IMERYS SOUTH AFRICA (PTY) LTD

Annual Rehabilitation Plan

Locality: Groot Marico, North-West

Departmental Ref No: NW30/5/1/2/2/522MR

Date: July 2018

SHANGONI
Management Services (Pty) Ltd

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Date: July 2018

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SHANGONI
Management Services (Pty) Ltd

PROJECT DETAILS

Project Title: Imerys South Africa (Pty) Ltd –Anref: Annual Rehabilitation Plan

Project Number: IME-ANR-17-12-09

Compiled by: Emma Fourie

Date: July 2018

Location: Groot Marico, North-West

Technical Reviewer: Jan Nel

Draft Copy

EXECUTIVE SUMMARY

Shangoni Management Services (Pty) Ltd was appointed by Imerys (South Africa) (Pty) to compile an annual rehabilitation plan for its mining activities Anref mine (hereafter Anref).

The purpose of this document is to supply the Department of Mineral Resources (DMR) with the requested information pertaining to closure planning at Anref, as required by the National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA) and the Mineral and Petroleum Resource Development Act, (Act 28 of 2002) (MPRDA). The contents of this final rehabilitation, decommissioning and closure plan are based on the requirements as stipulated under Government Notice Regulations 1147.

Anref is a refractory mineral mine owned by Imerys South Africa. The mine is situated within Ward 17 of the Ramotshere Moiloa Local Municipality (RMLM) in the Ngaka Modiri Molema District in the North-West Province. The mining right is on Portions 12, 13 and the remainders of Portion 8 & 11 of the Farm Kleinfontein 260 JP, Portion 1 and the former Portions 24, 39, 41, 42 and 44 of the Farm Driefontein 259 JP and the remainder of Portion 9 and the Mineral Area 2 of the Farm Wonderfontein 258 JP.

Since mining has ceased and final rehabilitation of the site has been implemented, this plan will focus on the identification of risks for the post rehabilitation period, as well as identifying corrective actions and maintenance measures for 2018.

The major issue identified during the site visit (14 June 2017) was erosion on the slimes dam and the waste rock dumps. Remediation measures will be implemented, such as in-filling eroded areas and re-seeding bare areas. Visual monitoring of erosion and vegetation will be implemented during the rest of 2018.

DETAILS OF THE EAP

Name of the Practitioner: Shangoni Management Services: Jan Nel / Emma Fourie
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Expertise of the EAP

Name	Qualifications	Summary of experience
Jan Nel	M.Sc. Environmental Management (UFS)	Jan Nel has been actively involved for the past 16 years in environmental management within the mining industry, providing assistance with EMP Compliance, Environmental Impact Assessments (EIA), Financial Provision Calculations, Closure Plans, Rehabilitation Plans, Environmental Management Programme Reports (EMP) and EMP Performance Assessments. Jan is the Technical Director: Rehabilitation and Closure at Shangoni.
Emma Fourie	B.Sc. (Hons): Geography and Environmental Management	Emma obtained a B.Sc. Hons degree in Environmental Management from the University of North West (Potchefstroom). She gained international exposure through participation in Finnish and Russian environmental management courses and conferences in 2010. Emma compiles Closure Plans, Rehabilitation Plans and Financial Provision calculations and reports. She also has experience in EIA, EMP compilation and EMP Performance Assessments.

TIMEFRAMES OF IMPLEMENTATION

Activity	Timeframe
Implementation of current rehabilitation activities (this plan)	July 2017 – July 2018
Implementation of previous rehabilitation activities	

REHABILITATION REQUIREMENTS TABLE

Appendix 3 of the Financial Provision Regulations, 2015 under the NEMA, 1998, lists aspects that must be included in the Annual Rehabilitation Plan. Table 1 indicates the sections where information has been provided as part of this Rehabilitation Plan.

Table 1: Annual rehabilitation plan in terms of Appendix 4 of the NEMA Financial Provision Regulations, 2015

(a) Details of the ─ (i) person or persons that prepared the plan;	Provided above
(ii) professional registrations and experience of the person or persons;	Provided above
(iii) timeframes of implementation of the current, and review of the previous rehabilitation activities;	Provided above
(b) The pertinent environmental and project context relating directly to the planned annual rehabilitation and remediation activity;	Section 1.2 – Project Context Section 1.3 – Environmental Context
(c) results of monitoring of risks identified in the final rehabilitation, decommissioning and mine closure plan with a view to informing rehabilitation and remediation activities;	Section 3 – Risks monitoring informing rehabilitation
(d) an identification of shortcomings experienced in the preceding 12 months;	Section 4 – Shortcomings identified during the preceding 12 months
(e) details of the planned annual rehabilitation and remediation activities or measures for the forthcoming 12 months, including those which will address the shortcomings contemplated in (d) above or which were identified from monitoring in the preceding 12 months, and including ─	Section 5 – Annual Rehabilitation Plan
(i) if no areas are available for annual rehabilitation and remediation concurrent with mining, an indication to that effect and motivation why no annual rehabilitation or remediation can be undertaken;	
(ii) where areas are available for annual rehabilitation and remediation concurrent with mining, annual rehabilitation and remediation activities related to previous disturbance or expected planned impacts and disturbance, as per the mine works programme, in the period under consideration, which should be tabulated and must indicate, but not necessarily be limited to, -- (aa) nature or type of activity and associated infrastructure;	
(bb) planned remaining life of the activity under consideration;	

	(cc) area already disturbed or planned to be disturbed in the period of review;	
	(dd) percentage of the already disturbed or planned to be disturbed area available for concurrent rehabilitation and remediation activities;	
	(ee) percentage of the already disturbed or planned to be disturbed area available as per (dd) and on which concurrent rehabilitation and remediation can be undertaken;	
	(ff) notes to indicate why total available or planned to be available area differs from area already disturbed or planned to be disturbed;	
	(gg) notes to indicate why concurrent rehabilitation will not be undertaken on the full available or planned to be available area;	
	(hh) details of rehabilitation activity planned on this area for the period of review;	
	(ii) the pertinent closure objectives and performance targets that will be addressed in the forthcoming year, which objectives and targets are aligned to the final rehabilitation, decommissioning and mine closure plan;	
	(jj) description of the relevant closure design criteria adopted in the annual rehabilitation and remediation activities and the expected final land use once all rehabilitation and remediation activities are complete for the activity or aspect; and	
	(iii) a site plan indicating at least the total area disturbed, area available for rehabilitation and remediation and the area to be rehabilitated or remediated per aspect or activity;	
(f) a review of the previous year's annual rehabilitation and remediation activities, indicating a comparison between activities planned in the previous year's annual rehabilitation and remediation plan and actual rehabilitation and remediation implemented, which should be tabulated and as a minimum contain —		
	(aa) area planned to be rehabilitated and remediated during the plan under review;	
	(bb) actual area rehabilitation or remediated; and	
	(cc) if the variance between planned and actual exceeds 15%, motivation indicating reasons for the inability to rehabilitate or remediate the full area; and	

(g) costing, including ─	Section 6 - Costing
(i) an explanation of the closure cost methodology;	
(ii) auditable calculations of costs per activity or infrastructure;	
(iii) cost assumptions; and	
(iii) monitoring and maintenance costs likely to be incurred both during the period of the annual rehabilitation plan and those that will extend past the period of the final rehabilitation, decommissioning and mine closure plan, on condition that the monitoring and maintenance costs included in previous annual rehabilitation plans must be accumulated into subsequent versions of the annual rehabilitation plan until such time as the monitoring and maintenance obligation is discharged.	

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Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002). *Republic of South Africa,* s.l.: s.n.

National Environmental Management Act, 1998 (Act 107 of 1998). *Republic of South Africa,* s.l.: s.n.

National Water Act, 1998 (Act 36 of 1998). *Republic of South Africa,* s.l.: s.n.

Shangoni Management Services, 2013. Anref Rehabilitation Plan, s.l.: s.n.

DEFINITIONS

Concurrent rehabilitation

Rehabilitation that occurs during the process of mining as the ore body is mined out in parts of a mine.

Environment

The surroundings (biophysical, social and economic) within which humans exist and that are made up of:

- the land, water and atmosphere of the earth;
- micro-organisms, plant and animal life;
- any part or combination of (i) and (ii) and the interrelationships among and between them; and
- the physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and wellbeing.

Environmental Aspects

Elements of an organisation's activities, products or services that can interact with the environment.

Environmental Degradation

Refers to pollution, disturbance, resource depletion, loss of biodiversity, and other kinds of environmental damage usually refers to damage occurring accidentally or intentionally as a result of human activities.

Environmental Impact Assessment

A study of the environmental consequences of a proposed course of action.

Financial Provision

The insurance, bank guarantee, trust fund or cash that applicants for an environmental authorisation must provide in terms of this Act guaranteeing the availability of sufficient funds to undertake the-

(a) rehabilitation of the adverse environmental impacts of the listed or specified activities;

(b) rehabilitation of the impacts of the prospecting, exploration, mining or production activities, including the pumping and treatment of polluted or extraneous water;

(c) decommissioning and closure of the operations;

(d) remediation of latent or residual environmental impacts which become known in the future;

(e) removal of building structures and other objects; or

(f) remediation of any other negative environmental impacts.

Land use

The various ways in which land may be employed or occupied.

Mine Closure

This entails the process of decommissioning and rehabilitation at the end of a mine's life leading to the issue of a closure certificate in terms of section 24R of NEMA.

Mine closure certificate

The holder of a prospecting right, mining right, retention permit or mining permit must apply to the Regional Manager for a closure certificate within 180 days of the occurrence of closure. No closure certificate will be issued unless the Chief Inspector and the Department of Water Affairs and Forestry have confirmed in writing that the provisions relating to health and safety and management of potential pollution to water resources have been addressed.

Mitigate

Practical measures that are implemented to reduce or avoid negative effects or enhance positive effects of a development action.

Pollution Prevention

Any activity that reduces or eliminates pollutants prior to recycling, treatment, control or disposal.

Rehabilitation

The process of reshaping and re-vegetating land to restore it to a stable condition with a land-use that is appropriate for the particular location and is not associated with any pollution issues such as water pollution.

Rehabilitation plan

Plan describing and detailing the concrete actions that are required to adequately mitigate environmental impacts and achieve rehabilitation outcomes.

Restoration

Restoring full ecosystem services, sustainably.

Rehabilitation

Regain some ecosystem services using the natural environment as baseline.

Reparation

Repair the site to a new sustainable land use.

Revegetation

Re-establish vegetation cover.

Reshaping

Reshape the topography to serve a landscape function.

Significance

A subjective judgement of the importance of an impact to an interested or affected party.

Vegetation

All of the plants growing in and characterising a specific area or region; the combination of different plant communities found there.

Waste

As per the definition of the National Environmental Management: Waste Amendment Act, 2014 - means

(a) any substance, material or object, that is unwanted, rejected, abandoned, discarded or disposed of, or that is intended or required to be discarded or disposed of, by the holder of that substance, material or object, whether or not such substance, material or object can be re-used, recycled or recovered and includes all wastes as defined in Schedule 3 to the Act; or

(b) any other substance, material or object that is not included in Schedule 3 that may be defined as a waste by the Minister by notice in the Gazette, but any waste or portion of waste, referred to in paragraphs (a) and (b), ceases to be a waste:

(i) once an application for its re-use, recycling or recovery has been approved or, after such approval, once it is, or has been re-used, recycled or recovered;

(ii) where approval is not required, once a waste is, or has been re-used, recycled or recovered;

(iii) where the Minister has, in terms of section 74, exempted any waste or a portion of waste generated by a particular process from the definition of waste; or

(iv) where the Minister has, in the prescribed manner, excluded any waste stream or a portion of a waste stream from the definition of waste.

Waste land

Abandoned sterile land (unsafe).

ABBREVIATIONS

BoQ - Bill of Quantities
CPI - Consumer price index
DMR - Department of Mineral Resources
EIA - Environmental Impact Assessment
EMPR - Environmental Management Programme Report
IDP - Integrated Development Plan
I&AP's - Interested and Affected parties
LOM - Life of Mine
Mamsl - metre above mean sea level
MPRDA - Mineral and Petroleum Resource Development Act
NEMA - National Environmental Management Act
SAHRA - South African Heritage Resources Agency

1. INTRODUCTION AND PROJECT BACKGROUND

1.1 Introduction

Shangoni Management Services (Pty) Ltd was appointed by Imerys South Africa (Pty) Ltd. to compile an annual rehabilitation plan as per the new financial provision regulations (GN. No. 1147 promulgated November 2015) for its mining activities at Anref Mine (hereafter Anref). The project entails compiling a plan in line with the requirements as stipulated in Government Notice, Regulation 1147 as promulgated on the 20th November 2015. The final product is required to meet the requirements of the NEMA EIA Regulations, 2014.

As required by Government Notice, Regulation 1147, an annual rehabilitation plan should be drafted. This document contains both the annual rehabilitation plan drafted for 2018 for Anref.

Figure 1 below provides a visual indication of the locality of the mine.

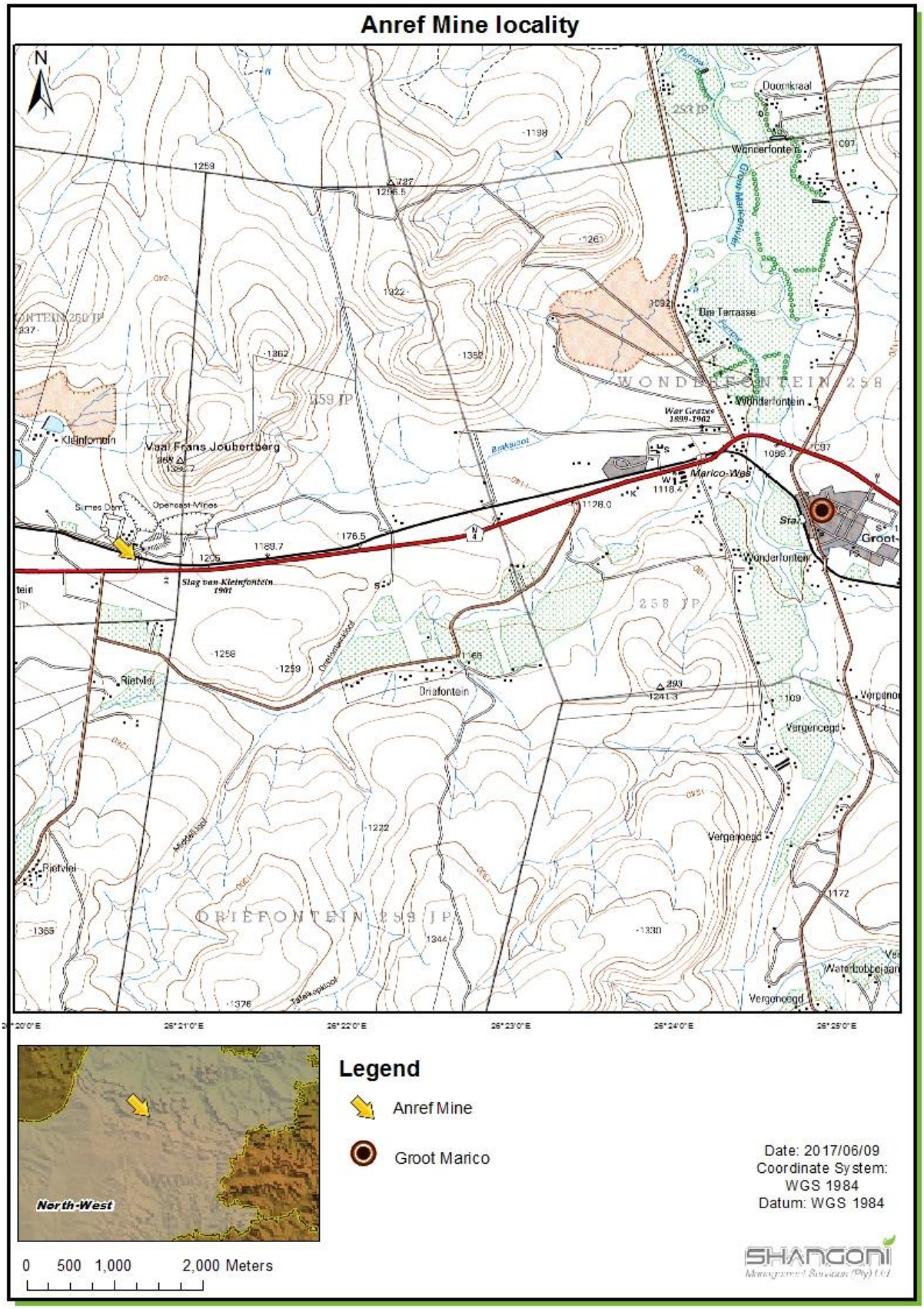


Figure 1: Locality Map

1.2 Project Context

Anref was an Andalusite mine situated west from the town of Groot Marico, which is 25 km east of Zeerust in the North-West Province. The mine has not been operational since 2008. Concurrent rehabilitation has been implemented since operations have ceased, subsequently submitting an application for Environmental Authorisation (Basic Assessment) for decommissioning of a mine in terms of the National Environmental Management Act, 1998 (Act No.107 of 1998) (NEMA) for the authorisation of listed activities contained in GN R 327 of 7 April 2017 (GN R 327), published in terms of Sections 24(2), 24 (5), 24D, 44 and 47(A) (1)(b) of the NEMA, and for a closure certificate in terms of Section 43 of the Mineral and Petroleum Resource Development Act, 2002 (Act 28 of 2002).

1.3 Environmental Context

Table 2 below attempts to summarise the pertinent environmental context relating directly to the planned annual rehabilitation and remediation activities for Anref.

Table 2: Summary of the environmental context

Activity	Context
Cessation of mining	Mining ceased in 2008. Final rehabilitation of the disturbed areas was conducted in 2016, with maintenance and aftercare scheduled for the rest of 2018.
Alien vegetation removal	Alien vegetation should be managed as per NEM:BA. Removal will lead to reduced pressure on water resources and an increase in indigenous vegetation. Improvement of the overall biological diversity of the area.
Erosion management	Erosion occurs on the old slimes dam and rehabilitated waste rock dumps due to ponding of water and storm events. In-filling areas where erosion occurred will promote the re-establishment of vegetation, subsequently contributing to reaching the final land use of grazing.
Re-seeding bare areas	This activity will occur after infilling eroded areas, to achieve the final land use, which is grazing.

2. LEGISLATION AND GUIDELINES APPLICABLE

National Environmental Management Act, 1998 (act 107 of 1998) NEMA.

The promulgation of GN 1147 on the 20th of November 2015 has resulted in a number of new requirements regarding closure and rehabilitation planning and financial provision. The purpose of these regulations is to regulate the determination and making of financial provision as contemplated in the Act for the costs associated with the undertaking of management, rehabilitation, and remediation of environmental impacts from prospecting, exploration, mining or production operations through the lifespan of such operations and latent or residual environmental impacts that may become known in the future.

According to regulation 11, *the holder of a mining right or permit must ensure that a review is undertaken of the requirements for –*

a) *Annual rehabilitation, as reflected in the rehabilitation plan;*
b) *Final rehabilitation, decommissioning and closure of the prospecting, exploration, mining or production operations at the end of life of operations as reflected in a final rehabilitation, decommissioning and mine closure plan; and*
c) *Remediation of latent or residual environmental impacts which may become known in the future, including the pumping and treatment of polluted or extraneous water, as reflected in an environmental risk assessment report.*

Appendix 3 of the regulations identifies the following minimum content of the annual rehabilitation plan:

- Relevant for 1 year – annual update to reflect progress related to rehab and remedial activities in preceding 12 months and plan for next 12 months.
- Contain information to define concurrent rehabilitation and remedial actions and how these relate to the closure vision as per closure plan.
- Indicate what closure objectives and criteria are being achieved.
- Must be measurable and auditable.
- Details of:
    - Person preparing the plan
    - Experience of person
    - Timeframes of implementation of current and review of previous rehabilitation activities.
- The pertinent environment and project context related to planned rehabilitation and remedial activities.
- Results of risk identified in closure plan.
- Identification of shortcomings experienced in preceding 12 months.
- Details of rehabilitation and remedial actions for next 12 months:
    - If no areas are available – motivate,
    - Where areas are available:
        - Nature or type of activity and associated infrastructure;

- Planned remaining life of activity under consideration;
- Area already disturbed or planned to be disturbed in period of review;
- Percentage of planned or already disturbed area available for concurrent rehabilitation;
- Notes on difference if any;
- Details on rehabilitation activities to be undertaken;
- The pertinent closure objectives and performance targets to be addressed in the forthcoming year;
- Description of the closure design criteria.

- Site plan indicating the total area disturbed, area available for rehabilitation and the area to be rehabilitated or remediated.
- Review of the previous year's annual rehabilitation and remediation activities.
- Costing:
  - Methodology.
  - Auditable calculations per activity or infrastructure.
  - Cost assumptions.
  - Monitoring and maintenance cost.

3. RISK MONITORING INFORMING REHABILITATION

The risks assessment identified various risks applicable to the closure and rehabilitation of the mine. Refer to the Closure Plan (Shangoni, 2017) for the full risk assessment. The following risks associated with rehabilitation and remediation activities were taken from the closure plan and linked to the appropriate planned rehabilitation action.

Table 3: Risk identified in the final rehabilitation, decommissioning and closure plan, and how monitoring of these risks informs rehabilitation activities

Risk	Monitoring outcome	Rehabilitation Action Planned
Ponding of water in the quarries as well as on the WRDs and slimes dam	n/a	Paddocks should be constructed on top of the old tailings dam and the waste rock dump. These paddocks should assist in retaining surface runoff to promote vegetation growth as well as to prevent erosion down the side slopes. Rocky bunding in the concentrated drainage areas should decrease the velocity of the runoff to prevent erosion threatening siltation of the water resources
Quarries will not be rehabilitated	n/a	Due to cessation of mining activities, the footprint of the quarries will not increase. The quarries are utilised by a local farmer as drinking source for cattle.
Disturbance of indigenous vegetation and alien vegetation establishment	n/a	Re-seeding bare areas and implementation of alien eradication programme.

4. SHORTCOMINGS IDENTIFIED DURING THE PRECEDING 12 MONTHS

This section is not applicable as this is the first draft of the annual rehabilitation plan as per GN 1147.

5. ANNUAL REHABILITATION PLAN

5.1 Site layout and rehabilitation areas

Refer to Figure 2 below as a representative map indicating the total area disturbed. This Figure contains all the areas which have been disturbed by historic mining activities. The disturbed areas, namely the slimes dam, quarries and waste rock dumps, have already been rehabilitated. The sheds will not be demolished as they are utilised by a local farmer. Al the disturbed areas identified above are scheduled for maintenance as part of annual rehabilitation planning. Refer to Figure 4 for the rehabilitation plan.

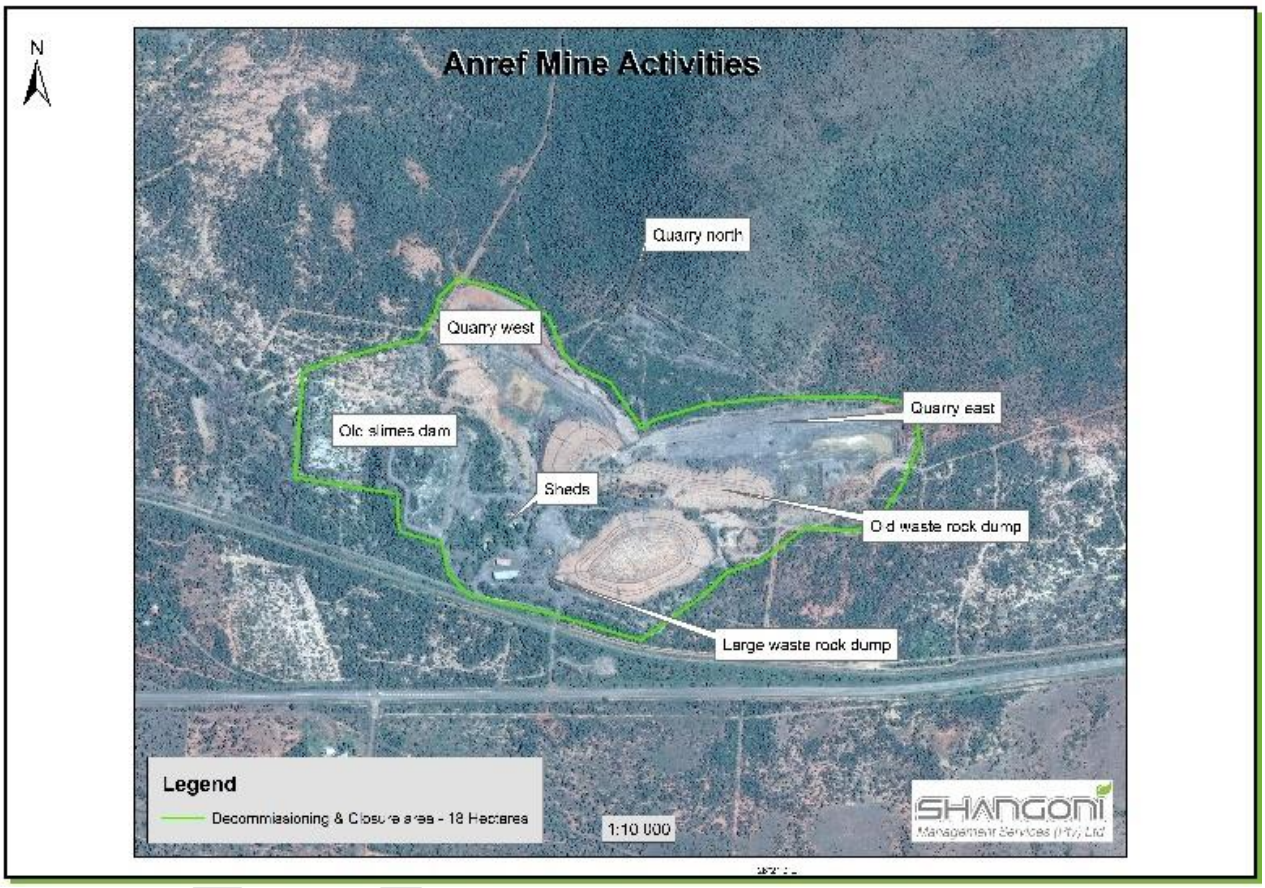


Figure 2: Anref mine layout

5.2 Rehabilitation Approach

5.2.1 Rehabilitation Approach

A rehabilitation plan was compiled for Anref by Shangoni in 2013. The rehabilitation measures identified in this plan has been implemented on site. The following principles are used in the sloping and earth moving component of the rehabilitation strategy, listed in hierarchy of importance:

1. Safety
2. End land-use
3. Functional slope for rehabilitation objectives

4. Optimal cut/fill operation

Safety

The excavated areas are located at the foot of a hill creating high walls with steep benches. These benches are a safety risk for both humans and animals moving on site. It is therefore the first main objective to level all of the benches to a safer, gradual slope.

End Land-use

The end land-use has been identified as livestock watering, grazing and potential game farming. Water bodies in dormant areas that exist due to excavations are already utilised by a farmer for cattle watering. With this end land-use in mind the sloping should be at a safe angle for cattle and other animals to graze on site and provide easy access to the water. Sloping should allow for free drainage and prevent siltation of the water resources. The mine has no available background water quality data. Data must be collected as part of the rehabilitation plan.

Functional slope for rehabilitation objectives

The functionality of the slope is largely determined by the local precipitation, soil type, and vegetation to be used during rehabilitation. The slope should allow for vegetation growth and minimise the risk of erosion caused by accelerated runoff. Evidence on site suggests that vegetation can grow naturally on very steep slopes. However, there are clear signs of erosion on un-rehabilitated side slopes of the waste rock dump and discard dumps.

A functional slope of 18 degrees has been identified as an acceptable angle for rehabilitation of this site. All earth moving operations will therefore be aimed to reach at least 18 degrees. It should be noted that a flatter slope does not necessarily constitute more successful rehabilitation as it will increase the footprint of disturbance. A well-balanced rehabilitation is proposed to optimise topography with the least disturbance of the surrounding natural habitat.

Optimise cut/ fill operation

Rehabilitation in general, and specifically earth moving activities, are expensive and should be planned properly. Ideally, the rehabilitation strategy should allow for making use of the material on site to reshape the desired topography. In order to avoid the need to bring in more material an optimised cut and fill strategy is proposed where equal amount of material is "cut" from the top and "filled" into the depressions.

5.2.2 Closure objectives

The closure vision for Anref is to return the mining right area to a landform that is suitable for potential cattle or game farming and grazing, as well as livestock watering.

5.3 Rehabilitation method

When considering which vegetation to use in rehabilitation, it is important to consider the natural vegetation of the site before mining (if known) and the natural and/or indigenous vegetation of the surrounding properties. This will guide the selection of vegetation species to ensure that vegetation used in rehabilitation is similar to that of the original vegetation and / or similar to surrounding properties. By using species indigenous to the area in which the mine is located, it will also facilitate the creation of habitats similar to those that should occur on the mining site. This will facilitate the re-colonisation of the site by indigenous fauna.

5.3.1 Veld types

Veld types were delineated according to Mucina & Rutherford's "The Vegetation of South Africa, Lesotho and Swaziland". The area of disturbance is situated within the Zeerust Thornveld vegetation units. The northern part is situated within the Dwarsberg-Swartruggens Mountain Bushveld (Mucina and Rutherford). These vegetation types include specific species compositions and vegetation structure. A list of these identified vegetation units is given below.

Table 4: Vegetation identified at Anref (Rehabilitation Plan, 2013)

Trees and shrubs	Grasses
Acacia nolitica;	*Eragrostis pallens;*
Acacia caffra;	*Perotis patens;*
Acacia karroo;	*Loudetia simplex;*
Acacia rehmanniana;	*Schmidtia pappophoroides;*
Acacia robusta;	Various *Aristida* spp;
Acacia tortilis;	*Themeda triandra;*
Terminalia sericea;	*Sporobolus nitens;*
Ochna pulcra;	*Panicum coloratum;*
Grewia flava;	*Digitaria eriantha;*
Pterocarpus rotundifolius;	*Anthephora pubescens;*
Mundulea sericea;	*Stipagrostis uniplumis;*
Dichrostachys cinerea;	*Cymbopogon plurinodis;*
Lannea discolor;	*Elionurus muticus;*
Sclerocarya birrea;	*Heteropogon contortus;*
Albizia anthelmintica;	*Eragrostis superba;*
Kirkia acuminata;	*Brachiaria nigropedata;* and
Rhus geunzii;	*Panicum maximum.*
Rhus divarticata;	
Rhus lancea;	
Rhus pallens;	
Rhus pyroides;	
Dombeya rotundiflora;	
Combretum zeyheri;	

Trees and shrubs	Grasses
Ziziphus mucronata; *Asclepias physocarpa;* *Celtis africana;* *Dodonea viscose;* *Elaenodendron transvaalense;* *Jacaranda mimosfolia;* *Melia azedarach;* *Pentanisia prunelloides;* and *Ximenia caffra*	

5.3.2 Grass species

The selection of grass species to be used in the rehabilitation of the mining area has been compiled using the information from Mucina & Rutherford's "The Vegetation of South Africa, Lesotho and Swaziland' and the Grab-a-Grass Dial provided by the ARC with the supporting document 'Rehabilitation Recommendations after Alien Plant Control' (Campbell 2001). This dial provides guidance with regards to the selection of grass species based on the characteristics of the grass species, the conditions in which they would be planted and the purpose of the vegetation cover (in this case for soil stability and soil cover).

According to Mucina & Rutherford these vegetation types include grass cover; therefore, rehabilitation will focus on the establishment of grass cover, with the species selected being determined by a number of factors. Based on the information provided on the Grab-a-Grass Dial, selection criteria have been identified for use in the selection of grass species. The list provided below gives the selection criteria.

1. The first step is to decide on the final land use of the area. This includes the type of soil binding the grass provides.
2. It is important to know how easily the grass can establish together with the lifespan of the grass, whether it is annual or perennial grass species. This may enhance the establishment of a grass species and help reduce the invasiveness of a grass species.
3. The third step is to consider whether the grass is indigenous and the invasiveness of non-indigenous grasses.
4. The climatic conditions of the site
    I. What is the minimum MAR needed for successful grass establishment?
    II. Is the grass tolerant to drought?
    III. Is the grass tolerant to frost?
5. Soil types where vegetation will be planted.
    I. What type of soil fertility is needed for the grass to grow?
    II. What type of texture is the soil?
    III. Is the grass tolerant to water logging?
6. What type of planting method should be used?
7. What is the planting time of the grass species?

Commercial grasses are commercially available species. Veld grasses are not usually commercially available and are harvested from the veld. Therefore, only small amounts are available. Veld seeds are also usually dormant that requires a period of after-ripening or has a low percentage viability. These grasses are more difficult to establish. It is also important to note that in the veld, grasses do not occur isolated, but are mixed with other seeds. To reduce the chances of mixing the selected seeds with other seeds, choose patches that are dominated by the chosen grass for seeds. EkoRehab of the Potchefstroom University may be referred to for availability of veld seeds. All grass seeds bought should be accompanied by a certificate.

5.3.2.1 End land use aims

It is necessary to decide what the end land use will be after rehabilitation. At present, the aim is to control soil erosion and to return the area to grazing for cattle or game farming. For the controlling of soil erosion, creepers are better than tufts. There are three grass species indicated in the Grab-a-Grass Dial that are creepers; however, all three of these plants are non-indigenous. *Cynodon dactylon* is a category 2 invasive plant. *Chloris gayana* and *Paspalum notatum* are not invasive plants according to Conservation of Agricultural Resources Act no. 43 of 1983 (CARA) and may be used; however, *Paspalum notatum* is highly invasive according to the Grab-a-Grass Dial and will not be used. Grasses that establish easily will also help to control erosion. These grasses are *Eragrostis lehmanniana* and *Eragrostis tef*. *Eragrostis tef* is also non-indigenous but has a low invasiveness according to the Grab-a-Grass Dial. Both *Chloris gayana* and *Eragrostis tef* can be used as barrier lines, which could help with the establishment of other grasses as well as trees and shrubs.

Final land use will be cattle or game farming; therefore, all listed vegetation species will be beneficial for end land use purposes. The grasses included in this rehabilitation plan have a high to very high grazing value except for *Eragrostis lehmanniana which* has a medium grazing value*. Panicum maximum, Themeda triandra, Digitaria eriantha, Cenchrus ciliaris, Eragrostis tef* and *Chloris gayana* can be used as pasture.

5.3.2.2 Establishment and lifespan

As discussed in section 5.3.2.1 above, some grasses establish easier than other grasses. *Eragrostis lehmanniana* and *Eragrostis tef* establish easily. *Digitaria eriantha* establish very slow. All remaining grass species establish moderately easily. Using *Eragrostis lehmanniana* and *Eragrostis tef* during the first season will provide rapid soil holding / binding and helps with the colonization of slower growing plants. None of the grasses indigenously occurring within this area is an annual, therefore *Eragrostis tef,* an annual, is included in the rehabilitation plan.

5.3.2.3 Indigenous and invasiveness

Eragrostis tef and *Chloris gayana* are both non-indigenous; however, theses grasses have a low invasiveness according to the Grab-a-Grass Dial. Due to their good quality for establishment and binding of soil, these grasses will also be used.

5.3.2.4 Tolerance to local climate

The MAR of the area is 400mm to 800mm. All grasses chosen for rehabilitation fall within this criterion. As South Africa is prone to drought, the ability of selected species to endure drought periods is very important. *Brachiaria nigropedata*, *Schmidtia pappophoroides*, *Cenchrus ciliaris* and *Eragrostis lehmanniana* are very tolerant to drought. *Panicum maximum*, *Themeda triandra*, *Digitaria eriantha, Chloris gayana,* and *Eragrostis tef* have a medium tolerance to drought. Frost may occur within May and September. *Schmidtia pappophoroides, Themeda triandra*, *Digitaria eriantha* and *Eragrostis lehmanniana* are tolerant to frost. *Brachiaria nigropedata*, *Chloris gayana* and *Panicum maximum* are medium tolerant to frost. *Cenchrus ciliaris* and *Eragrostis tef* are not tolerant to frost.

5.3.2.5 Tolerance to soil characteristics

The soil has a low water holding capacity but is calcareous or not prone to water logging. The application of organic material may help reduce any water logging that may occur in the soils. The area has medium soil fertility. All vegetation species are tolerant to soil with either low or medium fertility. Topsoil is dominantly loamy sands. All grasses can be planted in this type of soil texture.

5.3.2.6 Time of sowing

Moisture is the most important factor for germination of seed. Seed should be planted after the first reliable rains. All the grasses should be planted in spring. The first rains in the area occur in October; therefore, grass seeds would most likely be planted in October after the first rains. Seed must not be planted in December or January, as this time of the year is too hot for the germination of seeds. *Digitaria eriantha, Cenchrus ciliaris* and *Cenchrus ciliaris* can also be planted in autumn. This must be done at least ten weeks before the expected frost. When grasses are established vegetatively, planting should be done from spring to mid-summer preferably soon after the soils are wetted by good rains. Planting should be done directly after removal of alien plants. Bare soil may lead to erosion, etc. It is also important to keep on with alien control.

Most indigenous grasses have a dormancy period before seeds germinate. Seeds should usually be left to rest for a whole season if obtained from the veld. Seeds purchased from a seed merchant can usually be sowed immediately. Seed should not be stored for more than three years. Seed should be stored in a cool dry place below 25°C away from direct sunlight.

5.3.2.7 Planting Methods

There are different types of planting methods and plant uses. As the Grab-a-Grass Dial include many types of planting and uses; which has no reference to the grass species chosen, only those relevant to the grasses to be used will be described.

Seeds

All of the grasses can be planted by using this method. When planting grasses using seed, the seeds should be mixed with river sand or lime to make it bulkier. Lime also acts as a marker to indicate where sowing has taken place. The type of sowing depends on the terrain. The bulking of seeds are also advantageous of

sowing rate is low or if seed is easily blown by wind. Generally, all seeds must be covered with a thin layer of soil. Sowing should take place to a depth of 0.5cm. Compaction results in the close contact between seeds and soil. This leads to maximum moisture retaining and optimal seedling establishment. All grass species excluding *Digitaria eriantha* chosen, establish easily or medium well. Therefore, it is important to compact the seeds during sowing.

Broadcast Sowing

This type of sowing is suitable for flat ground and gentle slopes of 0% to 10%. This type of sowing involves the evenly spreading of seeds over and area. Steps to take for sowing:

1. Spread either by hand or cyclone seeder.
2. To ensure that the seed is evenly applied, the seed must be divided into two even portions.
3. Two seeders move in the opposite direction with seeds.
4. Areas where indigenous grasses are already established, seed should only be applied to bare soil patches.
5. Control the depth of the seeds by using hand tools. The back of garden rakes can be used to cover seeds or by sweeping with small branches.

Row Sowing

This type of sowing is suitable for shorter, gentle to steep slopes. Sharp-pointed hoes or forks must be used to make shallow furrows. Rows of grass seed will help trap silt and therefore help stabilize the area. The furrows must be space approximately 30-50cm apart on the natural contours. Contours should be made parallel with the horizon and not vertical.

1. Seed must be divided into two equal portions.
2. Cover all furrows with each of these portions. Short sticks should be used to cover the seed. Rows can also be scuffed with the shoe.
3. As with broadcast sowing, only sow in bare areas.

Thatching

Themeda triandra can be planted be means of thatching. The stalks provided by the thatch make mulching material and helps with seeding establishment. This method is labour intensive and seeding establishment is difficult. This type of planting method should only be tried on small areas at a time. Steps to be taken for thatching:

1. Lightly rake the bare soil if the soil crust is smooth or hard.
2. Spread the seed heads of the thatch evenly over the area.
3. Thatch should not be too deep – only 5cm of thatch is needed.
4. Hold thatch down with small amounts of soil, rocks or small branches.
5. Thatch can also be tied into small bundles and placed in the direction of water flow. These bundles of thatch also help with the trapping of soil to accumulate seed and stop soil erosion.

5.3.2.8 Sowing rates

It is important to note; sowing rates should be doubled where possible since many of the seeds may not germinate.

Row sowing rate

Seeds are sown in furrows spaced 30-50cm apart. The seeds are sown over 1ha e.g. 3kg/ha is sown in rows over and area of 100m X 100m.

Broadcast sowing rate

The row sowing rate must be multiplied by 1.5 to give the broadcast sowing rate e.g. 3kg/ha (if row sowing) will be 4.5kg/ha (to convert to broadcast sowing rate).

5.3.3 Barrier lines

Barrier lines are necessary on slopes. This is to prevent soil loss due to water flow. The aim is not to divert water flow but to merely slow it. There are two types of barrier lines that can be used. The first is using loose non-vegetative material and secondly, planting of vegetation. *Chloris gayana* can be used as vegetation barrier lines. *Chloris gayana* should be sowed in three lines of 15cm apart. This is followed by 3 rows of other indigenous grass species also sowed 15cm apart. Barrier lines should be established horizontally as with contour lines.

The following type of material can be used for non-vegetative barrier line:

- Brushwood;
- Branches;
- Thatch; or
- Stones.

Barrier lines using non-vegetative material depend on the slope of the area and the length of the slope. The following calculations must be done to find the slope percentage:

1. Measure the length of the slope from the top to the bottom (a).
2. Measure the difference in altitude from the top to the bottom (b).
3. Divide (a) into (b) and multiply by 100. This will be the slope percentage.

Refer to Figure 3 for the calculations of barrier lines.

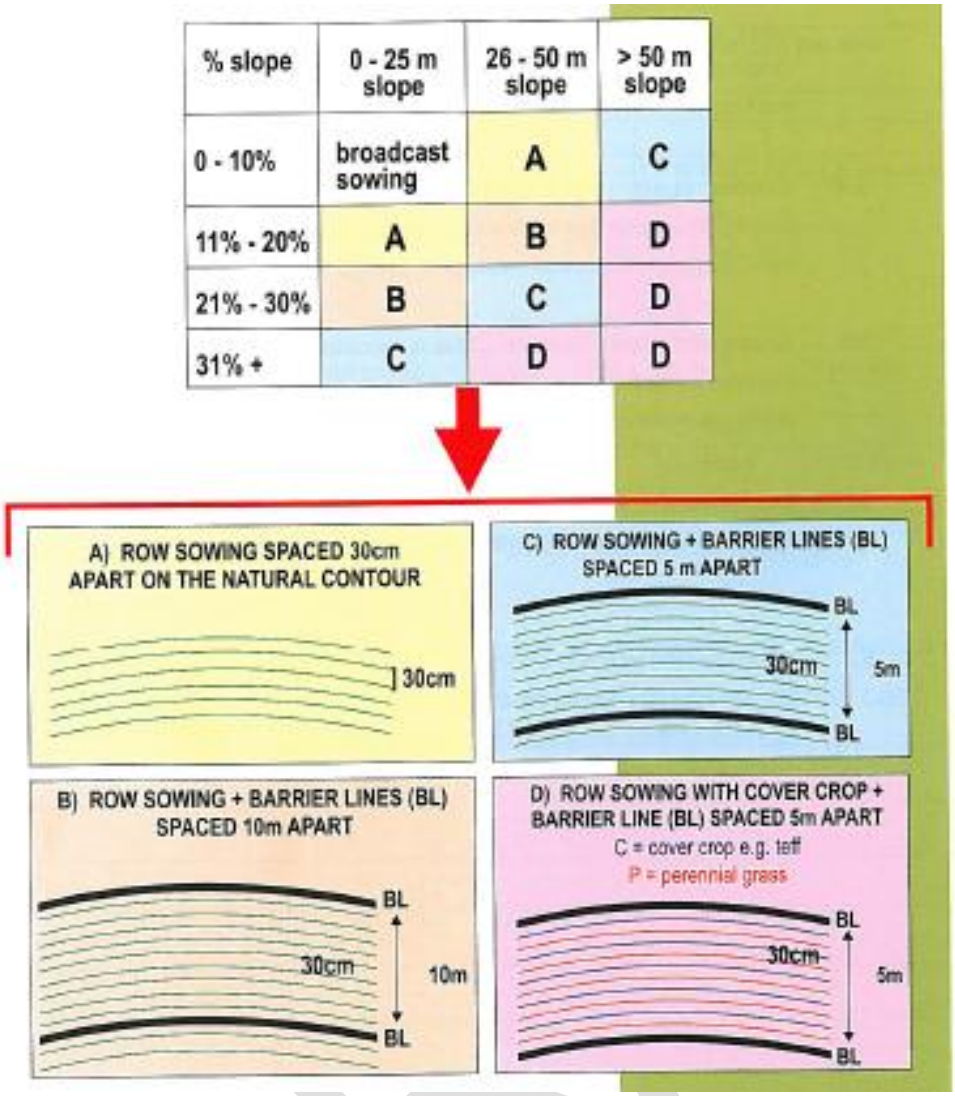


Figure 3: Calculating barrier spacing (Taken by Campbell)

5.3.4 Brushwood

Brushwood helps to prevent the loss of topsoil and seeds after heavy rains or during strong winds. The area is characterised with hot summers and late afternoon showers during this period. Wind is mild, except for short periods during thunderstorms when strong winds may occur. Therefore, brushwood is necessary on the site. Brushwood also breaks down and helps add organic carbon to the soil. Steps to take in placing brushwood on site:

1. Brushwood; which is twigs and small branches should be cut and placed evenly over the area.
2. The brushwood should be trampled to get good contact with the soil. Seeds or soil covering the seeds should not be disturbed.
3. Brushwood should be approximately 0.5-1m high. Too large heaps of brushwood will kill seeds.
4. As the placement of brushwood is labour intensive, only use it in areas where practical.

When placing branches against a slope to control erosion, the broad end of the branches (crown part) must be put uphill. This wider area of twigs and leaves will ensure that more soil and silt will be trapped. Steps to take on steep slopes:

1. Place brushwood horizontal with soil (parallel with natural contours).
2. Fasten brushwood with iron pegs or stabilize by using big rocks and branches.

5.3.5 Tree species

The selection of tree species to be used in the rehabilitation of the mining area has been compiled using the characteristic tree species as found in field. The distribution of tree species depends on factors including fire, frost, etc. to determine the type and density of trees to be planted in the area. The following aspects must be considered:

1. The vegetation type as described by Mucina and Rutherford must be considered. According to the literature, the area is dominated by various *Acacia* species.
2. It is evident on site that many indigenous trees, and many *Acacia* species, do grow on the already disturbed areas and will therefore not be replanted.

5.4 Annual rehabilitation and remediation activities

5.4.1 No concurrent rehabilitation planned

Not applicable, areas have been identified and earmarked for annual rehabilitation and/or remedial activities as per section 5.4.2 below.

5.4.2 Annual rehabilitation and remediation activities (Annual Rehabilitation Plan)

The following description has been included here to assist in understanding some of the descriptions indicated in the financial provisioning Regulations 1147, and how they were interpreted:

- **Area already disturbed or planned to be disturbed in the period of review (cc): "**Total disturbed area" (includes areas which are currently disturbed as well as those areas which will be disturbed during the period of this review);
- **Percentage of already disturbed or planned to be disturbed areas available for concurrent rehabilitation activities (dd): "**Total available area" (available now or during the period of this review);
- **Percentage of already disturbed or planned to be disturbed areas available for concurrent rehabilitation activities on which rehabilitation can be undertaken (ee):** "Available area planned for rehabilitation". This is translated to mean the percentage of the total available area which is available for concurrent rehabilitation now or within the next year.

Table 5 provides the annual rehabilitation plan as indicated in section (ii) of the regulations. Annual maintenance activities related to rehabilitated areas are described in the table and illustrated in Figure 4 below.

Table 5: Annual rehabilitation plan

Rehabilitation Approach:							Objective and success criteria:			Actual area planned for rehabilitation relating to:			Rehabilitation scheduling and costing	
Nature / type of Activity	**Planned life of mine of activity**	**Associated infrastructure**	**Map reference**	**Detail of rehabilitation activity planned on this area for the period of review**	**Frequency**	**Duration of activity**	**Closure objective / Performance target**	**Closure design criteria (Success Criteria)**	**Expected final land use**	**"Total Disturbed area"**	**"Total available area"**	**"Available area planned for rehabilitation"**	**Schedule**	**Cost**
aa	***bb***	***aa***	**iii**	**hh**			**ii**	**jj**	**jj**	**cc**	**dd**	**ee**		
Maintenance and aftercare	n/a	None	Figure 2	Infilling and re-seeding affected areas on rehabilitated waste rock dumps and slimes dam	Once-off activity	1 week	Landscaping should facilitate surface runoff and result in free draining areas.	In-filling of erosion gulley's that appeared after the March 2017 storm event. Reshape, rip and seed areas.	Grazing	Entire mine			2018	R254,852
Monitoring				Vegetation monitoring	Monthly	1 year	During the decommissioning phase the final portions of the mined area must be vegetated, and care should be taken to investigate the total area previously mined to identify areas where the progressive rehabilitation and vegetation has not been totally successful.	Vegetation has established on shaped slopes which limits visual impact. Weed species should not be dominating plant cover and indigenous species should be present.	Grazing				2018	
Monitoring				Erosion monitoring	Monthly or after heavy rainfall event	1 year	Landscaping should facilitate surface runoff and result in free draining areas.	Water drainage flows naturally without pooling or flooding. Minimal erosion where water flows from drainage structures.	Grazing				2018	

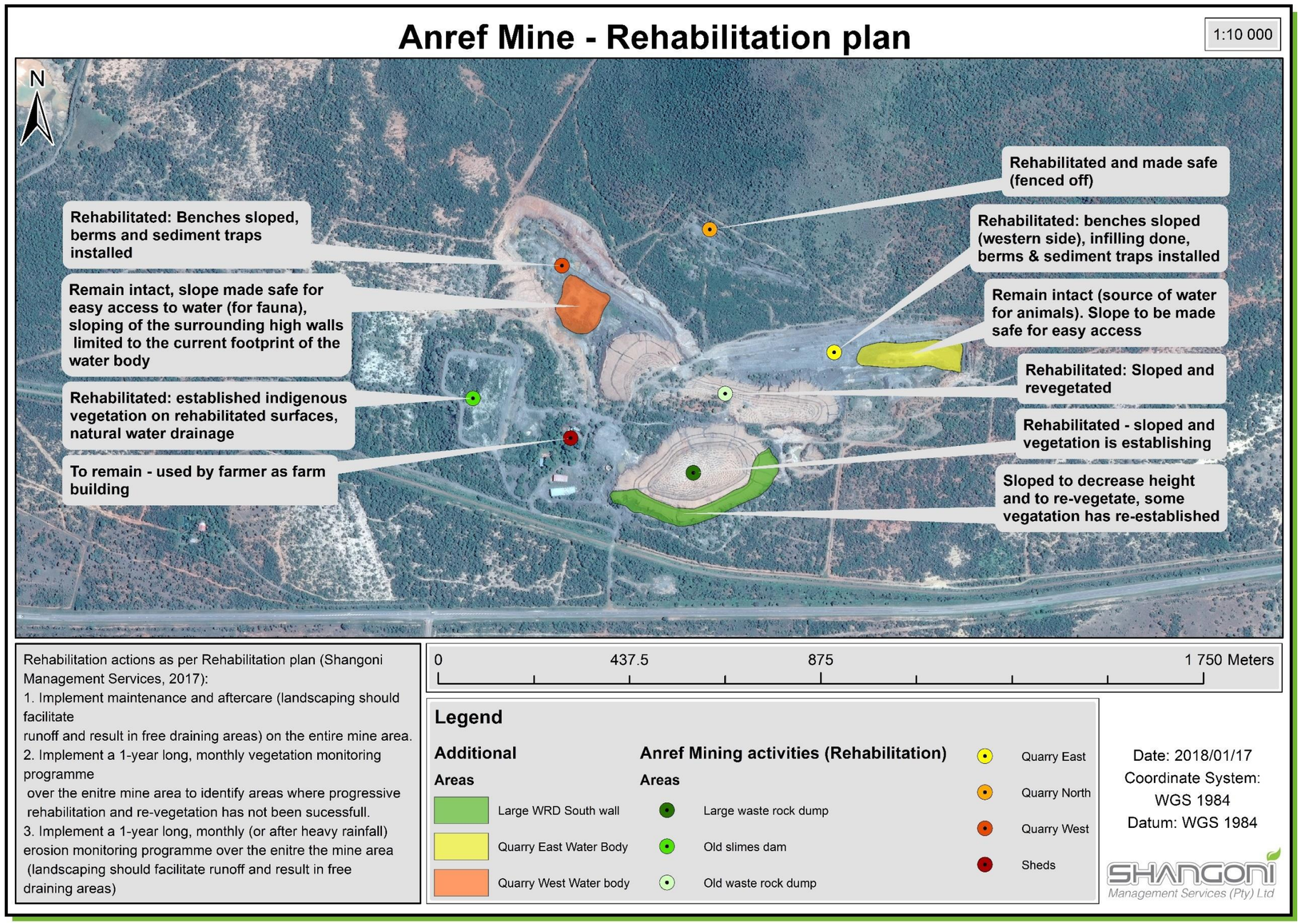


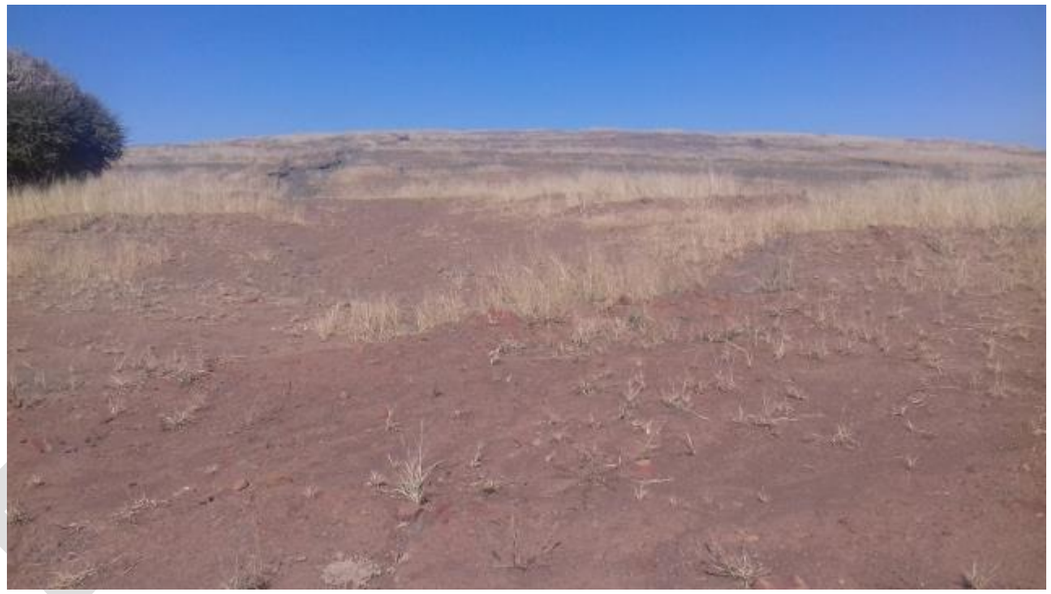
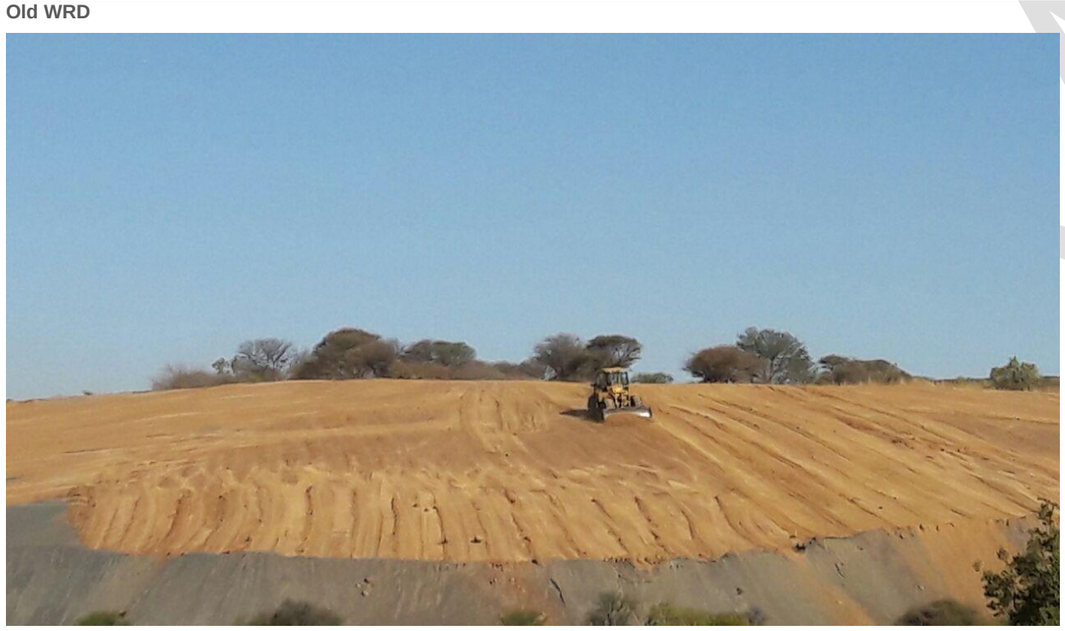
Figure 4: Rehabilitation plan

5.5 Review of previous year's annual rehabilitation and remediation activities

The table below compares photograph taken during the rehabilitation process in October 2016, compared to photographs taken during a site visit on the 14th of June 2017, to illustrate rehabilitation progress.

Table 6: Photographs of rehabilitation progress

October 2016	Progress
Quarry west 	**Quarry west June 2017** 
Quarry west 	**Quarry west June 2017** 

October 2016	Progress
Old WRD 	**Old WRD June 2017** 
Old WRD 	**Old WRD June 2017** 

October 2016	Progress
Old slimes dam 	**Old slimes dam June 2017** 
Large WRD 	**Large WRD June 2017** 

October 2016	Progress
Large WRD 	**Large WRD June 2017** 
Aerial image of old WRD, quarry west and old slimes dam (top left) 	**Google Satellite image 2018** 

October 2016	Progress
Aerial image of large WRD and quarry east	**Google Satellite image 2018**

5.5 Alien vegetation control

Information for this section was obtained from 'Rehabilitation Recommendations after Alien Plant Control' (Campbell, 2001) as well as from Bromilow (2010). The control of alien plants is a very important part of the rehabilitation of the site. Alien control should take place before and during the establishment of vegetation on site. There are three phases included in the control of alien plants. These phases are as follow:

1. The initial control. This is a very drastic reduction or eradication of the existing alien plant species on site.
2. The follow-up control. This phase will take place during the planting of vegetation. Alien vegetation seedlings, root suckers and coppice regrowth must be removed.
3. Maintenance control. This phase occurs when re-vegetation has already take place and alien infestation will no longer be a significant problem. This phase will take place two to three times each year during spring, mid-summer and autumn.

5.5.1 Individual alien vegetation control methods

Control strategies depend on different factor. These factors are:

1. The type of alien plant species;
2. The growth habit of these alien species;
3. The density of alien plants;
4. The terrain;
5. The rehabilitation requirements;
6. The availability of resources; and
7. The urgency / speed of alien control necessary.

There was no alien vegetation survey done on site. Only two alien plant species were observed on site during the site visits. These plants are contained in Table 7 below.

Table 7: Alien species occurring on site

SCIENTIFIC NAME	COMMON NAME	PLANT TYPE
Jacaranda mimosifolia	Jacaranda	Tree
Melia azedarach	Syringa	Tree

These two plants fall in category 3 in terms of CARA, which is a declared invader. No planting is allowed. No trading is allowed. It is prohibited within 30m of the 1:50 year floodline of watercourses or wetlands.

Jacaranda mimosifolia (Jacaranda):

This is a deciduous or semi-deciduous tree up to 22m in height with a rounded spreading crown. Leaves are dark green turning yellow in late autumn or winter. Flowers are mauvish-blue, lilac or rarely white. Flowering occurs from September to November. It originates from South America (North-West Argentina). It is

cultivated for ornaments, shade and timber. The tree invades Savannas, wooded kloofs, rocky ridges, riverbanks. Invasive status: transformer.

There is no biological agent currently available. Investigation into a seed feeding agent is underway. Cut stump treatment with a recommended herbicide (Chopper) is recommended. Use chainsaws, bow saws, brush cutters or cane knives to fell trees and saplings. Stump height should be less than 15cm. Apply chopper mix with hand sprayers, paint brushes or knapsack sprayers at low pressure, using solid cone nozzles to the cut surface of stumps. Do not spray the side of the stumps. Apply herbicide mix up to 1 hour after felling. Estimated volumes of product per ha are for a dense/closed stand of the specific species. For lower infestations volumes should be reduced accordingly.

- Medium: 75% of dense/ closed.
- Sparse: 50% of dense / closed.
- Scattered: 25% of dense / closed.
- Very scattered: 10 % of dense / closed.
- Occasional: 1 % of dense / closed.

For water based applications, actipron super wetter should be added where recommended on the label. Rate per hectare for dense/closed stand is 1.75l/ha. For all water based treatments a suitable dye should be added when necessary to ensure that all target plants are treated. rate per hectare for dense/closed stand - 350ml/ha for diesel based applications, sudan red dye should be added rate per hectare for dense/closed stand 300ml/ha.

Sow grass seed in the bare soil around the stumps immediately after the first reliable rains. Spread brushwood over the buried grass seed to aid seedling establishment.

Melia azedarach (Syringa)
It is a deciduous spreading tree up to 23m in height. The bark on young stems is reddish-brown and smooth. Leaves are deep green, glossy above turning yellow in autumn. Leaves are odd-pinnate and leaflets serrated and sometimes lobed. Flowers are lilac in colour ± 10 mm long with purplish central column in large terminal heavily perfumed sprays. The tree flowers in September to November. Fruits are berry like green in colour turning yellow, thinly fleshly and becoming wrinkled and persisting after the leaves fall. It is cultivated for ornament, shade. It invades Savannah, roadsides, urban open spaces, wastelands, and riverbanks. Its origin is Asia to Australia with the form in Southern Africa is an Indian cultivar. Its invasive status is classified as a transformer. The leaves bark and flowers are poisonous especially when ripe.

Vegetation control can be either mechanical or chemical. Mechanical control includes handpull and stripbark. Samplings and seedlings can be handpulled. Larger trees will be stripbarked. Strip the bark from the waist down to the soil. Bush knifes are more efficient than hand axes. No herbicide is needed for this control method. The trees take approximately 6-18 months to die. As the trees die, replant grasses in the bare soil.

Three types of chemical control can be applied, namely control stumps, basal bark and frill. For stump control; use chainsaws, bow saws, brush cutters or cane knives to fell trees and saplings. Stump height should be less than 15cm. Apply chopper mix with hand sprayers, paint brushes or knapsack sprayers at low pressure, using solid cone nozzles to the cut surface of stumps. Do not spray the side of the stumps. Apply herbicide mix up to 1 hour after felling.

Basal bark method is as follow: Apply Garlon 4 to the basal portion of the stems by mixing the herbicide with diesel. Spray the herbicide from knee high to the soil as well as any expose roots. Use a dye to mark trees already sprayed. Frill method is done using a bush knife or cane. Apply chopper to the cut. Use dye to mark areas already sprayed with herbicide. Sow grass seed in the bare soil around the stumps immediately after the first reliable rains. Spread brushwood over the buried grass seed to aid seedling establishment.

5.5.2 Disposal of alien vegetation

Small amounts of cut material can be left on the site to and adds to organic material provision, however, if seeds are left with the cut material, infestation will occur. Large amounts of cut material must be rolled into heaps and burn. Burning must take place during the wet season to prevent hot fires.

5.5.3 Follow-Up Control

It is very important to do a follow-up control after the initial alien control programme as alien vegetation will re-establish very easily. For the follow-up control the re-establishment must be evaluated to see if there is a dense regrowth or low-medium dense regrowth. Dense regrowth is usually in the form of seedlings, root suckers or stump coppice.

Chemical Control – Foliar Applications

Use knapsack sprayers with flat fan nozzles if the regrowth is uniform and less than 1m tall. This must be done as quickly as possible with a sufficient amount of people. If there are large assessable areas, a tractor-mounted tractor can be used. If there are indigenous species occurring in the same area, use selective registered herbicides only.

Mechanical Control

If plants are uprooted it will result in soil erosion. It is advised to cut the plant so that coppice growth can take place. The coppice growth can then be sprayed with herbicides. Plant grass after the area has been cleared of alien plants to prevent more regrowth. Areas that only have a low-medium dense regrowth must be high priority to control. If such areas are left uncontrolled, high dense regrowth will take place.

Chemical Control

Plant cut and control: Plants should be cut to a height of less than 15cm tall. Herbicide should be applied to the stumps by using hand sprayers, paint brushes or knapsack sprayers. Dye the stumps that are sprayed. This way it is easy to see what plants have been treated. The herbicide should be applied to the cut area of

the stump and not on the sides of the stump. Spray on coppice regrowth: Regrowth can be sprayed to a height of 1m tall. Use knapsack sprayers.

Mechanical Control

Hand pull of seedling can take place in wet soils. Ensure that workers wear gloves for protection as some of the plants are irritants or poisonous.

6. COSTING

The financial provision according to the previous quantum calculation, completed in March 2016 as per DMR quantum calculation guideline, is **R3 827 470.54.**, including P&G and contingency, but excluding VAT**.** This provision is provided by Imerys (Pty) Ltd. by means of a bank guarantee.

The re-calculated quantum using quantity survey (QS) rates (November 2015, escalated to 2017), has been calculated as **R 841,785.81**, including Preliminary and General (P&G) costs, and contingency, excluding VAT. The result is a decrease of R 3,627,931.96.

Reasons for the significant decrease in rehabilitation liability from March 2016 include:

- Rehabilitation of the mine has been completed. The liability that remains is for monitoring and maintenance for the next year, as well as for the rehabilitation of access roads that are currently still in use as part of maintenance.

Table 8: Cost of Physical and Bio-physical closure

Item	DMR maintenance	Ripping	Seeding	Grand Total
Access roads		R 236,751.00	R 190,005.00	R 426,756.00
Maintenance	R 254,851.94			R 254,851.94
Grand Total	R 254,851.94	R 236,751.00	R 190,005.00	R 681,607.94
P&G			13.50%	R 92,017.07
Contingency			10%	R 68,160.79
Sub-total 2				**R 841,785.81**
VAT			14%	R 117,850.01
Grand total				R 959,635.82