mine site is remote and no main tourism routes pass through this valley. Residents within a 5 km radius are few. Impact on visual resources would be considered unfavourable if the landscape was significantly degraded or modified. The presence of mine personnel, vehicles and other equipment may reduce the aesthetic appeal of the area. The position of WRDs are key issues with regards this impact. The new site is not visible to the people staying in Oroutumba. Also, the new quarries will not be visible to residents or tourists.		
Nature	Negative		
Phases	Phases during which traffic, infrastructure and dust plumes which potentially play a role in visual nuisances are highlighted below; Significance assessment was carried out on the operational phase which presents the long-term risk.		
Construction Phase	**Operational Phase**	**Decommissioning Phase**	**Post Closure**
Additional traffic on the district road and mine access roads	Ore haulage and blasting creating dust plumes	Denuded mountain slopes and open quarry not revegetated	Barren mountain slopes and quarry scarring
Dust plumes caused by mobile equipment operating at the mine	Bare slopes, waste rock dumps, topsoil stockpiles	Demolishing buildings causing dust plumes	
Severity	Moderate / measurable deterioration. Recommended level will occasionally be violated. Widespread complaints. Noticeable loss of resources. It is a remote area off the main tourism route. Only 26 residents stay within 500m of the new processing area.		
Duration	Reversible over time. Life of the project. Medium term (Except for the quarries which will remain visible for the long term.		
Spatial Scale	Fairly widespread – Beyond the site boundary. Localised at best. Though this does depend on mobility of particles and prevailing weather conditions. The setting is rural, and the only receptors currently are a few residents (26 at the time of the social survey).		

Probability		Definite (in terms of dust plume creation from blasting) and continuous (in terms of the barren mountain slopes until revegetated during post closure)				
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Unmitigated	**M**	**M**	**M**	**M**	**M**	**M**
Significance of Consequence		The two aspects for visual impact are under consideration: ➢ Unless it is mitigated the generation of dust should have a moderate influence on the decision to carry out the activity or not. However, natural weather conditions can also create very dusty atmospheric conditions. The mining and processing activities on site will contribute to local atmospheric dust levels and will potentially affect the visual experience of the people staying nearby. Those communities staying along the transport route are affected by other road users too, so this aspect is a cumulative impact. This latter aspect is considered a minor aspect and temporary in nature. The nearby residents (26) could be relocated to a more favourable location. ➢ The aesthetic changes to the landscape can be mitigated for all phases of the mining project. Alternatives have been considered which will reduce the visual impact of the mine on any who pass through the area.				
Prevention		➢ Dust creation cannot be prevented completely. Water is normally used to suppress dust on the roads. Blasting will be intermittent, and the plume will dissipate fairly rapidly. ➢ The bare slopes cannot be avoided in the medium term and the quarries will be a permanent feature of the mining area. ➢ For operations to continue, personnel, vehicles and machinery will operate within the area for the duration of the project. It is not possible to operate and have no visual presence.				
Mitigation Action		Best practice methodologies for operations will be employed. These may include the following: ➢ Existing roads and tracks are used to access the mine site. ➢ Dust suppression using water will most likely not be practical due to the non-sustainability of ground water usage. ➢ Product transport should either be containerised or at least installed with covers. ➢ Careful planning to avoid disturbing significant floral and faunal habitats when accessing the mining site ➢ Training personnel regarding the visible signs of faunal and floral biodiversity and the avoidance of habitat disturbance. ➢ Minimise the footprint of personnel, vehicles and machinery				

	➢ Rehabilitate habitats through the removal of obvious signs of human presence. ➢ Regular removal of waste (daily/weekly/monthly) and disposal of waste in the appropriate manner. ➢ Removal of machinery from the mining sites if periods of inactivity are prolonged. ➢ If lighting is required at night, lights need to be strictly controlled and fixtures should be low-glare lighting with downward facing directed beams (except for quarry walls) ➢ Constructed structures should have natural colours so that they can blend in with the surrounding environment. Often, the sites that are disturbed and rehabilitated at least from an aesthetic perspective will in time be recolonized by both plants and animals. The aim is to minimise the footprint so as to achieve the least impact due to anthropogenic influence. With respect to this the following has been considered: ➢ A reduction in the size or number of the WRDs. ➢ Location and design of WRDs to make them inobtrusive. ➢ Landscaping of quarry sites to reduce visual impact.

Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Mitigated	**L**	**M**	**L**	**L**	**L**	**L**

Significance of Consequence	The dust suppression techniques if applied diligently and consistently will result in a medium significance visual impact for the residents in the immediate vicinity because dust from heavy traffic on the main dirt road will not be mitigated except by reducing travelling speeds. Additionally, the visual alteration of the mountain slopes cannot be mitigated until mine closure when at that time the quarry will remain a visual reminder of the once active mine.
Confidence Level	High, provided management implements the mitigation action and the company provides the necessary financial support to implement the changes required. A commitment to rehabilitating the denuded slopes and waste rock dump with the stockpiled topsoil will need to be done where practical and necessary.
Monitoring	**Planning:** Visual baseline in the form of a photo survey should be undertaken. **Construction:** ➢ Carry out audits and report findings. ➢ Keep a visitors' log.

	➢ Maintain existing access road. **Operation:** ➢ Visual baseline (2nd) in the form of a photo survey should be undertaken. ➢ Enforce strict rules on the use of lighting by personnel on site. **Decommissioning:** ➢ Requirements for restricting or prohibiting access to the abandoned mine are implemented and records on file. ➢ Final visual baseline (3rd) in the form of a photo survey should be undertaken. A visual audit can be done prior to closure so that a landscaping plan can be drawn up for incorporation into the closure plan.

Table 7. Stakeholder Communication Management Programme: a. land use conflicts

Impact Event	**Herders could potentially experience restrictions to their grazing areas**		
Description	The mining area is situated on land belonging to the government of Namibia granted to rural people in the form of communal land. The mining areas fall within the Kunene River Conservancy. The mining area falls within the Epupa Constituency but falls under the stewardship of Okangwati's rural constituency councillor. The community has grazing rights to the area. The leaders of the community request that the area is kept safe for shepherd boys and their livestock. The pits may need to be fenced off to insure, the public safety. The community has many needs, and request was made that the proponent consider social responsibility projects to uplift the community. Initially, the well in the Ondoto river will be shared as it has been since the sodalite mining began decades ago.		
Nature	Negative		
Phases	Phases during which potential conflicts may apply are highlighted below; Significance assessment was carried out on the operational phase. However, the long-term presence of quarries pose a safety risk. This is included in the assessment.		
Construction Phase	**Operational Phase**	**Decommissioning Phase**	**Post Closure**
Access to site	Access to site	Access to site	Access to site
Access to groundwater resources / boreholes	Access to groundwater resources / boreholes	Access to groundwater resources / boreholes	Public safety
Public safety	Public safety	Public safety	Alternative uses for pit
Asset security	Asset security	Asset security	
Waste management	Waste management	Waste management	
Severity	Moderate / measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints. Noticeable loss of resources. Herders' area for grazing will be reduced marginally. Public safety must prevail, and access must be temporarily prohibited during blasting.		
Duration	Reversible over time. Life of the project. Medium term (except quarry which is long term)		
Spatial Scale	Localised. Within accessory works area and 500m boundaries around the quarries.		

Probability		Definite / continuous				
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Unmitigated	**M**	**M**	**L**	**M**	**H**	**M**
Significance of Consequence		Mitigations to ensure no conflicts with landowners occur will be necessary.				
Prevention		It is not possible to prevent all conflicts. Any unforeseen issues will be mitigated through the various mechanisms stipulated in the EMP				
Mitigation Action		The EMA requires that permission be provided by the competent authorities for the listed activity. The EIA has facilitated a transparent process by which concerns were raised. The PPP has ensured that all stakeholders have been informed. The proponent is subservient to the conditions laid down by the guidelines / conditions and the law that upholds it. The implementation of the mining programme will be in accordance with the approved Environmental Management Plan (EMP). The following mechanisms should be included in the environmental management system: ➢ Correspondence and agreements - document filing system ➢ Review memoranda of understanding annually ➢ Keep complaints register up to date ➢ Update stakeholder register regularly ➢ Engage land users regularly to maintain open channels of communication ➢ Fence off mining areas to increase public safety where necessary The Life of Mine is predicted to be 25 years. This represents a medium period compared to other larger mining operations at other mine sites. Depending on the management approach and decisions to allow access to grazing during no blasting periods and land markers or fences restricting access for safety and security the footprint and impact on normal usage of the area could be kept to a minimum thereby keeping the spatial extent localised.				
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Mitigated	**L**	**M**	**L**	**L**	**L**	**L**
Significance of Consequence		Maintaining good relationships with landowners is imperative so that the severity and duration of disputes can be kept low. This will ensure the probability is low.				

Confidence Level	I am confident that a well-designed and well implemented stakeholder engagement programme will cover the land use conflicts that could potentially arise.
Monitoring	The following mechanisms should be included in the environmental management system as monitoring tools and performance indicators: ➢ Correspondence and agreements - document filing system ➢ Review any memoranda of understanding annually ➢ Keep complaints register up to date ➢ Update stakeholders register regularly ➢ Fence off mining areas to increase public safety

Table 8. Stakeholder Communication Management Programme: b. socio economic impact

Impact Event		**Positive aspect of sustaining employment in the sector.**				
Description		The operations to be carried out on the five MCs are expected to employ about 50 (including haulage truck drivers) personnel of the contractor to manage the excavation, crushing, milling, screening and transportation processes. A security team of up to 3 personnel can also be employed. Herders use the area for grazing their livestock. The negative social impact is deemed negligible and the positive aspects of the mine on the economic benefits outweigh any negative aspects.				
Nature		Positive				
Phases		Phases during which mining activities may contribute to the local economy are highlighted below; The significance assessment was carried out on the operational phase which represents the longest term when benefits are greater.				
Construction Phase		**Operational Phase**		**Decommissioning Phase**	**Post Closure**	
Construction personnel		Operational personnel		Demolition personnel	No employment	
Security personnel		Security personnel		Security personnel		
Support services		Support services		Support services		
Severity		Substantial improvement. Will be within or better than the recommended level. Favourable publicity.				
Duration		Reversible over time. Life of the project. Medium term				
Spatial Scale		Fairly widespread – Beyond the site boundary. Local				
Probability		Possible/ frequent				
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Unmitigated	**M+**	**M+**	**M+**	**M+**	**M+**	**M+**
Significance of Consequence		A medium positive significance is expected.				
Prevention		Economic benefits could be prevented locally if no residents are employed and all materials and equipment is imported from other towns in the region and beyond.				

		Actions that will prevent the positive impact of employment creation for this project would be the no go alternative due to either a fatal flaw from socio-economic or biodiversity impacts being of high significance. Retrenchment of permanently employed can be avoided by diversifying the business options in the construction industry.				
Mitigation Action		Where possible personnel should be hired from the local resident pool. At least this should apply to the unskilled vacancies. The company could start social responsibility projects to uplift the areas health and educational needs.				
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Mitigated	**M+**	**M+**	**M+**	**M+**	**H+**	**M+**
Significance of Consequence		A medium positive significance is expected.				
Confidence Level		Provided local residents are hired then one can be more confident in achieving the medium significance. Through meaningful permanent employment economic development can be secured for all concerned.				
Monitoring		Provided local residents are hired then one can be more confident in achieving the medium significance. Through meaningful permanent employment economic development can be secured for all concerned. Include the employee statistics in the annual audit showing long term trends. Company annual production report. Ensure upgraded skills of employees during employment at mine is documented and accredited where possible so that skills are recognised with future employers.				

Table 9. Stakeholder Communication Management Programme: c. heritage related impact

Impact Event		**Heritage related impacts.**				
Description		Kaokoland is a special place and it is recognised for its world heritage and for the people who continue to live off the land there. It is expected that the area has important sites of national importance from a historical and pre-historic perspective. The siting of graves, ritual sites, middens and other such important heritage aspects within the mining area could mean that specific areas within the mining claims need to be kept pristine for further study If these sites were damaged in any way it would be considered a heritage impact and depending on the importance of the site result in a great loss were it damaged by mining.				
Nature		Negative				
Phases		Phases during which the significance assessment was carried out is highlighted in green. It is the various personnel who could potential come across as yet to be documented find.				
Construction Phase		**Operational Phase**		**Decommissioning Phase**		**Post Closure**
Construction personnel		Operational personnel				
Security personnel		Security personnel				
Residents		Residents				
Severity		undetermined as yet				
Duration		Not reversible over time. long term				
Spatial Scale		Localised to within the mining claims.				
Probability		Possible because no records known to proponent				
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Unmitigated	**H**	**H**	**L**	**H**	**L**	**M**
Significance of Consequence		A medium significance is expected.				
Prevention		Well trained staff who know what to look for during the construction and operational phases could prevent any destruction of important sites.				

Mitigation Action		Undertake a survey of the area with the help of local leaders to identify any place of importance before any construction starts. The completed report is found in **Appendix G.** Submit the survey report and apply for the necessary clearance from the Heritage Council to be able to start construction on the planned site. Should anything come up during construction or operations then work should stop and the police should be informed. A member of the heritage council would need to assess the importance of the find and provide the necessary permission to continue with works at that specific site.				
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Mitigated	**L**	**H**	**L**	**M**	**L**	**L**
Significance of Consequence		A low significance is expected.				
Confidence Level		Provided all personnel are trained in the procedure of chance finds the destruction of anything important could be prevented.				
Monitoring		Clearance from the heritage council is on file. Include any chance findings in the bi-annual report.				

Table 10. Waste Management Programme

Impact Event	**Waste Production**
Description	Waste is generated during the construction, operational and decommissioning phases of the mine's life. Waste can be classified into mineralised and non-mineralised waste. Non-mineralised waste can be classified as non-hazardous and hazardous waste. Medical waste is an additional category. 1. **Non-Hazardous non-Mineralised includes:** Metal cut offs, rubber, wood, product packaging, organic materials, glass, plastics, food scraps, cardboard/paper, used PPE, etc. 2. **Hazardous non-mineralised:** Printer cartridges, sewerage, batteries, hydrocarbons (oils, grease), fluorescent, etc. 3. **Medical waste:** Syringes, material with blood stains, bandages, etc. 4. **Mineral waste includes:** waste rock, tailings from mineral processing, rejects from beneficiation or concentration of other minerals, refinery or processing discards and sludges, smelter and other furnace slags, ashes, etc. (not all apply to this site but provided as examples). In addition to these radioactive waste rock

	or radioactive processed waste must be handled in accordance with the **Radiation Management Plan**.					
Nature	Negative					
Phases	Phases during which waste will be produced are highlighted below; Significance assessment was carried out on the operational phase which presents a long-term risk. Receptors potentially affected by waste are listed.					
Construction Phase	**Operational Phase**	**Decommissioning Phase**	**Post Closure**			
Company personnel health	Company personnel health	Company personnel health	General public health			
General public health	General public health	General public health	Groundwater			
Groundwater	Groundwater	Groundwater	Biodiversity			
Biodiversity	Biodiversity	Biodiversity	Soil			
Soil	Soil	Soil	Atmosphere - dust and other volatiles emitted from waste are covered under air quality impacts but there is some overlap with waste management risks			
Atmosphere	Atmosphere	Atmosphere				
Severity	Moderate / measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints. Noticeable loss of resources.					
Duration	Reversible over time. Life of the project. Medium term					
Spatial Scale	Fairly widespread – Beyond the site boundary. Localised at best.					
Probability	Definite / continuous					
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Unmitigated	**M**	**M**	**M**	**M**	**H**	**M**
Significance of Consequence	The mining activities will generate waste. Preventative and Mitigating mechanisms are imperative.					
Prevention	Some waste products of categories 1-3 that can potentially impact the listed receptors can be managed to prevent impacts. Actions and company commitments that can prevent the impacts include the following:					

	➢ A waste management procedure should cover recycling, re-use, storage, handling, transportation, and disposal ➢ Collection and disposal of waste must be effective enough to not impact any of the receptors ➢ If waste must be stored and separated on site then the activities must take place on sealed surfaces, within bunds and fenced areas, and made ready for transport off-site by packaging the waste in sealed containers
Mitigation Action	Where waste product impacts on the receptors cannot be prevented the preventative measures above should still be employed to mitigate or reduce the impacts. Mitigations for the various receptors include the following: ➢ Personal protection equipment (PPE) can protect personnel from exposure to disease or toxic chemicals ➢ Awareness training for company personnel and the general public will inform them of those wastes that may cause harm, pollute the soil, groundwater or air (if particulate) ➢ Some wastes are dangerous to fauna and flora; Animals should not be able to access the waste management area; waste must be contained so that it cannot enter the naturally vegetated areas beyond the accessory works area. ➢ Containerisation of highly volatile wastes should be actioned to reduce emissions but not so effectively that creates explosive risks if pressures build up. The latter may occur if the containers are stored outside in the heat of the sun. A waste management programme as outlined in the EMP should keep records in the form of an inventory of waste products collected, sorted, stored, recycled, reused or disposed. Certificates for disposal of hazardous waste should be filed. The mineral waste (category 4 above) will most likely only be waste rock and process tailings that cannot be processed for product. This waste rock will be dumped or stockpiled on site or alongside the new processing plant on ML 40 and could be used in the rehabilitation during decommissioning phase. The health risks associated with the process tailings is discussed under the health impacts above. Sewerage created at the camp or management offices either needs to be deposited directly into approved and permitted French drains or removed offsite. If the latter is to be done then sealed sewerage tanks are required. The regulations under the Water Resource Management Act need to be consulted with regards to the erection of French drains near water courses. They cannot to be constructed within 100m of the banks of a water course. Storage of hazardous liquid waste must by law follow industry standards. These standards will be communicated in fuller details by the fuel supplier. Ideally, self bunded containers should be brought to site and placed upon sealed surfaces with waste collection sumps. Fuel collection should be carried out upon the same sealed surface with slopes for runoff into the sumps. At the mining claim itself a similar bunded surface must be

	constructed where fuel from a bowser can be transferred to the mobile plant. An oil water separator and wash bay could be constructed in conjunction with fuel dispensing to reduce costs and the concretised footprint. Regardless of this the oil water separator is a requirement to ensure hydrocarbons do not enter the environment indiscriminately. The mobile plant workshop also needs to be constructed on a sealed surface and have liquid waste sumps so that spills can be collected and removed from site on a regular basis. A sealed waste oil contain should be constructed at the vehicle workshop. Regular removal of oil to recyclers is advised. All hazardous liquid waste should be stored on sealed surfaces.
Rehabilitation	If the mitigation hierarchy is followed, rehabilitation may or may not be required. Should an accident occur during the process of collection, storage or disposal of waste and no mitigation be actioned then one of the receptors may be impacted. Consequently, the following examples of rehabilitation may be required: ➢ A person who is exposed to disease (bacteria from organic waste) or toxic waste (mineral or non-mineral), which results in harm, will need medical attention ➢ Soil which is contaminated by used hydrocarbons needs to be relocated to a remediation cell where the material after treatment, i.e. the addition of fertiliser, air and water will within a year be suitable for re-use. ➢ In the event of groundwater contamination by chemicals or hydrocarbons, the sinking of a borehole or the excavation of a pit in the vicinity of the contaminate source will allow the pumping of the groundwater into a holding dam. Through the continued pumping a cone of depression will draw the contaminated water towards the pump. The collected contaminated water can be discarded at a registered hazardous waste site or if separable the contaminant can be removed from the water before disposal. The reclaimed water could be pumped back in the pit or borehole.

Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Mitigated	**L**	**M**	**L**	**L**	**L**	**L**

Significance of Consequence	If the mitigation hierarchy is followed through to rehabilitation, then the resultant consequence could be insignificant.
Confidence Level	A well designed and well implemented waste management programme will provide the necessary confidence that the risks to receptors will be of low significance.
Monitoring	**Planning:** ➢ Waste Management Plan on file.

	➢ Accessory works application submitted and receipt kept on file. ➢ Accessory works plan on file. ➢ Application for effluent discharge submitted to competent authority and receipt on file. ➢ Maintenance plan on file. **Construction:** ➢ Monitor compliance and file report. ➢ Hazardous waste certificate from hazardous waste dump on file. **Operations:** **Monitoring:** ➢ **Regular** inspection of waste collection and disposal areas. ➢ Check and file waste disposal slips. ➢ Compile all monitoring information in an **annual** report and audit this report against the waste management plan. ➢ Emergency Response Plan on file. ➢ Hazardous waste disposal certificate on file. ➢ Monitor maintenance workshop and wash bays for compliance and file reports. **Performance Indicators:** ➢ Availability of plan ➢ Extent to which plan is complied with ➢ Presence of litter within the area and surrounding land ➢ Availability of rubbish bins and skips ➢ Total volume of general and hazardous waste storage capacity ➢ Total volume of general and hazardous waste stored on site ➢ Degree to which different waste is separated ➢ Frequency of waste collection **Decommissioning:** Monitor compliancy and report on file.

Table 11. Ecological Management Programme

Impact Event	**Mining activities may affect biodiversity of fauna and flora directly or through habitat alteration.**
Description	Through mining in general there is potential for impacting the diversity of species within the various habitats by reducing population numbers of certain species. Pressures on the population numbers can potentially lead to a reduction of a population within an area causing the species to no longer exist within that area. Should a species be endemic to that same area then the risk of extinction is high. Habitats can be severely altered potentially changing the type of habitat or leading to the removal of micro habitats. Specialist fauna and flora studies were commissioned for the larger Ondoto project accessory works area and the activities therein. Site visits, species lists for the area and reference to other studies carried out nearby and elsewhere reveal that the habitats, fauna and flora present in the area are not endemic to claim and accessory works area specifically but are either common or potentially rare throughout the Kunene Region. Refer to the chapter on the fauna and flora above and to the specialist study reports in the Appendices. Three habitat types were identified in the vegetation and vertebrate studies for this project and were integrated in one combined floral and faunal classification: Mopane scrub, rocky outcrops and river/drainages. The habitats were rated as to their sensitivity, with the caveat that all habitats are sensitive to disturbance and deserving of conservation measures. A sensitivity rating was assigned based on properties of the habitat itself, including: ➢ nationally or regionally scarce habitats ➢ size of habitat, in the context of the total availability of comparable habitats in Namibia and/or the region. ➢ exceptionally high diversity and/or abundance of species ➢ high level of endemism ➢ support to species of conservation concern ➢ key ecological processes ➢ contribution to ecological functions (nutrient and energy flows) ➢ provision of critical resources ➢ restorability after disturbance Human habitation, grazing and mining activities have resulted in modified areas, some of them get severely degraded such as the rocky ridge south of ML40 and the quarry/mine sites on the Mining Claims. The village Oroutumba, located downstream in Mopane scrub habitat adjacent to the Ondoto River, also constitutes an anthropologically modified area.

	The assessment considered all project activities and how these could potentially impact the various habitats. **Fauna:** A key habitat in the larger woodland mosaic is the rocky outcrops habitat. The physical diversity of the hills and rocky ridges leads to a higher and more specialised biodiversity than the surrounding Mopane woodland, and it supports many species that would otherwise not be present. Seeing as mineral-bearing ore is located almost exclusively in the rocky ridges, restoration of this habitat after mining operations will not be possible to any meaningful extent. Riverine habitat has a high ecological value for all taxa, it plays a keystone role in nutrient transport and serves as important source areas for recolonisation after operations cease. In this project footprint, the Ondoto River is considered very sensitive and apart from the proposed linear infrastructure, no development should take place there. In addition, the natural flow patterns in washes and drainages should be maintained, particularly important when designing and constructing a road network and any other linear development. Destruction of organisms and habitats and alteration of topography both have high unmitigated significance, but potentially decrease to medium significance through the application of management measures if those are carried out effectively. The cumulative nature of mining activities in the Kunene Region and in the Kaokoveld Centre of Endemism, the irreversible damage to the rocky outcrops (as the most sensitive, ecologically valuable habitat) and the persistence of the excavations after the lifespan of the mine, are three factors that decrease the likelihood of these impacts being mitigated to low significance. However, the strict implementation of mitigation measures and restoration plan can improve the situation significantly for other habitats and aspects such as the accessory works, linear infrastructure and any staff accommodation areas. **Potential destruction of habitats and organisms** could take place during construction and operations, construction and use of roads by vehicles and machinery, clearing of land, building of infrastructure, within laydown areas, around water tanks, at accommodation, around human activities, during blasting and earthmoving, around vehicle movements, and the operation of machinery. A ccumulative impact of mining in the Kunene Region, especially on ecologically valuable rocky ridges and outcrops as follows: ➢ Death of animals that are struck by earthmoving equipment, vehicles and machinery. Protected and at-risk species such as bat-eared fox, Cape fox, aardwolf and brown hyena are vulnerable to roadkill. ➢ Death of animals due to poaching. ➢ Raptors, bustards and migrating birds are vulnerable to power line impacts such as collision and electrocution. ➢ Bird nests, nesting habitats and feeding habitats are destroyed, affecting the viability of bird populations.

	➢ Mammal and reptile burrows, burrow habitats and feeding habitats are destroyed, affecting the viability of the populations of these taxa. ➢ Parts of territories and home ranges are destroyed. ➢ Loss of plants and decline in habitat quality. ➢ Dust causes a decline in air quality and creates conditions for health decline in plants and animals. ➢ Noise disturbs animals and causes increase in stress. **Potential disturbance of animals and interference with their behaviour** during operations, when infrastructure and roads form obstacles to the directional movement of animals, when an increase in human and vehicle presence and movement results from mining activities, as a result of loud noises caused by blasting and the operation of heavy machinery. The potential impact could be as follows: ➢ Larger mammals and birds are the taxa most likely to be affected. ➢ The loss of migration corridors causes stress and an increased risk of death to various taxa. ➢ Birds and eggs could be poached. ➢ Animals, particularly birds, are disturbed while going about their daily activities, such as feeding, roosting and breeding. ➢ Dust creates conditions for health decline in plants and animals, and an increase in stress for animals. ➢ Noise disturbs the normal behaviour of animals, specifically mammals. **Potential light pollution as result of light sources** that are visible outdoors in the accessory works area and in the mining area. This can impact in the following ways: ➢ Invertebrates that are attracted to the light provide an unnatural food source for taxa such as bats, geckos, nightjars and frogs. These insectivores are attracted to the food and then face conditions where they are more likely to die from causes such as collisions and predation. ➢ Invertebrates could die every night from exhaustion or predation, potentially disrupting their population numbers and causing disturbances in ecological processes. **Alteration of topography** during construction and operational phases can occur because of excavation of the ore bodies leaving a deep, open pit or several smaller quarries on the mountain. This cumulative (for mining in the Kunene Region) impact acts on the level of ecosystems and could result in the following: ➢ Irreversible alteration of the ecologically valuable rocky outcrops. ➢ This impact may affect ecosystem functioning. ➢ Direct destruction of habitat and organisms (see A above).

	➢ Fragmentation of habitat, leading to the loss of migration corridors for various taxa, in turn resulting in the loss of individual organisms and potentially populations. **Groundwater drawdown** - Abstraction of water from the Ondoto River and Kunene for drilling, mining, ore processing and human consumption: ➢ River vegetation is dependent on groundwater to some extent. Of particular concern are woody species in the Ondoto River, e.g. *Acacia erioloba, Faidherbia albida and Ficus spp.* ➢ Deterioration of the river habitat has negative impact on biodiversity outside the boundaries of the project site, specifically the Kunene River. **Contamination of soil and water** - Chemicals used in the processing of ore, e.g. radioactive thorium, escape containment and contaminate the soil, surface and groundwater ➢ Chemicals leach into soil, causing contamination of soil and eventually groundwater. ➢ Effects of chemicals are cumulative and build up in groundwater over time. ➢ Once in the groundwater, there is the potential for contamination to spread beyond site boundaries. The Kunene River is an internationally important ecological feature that could potentially be directly affected. ➢ Birds, mammals and reptiles are attracted by an unnatural source of water (open water body) and either drown or ingest contaminated water. **Impacts associated with accommodation of staff** – During construction, operational and closure phases, vehicles can cause death of organisms, staff could be involved in poaching and plant collection, cooking and lighting practices cause fires, water use in an arid zone with few resources, poor sewerage practices and from cooking and cleaning cause oil spillage. ➢ Direct destruction of organisms and habitat. ➢ Oil spills and sewerage contaminate soil and water. ➢ Fires destroy habitats and cause death of animals. **Flora:** The habitats and flora are either common throughout the Kaokoland and if restricted in distribution or to micro habitats, they do occur outside the planned mining areas. Riverine and drainage habitats present a high ecological value for most taxa and are considered very sensitive. Blocking of surface and/or groundwater flow will result in loss of perennial plant species and a reduction in the resources, such as food, shelter and soil stabilisation for burrows that they represent to other trophic groups. The rocky outcrops present both abundance and richness of plants that are much higher than those of the surrounding scrubland, contributing to the

	ecological value of this habitat. The location of the study area in the foothills of the Zebra Mountains and in the Kaokoveld centre of endemism, a biogeographical region rich in range-restricted plants and animals, further increases the sensitivity of the rocky ridges. Sodalite and the rare earth minerals are located in this habitat; it is where mining will be done and where most of the irreversible impacts (drilling, blasting and open cast mining) will take place. The largest part of the area consists of open Mopane scrubland. The topography is gently undulating, bisected by drainages and ridges topped with rocky outcrops. In the east and southeast of the study area the profile is flatter than in the west and northwest, where there are more and steeper rocky ridges. This habitat has been modified by human activities such as harvesting and livestock grazing. Both these activities are current and ongoing, and the village Oroutumba is in a degraded area in Mopane scrub abutting the Ondoto River. Pipelines, powerlines, roads, and the accessory work area will all be in this habitat. Species are potentially of conservation concern when they are endemic or near endemic to Namibia, have a threatened Namibian or IUCN status, or are legally protected in Namibia. Three recently described species, *Maerua sebrabergensis*, *Erythrococca kaokoensis* and *Ocimum sebrabergensis* are known only from a few specimens collected in the Zebra Mountains but they are likely to be found on the ridges and rocky outcrops in around the area as well. The fact that they were found and described as recently as 2015 and 2019 illustrates both the importance of the Kaokoveld Centre of endemism and how under-collected it is in terms of herbarium specimens. This is largely a result of the remoteness and inaccessibility of much of the region and of the Zebra Mountains specifically. The following potential aspects were assessed: Mining activities may affect the ecology of the flora directly through **habitat alteration or destruction** within the planned mining claim and accessory works area: ➢ Cumulative impact: mining in Kunene Region, especially on ecologically valuable rocky ridges and outcrops. ➢ Loss of plants and decline in habitat quality. ➢ Dust causes a decline in air quality and creates conditions for health decline in plants and animals. **Alteration of topography –** the sources of the impact during the construction and operational phases are from excavation of the orebodies that leave deep open pits caused by drilling, blasting and open cast mining and the use of equipment such as excavators, compressor driven drill rigs and cutting machines. The processing plant and mineral waste is deposited on the cleared ground. ➢ This is a cumulative impact of mining in the Kunene Region. ➢ Irreversible alteration of the ecologically valuable rocky ridges. ➢ This impact may affect ecosystems. ➢ Direct destruction of plants and habitat.

<table>
<tr><td></td><td colspan="3">
Fragmentation of habitat, leading to the disruption or loss of colonisation pathways for seed dispersal, in turn resulting in the loss of individual organisms and potentially populations.
Groundwater drawdown - Abstraction of water from the Ondoto River for drilling, mining, ore processing and human consumption.
River vegetation is dependent on groundwater to some extent. Of particular concern are woody species in the Ondoto River and drainages, e.g. Acacia erioloba, Faidherbia albida and Ficus spp.
Deterioration of the drainage and river habitat has negative impact on biodiversity outside the boundaries of the project site, specifically the Kunene River
Contamination of soil and water - Chemicals used in the processing of ore, e.g. radioactive thorium, escape containment and contaminate the soil, surface and groundwater.
Chemicals leach into soil, causing contamination of soil and eventually groundwater.
Effects of chemicals are cumulative and build up in groundwater over time.
Once in the groundwater, there is the potential for contamination to spread beyond site boundaries. The Kunene River is an internationally important ecological feature that could potentially be directly affected.
</td></tr>
<tr><td>Nature</td><td colspan="3">Negative</td></tr>
<tr><td>Phases</td><td colspan="3">Phases during which mining activities may impact the ecology and biodiversity through habitat alteration or destruction are highlighted below; The significance assessment was carried out on both the construction and operational phases.</td></tr>
<tr><td>Construction Phase</td><td>Operational Phase</td><td>Decommissioning Phase</td><td>Post Closure</td></tr>
<tr><td>Flora</td><td>Flora</td><td>Flora</td><td>Flora</td></tr>
<tr><td>Fauna</td><td>Fauna</td><td>Fauna</td><td>Fauna</td></tr>
<tr><td>Habitat</td><td>Habitat</td><td>Habitat</td><td>Habitat</td></tr>
<tr><td>Species diversity</td><td>Species diversity</td><td>Species diversity</td><td>Species diversity</td></tr>
<tr><td>Severity</td><td colspan="3">Moderate / measurable deterioration. Noticeable loss of resources.</td></tr>
<tr><td>Duration</td><td colspan="3">Permanent, beyond closure, long term.</td></tr>
<tr><td>Spatial Scale</td><td colspan="3">Localised - Within the site boundary for flora but beyond the site boundary for fauna</td></tr>
</table>

Probability		Possible/frequent				
Unmitigated	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Fauna - A. Potential destruction of habitats and organisms						
Fauna A.	**M**	**H**	**M**	**H**	**M**	**H**
Fauna – B. Potential disturbance of animals and interference with their behaviour						
Fauna B.	**M**	**M**	**L**	**M**	**H**	**M**
Fauna – C. Potential light pollution as result of light sources						
Fauna C.	**M**	**M**	**L**	**M**	**H**	**M**
Fauna - D. Alteration of topography						
Fauna D.	**M**	**H**	**M**	**H**	**H**	**H**
Fauna - E. Groundwater drawdown						
Fauna E.	**M**	**M**	**M**	**M**	**M**	**M**
Fauna - F. Contamination of soil and water						
Fauna F.	**M**	**H**	**M**	**H**	**M**	**M**
Fauna - G. Impacts associated with the accommodation of staff						
Fauna G.	**M**	**M**	**M**	**M**	**M**	**M**
Flora – A. Destruction of plant and habitats						
Flora A.	**H**	**H**	**L**	**H**	**H**	**H**
Flora – B. Alteration of Topography						
Flora B.	**M**	**H**	**M**	**H**	**H**	**H**
Flora – C. Groundwater Drawdown						
Flora C.	**M**	**M**	**M**	**M**	**M**	**M**
Flora – D. Contamination of soil and water						
Flora D.	**M**	**H**	**M**	**H**	**M**	**M**
Significance of Consequence		The mining activities will alter the habitats that previously existed. Soil and flora will be removed. Some fauna will relocate and compete for resources in adjacent habitats, but many will be destroyed and/or affected				

	negatively. Dust and lighting will also impact ecosystem. Mitigating & rehabilitation mechanisms are imperative.
Prevention	Not possible as at least many specimens of the most common flora taxa found in the district will be removed during construction activities and quarry creation.
Mitigation Action	*Suggested by fauna specialist:* **Destruction of organisms and their habitats:** ➢ Keep the overall development footprint as small as possible. ➢ The extent and location of the construction site should be fenced and all construction activities should take place within the fence. Adherence should be strictly enforced. ➢ The location of roads, pipelines and power lines must be planned to minimise fragmentation or disturbance of habitats. ➢ Anti-erosion measures must be taken where roads and tracks cross a wash or drainage. ➢ Carefully plan the placement of stockpiling construction material so as to avoid sensitive areas. ➢ Limit construction activities to daytime hours to reduce noise. ➢ Educate construction and permanent staff as to their environmental obligations. All contractors should be held responsible for transgressions and significant penalties should be levied in order to ensure compliance. ➢ Position temporary construction infrastructure (e.g. accommodation) in areas that will definitely be disturbed during operations. ➢ Erect linear structures (power lines, water pipelines) as close as possible to existing roads and tracks. Maintenance roads/tracks for linear structures should be built as close as possible to the structure and access should be limited to essential maintenance. ➢ Do not put water tanks, power pylons or any other large infrastructure in the river or washes. ➢ No sewerage overflow or French drain may be placed within 100 m of a wash or river. ➢ A vertebrate specialist should identify nests, dens and other breeding locations and demarcate them before construction so that these sites can be avoided as part of the EMP. ➢ Reptiles and amphibians that are exposed during ground clearing should be captured for translocation by a qualified expert. ➢ No collection of plants should be allowed. No fires should be allowed.

	➢ A comprehensive restoration plan should be drawn up by an expert BEFORE construction commences, at least at conceptual level, and should make provision for monitoring and adaptive management as the project develops. Some rehabilitation actions should be implemented during operations in order to be effective, e.g. removal and location of topsoil; location of waste rock dumps to ensure efficient restoration later; road and pipeline locations. **Disturbance of animals and interference with their behaviour**: ➢ The extent of the operation should be clearly demarcated on site layout plans and fenced in. The nature of a fence would be informative rather than restrictive – it is to make the boundaries of the area of operations clear to staff, visitors and contractors, and to effectively control access to undeveloped areas. ➢ Areas surrounding the mine and accessory works that are not part of the demarcated development should be considered a no-development zone. ➢ No employees, visitors or machinery should be allowed in such a zone. ➢ No off-road driving should be allowed. ➢ Limit activities to day-time hours so as to reduce noise. ➢ Only controlled and contained fires should be allowed for cooking and heating purposes. Only wood collected during the clearing of areas during the construction phase should be used for firewood. ➢ The significance of this impact is somewhat decreased by the fact that human presence and human-caused disturbance in the region is already interfering with the presence and movement of many taxa, particularly large mammals. ➢ Staff and contractors should be trained in sensitive human-wildlife interaction. **Light Pollution**: Not much is known about the effect of light on populations and ecosystems and the precautionary principle is applied here. ➢ Install motion detectors to limit light use to the minimum possible. ➢ Outdoor lights should be directed downwards and not up into the sky. ➢ Use yellow or amber outdoor lights because invertebrates don't detect yellow light as well as white. ➢ Install insect screens in doors and windows located in buildings that are used at night. **Alteration of Topography**:

	➢ It may not be possible to rehabilitate the site significantly, but a comprehensive restoration plan would mitigate impacts to some extent. ➢ A comprehensive restoration plan with financial mechanisms for implementation should be drawn up by an expert during the construction phase. It is possible that some mitigation measures and rehabilitation actions should be implemented during operations in order to be effective; therefore, a restoration plan should be in place at the start of operations. ➢ Implement the restoration programme as soon as possible after the impact has ceased. **Groundwater drawdown:** ➢ Monitor groundwater levels. ➢ Monitor plant and vertebrate diversity downriver from the abstraction site at a minimum of once a year. **Contamination of Soil and Water**: ➢ Containment measures should be strictly enforced to the highest existing standards. Open water structures should be sealed and provide no opportunity for either leakage or entry by animals. ➢ Constant monitoring of open bodies of water and their associated pipes, lining and covers is essential to ensure that there is no malfunction, tear or opening. ➢ Treatment of the final discharge of water should be in such a way as to eliminate any possibility of active chemicals entering the soil or groundwater. **Natural spring water Levels:** ➢ The water levels in the natural springs of the Ondoto river must be monitored to ensure the survival of the rare fish that are present there. **Impacts linked to accommodation of staff** ➢ All inhabitants and visitors in the staff compound should receive environmental awareness training, including training on indiscriminate defecation. ➢ The staff compound should be fenced in and the only access allowed outside the fence is on the entrance road. ➢ All cleaning and washing should take place inside a designated area (e.g. kitchen, laundry) and fat traps should be installed at the drain outlet from these areas. ➢ No collection of plants or plant material should be allowed. ➢ No open fires or flames should be allowed in the staff compound. ➢ Gas cooking facilities should be provided.

	➢ Lights should be solar, or generator powered - no candles or paraffin lamps. ➢ Firefighting equipment should be placed in the compound. Equipment should always be tested regularly and be in working condition. All inhabitants of the compound should be trained in the use of this equipment and know where it is. ➢ Water saving measures should be put in place, e.g. low-pressure shower heads and taps; daily checks of pipes and tanks; immediate repair of leaks. ➢ Sewerage should be of sufficient capacity for the number of people, and should be a sealed breakdown system. ➢ No sewerage overflow structure or French drain may be placed within 100 m of a wash, drainage line or river. *Suggested by flora specialist:* **Habitat alteration and destruction** - The spatial extent of the infrastructure should be planned to keep it as small as possible. Then when clearing areas, where possible, do not fell the larger and older trees as they act as seed (genetic stock) sources. By changing the location of the new processing plant and WRD and area of lower diversity will be impacted. However, it is not possible to reduce the impact of the quarries on the rocky habitat that harbours several protected tree species. It is recommended that a the NBRI be supported in doing a comprehensive survey of the area during the MEFT EIA review period. Roads, pipelines and power lines must be planned in order to minimise fragmentation or disturbance of habitats The following most important mitigations should be implemented: ➢ Do not put water tanks, power pylons or any other large infrastructure in the river or washes. ➢ Position temporary construction infrastructure (e.g. accommodation) in areas that will definitely be disturbed during operations. ➢ Erect linear structures (power lines, water pipelines) as close as possible to existing roads and tracks. ➢ Carefully plan the placement of stockpiling construction material so as to avoid sensitive areas. Awareness training for management & other personnel must focus on: ➢ Training of all personnel to limit the habitat alteration during the construction and operational phases of the mine ➢ Teach knowledge and understanding of the flora and its ecology The following basic rules must be adhered too: ➢ No littering ➢ Driving only on existing roads (roads created by the mine inside the mining areas.

	➢ Firewood should come from trees that were felled within the cleared areas and no additional clearing for firewood should occur. A restoration plan should be drawn up by an expert BEFORE operations commences, at least at conceptual level before construction starts, and should make provision for monitoring and adaptive management as the project develops. Some rehabilitation actions should be implemented during operations to be effective, e.g. removal and location of topsoil; location of waste rock dumps to ensure efficient restoration later; road and pipeline locations. **Alteration of Topography** ➢ It may not be possible to rehabilitate the mining sites significantly, but a comprehensive restoration plan would mitigate impacts to some extent. ➢ A restoration plan should be drawn up by an expert BEFORE operation commences. ➢ Implement the restoration programme as soon as possible after the impact has ceased. **Groundwater drawdown** ➢ Conduct a specialist hydrogeological study for the project. ➢ Monitor groundwater levels. ➢ Monitoring of the plant and vertebrate diversity downriver from the abstraction site is recommended and at a frequency that is warranted. ➢ Ensure sustainable water supply to the project based on the findings of the hydrogeological study. **Contamination of soil and water** ➢ Conduct specialist work on element mobilisation from the different types of ore and waste rocks. ➢ Containment measures should be strictly enforced to the highest existing standards in the mining industry. ➢ Constant monitoring of open bodies of water and their associated pipes, lining and covers is essential to ensure that there is no malfunction, tear or opening. ➢ Treatment of the final discharge of water should be in such a way as to eliminate any possibility of active chemicals entering the soil or groundwater.
Rehabilitation	Rehabilitation at mine closure should be applied to the accessory works areas as defined in the project description in this flora assessment. The waste rock dump should be constructed in such a way that fits in with the surrounding physical features and so that water infiltration is maximised, and erosion minimised. These latter points will allow for natural regrowth of the vegetation on the waste rock dump. The following aspects should be considered when finalising the mine closure plan:

	➢ The infrastructure removal and landscaping of the accessory works area to match as far as possible the baseline conditions. ➢ Funds for rehabilitation should be set aside from the start of the operational phase. A mechanism for securing these funds should be in place during the construction phase. ➢ Reasonable and acceptable ways of rehabilitation should be implemented on an ongoing basis as well as at the time of site closure. ➢ Where the ground has been affected by spillages such hydrocarbons, these soils should be stockpiled and appropriately treated to regulate the contamination levels prior to being used for rehabilitation purposes.

Mitigated	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Fauna A.	**M**	**M**	**L**	**M**	**M**	**M**
Fauna B.	**L**	**L**	**L**	**L**	**L**	**L**
Fauna C.	**L**	**M**	**L**	**L**	**M**	**L**
Fauna D.	**M**	**M**	**L**	**M**	**M**	**M**
Fauna E.	**L**	**M**	**M**	**L**	**L**	**L**
Fauna F.	**L**	**L**	**L**	**L**	**L**	**L**
Fauna G.	**L**	**L**	**L**	**L**	**L**	**L**
Flora A.	**M**	**M**	**L**	**M**	**M**	**M**
Flora B.	**M**	**M**	**L**	**M**	**M**	**M**
Flora C.	**L**	**M**	**M**	**L**	**L**	**L**
Flora D.	**L**	**L**	**L**	**L**	**L**	**L**
Significance of Consequence		If the mitigation hierarchy is followed through to rehabilitation, then the resultant consequence could be insignificant overall.				
Confidence Level		A well designed and well implemented rehabilitation programme will provide the necessary confidence that the altered habitats could be rehabilitated at mine closure to a degree that the final footprint of the mine will be acceptable. Provided the waste rock dump is covered with the stockpiled topsoil at mine closure, natural revegetation of this area could occur in the long term.				
Monitoring		**Planning:**				

	➢ List of plant species expected to occur within the area is on file. ➢ Bush clearing permit must be applied for prior to clearing of any areas. ➢ Environmental Clearance Certificate is on file ➢ Schedule for developing EMS documentation is on file. ➢ Visual baseline imagery to indicate which plant species preferred which habitats. ➢ Train personnel regarding the impact on the surrounding habitats. ➢ Plan mine layout to reduce the footprint size and thereby conserve more biodiversity **Construction & Operation:** ➢ Monitor compliance and file report. ➢ Mine closure plan to be developed and put on file. ➢ Rehabilitation of cleared areas to be planned and put on file. (use baseline imagery for planning) ➢ Water level and water quality testing of boreholes and springs in accordance with the Department of Water Affairs water abstraction permits. **Decommissioning:** ➢ Monitor compliance and file report. ➢ Compare final revegetation layout with visual baseline imagery

Table 12. Water Resource Management Programme: a. sustainable water use

Impact Event	**Mining activities may affect water resources through over utilisation**					
Description	Water demand for mining, processing and domestic use is estimated as 100,000 m^3/year for the overall Ondoto project. During the construction phase and first year of operation, water will be sourced from the Ondoto River hand dug well, close to Mining License 40 boundary. The sustainable yield of the Ondoto River is low mainly due to irregular river flow and recharge. The mine area is underlain by anorthosite that generally has poor groundwater potential.					
Nature	Negative					
Phases	Phases during which mining activities may impact the water resources are highlighted below.					
Construction Phase	**Operational Phase**		**Decommissioning Phase**		**Post Closure**	
Alluvial hand dug well of the Ondoto River	Hand dug well of the Ondoto River & the pipeline from the Kunene River		Hand dug well of the Ondoto River & the pipeline from the Kunene River		With ceasing of abstraction, water level in the aquifer will be restored with time.	
Groundwater (via borehole abstraction)	Groundwater (via borehole abstraction)		Groundwater (via borehole abstraction)			
Severity	Recommended water level could often be violated. Interruption of supply to mine and community.					
Duration	Reversible over time.					
Spatial Scale	Fairly widespread, at the mine site and neighbouring Oroutumba village.					
Probability	Definite / continuous					
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Unmitigated	**H**	**M**	**M**	**M**	**H**	**H**
Significance of Consequence	A high significance is expected if no mitigation measures are implemented.					
Prevention	Alternative water sources to be developed such as direct intake from the Kunene River or aquifer in the bank of the Kunene River are sustainable sources. Monitoring of groundwater level and water quality should serve as early warning of overexploitation of groundwater.					

Mitigation Action	Limit the use of the Ondoto River alluvium to initial stages of the project. If the Ondoto River alluvial aquifer shows signs of overexploitation (drop in groundwater level and increasing salinity), the use of the resource should be stopped, and alternative sources used. The community affected by the disruption of supply should be supplied from the alternative source till supply from the Ondoto River is restored. Develop the alternative source of water (Kunene River or Dwyka Aquifer) for long term use.					
Decommissioning & Rehabilitation	Upon decommissioning of the mine the water levels in the borehole of the Ondoto river will resume the levels that existed prior to use by the mine. The pipeline bringing water to the mine from the Kunene River borehole could be handed over to the community to maintain and future use so that a more sustainable source of water could supply the community.					
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Mitigated	**M**	**M**	**L**	**M**	**L**	**L**
Significance of Consequence	Provided the development of the alternative Kunene River borehole source goes ahead the impact would be low as the abstraction from the Ondoto River alluvial aquifer for mine process water could be stopped. The groundwater level will be restored with natural recharge over time.					
Confidence Level	The restoration of any impact of abstraction of groundwater is dependent on groundwater replenishment by river flow. Arid region river flow and recharge is episodic and not often predictable. Continuous monitoring will provide feedback on the restoration of conditions of the water resource.					
Monitoring	Monitor groundwater level, gauge river level, rainfall, and abstraction daily. Groundwater levels monitoring is recommended for the Ondoto River hand-dug well, and also for the proposed new boreholes. Water levels are to be measured continuously, preferably by using pressure transducers. Overall the water balance of the mine and associated operations is to be monitored particularly on the following main components: ➢ Water disposal in tailings ➢ Recovered water and decrease in recovered water volumes ➢ Intake of freshwater to the mine and plant form the water supply wellfield ➢ Increase or decrease of outflow to the evaporation dam Gauging of the Ondoto River is recommended at a selected reach where the river has a straight course and flows over bedrock. The purpose of such monitoring will be to record river flow and therefore the frequency of recharge of the groundwater resource in the alluvium in case this source is tapped for mine supply. Declining water levels can be related to abstraction or lack of recharge.					

	Monitoring is to be carried out using a pressure transducer housed in an installed perforated borehole casing. The level of the pressure transducer, cross-section and slope of the reach can be surveyed, and flow rates estimated from the information. **Planning:** ➢ Water Management Plan on file ➢ Application for effluent discharge submitted to competent authority and receipt on file ➢ Water abstraction permit on file ➢ Keep water abstraction permit and effluent discharge permit on file **Construction & Operations:** ➢ Monitor compliance and file report ➢ All certificates for hazardous waste disposal filed. ➢ Checklists and schedule for auditing compliance to the EMP are filed. ➢ Reports are filed. ➢ Awareness training attendance lists signed and filed ➢ Monitor oil water separators, oil sumps, bunds and assess compliance and file reports. ➢ Monitor water use and report on file. **Decommissioning:** Monitor rehabilitation and report on file.

Table 13 Water resource quality management: b. contamination

<table>
<tr><th>Impact Event</th><th colspan="3">Mining activities may affect water resources through contamination</th></tr>
<tr><td>Description</td><td colspan="3">The containment effluents and runoff from the tailings and waste rock dumps, particularly in the rainy season is of concern. Water diversion structures and a containment dam for the run-off and seepage need to be constructed with design capacity of the diversion and containment dam adequate for handling large rainfall events as experienced in this area. Potential impacts are as follows:
Leaching of contaminants and erosion of material from the TSF and waste rock dumps into surface water channels by discarded process water and rain events are of high intensity. The leachate from the TSF and mine waste is however likely to be alkaline thus limiting the mobility of metals.
Erosion of material and mobilisation of precipitates and fines is possible.
Wastewater disposal reaching natural drainage</td></tr>
<tr><td>Nature</td><td colspan="3">Negative</td></tr>
<tr><td>Phases</td><td colspan="3">Phases during which mining activities may impact the water resources are highlighted below.</td></tr>
<tr><td>Construction Phase</td><td>Operational Phase</td><td>Decommissioning Phase</td><td>Post Closure</td></tr>
<tr><td>Hand dug well of the Ondoto River</td><td>Hand dug well of the Ondoto River & the pipeline from the Kunene River</td><td>Hand dug well of the Ondoto River & the pipeline from the Kunene River</td><td rowspan="2">The waste rock dump and TSF will remain exposed to risk of erosion and mobilisation into surface water channels. Wastewater disposal will cease.</td></tr>
<tr><td>Eroded material and fines reaching the alluvial aquifer during severe rainfall events.</td><td>Eroded material and fines reaching the alluvial aquifer during severe rainfall events.</td><td>Eroded material and fines reaching the alluvial aquifer during severe rainfall events.</td></tr>
<tr><td>Severity</td><td colspan="3">The mobilisation of material from the TSF and waste rock dump into natural water channels and eventually to the Ondoto River is possible. The area experiences high intensity rainfall following extended dry periods that can mobilise sediments and material.</td></tr>
<tr><td>Duration</td><td colspan="3">The duration of the impact will continue through the development, operational and after closure of the mine.</td></tr>
<tr><td>Spatial Scale</td><td colspan="3">Fairly widespread, in the mine site and neighbouring village.</td></tr>
<tr><td>Probability</td><td colspan="3">Possible / continuous</td></tr>
</table>

Mitigation	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Unmitigated	**M**	**H**	**M**	**H**	**M**	**H**
Significance of Consequence	A high significance is expected if no mitigation measures are implemented.					
Prevention	Reclaim of process water and reuse to limit the amount of water used. Design, construction and maintenance of TSF and waste rock dumps to prevent erosion.					
Mitigation Action	Measures to mitigate contamination of the soils, surface water and groundwater are as follows: ➢ Evaporation of contained water that is not reused. ➢ Maintain water balance as a check on any significant water leakage from the operation. ➢ Regular inspection of TSF and WRDs. ➢ During the operation of the mine, the sediment material accumulated in the containment dam should be moved to the tailings at regular intervals so that the maximum capacity of the dam is retained and the risk of mobilising the material downstream is reduced. For the management and mitigation of possible impacts from the mining pits the following measures are recommended. ➢ The pits to a maximum depth of 40 m below ground level will be above the groundwater level and no groundwater inflow is expected. ➢ Surface flow to the pits is possible and the pits should be protected against inflow of surface runoff water and discharge from the pits should be avoided. Therefore, the pits should be cordoned off with berms (1 m high) to avoid surface inflow to the pit					
Decommissioning & Rehabilitation	Upon closure of the mine, the surface of the TSF should be graded to avoid ponding and encourage surface runoff thus limiting infiltration. Placement of a low permeability seal on the TSF is the preferred measure to avoid infiltration and salt accumulation in accordance with best practice measures proposed by the British Columbia Acid Mine Drainage Task Force (1989). For establishing such top seal, a large quantity of clay rich material would be required which may not be available locally. Alternatively, other material of good compatibility or low permeability such as compacted calcrete can be used. On closure the pits should be cordoned off with berms to avoid and prevent access to the sites by animals and humans.					
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Mitigated	**M**	**L**	**L**	**M**	**L**	**L**

Significance of Consequence	The possibility of wastewater, leachate and eroded material reaching the natural river channels is significantly reduced by the construction of a containment dam. The overall risk of leaching of metals will be low due to the alkaline nature of the tailings.
Confidence Level	Continuous monitoring and implementation of mitigation measures will significantly reduce the probability of waste material reaching the downstream natural drainage channels.
Monitoring	Monitor field water quality parameters of downstream aquifer, seepage (TSF, waste dumps, containment dam); quarterly sampling and analyses The following recommendations are made for the water quality monitoring. ➢ Water quality monitoring will include the following well head parameters for all water points. Well head chemistry parameters would include pH, EC, temperature, and alkalinity. Monitoring will be carried out in-house at one-month intervals. ➢ The above parameters will be monitored also on the ponding on the storage /evaporation dam and outflow, if any, from the tailings and waste rock dumps. ➢ Quarterly sampling and analyses of water chemistry is to be done during the initial year of operation from the supply boreholes, storage / evaporation dam, the Ondoto hand-dug well and any water point established in the future downslope of the mine (north). The parameters will include major ions, minor and trace ions analysed during the project (Appendix B of the Water Study Report). ➢ Reassessment of sampling parameters and frequency of the sampling is recommended after 1 year of operation.

Table 14. Traffic Management Programme

Impact Event	**Transporting bulk sodalite dimension stones and other mineral concentrates by trucks (PBS) along national roads**		
Description	The potential impacts of the haulage of bulk sodalite dimension stones can be categorised in terms of public safety and capacity of the road to handle 67 tonne vehicles. For public safety the Proponent or contractor must abide by the rules and regulations that are enforced by the Roads Authority. The vehicles need to be routinely checked for road worthiness and the containment of the goods needs to be such that no harm may come to the public and other road users during the transit from the mine to the Port of Walvis Bay. No product may be strewn along the roadside as part of the normal transit. Covers over bulk transporters must be adequate at all times. Drivers must follow the rules of the road at all times. Additionally, the route provides for adequate visibility on hills and turns and that the road will be safe for two-way traffic at all times except where single traffic bridges exist. The capacity of the whole road should be such that the surface is not damaged beyond the normal wear as a result of the load and that the bridges to be crossed have the integrity to handle multiple crossings at the frequency expected. A route might need to be altered should a bridge not be sufficiently strong to handle the 67tonne laden vehicle. Additionally, the frequency of trucks per day is such that it does not exceed the threshold that was originally designed for the route. A maximum of 1 truck per day is expected to travel from the two Mining Claims along either of the possible routes. The preferred shorter route is less frequented by traffic but currently has long stretches of gravel road. The PBS option will mean slower travel and less impact on the road surface. Thus the gravel road sections are expected to be less dusty due to slower travelling speeds and will not be negatively impacted by the 67 tonne laden vehicles.		
Nature	Negative		
Phases	Significance assessment was carried out on the operational phase which represents the period the road, road users and the general public are exposed to the hazard.		
Construction Phase	**Operational Phase**	**Decommissioning Phase**	**Post Closure**
	Public safety – pedestrians and road users		
	Road design – surface integrity and bridge strength		

		Regulations – mass of vehicles when fully laden and permits				
Severity		Moderate / measurable deterioration. Noticeable loss of resources.				
Duration		Medium term. Life of Mine.				
Spatial Scale		Widespread – Far beyond site boundary. National				
Probability		Possible/ frequent				
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Unmitigated	**M**	**M**	**H**	**H**	**M**	**H**
Significance of Consequence		Mitigations to reduce risks to Public Safety are imperative.				
Prevention		The removal of all hazards will not be possible.				
Mitigation Action		As far as public safety is concerned it is not possible to prevent all incidents from occurring completely, but the probability can be reduced if the following aspects are considered: - ➢ Draw up operational procedure manual ➢ Provide road safety awareness training ➢ Establish specific rules for driving including travelling speed and rest times. ➢ Devise and implement emergency response plans ➢ Close coordination with the traffic authorities to ensure road safety signs are strategically placed and ensure all employee drivers are well trained ➢ Provide easy access to Material Safety Data Sheets (MSDS) for drivers ➢ Provide first aid training ➢ Devise emergency medical procedures for all eventualities ➢ Undertake daily safety reminders and/or drills ➢ Establish regulations for handling fuel ➢ Establish and implement measures to exclude discharge of minerals particulates during travel As far as capacity is concerned the frequency and of trucks must be maintained at the stated daily rate and there should be at least 2 km travelling distance between trucks. Only one truck should travel over a				

		bridge at any one time. Avoidance of travelling during peak times on busy sections of road should be practiced. The capacity of the road to handle the additional trucks is within the road design.				
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Mitigated	**M**	**M**	**H**	**M**	**L**	**M**
Significance of Consequence		If all the mitigations listed are implemented, then the significance will be maintained at medium.				
Confidence Level		The significance would be lower had the spatial extent not been over such a long stretch of road.				
Monitoring		A complaints register should be opened and maintained. All necessary permits should be on file and maintained in accordance with the required renewal periods.				

Table 15. Product Handling & Storage Programme

<table>
<tr><td>Impact Event</td><td colspan="3">Bulk storage and handling of product at Walvis Bay Port</td></tr>
<tr><td>Description</td><td colspan="3">The management of the product at the Port of Walvis Bay involves various hazards that can have an impact on the Port functioning, on third parties and on the proponent. The potential impacts on human health and safety resulting from activities at the port could include occupational accidents and injuries, vehicle accidents, exposure to weather extremes, trips and fall on uneven terrain, adverse health effects from dust generation and emissions Failure to store and handle the product safely at any point between the storage facility and the stowage on board the ship could have negative impacts on the other users of the port and areas they are responsible for. The proponent and contractors must follow a set of industry-specific safety and health policies at the Port.

Typical operational procedures that pose risks to operational personnel are:
➢ Operating heavy machinery such as, front-end loaders, conveyors, forklifts, articulated trucks and trains during handling and transfer to ships
➢ Operating haulage trucks during offloading
➢ Prolonged proximity to and exposure to radioactive particulates either inside a warehouse or around exposed stockpiles.</td></tr>
<tr><td>Nature</td><td colspan="3">Negative</td></tr>
<tr><td>Phases</td><td colspan="3">The significance assessment was carried out on the operations at the port. No construction phase is expected.</td></tr>
<tr><td>Construction Phase</td><td>Operational Phase</td><td>Decommissioning Phase</td><td>Post Closure</td></tr>
<tr><td rowspan="3"></td><td>Receiving product from the mine in bulk or bulk bags</td><td rowspan="3"></td><td rowspan="3">.</td></tr>
<tr><td>Storage and containment of bulk bags or bulk product at the port</td></tr>
<tr><td>Transfer of the product to the vessel</td></tr>
<tr><td>Severity</td><td colspan="3">Moderate / measurable deterioration. Noticeable loss of resources.</td></tr>
</table>

Duration		Medium term. Life of Mine.				
Spatial Scale		Localised - Within the site boundary. Temporary storage at Walvis Bay Harbour				
Probability		Definite and continuous				
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Unmitigated	**M**	**M**	**L**	**M**	**M**	**M**
Significance of Consequence		Mitigations to reduce exposure to health and safety risks for personnel are imperative.				
Prevention		The removal of hazards or risks will possibly prevent accidents from occurring. However, it is not possible to remove all risks.				
Mitigation Action		It is not possible to prevent all incidents from occurring completely. An accident is an unplanned incident though it could have been foreseen if the necessary precautions had been taken. Not all hazards can be removed but the risk it presents can be lowered. An integrated health and safety management system acts as a monitoring tool and mitigating tool to reduce the risks. Typical mitigating measures within the health and safety management systems are:- ➢ Draw up operational procedure manuals ➢ Provide health and safety awareness training ➢ Establish practical standard housekeeping rules ➢ Colour code certain areas, equipment and substances to thereby classifying the risks. ➢ Provide signage for personal protective equipment (e.g. protective clothing like safety boots and hard hats) ➢ Institute safe working procedures and require permits to work ➢ Devise and implement emergency response plans ➢ Close coordination with the traffic authorities to ensure road safety signs are strategically placed and ensure all employee drivers are well trained ➢ Provide easy access to Material Safety Data Sheets (MSDS) ➢ Provide first aid treatment and training ➢ Devise emergency medical procedures for all eventualities ➢ Undertake daily safety reminders and/or drills ➢ Establish regulations for handling the product ➢ Establish monitoring points for particulate contamination around the storage facility if dust emissions are reported. ➢ Procedures for dealing with injuries or accidents must be in place and all contact details for emergency personnel must be available. ➢ This list is not comprehensive and could be supplemented substantially by the Health & Safety Manager				

		➢ With respect radiation exposure if base and rare elements is mined within the claims the following mitigations and monitoring are either mandatory by law or recommended: ➢ Annual medical assessment ➢ PPE – dust masks are worn by all employees exposed to radioactive dust particulates. The type used is FFP3; ➢ Rules applicable to the Port Authority must be applied. ➢ Equipment for measuring radiation emissions need to be purchased and personnel trained to use them.				
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Mitigated	**L**	**L**	**L**	**L**	**L**	**L**
Significance of Consequence		If all the mitigations listed are implemented, then the significance will be maintained at low.				
Confidence Level		The EAP is quite confident that the mitigations will result in low significance. Continuous training and medical monitoring of personnel and the regionally (SADC region) recommended frequency is imperative. The port authority will place the onus on the proponent to provide proof that the source of pollutants is not from the site of proponent.				
Monitoring		Monitoring of dust for particulates may be necessary to ensure third parties are considered and an alarm can be raised should toxic minerals particulates be present. The port authority will place the onus on the Proponent to provide proof that the source of pollutants is not from the site of the Proponent.				

Table 16. Mine Closure & Rehabilitation Management Programme

Impact Event	**Abandonment of the mining site potentially exposes public and wildlife to hazards**
Description	When a mining area is abandoned the infrastructure and altered landscape can affect the safe access of wildlife and general public if not rehabilitated. The altered habitat may or may not promote the re-establishment of organisms once found there. Visual rehabilitation to the original state is not always practical due to economic factors.
Nature	Negative
Phases	Phases during which decommissioning, and mine closure may impact public safety, future ecosystem functioning for domestic livestock and wildlife, economic stability and social health, and asset security. The significance assessment is carried out for the post closure phase.

<table>
<tr><th colspan="2">Construction Phase</th><th colspan="2">Operational Phase</th><th>Decommissioning Phase</th><th>Post Closure</th></tr>
<tr><td colspan="2" rowspan="4">Not applicable</td><td colspan="2" rowspan="4">Not applicable</td><td>Ecosystem functioning</td><td>Ecosystem functioning</td></tr>
<tr><td>Public safety</td><td>Public safety</td></tr>
<tr><td>Economic uncertainty</td><td rowspan="2">Social challenges of unemployment</td></tr>
<tr><td>Asset security</td></tr>
<tr><td colspan="2">Severity</td><td colspan="4">Substantial deterioration after mine closure with respect to aspects listed above.</td></tr>
<tr><td colspan="2">Duration</td><td colspan="4">Permanent. Beyond closure. Long term.</td></tr>
<tr><td colspan="2">Spatial Scale</td><td colspan="4">Fairly widespread – Beyond the site boundary. Local</td></tr>
<tr><td colspan="2">Probability</td><td colspan="4">Definite / continuous</td></tr>
<tr><td>Mitigation</td><td>Severity</td><td>Duration</td><td>Spatial Scale</td><td>Consequence</td><td>Probability of Occurrence</td><td>Significance</td></tr>
<tr><td>Unmitigated</td><td>H</td><td>H</td><td>M</td><td>H</td><td>H</td><td>H</td></tr>
<tr><td colspan="2">Significance of Consequence</td><td colspan="5">A high significance is expected if no mitigation mechanisms are implemented. This is a worst-case scenario where no alternative uses of the altered habitat is considered.

In terms of economic benefits lost, it is important to note that the longer the mine stays open the longer the benefit to the community which if the mine did not start up would not have been realised in the first place.</td></tr>
<tr><td colspan="2">Prevention</td><td colspan="5">The resources are finite and so decommissioning is inevitable at some point. The degree to which the impact of closure will have will depends on the mitigations that can be considered.

Ecosystem functioning of the whole area cannot return to baseline conditions unless the excavated quarry is refilled and the area revegetated to baseline conditions. This is not practical

Public harm can be prevented provided the area is secured and the risky hazards are inaccessible.

Jobs within this sector will be lost. This cannot be prevented unless the employees move with the company to the next site.

Theft and damage to equipment can be prevented during the decommissioning phase provided good security prevents any form of criminal behaviour by disgruntled employees.</td></tr>
<tr><td colspan="2">Mitigation Action</td><td colspan="5">Visual impacts can be mitigated through a thorough removal of all infrastructure.</td></tr>
</table>

	The reduction in the size of the mine footprint during operations and decommissioning increases the probability that more habitat will become fully functional when the mine closes. Secure fencing or other physical objects (rock piles) around any hazardous quarry pits (i.e. height risks) could prevent accidents from occurring but the permanent and visually acceptable barrier to humans and wildlife would be required to prevent injuries due to falling from heights. Access down into the pit could be allowed provided there is no risk from falling rocks. The access road leading to the pit, waste rock dumps areas should be closed off to the public except to those that need access to the facilities for inspection after closure. Wherever there are safe access roads that are useable by the neighbours, these should be left. Some infrastructure could remain if alternative uses for buildings could be found. When the mine closes the losses of employment will have a negative economic effect on the livelihoods of the workers and the region. To mitigate this impact all stakeholders should be notified about the mine closure in good time.
Rehabilitation	Reasonable rehabilitation of the mine site should take place. The proponent will be responsible to put aside funds for rehabilitation. The mine closure plan with the mine rehabilitation or restoration plan should be written up during the first three years of the first environmental clearance. Rehabilitation of the abandoned mining area will amongst other things include the following: ➢ All movable assets to be removed off site ➢ All waste to be removed from site to prevent later potential excavation by people trying to recover any sort of usable scrap / materials ➢ All immovable machinery to be dismantled and removed from site ➢ Possibly create shallow sloped sides of quarried areas ➢ WRD material is used in landscaping ➢ All stockpiled topsoil will be re-laid on the landscaped areas. ➢ Designed landscaped areas to be revegetated with plants from the nursery ➢ Finally, erect fencing or barriers to prevent access by public or animals to cliff faces of the quarried pits

Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Mitigated	**L**	**M**	**L**	**L**	**L**	**L**

Significance of Consequence	If the mitigation hierarchy is followed through to rehabilitation, then the resultant consequence could be insignificant or at worst a low significance.
Confidence Level	A well designed and well implemented mine closure plan should provide for a low significance upon mine closure.
Legal	**Risks associated with abandoning a mine without rehabilitating according to an approved plan:** **Minerals Act: Section 54** Any person who contravenes or fails to comply with the provisions of subsection (2) shall be guilty of an offence and on conviction be liable to a fine not exceeding R8 000 or to imprisonment for a period not exceeding 12 months or to both such fine and such imprisonment. **Contractual Agreements** The Contractor's failure to meet the obligations as stipulated in the contractual agreement with regards to rehabilitation will incur penalties to the value of the cost of rehabilitating the quarry and works area to a state agreed upon by the Contractor and Proponent at the start of the contractual agreement. **Minerals Act:** **Section 54** **Abandonment of mining areas** The holder of a mineral licence may abandon the mining area by notice in writing addressed and delivered to the Commissioner who in turn will notify the license holder that the mine has been abandoned as from the date of the cancellation notice. (2) The holder of the mineral licence to which such area relates shall: ➢ demolish any accessory works erected or constructed by such person in such area, except in so far as the owner of the land retains such accessory works on such conditions as may mutually be agreed upon between such owner and person and remove from such land all debris and any other object brought onto such land; ➢ take all such steps as may be necessary to remedy to the reasonable satisfaction of the Minister any damage caused by any mining operations carried on by such holder to the surface of, and the environment on, the land in the area in question. ➢ The abandonment of a mining area shall not affect any legal proceedings instituted against such holder or any obligation or liability of such holder in terms of the provisions of the Act.
Monitoring	At the time of quarry closure and abandonment the contractor must rehabilitate the mine site.. In general as discussed above the following must be monitored: ➢ Removal of movable assets i.e. plant equipment

	➢ Demolishment of fixed immovable assets ➢ Removal of this demolished plant and building rubble ➢ Fence off dangerously deep pits or holes in the ground that pose a threat to the public safety ➢ The proponent is to fulfil the same rehabilitation tasks as above for all the accessory works area, including infrastructure, tailings, pits and holes etc. which they created before the contractor began works in the quarry area. ➢ The proponent should regularly engage with the affected communities and stakeholders to record and respond to any grievances that may arise as a result of the project impacts and implement a monitoring process that seeks for feedback from stakeholders on the rehabilitation process. ➢ A **mine closure and rehabilitation plan** and associated checklists must be followed and signed off at each stage of the mine closure/rehabilitation process.

Ondoto Mining (Pty) Ltd


Radiation Management Plan

May 2021

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Ondoto Mining (Pty) Ltd

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First RMP	May 2021	submitted to NRPA	Dr R Ellmies	• Ondoto Mining (Pty) Ltd management and relevant staff • NRPA

Purpose

This document is

Ondoto Mining (Pty) Ltd's Radiation Management Plan (RMP)

for the mining of rare earth minerals in Namibia's Kunene Region.

The content of this RMP is – as far as reasonably achievable – based on the requirements and stipulations of the Namibian *Atomic Energy and Radiation Protection Act, 2005 (Act No. 5 of 2005)* [AEA, 2005], and the relevant stipulations in the *Radiation Protection and Waste Disposal Regulations* under the *Atomic Energy and Radiation Protection Act, 2005 (Act No. 5 of 2005)* [NRPA, 2012].

The structure of this RMP follows the guidelines for RMPs as issued by the National Radiation Protection Authority (document no NRPA_G_01).

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Abbreviations

α	– alpha radiation
β	– beta radiation
γ	– gamma radiation
µm	– micro-meter, 10^{-6} meter
ALARA	– as low as reasonably achievable
EGR	– External Gamma Radiation
EPD	– Electronic Personal Dosimeter
EPL	– Exclusive Prospecting Licence
ERP	– Emergency Response Plan
EIA	– Environmental Impact Assessment
HR	– Human Resources
IAEA	– International Atomic Energy Agency
LDV	– light delivery vehicle
MEFT	– Ministry of Environment, Forestry and Tourism
MSDS	– Material Safety Data Sheet
NORM	– Naturally Occurring Radioactive Material
NRPA	– National Radiation Protection Authority
O&M	– Operation and Maintenance
OH&S	– Occupational Health and Safety
OM	– Ondoto Mining (Pty) Ltd
pXRF Analyser	– portable X-ray fluorescence instrument
PM10	– particulate matter in the air with mean diameters of less than 10 µm
PRD	– Personal Radiation Detector
RMP	– Radiation Management Plan
RSO	– Radiation Safety Officer
SHE	– Safety, Health and Environment
WHO	– World Health Organisation
XRF	– X-ray fluorescence

Definitions

ALARA	as low as reasonably achievable, i.e. the basic principle underpinning radiation protection. The principle of ALARA implies that all exposures to radiation are to be kept *"as low as reasonably achievable, social and economic factors taken into account"*
Critical group	the group who are reasonably expected to receive the highest exposure to radiation from the radiation source(s) considered
Exposure pathway	the route between the radiation source and the receptor(s)
External gamma radiation	gamma radiation emitted by a given radiation source outside the human body and/or entering the human body from the outside
Final product	rare earth minerals produced by Ondoto Mining (Pty) Ltd
NORM	abbreviation for naturally occurring radioactive material, referring to radioactive materials found in the environment, including ores containing radioactive elements such as uranium, thorium and potassium, and their radioactive decay products. All ores and radioactive waste materials arising from OM's activities are NORM.
Radioactive	atoms that have unstable nuclei that undergo a decay by emitting radiation from the atomic nucleus are termed radioactive
Receptor	person exposed to radiation from one or several radiation sources
Source	a source of ionising radiation, such as naturally occurring radioactive mineral ore or the pulps, sludge or waste materials of such mineral ore, or another source of radiation such as a pXRF Analyser emitting ionising radiation, thereby exposing receptors to potential radiological risk
pXRF Analyser	a pXRF Analyser is a portable instrument that emits X-rays to excite atoms in mineral ores to determine the elemental composition of such materials, including ores, NORM sources and alloys

1 BACKGROUND TO ONDOTO MINING'S OPERATIONS

1.1 PREAMBLE

Ondoto Mining (Pty) Ltd produces rare earth minerals at its processing facilities at the company's mine located at Swartbooisdrif on the Kunene River some 125 km by road north of Opuwo in the western part of Namibia's Kunene Region.

This document is OM's Radiation Management Plan, which was compiled to comply with the provisions in Namibia's Atomic Energy and Radiation Protection Act, 5 of 2005, and the Regulations under the Act.

1.2 KEY ABBREVIATIONS

The following abbreviations apply throughout the remainder of this document:

- **Ondoto Mining (Pty) Ltd is abbreviated 'OM';**
- **Radiation Management Plan is abbreviated 'RMP';**
- **Radiation Safety Officer is abbreviated 'RSO';**
- **naturally occurring radioactive mineral is abbreviated 'NORM'.**

All abbreviations used in this RMP are listed in the Abbreviations section on page vi.

1.3 PURPOSE AND SCOPE

This chapter provides the background and a brief introduction to OM, as well as the rare earth element (REE) production at the company's mine in Namibia's Kunene Region.

The present chapter covers the following topics:

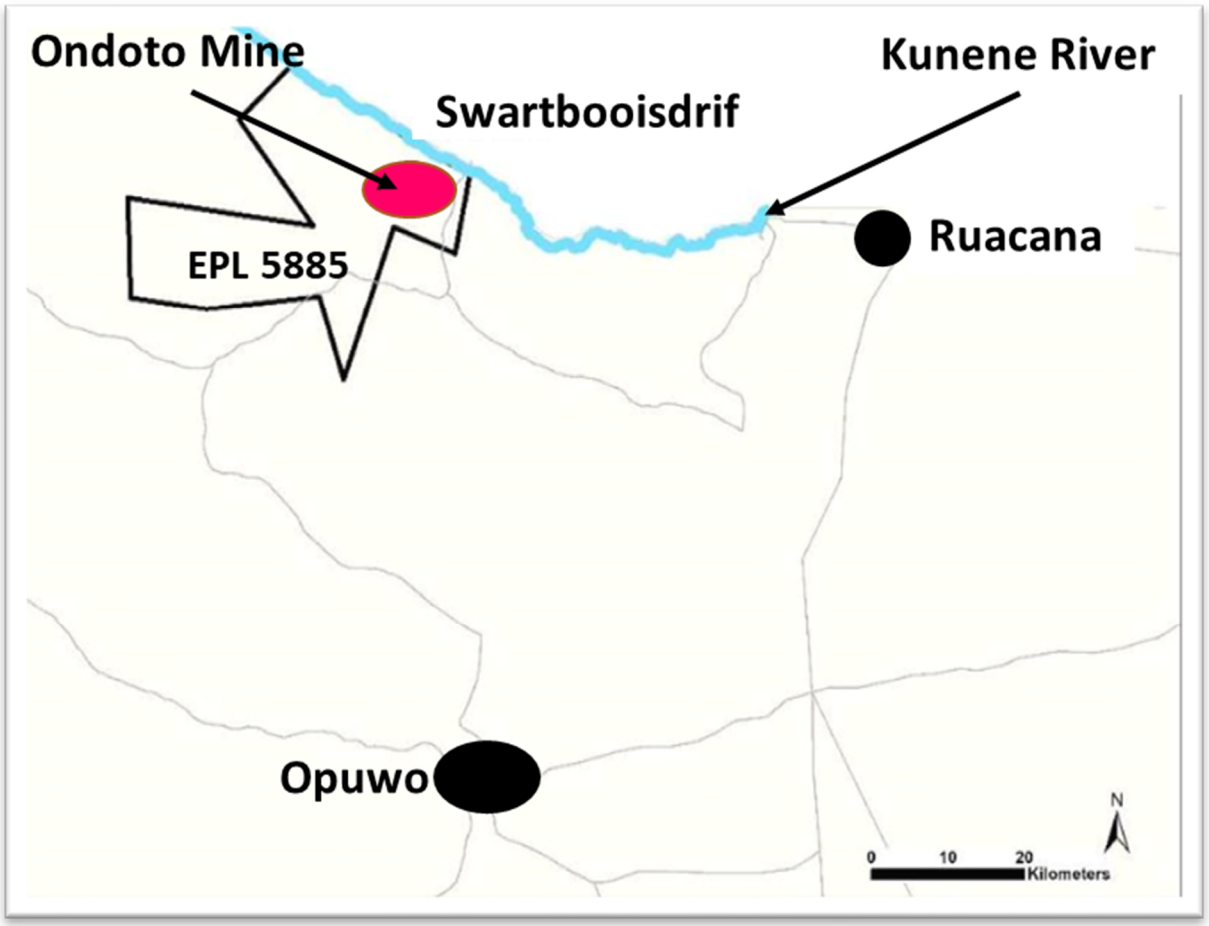
- Section 1.4 provides a short background and introduction to OM;
- Section 1.5 describes the main activities undertaken by OM at the company's rare earth mining and production which are of relevance to radiation safety, radiation protection, and the management of exposures to radiation;
- Section 1.6 introduces the sources and types of ionising radiation arising from OM's rare earth mining and production; and
- Section 1.7 identifies the main exposure pathways of relevance in OM's rare earth mining and production.

1.4 BACKGROUND AND INTRODUCTION

This section provides a short background and introduction to OM.

OM is a private Namibian-registered company, producing rare earth minerals at its mining site in EPL 5885 near Swartbooisdrif, which is located some 125 km by road from Opuwo in Namibia's north-western Kunene Region, as shown in Figure 1.

Figure 1: Location of OM's rare earth processing site in Namibia's north-western Kunene Region



OM's main administrative offices are located in Windhoek, and the contact details are:

Ondoto Mining (Pty) Ltd
8 Brandberg Street
Windhoek
Namibia

OM's contact details are as follows:

Tel: +264 64 258 350
P O Box 2967
Walvis Bay, Namibia
Email: morne.dutoit@gecko.na
Mob: +264 81 129 1779 (Morné du Toit, CEO, Mine Manager OM's legal person).

OM's rare earth mining and production include radiation-related aspects that are regulated in Namibia, therefore requiring radiation protection measures and the management of radiation exposures of staff, members of the public and the environment.

This RMP identifies and describes those management actions that will limit occupational, transitional, occasional and accidental exposures to radiation resulting from OM's rare earth exploration and mining activities. In this way, radiation-related safety activities are compliant with current legal and regulatory provisions as are applicable in Namibia.

Minerals of interest to OM include rare earth elements (REEs), including bastnäsite (about 75-90%), monazite (up to about 20%, but highly variable) and carbocernaite (only select findings). These REE-containing minerals are often found with uranium (U) and/or thorium (Th). In the case of OM, the average Th content in high-grade REE ore (with a total rare earth oxide (TREO) content of 21.6%) amounts to some 530 parts per million (ppm) Th, which is the average for deposits comprising of light REEs [1].

The Th content is directly proportional to the TREO grade of the ore and its concentrates. All Th is hosted by the LREEs without mineralisation that would allow the separation of Th from the REE ore or its concentrate. The Th content per 1% TREO amounts to approx. 26 ppm Th, and accordingly, a 10% TREO mixed ore has 260 ppm Th, high grade RM with 20% TREO about 520 ppm Th, a 70% TREO concentrate 1 820 ppm Th.

During the concentration of the REE, for example by way of mechanical processing and flotation, the Th content increases proportionally to the TREO content. This implies that both the ore and concentrates handled by OM, contain Th, and must therefore be treated with all precautionary and safety measures as apply for naturally occurring radioactive material (NORM). Amongst others, this implies that during mining and production, employees and contractors will be exposed to Th-bearing NORM and may thereby be exposed to ionising radiation from this weakly radioactive mineral.

The handling, processing and conveyance, as well as the disposal of NORM waste necessitate the application of appropriate radiation management activities, including the use of radiation safety instructions, radiation monitoring, radiation contamination control procedures, the use of personal protective equipment (PPE) and associated monitoring, all of which is detailed in the remainder of this RMP.

This RMP outlines the procedures by which the exposure to ionising of OM's workers are to be managed by way of optimisation, limitation and monitoring, and lays down the approaches to control and prevent the dispersion of radioactive mineral materials, to minimise potential exposures of members of the public and the environment.

[1] A common distinction between REEs is based on the atomic numbers of their main constituent minerals. REE minerals with low atomic numbers are referred to as LREEs, while those with high atomic numbers are the so-called heavy rare earth elements (HREEs).

1.5 OM's Main Radiation-Related Activities

This section summarises the main activities undertaken by OM at the company's REE mine that is of relevance to radiation safety, radiation protection and the management of exposures to ionising radiation.

OM's REE mining and production includes:

1. Field work and geotechnical assessments, including the use of a pXRF analyser;
2. Primary crushing and conveyance of REE mineral ore;
3. Screening and secondary crushing of REE mineral ore;
4. Concentration of REE content;
5. Disposal of waste ore residues;
6. Drumming of REE concentrate; and
7. Transport of drummed REE concentrate to the port of Walvis Bay, for export to international off-takers.

1.6 Sources and Types of Radiation

This section introduces the sources and types of ionising radiation arising from OM's REE mining, processing and conveyance.

Atoms with unstable nuclei will strive towards stability by undergoing a series of decays. Unstable atoms undergoing decays are called "radioactive". To illustrate, thorium-232 (Th^{232}) decays in an alpha decay to radium-228 (Ra^{228}), which is also unstable and decays into actinium-228 (Ac^{228}) in a beta decay. This series of decays continues until after 10 decays, the stable nucleus of lead-208 (Pb^{208}) is reached, which is the stable member and final product of the Th^{232} decay chain [Von Oertzen, 2017].

Radioactive decays occur imply that part of the original nucleus is emitted: one distinguishes between alpha decay whereby two protons and two neutrons are emitted (which is a so-called alpha (α) particle), or beta decay whereby an electron (called a beta (β) particle) is emitted. In addition to alphas or betas, an unstable nucleus also emits excess energy in the form of electromagnetic radiation, which is called gamma (γ) radiation [Von Oertzen, 2017].

OM's unprocessed mineral ore has an average Th concentration of 26 ppm, which is below the Namibian exemption limit as per the stipulations of the Act, i.e. 1 Bq/g for Th-natural. However, the Th concentration of REE minerals is highly variable, and the processing steps result in the successive concentration of the percentage Th contained in the concentrate.

Concentrated NORM sources, as produced by OM, are potentially hazardous and may negatively affect workers who come in contact with it. In addition, they can potentially have a negative impact on members of the public as well as the environment.

Table 1 summarises the main radiation-relevant activities undertaken by OM, and identifies the associated potential radiation hazard and main type of ionising radiation encountered for each potential source.

Table 1: Activities, potential radiation hazard and type(s) of radiation per source

#	Activity	Potential radiation hazards	Type of radiation
1	Field work, incl. from pXRF instrument	• airborne radioactive dust • thoron and thoron progeny • direct external radiation from ore and waste materials • direct external radiation from pXRF instrument	• alpha radiation, internal, by way of inhalation of long-lived radioactive dust (LLRD) and short-lived thoron progeny, and ingestion of LLRD • gamma and X-ray radiation (from pXRF), direct external radiation
2	Primary crushing and conveyance of REE ore		
3	Ore screening and crushing		
4	Concentration of REE content		
5	Disposal of mineral waste ore residues		
6	Drumming of REE concentrate	• radiation from REE concentrate	• direct external gamma radiation
7	Transport and export of REE concentrate		

As per Table 1, the main exposure pathways for concentrated NORM are:

- direct external gamma radiation;
- inhalation of dust arising from the mining and processing of the mineral ore;
- inhalation of thoron / thoron progeny exhaled by Th-bearing mineral ore; and
- ingestion of NORM-bearing dust;

which will be further elaborated in section 1.7 below.

NORM may also contaminate the environment, and thereby become part of various natural pathways in the atmosphere, the geo-sphere, the general biosphere and with it, the human habitat. Radionuclides may become permanently lodged within any one of the environmental niches, where they will eventually decay, while others are transported by means of chemical or mechanical forces from area to another. When employees, contractors and/or members of the public interact with such radionuclides and their decay products, they may be exposed to ionising radiation from such materials and incur an exposure dose.

1.7 EXPOSURE PATHWAYS

This section identifies the main exposure pathways of relevance to OM's operations.

An exposure pathway is the specific route taken by radionuclides from the original undisturbed locality to a receptor. Exposure pathways often lead through the air, soil and water before they reach a receptor.

Generally, one distinguishes between radiation reaching a receptor from outside the receptor, and therefore calls such exposure 'external radiation', and the radiation reaching a receptor from within. The latter is referred to as 'internal radiation', and is the result of the inhalation and/or ingestion of radionuclides [Von Oertzen, 2017].

The most likely pathways of radiation exposure that must be considered when estimating potential exposures of exposure groups are:

- external exposure to gamma radiation and X-rays from the pXRF analyser;
- inhalation of dust;
- inhalation of thoron and thoron and their decay products;
- ingestion of dust and soil because of surface contamination;
- ingestion of contaminated food and water; and
- in case food is derived from areas that have been contaminated with radioactive substances (i.e. NORM dust), the ingestion of such contaminated foodstuff, including vegetables and animal products such as eggs and animal meat.

The potential exposure pathways are summarised and further characterised in Table 2.

Table 2: Types of exposure, exposure pathways, types of radiation and main sources

#	Type of exposure	Exposure pathway(s)	Type of radiation	Source(s)
1	internal	Atmospheric - inhalation	long-lived α	NORM, dust & waste
2	internal	Atmospheric - inhalation	short-lived α	thoron
3	internal	ingestion	α, β and γ	NORM & dust
4	external	direct	γ	NORM, dust & sludge, and XRF analyser
5	external	direct	β	NORM, dust & waste

2 PRE-OPERATIONAL SAFETY ASSESSMENT

2.1 PURPOSE AND SCOPE

This chapter provides a brief overview of the pre-operational assessments of relevance to managing the potential and/or actual exposure to radiation which may occur as part of OM's rare earth production and related activities.

The chapter covers the following:

- Section 2.2 summarises the main aspects regarding the environmental impact assessment prepared by OM and the activities that have an impact on radiation-related issues and actions described in this RMP; and

- Section 2.3 presents a summary of the main best practices of relevance to OM's radiation-related management of REE mining and processing activities.

2.2 OVERVIEW

This section summarises the main aspects regarding the environmental impact assessment prepared by OM and the activities that have an impact on radiation-related issues and actions described in this RMP.

No pre-operational radiological baseline assessment or radiological impact assessment was undertaken prior to OM's REE mining and processing.

Prior to the commencement of full-scale REE concentrate production on site, an Environmental Clearance Certificate will be issued by the Environmental Commissioner in the Ministry of Environment, Forestry and Tourism (MEFT), based on the Environmental Impact Assessment that OM is to submit to the MEFT in 2021.

2.3 BEST PRACTICES OF RELEVANCE TO OM'S RADIATION-RELATED ACTIVITIES

This section presents a summary of the main best practices of relevance to OM's radiation-related management of REE mining and processing activities.

The following main lessons are of relevance to the management of radiation as it pertains to OM's REE mining and production:

- **Dust generation** must be controlled to minimise the total suspended particle concentration in ambient air and the inhalable dust as is typically liberated during the crushing, processing, transport and handling of REE NORM and concentrate.
  Dust mitigation measures are to include:
  - use of spray water to suppress dust during dusty operations, where relevant;

- use of dust suppressants and/or water sprayers to limit the generation of dust on unpaved roads, where relevant;
- strict application of personal hygiene measures to limit the intake and associated ingestion of radionuclides contained in airborne dust and dust that has settled on exposed surfaces; and
- reduction of dust generation from mineral waste facilities.

- **Radiation-related indicators** must be monitored, including associated environmental flows as are elaborated in Chapter 4 and Chapter 5.

- **Environmental indicators** need to be monitored (refer to Chapter 5), including
  - ambient atmospheric dust concentrations, including dust fallout rates, inhalable fraction monitoring as well as ambient thoron concentrations where Th-bearing materials is stored in unventilated storage settings.

3 ORGANISATIONAL ARRANGEMENTS

3.1 PURPOSE AND SCOPE

This chapter describes how the various responsibilities related to the management of potential exposure to radiation are assigned, acted upon and controlled by OM.

The chapter covers the following:

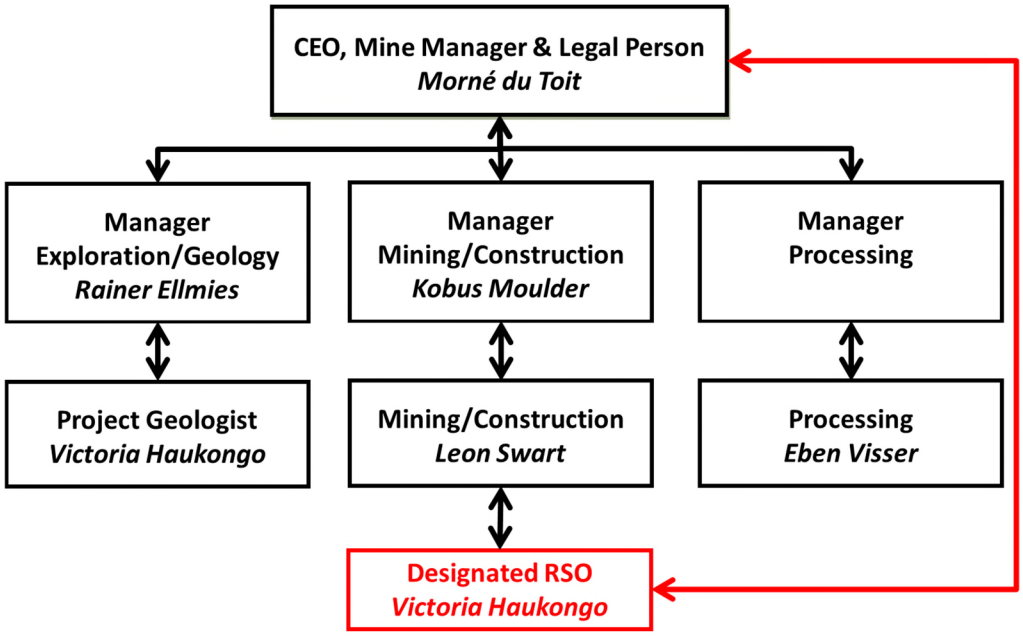
- Section 3.2 describes OM's current organisational arrangements and lines of reporting relevant to the management of radiation;
- Section 3.3 provides an overview of the main roles, responsibilities and reporting function of OM's Radiation Safety Officer (RSO); and
- Section 3.4 describes the interactions related to radiation safety that OM has with its contractors and sub-contractors.

3.2 ORGANISATIONAL STRUCTURE AND REPORTING LINES

This section describes OM's current organisational arrangements and lines of reporting relevant to the management of radiation.

Figure 2 shows an abridged organogram and illustrates the main chain of command of relevance to radiation-related management at OM. Radiation-relevant reporting lines are indicated in red, spanning from the Mine Manager and OM's legal person, Mr Morné du Toit, to Ms Victoria Haukongo as OM's designated Radiation Safety Officer (RSO).

Figure 2: OM's radiation-relevant organogram (status May 2021)



OM has appointed Ms Victoria Haukongo as the company's **designated Radiation Safety Officer (RSO),** refer to the Letter of Appointment as shown in Appendix B.

Ms Haukongo holds a BSc (Honours) in Geology, from the University of Namibia. She has some four (4) years of working experience in the exploration and mining industry. For 2021, Ms Haukongo plans to enrol in the RSO training course offered through the Namibian Uranium Institute, to gain the formal Radiation Safety Officer certificate.

OM retains the services of **Dr Detlof von Oertzen** of **VO Consulting**, who assists the company on radiation-related matters on an ad hoc basis.

3.3 RESPONSIBILITIES OF OM'S DESIGNATED RADIATION SAFETY OFFICER

This section provides an overview of the main roles, responsibilities and reporting functions of OM's designated RSO, taking cognisance of the stipulations as per section 30 of the Atomic Energy and Radiation Protection Act [AEA, 2005].

OM's designated RSO is the person who is in charge of all radiation-related matters at the company, including the day-to-day radiation safety of workers, monitoring and dosimetry, data collection and verification and radiation-related reporting.

OM's RSO has the following radiation-related responsibilities:

- direct OM's radiation management program;
- identify the main sources of radiation and radioactive substances used as part of OM's activities;
- devise, implement and report on all radiation-related monitoring activities;
- implement a data collection drive to capture and codify all radiation-related monitoring data;
- ensure that all radiation-related monitoring activities, including the personal dosimetry and public exposure monitoring, make use of instruments that are fully operational, calibrated and maintained as per manufacturer's guidelines;
- establish, keep current and maintain the company's exposure records and data;
- regularly analyse the company's exposure records to identify any aberrant data;
- investigate, if required, the reason for any anomalous radiation monitoring data, report on such findings, and devise remedial activities;
- report on radiation-related exceedances to senior management;
- provide OM employees and contractors and their personnel with induction and ongoing training related to radiation safety;
- raise awareness within OM as to the management of radiation safety;
- ensure that employees and contractors are and remain fully aware of the protective and remedial actions to minimise any potential exposure to radiation;
- advise the company on matters of radiation safety and protection, including the relevant national legislative requirements;

- regularly train OM employees, contractors and their personnel about current and ongoing protective and remedial activities and requirements to minimise their exposure to radiation;
- ensure that all company regulations pertaining to the management of radiation are regularly reviewed by an external reviewer, to ensure that OM's procedures remain up to date, and that procedural gaps are identified and addressed;
- regularly report to the company's CEO on radiation-related developments at OM;
- ensure that all employees have access to and use personal protective equipment;
- ensure that employees and contractors remain aware and apply the company's procedures and guidelines regarding minimising their exposure to radiation;
- apply for the required permits for the transport of radioactive materials;
- ensure that any radioactive materials are transported in accordance with IAEA guidelines and local regulatory provisions;
- regularly liaise with the National Radiation Protection Authority regarding all matters pertaining to the safe and responsible management of radiation at OM; and
- report to the National Radiation Protection Authority as per their requirements.

3.4 RADIATION SAFETY OF OM'S CONTRACTORS

This section describes the interactions related to radiation safety that OM has with its contractors and sub-contractors.

OM makes use of a variety of contractors to provide services to the company. Such services include conveyance, processing, rehabilitation, water supply, waste disposal, transport, maintenance, sample preparation and electrical services and others. OM is responsible for all aspects relating to radiation safety of its contractors. In this regard, the company's designated RSO forms the link between OM and its contractors and the RSO is responsible for the induction of all contractors coming to site, provided their site visit as affected by radiation-related matters. Before the commencement of duties, contractors and their personnel participate in a general induction session, which are held at OM's site.

Inductions include topics on safety, environmental, radiation safety, personal protective equipment, duty of care, hazard awareness, incident and accident rules, and safe driving. All contractors and their employees are re-inducted as required, usually once every six months. Upon successfully completing an induction session, contractors are issued an induction card, and a pamphlet with the main *do's and don'ts*, including on radiation safety. Contact telephone numbers for the RSO and senior OM personnel are provided. Attendance of induction sessions is recorded, and proceedings are recorded and filed.

Access to OM's site is only granted to contractors who have successfully been indicted. Personal and vehicle data is recorded upon entry to field sites. Adherence to occupational

health and safety at field sites is regularly monitored by the RSO, and non-adherence of OH&S rules is recorded, and reported to the relevant contractor.

OM's RSO ensures that all radiation-related induction, training, control and management functions are undertaken as per the company's guidelines. The occupational monitoring program introduced in Chapter 4 describes how OM monitors the occupational exposure to radiation of its contractors.

Contractors are aware of OM's Occupational Health and Safety (OH&S) guidelines, and with it those pertaining to radiation safety. In turn, they are responsible to ensure that their employees adhere to such guidelines, and that all necessary equipment is in place to allow employees to adequately protect themselves and minimise their potential exposure to radiation. During such inductions, the OH&S guidelines are introduced, which allows contractors and their staff to be adequately trained to take the necessary remedial actions, as and when required.

Compliance with the company's guidelines is monitored by OM's RSO, including the contractor adherence with the occupational health and safety procedures which include stipulations on all relevant aspects relating to radiation safety.

4 OCCUPATIONAL RADIATION PROTECTION PROGRAM

4.1 PURPOSE AND SCOPE

This chapter describes OM's occupational radiation protection program, which is the company's approach to monitor, evaluate, quantify and manage the exposure to radiation arising from its activities at the mining and production site.

This chapter covers the following aspects:

- Section 4.2 identifies the main radiation hazards at OM's operations;
- Section 4.3 summarises the applicable dose limits as per the Namibian Regulations under the Atomic Energy and Radiation Protection Act for occupationally exposed employees;
- Section 4.4 introduces the exposure group and work area classification used in this RMP;
- Section 4.5 provides an overview of the equipment used to monitor occupational exposures because of exposure to ionising radiation;
- Section 4.6 describes how OM monitors the occupational exposure of employees and contractors;
- Section 4.7 describes the personal protective equipment (PPE) and behavioural measures used by OM to minimise the occupational exposure of employees and contractors;
- Section 4.8 describes how OM's radiation management activities are supervised and how the company integrates its radiation-related management efforts into its occupational health and safety program;
- Section 4.9 describes OM's current induction and radiation training programs; and
- Section 4.10 describes how OM manages the radiation-related data and dose records of staff and contractors.

4.2 OM'S RADIATION HAZARDS

This section identifies the main radiation hazards encountered in OM's operations.

Table 3 summarises the activities undertaken at OM's production site, which are of relevance to managing the exposure to radiation, also indicating the type(s) of radiation associated with each such activity, the type(s) of exposure, and the classification of the main exposure groups associated with an activity.

Table 3: Characterising OM's potential radiation hazards

#	Activity	Type(s) of radiation	Type(s) of exposure
1	Field work, incl. exposure from pXRF analyser	long-lived α, as well as α, β and γ radiation	both internal and direct external exposure to radiation
2	Primary crushing and conveyance of REE ore		
3	Ore screening and crushing		
4	Concentration of REE content		
5	Disposal of mineral waste ore residues		
6	Drumming of REE concentrate	γ radiation	direct external radiation only
7	Transport and export of REE concentrate		

4.3 EXPOSURE GROUP AND WORK AREA CLASSIFICATION

This section introduces the exposure group and work area classification used in this RMP.

The potential exposure to ionising radiation, as a result of OM's activities, is based on three distinct but interrelated aspects:

a. human behaviours at or near the sources of radiation, such as time spent near to a source, distance to source(s), shielding used when in the presence of sources, hygienic behaviours and breathing rate

b. the technical processes used to mine, produce, transport, handle and dispose of the sources of radiation, such as drilling and crushing techniques applied, waste disposal processes, rehabilitation activities and others, and

c. the ability to absorb, inhale and/or exhale radioactive substances, and the dynamic processes governing all processes in the natural environment which determine and have an impact on the absorption, storage and transport of radionuclides.

Human behaviours at or near sources of radiation can be significantly influenced, which in turn can limit the exposure to radiation of employees, contractors and/or members of the public. Management of such human behaviours, e.g. by way of awareness raising and using practical mitigation measures, can result in a significant reduction of any potential exposure to ionising radiation. The behavioural measures put in place by OM are further discussed as part of the occupational monitoring program, and is covered in chapter 4.

Technical processes, such as the processing of NORM, the use of spray water to limit dust generation, and the specific handling, transport and storage practices of NORM used by OM are under the direct influence of the company. Therefore, a combination of work processes, control measures and technologies are used to limit the potential exposure of workers to ionising radiation, which at the same time also limits any potential exposure of members of the public because of OM's activities. The occupational exposure management is further elaborated in chapter 4, and is covered in chapter 5.

Natural processes, such as the wind, rain and general weather patterns on the other hand cannot readily be influenced by OM's management. This implies that activities that are directly or indirectly influenced by natural factors must be regularly monitored and optimised as may be necessary. The exposure to ionising radiation arising as a result of not taking such natural processes into account can significantly influence the number and exposure doses of exposed receptors.

4.3.1 Classification of Exposure Groups

Based on the nature of OM's mining and processing activities, **this RMP introduces three distinct exposure groups, namely:**

- **Exposure group EG 1:** persons who are directly involved with the final concentrated REE product that is produced by OM. This RMP refers to members of this occupational group as **exposure group 1, or EG 1**.

  The exposure to radiation of members of this occupational worker group includes
  - external exposure to gamma radiation at or near to the NORM sources, as well as the pXRF Analyser, as well as from OM's REE concentrate; and
  - internal exposure from radioactive dust, thoron and its progeny.

- **Exposure group EG 2:** persons who are *occasionally* exposed to sources of ionising radiation arising as part of the mining and processing activities at OM. This RMP refers to members of this occupational group as **exposure group 2, or EG 2**.

- **Exposure group EG 3:** persons, including members of the public, who voluntarily or by accident encounter radionuclides released into the environment as a result of the mining and processing activities at OM. This RMP refers to members of this general albeit not occupationally exposed group of persons as **exposure group 3, or EG 3**, and considers all members of this group to be members of the public.

4.3.2 Classification of Work Areas

The work areas associated with the three exposure groups introduced in this RMP are motivated by the main activities taking place at OM's mining and processing site.

4.3.2.1 Controlled Areas

The storage shed in which REE concentrate is stored is classified as OM's **controlled work area, i.e. WA 1**. Access to WA 1 is strictly limited to persons classified as EG 1.

4.3.2.2 Supervised Areas

All work areas where mining and processing takes place, except WA 1, are classified as **supervised work areas, i.e. WA 2.** Access to WA 2 is limited to persons classified as EG 1 or EG 2. All persons classified as EG 3 must be accompanied by a staff member classified as EG 1 or EG 2 when entering any work area classified as WA 2.

4.3.2.3 Public Areas

This RMP classifies all **public work areas as WA 3**. These include all work areas that do not require to be radiologically classified, and can therefore be accessed by any person as these are not considered radiologically relevant, including, amongst others, all offices and storage areas that have been classified as being a WA 3 area.

Table 4 presents the classification of exposure groups and work areas as per this RMP.

Table 4: Exposure group and work area classification used in the RMP

Exposure Group Classification	Definition of exposure group	Work Area Classification
EG 1	Occupationally exposed staff or contractors	**WA 1**
EG 2	Occasionally exposed staff or contractors	**WA 2**
EG 3	Member of the public and non-occupationally exposed members of staff or contractors	**WA 3**

4.3.3 Communicating Exposure Group and Work Area Classifications

All staff and contractors commencing duties at OM's mining and processing site receive a site induction, which includes an overview of OM's access rules to work areas and the exposure group of each individual. In this way, employees and contractors are trained in matters relating to radiation safety and occupational health and safety rules prior to being allowed to enter the radiologically relevant work areas WA 1 and WA 2.

4.3.4 Pregnant Female Radiation Workers

Female employees who are classified as EG 1 or EG 2 are encouraged to undergo monthly pregnancy tests to limit any exposure to the unborn child.

OM endeavours to re-assign pregnant EG 1 or EG 2 employees to tasks undertaken by EG 3 employees until the end of the pregnancies.

4.3.5 Minimum Age of OM Staff

OM's company policy stipulates that every staff member and contractor staff must be at least 18 years of age at the commencement of duties at OM. This also implies that no age-specific precautions are not considered necessary.

4.4 OCCUPATIONAL EXPOSURE DOSE LIMITS

This section summarises the applicable dose limits as per the Namibian Regulations [NRPA, 2012] under the Atomic Energy and Radiation Protection Act for occupationally exposed employees [AEA, 2005].

A dose limit is the upper value of the annual (or 5-yearly) exposure dose that a member of a specific exposure group should not exceed during any one year (or a period of five years).

Table 5 summarises the applicable dose limits for persons classified as EG 1, EG 2 or EG 3, based on the Namibian Regulations [NRPA, 2012] under the Atomic Energy and Radiation Protection Act [AEA, 2005].

Table 5: Namibian occupational exposure dose limits

Occupational exposure group	Explanation	Namibian annual effective dose limit [mSv/a]	OM's effective dose limit [mSv/a]
EG 1 & EG 2	For occupationally exposed employees or contractors, a maximum dose of 50 mSv in one year is allowed, provided that the total effective dose of 100 mSv over a 5-year period is not exceeded.	**20**	**5**
EG 3	As per the Namibian Regulations under the Atomic Energy and Radiation Protection Act.	**1**	**1**

4.5 MONITORING EQUIPMENT

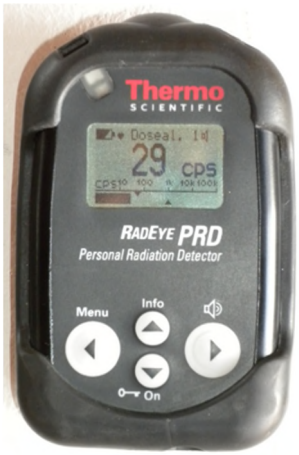
This section provides an overview of the equipment used by OM to monitor occupational exposures as a result of exposures to ionising radiation.

4.5.1 Monitoring Exposure to External Gamma Radiation

Occupational gamma dose monitoring is undertaken using a Thermo Scientific Personal Radiation Detector (PRD), as shown in Figure 3.

Three (3) such instruments are in use, and are regularly calibrated and maintained as per the manufacturer's guidelines using representative service agents authorised by the manufacturer Thermo Scientific.

Figure 3: RadEye PRD instrument to monitor the exposure to gamma radiation at OM



4.5.2 Monitoring Exposure to Long-lived Alpha in Dust

Airborne alpha activity is occasionally monitored by an external service provider, focusing specifically on work areas where the risk of dust inhalation is deemed to be the highest.

4.5.3 Monitoring Exposure to Thoron and its Progeny

Exposure to ambient thoron concentrations is occasionally monitored by an external service provider, in work areas where the risk of dust inhalation is deemed to be the highest. Such areas include enclosed areas, where NORM is stored for longer periods and where the risk for the build-up of thoron may exist.

4.5.4 Monitoring Surface Contamination

Surface contamination is occasionally measured by an external service provider. Such monitoring campaigns also serves as a control measure to ensure the cleanliness in the specific workplaces and to maintain best work practices.

4.6 MONITORING EXPOSURE TO RADIATION

This section describes how OM monitors the occupational exposure of employees and contractors.

Table 6 summarises the monitoring activities for all exposure groups and provides the frequency of such monitoring activities.

Table 6: Summary of OM's occupational exposure monitoring program

Occupational exposure group	Type of exposure	Exposure pathway	Equipment	Frequency
EG 1 & EG 2	Internal	Inhalation of dust	as used by the external service provider	once per year or as required
		Inhalation of thoron & progeny		
		Ingestion of dust		
	External	Direct	Thermo Scientific PRD	PRD is worn by select individuals for a period determined by the RSO
EG 3	Internal	Inhalation of dust	as used by the external service provider	once per year or as required
		Inhalation of thoron & progeny		
	External	Direct	Thermo Scientific PRD	PRD is worn by select individuals for a period determined by the RSO

4.7 PERSONAL PROTECTIVE EQUIPMENT AND BEHAVIOURAL MEASURES

This section describes the personal protective equipment (PPE) and behavioural measures used by OM to minimise the occupational exposure of employees and contractors.

Table 7 summarises the PPE requirements of OM staff and contractors working on site, noting that it excludes PPE that has no relevance for radiation safety.

Table 7: Protective equipment and its use by OM's different exposure groups

Occupational exposure group	Protective equipment	Rationale	Image	Work Area(s) where specific PPE is obligatory
EG 1 & EG 2	dust mask	minimise inhalation of dust		• mining • processing plant • sample preparation
EG 1 & EG 2	overall	minimise potential contamination of exposed surface areas of the body		• all
EG 1 & EG 2	safety glasses	minimise risk of eye damage		• mining • processing plant • drumming
EG 1 & EG 2	safety shoes	minimise risk of injury of feet		• all
EG 1 & EG 2 (as needed)	gloves	minimise direct contact between substances and body		• mining • processing plant • drumming • drum loading

The use of PPE alone is insufficient to minimise the risk of exposure to radiation in the production of rare earth concentrates. OM therefore applies select behavioural measures, refer to Table 8, to complement the use of PPE as is assigned to employees.

Table 8: Behavioural measures used at OM to minimise the exposure to radiation

Behavioural measure(s)	Rationale
• employee/contractor induction program • coaching and mentoring by management • penalties in case of a transgression with site rules	standard measures as per OM's induction program
minimise time in work areas where exposure to radiation is likely to occur	reduce exposure time
maximise the distance between source(s) and person(s)	minimise exposures
use shielding as and when reasonable to use	use all measures that can be reasonably and practically used to minimise potential exposure
Minimise the generation of dust	minimise potential exposure to radioactive dust
Apply hygiene measures, incl. washing of hands and face prior to eating, drinking or smoking	minimise ingestion of dust
Stand up-wind of source(s) of dust	minimise inhalation of dust
Eat and drink in designated areas only	minimise potential ingestion of dust
Smoking is only allowed in demarcated areas and while taking a break or being off-duty	minimise the opportunities for removing dust masks, and limit additional exposure arising from smoking
Leave working clothes and equipment at designated areas for safekeeping and cleaning, and removing dust with compressed air at drill sites	minimise the transfer of dust from place of work into public areas
Do not handle material if not authorised to do so	
Report deviations immediately	minimise opportunities for mistakes
Support staff and contractors to remain safe	actively assist others to stick to established procedures

4.8 MANAGING OCCUPATIONAL EXPOSURE TO RADIATION AT OM

This section describes how OM's radiation management activities are supervised and how the company integrates its radiation-related management efforts into its occupational health and safety program.

Overall, OM's designated RSO is responsible for the implementation of the company's RMP, including the implementation of all regular, occasional and ad hoc activities related to the management of radiation.

The designated RSO's tasks related to the management and monitoring of the occupational exposure groups include the following:

- ensure that all employees and contractors are inducted prior to commencing any work at OM, including on aspects related to radiation safety;
- ensure that the induction training includes all aspects relating to activities aimed at minimising any occupational exposures, including approaches and techniques to minimise the inhalation and/or ingestion of dust;
- regularly raise awareness amongst staff and contractors on matters relating to radiation safety and its management at OM;
- initiate the necessary remedial action if any employee or contractor is likely to exceed the dose limits of his/her exposure group;
- allocate PRDs to members of the exposure groups EG 1 and EG 2;
- ensure that employees and contractors classified as EG 1 or EG 2 are correctly wearing the monitoring instruments;
- ensure that dust emissions are kept as low as reasonably achievable;
- capture, analyse and interpret data from routine monitoring actions;
- receive, analyse and follow up on any unexplainable or otherwise exceptional exposure dose revealed during the analysis of PRD data;
- prepare regular radiation exposure summary reports;
- enter individual exposure data into employees' health surveillance sheet;
- compute average exposure doses for staff and contractors, based on monitored results;
- prepare cumulative exposure doses for all employees and contractors; and
- identify individual exposures that are close to or have exceeded the applicable dose limit.

OM's employee OH&S register includes the following details:

- names of all OM employees;
- date of commencement of duties at OM;
- record of employee's previous employment, provided such employment may have exposed employee to ionising radiation;

- name and address of medical practitioner who undertook pre-employment medical assessment, and who holds relevant employee/contractor medical record(s);
- dates of any medical examinations initiated and/or required by OM, and name and address of medical practitioner;
- attendance record of annual (for field employees) and 2-yearly (administrative employees) medical check-up;
- record of participation at radiation-related induction and training courses; and
- radiation-related data and information.

4.9 RADIATION-RELATED INDUCTION AND TRAINING AT OM

This section describes OM's induction and radiation training program.

Every OM employee and all contractors and their staff participate in a general and a radiation-related induction program prior to the commencement of their duties.

Induction and radiation-related training is offered by the designated RSO or an external service provider, as available. The radiation safety induction program includes the following topics:

- introduction to radiation
- description of the types, sources and uses of radiation
- introduction of the concept of a radiation dose and dose limits
- introduction to the effects of radiation on the human body
- description of the main exposure pathways, and work areas
- radiation safety basics
- hazards related to radiation are generally managed
- description of how an individual can limit the personal exposure to ionising radiation, including a description of the basic hygiene procedures and requirements
- description of the required personal protective equipment to wear
- illustration of how the potential exposure to radiation is monitored at OM
- overview of how radiation management is undertaken at OM, and
- summary of the most important "*do's and don'ts*" to limit the exposure to radiation.

As part of the radiation-related induction and training program, the designated RSO also introduces new employees to the company's occupational health, safety and environment rules, as well as OM's emergency procedures applicable to incidents and accidents. OM's emergency procedures are further described in Chapter 8.

OM re-inducts staff and contractors annually.

4.10 MANAGING RADIATION-RELATED DATA AT OM

This section describes how OM manages the radiation-related data and dose records of staff and contractors.

Radiation-related exposure dose data is summarised in the employee health surveillance register, which also contains specific health information of an employee.

For individuals classified as EG 1 or EG 2, the company's health surveillance register contains the following radiation-related exposure dose data and information:

a. results of the PRD monitoring program;

b. PRD number issued, the period during which the PRD was worn, and gamma exposure data from the PRD;

c. monthly and running total exposure dose for the year, based on the above data; and

d. results of the dust and thoron exposure monitoring program, if available.

Exposure data is stored in a database, which is administered and managed by OM's designated RSO, containing data related to actual exposure doses of staff and contractors.

OM's human resources section supports the designated RSO in the maintenance of the occupational exposure dose database and ensures that it is kept up to date and stored in paper as well as electronic format.

The occupational exposure dose database is kept for such periods as prescribed by the NRPA.

5 PUBLIC MONITORING PROGRAM

5.1 PURPOSE AND SCOPE

This chapter describes OM's rationale for not monitoring public exposures.

The chapter covers the following:

- Section 5.2 summarises the public dose limits of relevance to OM's operations;
- Section 5.3 describes the main exposure pathways of relevance to members of the public and defines the critical group(s) and the types of radiation along the main exposure pathways;
- Section 5.4 identifies the main public risks and risk areas where the potential for exposure to ionising radiation from OM's activities are most significant and quantifies the potential exposure dose at such locations;
- Section 5.5 describes the measures employed by OM to minimise the exposure of members of the critical group and other members of the public that may potentially be affected by the company's activities;
- Section 5.6 describes OM's monitoring activities for potential public exposures; and
- Section 5.7 describes how OM manages the radiation-related public exposure data.

5.2 PUBLIC DOSE LIMITS

This section summarises the public dose limits relevant to OM's operations.

The Namibian public dose limits are summarised in Table 9.

Table 9: Annual public dose limits as per the Namibian Regulations

Type of dose received	Comment	Annual dose limit [mSv/a]
Effective dose	In special circumstances, an effective dose of up to 5 mSv in a single year provided that the average dose over 5 consecutive years does not exceed 1 mSv per year.	1

5.3 EXPOSURE PATHWAYS OF RELEVANCE TO MEMBERS OF THE PUBLIC

This section describes the main exposure pathways of relevance to members of the public and defines the critical group(s) and the types of radiation along the main exposure pathways.

This RMP classified the main exposure groups in section 4.3.1. The exposure group associated with members of the public and those who are potentially affected by OM's activities was defined as **EG 3.**

Members of the EG 3 exposure group are members of the public, including select non-occupationally exposed employees and contractors, who because of their movements close to OM's activity centres may occasionally and/or accidentally be exposed to ionising radiation attributable to OM's activities.

This RMP defines a critical group of members of the public as follows: *members of the critical group are members of the public who are reasonably homogeneous with respect to their exposure to specific radiation sources and exposure pathways, and who are representative of those individuals that are potentially receiving the highest exposure dose along a given exposure pathway from the sources under consideration*.

Applying the above definition results in the identification of the following critical group that is part of the company's public monitoring program: members of staff as well as those members of the public who occasionally visit the mining and production site. Such persons are collectively represented by select staff members who are classified as EG 3, and such persons are considered a proxy for all relevant members of the public.

For the purposes of this chapter, members of the public are considered critical group and their potential dose as a result of exposure to radiation from OM's activities is relevant.

Exposure group EG 3, and therefore the members of the critical group, may potentially be exposed to ionising radiation from OM's activities and is mainly due to direct exposure to gamma radiation as a result of accidentally coming in contact with the REE concentrate, mineral ore, waste material and/or pulp from OM's mining and processing operations.

5.3.1 External exposure from NORM ore and waste

Members of EG 3, and therefore the members of the critical group, can potentially be exposed to direct external gamma radiation from NORM ore and/or waste originating from OM's operations and activities.

5.4 MAIN PUBLIC RISKS AND RISK AREAS

This section identifies the main public risks and risk areas where the potential for exposure to ionising radiation from OM's activities are most significant and quantifies the potential exposure dose at such locations.

Members of the public use the access roads at and close-by OM's mining and processing site may potentially be exposed to ionising radiation from NORM ore/waste materials, and/or inhale dust and/or thoron released as a result of OM's operations. It is noted that the potential exposure to thoron progeny, while it may exist in principle, is likely to be extremely low provided that areas frequented by members of the public are well-ventilated. In addition, while the ingestion of radionuclides from the aquatic pathway may be a potential risk, it is considered very unlikely, and is therefore not considered further.

To quantify the potential exposure of a member of the public requires an understanding of the baseline gamma radiation field prior to the commencement of OM's operations. Such a baseline assessment is unavailable, which implies that the main public risks can only be estimated but not exactly quantified. The process to provide estimates of potential exposures is achieved by considering specific scenarios.

Scenario 1: A member of the public spends approx. 2 000 hours per year in a location immediately adjacent to OM's mining and processing site. The average gamma dose rate at this location is determined to be 0.15 µSv/h, which includes the gamma background contribution of approx. 0.1 µSv/h. The incremental gamma dose rate as a result of OM's activities therefore amounts to some 0.05 µSv/h. This implies that a person exposed to this incremental radiation field is exposed to some 100 µSv/a when spending 2 000 hours at the location mentioned before.

An exposure dose of 100 µSv/a is one-tenth of the public dose limit as has been specified in section 5.2 and is therefore very low. It must be noted however that such an exposure dose excludes contributions arising from the inhalation of radioactive dust and thoron progeny, as may also be present at the receptor location.

Scenario 2: A member of the public ventures onto OM's mining and processing site, and comes close to the NORM heaps stacked at site. The person spends some 3 hours near such material, where he/she is exposed to a gamma dose rate of some 2.5 µSv/h. This dose rate is factor 25 larger than the prevailing background gamma dose rate in the area, amounting to approx. 0.1 µSv/h.

The incremental gamma dose due to exposure to the NORM ore therefore amounts to less than 3 x 2.4 µSv = 7.2 µSv. Such an exposure dose is commonly considered to be a trivial dose as it is below 10 µSv.

It is noted that the incremental exposure dose excludes possible contributions from the inhalation of radioactive dust and thoron progeny. However, in an open mining and processing setting which is mostly well-ventilated the contributions of dust and thoron are mostly low, provided that best practice measures are applied to limit dust emissions and keep workplaces adequately ventilated.

Scenario 3: A truck transporting 900 kg of OM's REE concentrate is involved in an accident with a vehicle that transports several members of the public. The accident leads to the complete loss of load with the drums containing REE concentrate dislodging from their positions as a result of the collision. Two drums with concentrate are severely damaged which leads to the partial release of the concentrate into the environment.

The driver of transport vehicle as well as the members of the public involved spend 2 hours in close vicinity to the dislodged load, including the REE concentrate that was released during the accident. The average gamma dose rate excluding natural background radiation is found to amount to 5 µSv/h.

Individual exposure doses due to the exposure to the REE concentrate amount to 2 x 5 = 10 µSv, which is a trivial dose. As the accident took place in the open, the well-ventilated environment makes it unlikely that radioactive REE concentrate dust was inhaled in appreciable quantities.

5.5 MINIMISING THE EXPOSURE OF MEMBERS OF THE PUBLIC

This section describes the measures employed by OM to minimise the exposure of members of the critical group and other members of the public that may potentially be affected by the company's activities.

Table 10 identifies the main sources of potential exposure of members of the public, and by implication of members of the EG 3 work group, and summarises the mitigation measures applied by OM to minimise such potential exposures.

Table 10: Sources of radiation potentially causing public exposures from OM's operations

Source	Activity generating / exposing radionuclides	Mitigation measure(s)
Dust	NORM mining	• use access control measures to the sites • limit access to the mining and processing site • only allow supervised visitors on site • use area warning signage
	mineral waste removal	• regularly dispose of all mineral waste • cover waste skips with a tarpaulin • only load / offload waste in still-air conditions
	REE preparation and concentration	• limit access to the processing site • allow only supervised visitors at the processing site • use dust suppression measures • strictly enforce the use of PPE
	rehabilitation of site	• limit access to all sites characterised by NORM • use spray water to suppress dust, when required
	vehicle transport on unsurfaced roads	• apply dust suppression measures on dusty roads • use spray water where available • apply speed limit on all unsurfaced roads and tracks
Gamma	all activities	• limit access to site • limit time at site • maximise distance to all on-site radiation sources
NORM samples and waste	accidents / incidents involving transport entity that conveys sources and member(s) of the public	• apply emergency and risk minimisation measures as presented in chapter 8

5.6 MONITORING PUBLIC EXPOSURES

This section describes how OM monitors potential public exposures.

In most cases, exposures of members of the public are the result of exposures to NORM and mineral waste. OM uses a variety of mitigation measures to ensure that dust generated by its on-site operations are minimised. As a result, dust concentrations in air are only monitored when dust suppression measures are shown to be inadequate.

The following gamma monitoring activities are undertaken:

- Identify select staff members that are classified as EG 3;
- Equip such members with PRDs;
- Monitor the gamma exposure doses of such select staff members to infer the gamma exposure doses of the EG 3 cohort.

5.7 MANAGING RADIATION-RELATED PUBLIC EXPOSURE DATA AT OM

This section describes how OM manages the radiation-related public exposure data.

Data from the radiation-related monitoring is captured in OM's radiation database, which is administered and managed by OM's designated RSO.

Public exposure dose records are kept for such periods as prescribed by the NRPA.

6 SAFETY AND SECURITY OF RADIATION SOURCES

6.1 PURPOSE AND SCOPE

This chapter describes the measures taken by OM to ensure that the mineral and non-mineral sources of ionising radiation under the company's control remain safe and secure.

The chapter covers the following:

- Section 6.2 describes the sources of ionising radiation under OM's control; and
- Section 6.3 describes the approaches used by OM to control access to and safe-guard the sources of ionising radiation under its control.

6.2 RADIATION SOURCES UNDER OM'S MANAGEMENT

This section describes the sources of ionising radiation under OM's control.

The following sections identify and describe OM's mineral/non-mineral radiation sources.

6.2.1 Handheld pXRF Analyser

OM has one (1) pXRF Analyser; this instrument has the following technical specifications:

- **Make:** Niton Handheld XRF Analyser
- **Model:** XL3t 950
- **Serial Number:** 111651
- **Manufacturer:** ThermoFisher Scientific
- **Tube voltage:** 50 kilo-Volt maximum
- **Maximum current:** 200 micro-Ampere maximum
- **Application:** mobile mineral analysis.

6.2.2 REE NORM Sources

REE NORM is stored on site, until fully processed. These minerals are stored in form of

- Final product containing REE NORM;
- Mineral feedstock containing REE NORM prior to processing; as well as
- Mineral NORM waste from the processing plant.

6.3 SAFE-GUARDING OM'S SOURCES OF IONISING RADIATION

This section describes the approaches used by OM to control access to and safe-guard the sources of ionising radiation under its control.

6.3.1 Access to OM's pXRF analyser

OM has a handheld X-ray fluorescence instrument (pXRF Analyser) capable of producing ionising radiation. The instrument is housed in a separate room at OM's mining and processing site, and admittance to this room is limited to select OM staff.

6.3.2 Access to the mining and processing site

Access to the mining and processing site is strictly limited to persons having the necessary authorisations and all persons wishing to enter the site must be authorised by OM.

Signage at the access points to the OM site indicate that access to the mining and processing site is for authorised persons only, which minimises the opportunities that unauthorised third parties get in contact with the REE NORM materials. In addition, these access restrictions also serve to enhance the safety and security of operations.

6.3.3 Access to OM's REE concentrate store

OM's REE concentrate, which is the final product that is drummed following on-site processing, is stored for short periods at the company's on-site concentrate store before being transported off-site and exported.

OM's REE concentrate storage facility is manned on a 24/7 basis. Access to the concentrate store is through a gate, which is kept locked and must be manually opened. Access to the store is for authorised personnel only, and signage at the store indicates that access is strictly limited.

7 TRANSPORT PLAN

7.1 PURPOSE AND SCOPE

This chapter describes the transport of OM's REE concentrate from the company's mining and processing site to the port of export. The chapter also summarises how OM handles, packages and labels its REE concentrate prior to it being transported off-site.

This chapter covers the following:

- Section 7.2 describes how OM handles, packages and labels its REE concentrate prior to its conveyance; and
- Section 7.3 describes the transport arrangements used to convey REE concentrate between OM's mining and processing site and the port of export.

7.2 HANDLING, PACKAGING AND LABELLING OF REE CONCENTRATE

This section describes how OM handles, packages and labels its REE concentrate prior to its conveyance.

As OM's REE concentrate has a specific activity exceeding 1 Bq/g (from thorium only), a transport permit from the NRPA is required for the conveyance of this final product.

7.2.1 Organisation

OM's designated RSO is responsible to ensure that the transport of the company's REE concentrate is planned, coordinated, recorded and monitored. To this end, the RSO ensures that

- monthly schedules for transport activities are drawn up;
- a material safety data sheets (MSDS) are available and accompany all consignments;
- transport schedules are coordinated with OM staff and the relevant institutions (NRPA, MME and MEFT) as well as relevant transport firms;
- the required transport permits are timeously applied for from the NRPA;
- the required export permits are timeously applied for from the MME;
- drivers of the entities transporting OM's REE concentrate
  - have a valid transport-rated driver's license
  - have passed a first aid course within the past two years
  - hold a valid OM induction certificate (in case of in-house drivers)
  - are equipped and can operate the emergency communication equipment
  - are fully conversant with the company's emergency procedures

  - are fully conversant with the clean-up procedures elaborated in section 8.4
  - have been trained in the management of incidents and accidents
  - have equipment and have practical experience in containing and removing spills
  - have successfully attended an incident/accident training course within the past six months
- employees/contractors wear the necessary PPE when handling, packing and loading the company's REE concentrate
- employees/contractors preparing OM's REE concentrate for transport follow the relevant procedures for handling and packaging such materials
- employees/contractors handling OM's REE concentrate are familiar with the MSDS
- an up-to-date register is kept of all transport events involving OM's REE concentrate
- all transport procedures and activities are regularly monitored
- spot checks are undertaken to ensure that employees and contractors have an adequate understanding OM's safety procedures
- routine transport movements involving OM's REE concentrate are reported
- spot checks are regularly undertaken at the mining and processing site and the packing site, to determine whether all applicable safety precautions and procedural arrangements are practised, and that the preparation, handling and transport of such materials requires any additional safety or procedural guidance.

7.2.2 Identification

OM's REE concentrate is transported by or on behalf of the company. The product is classified as "radioactive for transport" and therefore requires an explicit clearance from the designated RSO prior to its conveyance.

Prior to its conveyance, OM's designated RSO assesses the contact gamma dose rate, and the radiation levels are recorded in the consignment note.

As per the relevant IAEA guidelines and classification, OM's REE concentrate is classified as "low specific activity – I" (LSA-I) material [2] [IAEA, 2012].

7.2.3 Packaging OM's Final Product

OM's REE concentrate is filled into 200 litre steel drums, which are sealed and packed on wooden pallets, whereafter they are shrink-wrapped. Thereafter, the packed pallets are loaded on a truck for conveyance to a port for export.

[2] Section 409, paragraph a) of the IAEA's Safety Standards, 'Regulations for the Safe Transport of Radioactive Material 2009 Edition', the classification LSA-I applies to (amongst others) "Uranium and thorium ores and concentrates of such ores, and other ores containing naturally occurring radionuclides which are intended to be processed for the use of these radionuclides".

7.3 TRANSPORT ARRANGEMENTS

This section describes the transport arrangements used to convey REE concentrate between OM's mining and processing site and the port of export.

7.3.1 Documentation

OM transports its final product in accordance with the relevant stipulations of the IAEA regulations guiding the safe transport of radioactive materials [IAEA, 2012], and the requirements and stipulations as per the Namibian Regulations.

OM's RSO keeps a register of the REE concentrate transported by or for the company as well as the entities to whom such transport may be outsourced. The transport register includes the

- date of transport;
- destination;
- quantity;
- approximate specific activity and/or contact dose rate of material transported;
- name, affiliation and contact details of entity responsible for transport;
- reference to the radiation safety clearance certificate;
- reference to an incident or accident report, if applicable;
- reference to the NRPA and/or MME mineral export permit, if applicable; and a
- reference to shipment and/or consignment note, if applicable.

7.3.2 Reporting

OM's designated RSO is responsible for the documentation required for the orderly transport of REE concentrate conveyed by or on behalf of the company.

The RSO regularly aggregates such transport data, and prepares relevant summary reports for OM management and the NRPA, as required.

The RSO informs the NRPA of any incidents / accidents involving the transport of OM's REE concentrate.

7.3.3 Monitoring

OM's designated RSO regularly monitors the transport arrangements and their execution to ensure that the company remains compliant with the IAEA transport requirements, and those stipulated by the NRPA and other Government agencies, as applicable.

8 EMERGENCY PREPAREDNESS & RESPONSE PLAN

8.1 PURPOSE AND SCOPE

This chapter describes those elements of OM's overall emergency preparedness and response plan that are of relevance to radiation safety and the optimisation of potential exposures to radiation. The chapter also provides an overview of the procedures applied in case of incidents and accidents involving OM's REE concentrate.

This chapter covers the following:

- Section 8.2 identifies the main risk areas where an accidental exposure to radiation may occur.
- Section 8.3 describes OM's emergency response plan (ERP), including the emergency command and control structure applicable in a radiation-related emergency.
- Section 8.4 describes how OM cleans up REE concentrate spills and deliberate the clean-up procedure.

8.2 MAIN RISK AREAS – ACCIDENTAL EXPOSURE TO RADIATION

This section identifies the main risk areas where an accidental exposure to radiation may occur. It also identifies the main radiation sources that could potentially cause accidental exposure and quantifies the maximum activities of such sources. The section also estimates the maximum scale of any single event in which accidental exposure may occur.

The main risk areas associated with potential accidental exposures to radiation from OM's REE concentrate are related to handling, transporting and conveyance of this final product.

Table 11 lists OM's main radiation-related activities and associated risk areas in which accidental exposure to REE concentrate may potentially occur.

Table 11: Key risks which could lead to accidental exposures to radiation from OM's product

Activity	Main risks
Transport of REE concentrate from the mining and processing plant to a port of export	An incident / accident involving a transport vehicle conveying OM's REE concentrate. Examples include potential occurrences where the a) transport vehicle overturns, or b) is involved in a collision with another vehicle, or c) experiences a complete or partial loss of load during transport. The above incident / accident scenarios may cause a spill of OM's REE concentrate which will then likely result in the uncontrolled release of this product into the environment. If this were to happen, employees, contractors and members of the public may be negatively affected.

OM's REE concentrate, including in the form of airborne inhalable dust, is the main source of radiation that could give rise to accidental exposures of members of the public, employees and/or contractors

The maximum scale of any single incident in which an accidental exposure may potentially occur is related to the size of the transport containers used. In the case of REE concentrate consignments transported from the mining and processing site to Namibia's borders, the maximum load per single consignment is always less than 30 metric tonnes per load.

8.3 OM'S EMERGENCY RESPONSE PLAN

This section describes OM's emergency response plan (ERP), including the emergency command and control structure applicable in a radiation-related emergency.

OM's *Emergency Response Plan* (ERP) describes how the company identifies, communicates and deals with general emergency situations, including the accidental exposure to radiation.

OM's ERP spells out general emergency procedures and guides employees and contractors faced with radiation-related emergencies. Figure 4 shows a schematic diagram depicting the high-level emergency response processes applied by OM.

OM's ERP identifies **road traffic accidents as an emergency** and advises the following response in addition to general procedures:

1. The driver of the transport vehicle or relevant other individual noting that an incident/accident occurred raises the alarm and provides the location of the event;

2. Staff or emergency personnel at the scene must shut down the vehicle as long as it is safe to do so;

3. Vehicles must be made safe first by trained professionals (e.g. crushed or overturned vehicles);

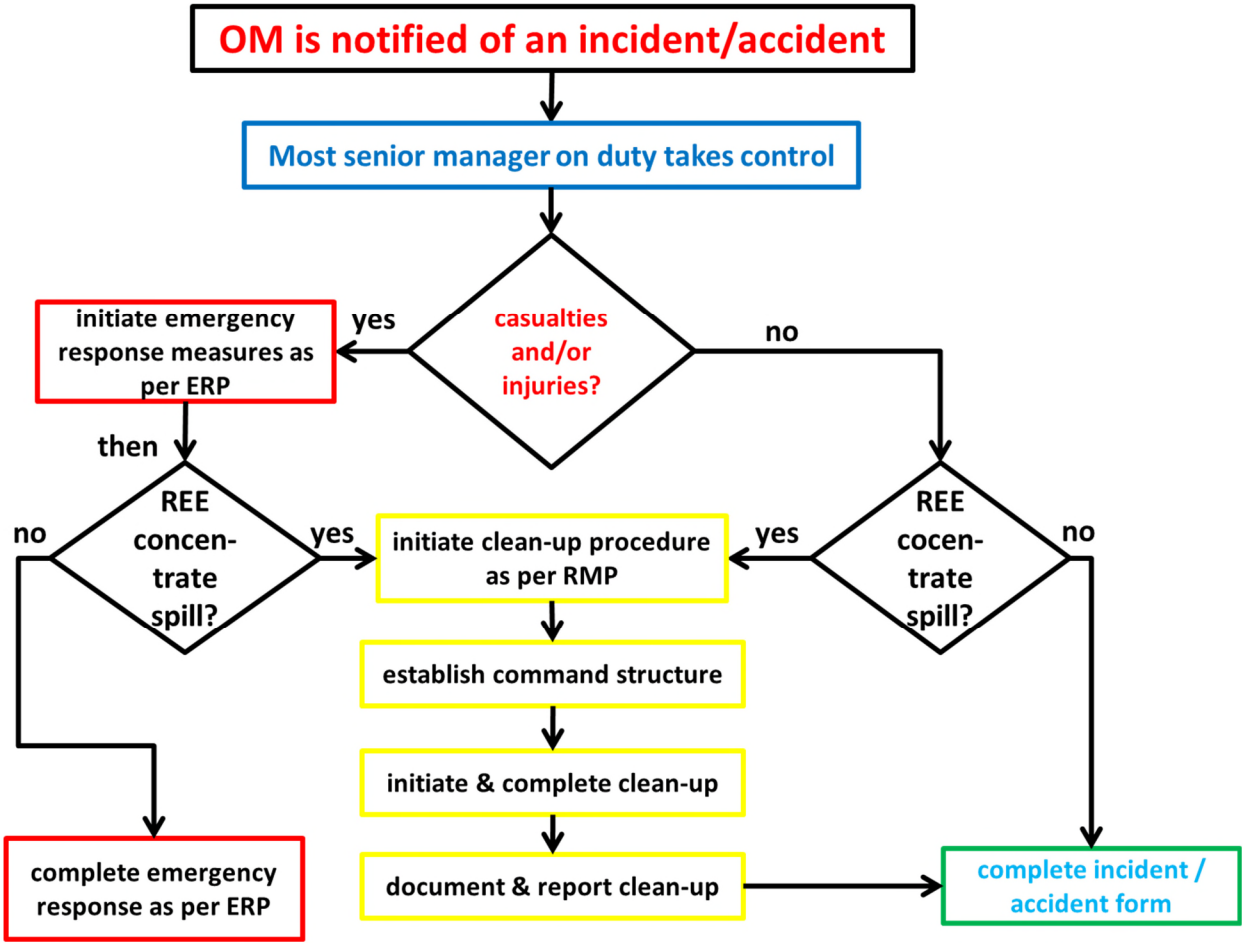
4. Access to the area must be restricted (if possible) and access roads cleared for the emergency response team;

5. Casualties are to be moved to safety – if at all by trained professionals providing medical assistance;

6. Nearby medical centres having appropriate medical capabilities are to be notified where multiple seriously injured casualties are expected to be delivered; and

7. In the event of animal injuries or fatalities, these are to be reported to relevant authorities, and reasonable assistance is to be provided where possible.

Figure 4: OM's emergency decision-making and response process



The following **emergency command and control structure** is established in case of an incident/accident involving spilled REE concentrate:

1. The most senior manager on duty at OM at the time of an incident/accident is responsible for the overall implementation and coordination of appropriate emergency response measures, including in cases of spilled REE concentrate;
2. The emergency response manager sets up command and control structures to ensure that emergency measures can be effectively and efficiently provided;
3. A participant involved in the incident/accident or the emergency manager initiates appropriate emergency responses as per the emergency contact list provided in the ERP;
4. The emergency response manager determines how and to whom information about an emergency is to be communicated and specifies the actions to be undertaken, including those for the clean-up of REE concentrate spills; and
5. The ERP is communicated to all employees and contractors as part of OM's induction program to employees and contractors.

8.4 CLEAN-UP OF REE CONCENTRATE SPILLS AND CLEAN-UP PROCEDURE

This section describes how OM cleans up REE concentrate spills and deliberate the clean-up procedure.

8.4.1 Application of OM's clean-up procedure

In the context of this RMP, OM's clean-up procedure is applied in the following situations:

a) REE concentrate spills occurring during the transport of the product between the mining and production site and a Namibian border post; and

b) REE concentrate spills occurring at OM's REE concentrate production facility.

8.4.2 Identification of a spill

REE concentrate spills may occur as a result of one or several of the following conditions:

- during REE concentrate production and drumming;
- an accident involving a vehicle conveying REE concentrate; and
- loading / off-loading REE concentrate onto/from a transport vehicle.

8.4.3 Notification and command structure

When a REE concentrate spill occurs, OM's emergency procedures are enacted.

The senior manager who is overall in charge of operations and coordinates the response measures informs the designated RSO of the emergency, who assists in all matters relating to the clean-up of spilled REE concentrate.

8.4.4 Clean-up procedure

The final product clean-up procedure has several stages, all of which are obligatory.

8.4.4.1 Assessment

A competent person(s) closest to the spill assesses the extent of the spill and communicates this to the senior manager in charge of the emergency using a mobile telephone, by way of a two-way radio or otherwise.

8.4.4.2 Response decision

Once the scope and scale of the has been assessed, the senior manager in charge decides on the most appropriate actions to be initiated.

The response decision is communicated to persons at the spill, relevant local government entities and/or ministerial bodies, as well as the support crew(s) that will assist in cleaning up the spill.

8.4.4.3 Preparation

In case the senior manager in charge of the emergency decides that the magnitude of the spill warrants assistance from persons other than those at the scene of the spill, the RSO assembles the following emergency clean-up equipment and has these loaded onto a suitable emergency response vehicle:

- Mobile radiation detector, e.g. RadEye PRD
- Camera
- Note pad and two (2) pens
- One hundred (100) 50 kg plastic bags and 200 cable ties (more if the spill exceeds 2 500 kg of REE concentrate)
- Two (2) brooms, two (2) hand brooms, two (2) dustpans and two (2) spades
- Four (4) overalls, four (4) dust masks and four (4) pairs of gloves
- Area demarcation band (red-and-white, five (5) rolls of 100m)
- Ten (10) road-safety cones, bright orange
- Drinking water (10 l)
- Water to suppress dust (~200l) (more if the spill exceeds 2,500 kg)
- Two (2) watering cans

The RSO and other persons as directed by the senior manager in charge of the emergency, depart for the spill site as soon as the clean-up gear has been loaded onto the emergency response vehicle.

8.4.4.4 Clean-up

On arrival at the site of the spill, the RSO or person in charge of the clean-up operation ascertains that no employee, contractor or member of the public requires immediate medical attention. In case such medical attention is required, the person in charge arranges for such medical assistance via OM's head office. Once the immediate health requirements of employees, contractors or third parties involved in the spill have been ascertained, the clean-up of the spill commences.

The clean-up process is undertaken as follows:

1. The RSO and assistants put on all necessary PPE, including dust masks.
2. The RSO documents the spill using the camera.
3. The RSO instructs the assistants to demarcate the complete spill area, and ensures that any vehicle traffic is not unduly constrained, if applicable.
4. If members of the public are involved / affected, the RSO explains the nature of the material involved in the spill, and advises on the necessary measures (washing all contaminated areas on the body, cleaning all clothes) to be taken provided such persons had been in contact with REE concentrate.
5. The RSO records the names and contact details of the individuals involved.
6. The RSO undertakes a brief dose rate assessment of the immediate area surrounding the spill, and records the maximum dose rates measured.
7. The RSO instructs the assistants to commence with the clean-up.
   a. areas where REE concentrate is spilled are cleaned up first, using shovels, brooms and hand-brooms.
   b. Water is used to suppress dust, if required.
   c. The spilled REE concentrate material is gathered and placed into plastic bags, which are then sealed using cable ties.
   d. REE concentrate recovered in this way is placed in a well-ventilated area.
   e. In all clean-up efforts, care should be taken that traffic is not obstructed.
8. The RSO documents the progress of the clean-up using the camera. Notes are taken to record additional info, as required.
9. Once all visible spilled REE concentrate has been removed from a particular area, the RSO monitors whether the gamma dose rate from the affected area corresponds to areas close-by but unaffected by the spill.
10. If the dose rate exceeds the maximum dose rate recorded in areas adjacent to the spill, further clean-up is required, which is undertaken using additional rinsing water and brooms, where necessary.
11. Upon completion, the RSO takes the final dose rate measurements from the site of the spill, and records these. Photos are taken to document the clean-up.
12. The RSO interviews the transport driver, if available, and any other person(s) at the site of the spill. Notes are taken whenever possible.
13. Once the clean-up has been completed, the RSO instructs employees who participated in the clean-up to place their protective clothing into plastic bags, and seals these using a cable tie.
14. The RSO ensures that all persons involved in the clean-up wash their hands and faces before consuming food or water or embarking a vehicle.
15. On completion of the above steps, the RSO provides verbal feedback to the senior manager in charge of the emergency.

8.4.4.5 Documenting and Reporting

1. The senior manager in charge of the emergency instructs the driver of the transport vehicle involved in the spill (if applicable) to compile an incident / accident report, as applicable.
2. The senior manager, RSO and other OM managers, as required, undertake a post-spill analysis, to determine how the spill occurred, and how such an incident / accident is best to be avoided in future.
3. The RSO summarises those aspects of the clean-up operation that require further strengthening in future clean-up operations.
4. The RSO summarises the events leading up to the spill, describes the clean-up operation and formulates recommendations as to how such spills can be prevented in future, and how the clean-up of spills can be made more effective.
5. The RSO estimates the external exposure dose incurred by all individuals who participated in the clean-up.
6. All PPE, tools and equipment used in the clean-up is cleaned.
7. The incident/accident, the company's response measures, lessons learnt and recommendations are presented at a special internal managers meeting. The meeting is to be attended by relevant contractors and experts, as required.

8.4.4.6 Conclusion

The senior manager in charge of the emergency declares the official end of the emergency once all required reports have been received and the necessary follow-up actions have been successfully completed.

9 WASTE MANAGEMENT PROGRAM

9.1 PURPOSE AND SCOPE

This chapter describes how OM manages the radioactive waste from the company's REE mining and production activities, focusing exclusively on NORM waste, i.e. mineral ore and associated waste.

This chapter covers the following:

- Section 9.2 identifies the main radioactive waste products arising from OM's REE mining and processing operations and describes how such waste materials are generated.
- Section 9.3 describes how OM handles, treats and disposes of NORM waste.
- Section 9.4 describes OM's procedures to minimise the generation of NORM waste arising from the company's mining and processing operations.
- Section 9.5 introduces OM's mineral waste management approach and describes how NORM waste is classified, waste quantities are recorded and the company's mineral waste inventory. The section also describes how OM disposes of NORM waste and how it manages the NORM disposal process.

9.2 WASTE MATERIALS ARISING FROM OM'S ACTIVITIES

This section identifies the main radioactive waste products arising from OM's REE mining and processing operations and describes how such waste materials are generated.

Section 1.5 described the various radiation-related activities undertaken by OM. The re-processing of waste rock in particular generates NORM waste and residues that necessitate specific waste management activities as are further described in this chapter.

9.3 HANDLING MINERAL WASTE MATERIALS

This section describes how OM handles, treats and disposes of NORM waste.

The primary NORM waste of relevance in this RMP is in the form of waste ores, pulps, sludges and dust, in addition to gaseous exhalations such as thoron. Table 12 summarises how OM handles, treats and disposes of such waste as well as their main environmental discharge pathways.

Table 12: Handling, treating and disposing NORM waste and environmental discharge pathways

Type of waste material	Handling & treatment	Disposal	Environmental discharge pathway(s)
NORM dust	• Minimise dust, for example by way of wetting and using active dust suppression measures • monitor dust emissions at key sources	• deposited dust is filled into plastic bags • plastic bags are stored in a waste container / waste skip • waste is transported to final disposal site	• dust enters atmosphere and is thereafter deposited onto soils • slow nuclide transport from permanent waste disposal site into adjacent soils and groundwater
crushed and partially pulverised NORM ores, NORM waste and NORM pulps	• collect into plastic bags • monitor the collection and regular disposal of waste disposal bags	• waste materials filled into plastic bags • plastic bags • waste is transported to final disposal site	• slow nuclide transport from permanent waste disposal site into adjacent soils and groundwater
thoron and its progeny	• adequately aerate any closed areas before entry • monitor airborne thoron & thoron concentrations, when required	• ensure sufficient airflow to dilute any build-up of gases • disperse high thoron concentrations by using fans, as required	• dispersion into atmosphere

9.4 MINIMISING WASTE GENERATION

This section describes OM's procedures to minimise the generation of NORM waste arising from the company's mining and processing operations.

Table 12 above summarises the main types of NORM waste produced at OM's operations, the corresponding waste minimisation and handling approaches are listed in Table 13.

Table 13: NORM waste-specific minimisation and handling approaches applied by OM

Type of NORM waste	Waste minimisation and waste handling approaches
NORM dust	• apply partial wetting of dusted surfaces before handling materials • avoid windy conditions when dust generation is likely to occur • ensure that employees wear proper PPE • stand up-wind of main sources of dust • monitor total and inhalable airborne dust concentrations
crushed and partially pulverised NORM ores, NORM waste and NORM pulps	• limit areas where crushed and partially pulverised rock samples are deposited • demarcate areas where NORM waste is temporarily stored • use water sprayers to reduce dust generation where this is possible • apply partial wetting of dusted surfaces before handling NORM waste • use plastic bags to collect small quantities of NORM waste • ensure that plastic bags are removed as soon as possible after filling • use plastic bags to collect crushed/pulverised NORM ore and its waste • close waste bags with a cable ties • temporarily collect waste bags in select waste skips • minimise the time that NORM waste is stored in waste skips • avoid windy conditions when working with crushed and pulverised NORM waste
thoron and progeny	• ensure that storage areas for drill cores and ore samples are and remain well ventilated • minimise the time spent in unventilated or poorly ventilated NORM storage areas • use minimum aeration times before entering the NORM sample store • monitor airborne thoron concentrations

9.5 MANAGING NORM WASTE AND CONTAMINATED MINERAL WASTE

This section introduces OM's mineral waste management procedure and describes how NORM waste is classified, waste quantities are recorded and the company's mineral waste inventory. The section also describes how OM disposes of NORM waste and how it manages the NORM disposal process.

Generally, OM backfills NORM waste onto existing waste rock dumps.

9.5.1 Waste Management Procedure

The following steps describe OM's waste management procedure and illustrates the company's quality assurance program as it relates to the disposal of NORM waste.

9.5.1.1 Responsibility and control

1. OM's RSO oversees the company's NORM waste disposal program and coordinates the disposal of such mineral waste.
2. The RSO ensures that the management of all NORM waste is carried out in accordance with the company's waste, health, environment and safety procedures, as well as the NRPA stipulations and MEFT requirements of relevance to the disposal of NORM waste.
3. The RSO regularly undertakes spot checks at the NORM waste disposal sites.

9.5.1.2 Documentation and reporting

1. The RSO is responsible for the NORM waste inventory and prepares and maintains the company's inventory system.
2. The RSO regularly aggregates the NORM waste disposal data and regularly prepares summary reports for OM's management.
3. The RSO regularly prepares waste management reports for the NRPA and the MEFT, as per OM's radiation-related license conditions and the stipulations of its Environmental Management Plan.
4. The RSO informs the NRPA of incidents / accidents involving the disposal of NORM waste when discharge limits as stipulated in OM's license conditions are exceeded.

9.5.1.3 Monitoring

The RSO and/or OM's Environmental Officer regularly monitor the disposal of NORM waste to ensure ongoing compliance with the above procedure as well as the company's radiation- and environment-related license stipulations and requirements.

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APPENDIX A: LETTER OF APPOINTMENT – OM'S RSO