Imerys (South Africa) (Pty) Ltd – Anref Operation

Final rehabilitation, decommissioning and mine closure plan

Locality: Groot Marico, North-West

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

Management Services (Pty) Ltd

Imerys (South Africa) (Pty) Ltd

Anref Operations – Rehabilitation, Closure and Decommissioning plan

Locality: Groot Marico, North-West

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

Date: July 2018

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SHANGONI Management Services (Pty) Ltd

PROJECT DETAILS

Department of Mineral Resources (DMR)

Reference No.: NW30/5/1/2/2/522MR

Project Title: **Anref Mine – Final Rehabilitation, Decommissioning and Mine Closure Plan**

Project Number: **IME-ANR-17-02-09**

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 conduct the process of applying for a closure certificate for its mining activities at 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.

Closure Vision: 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.

Concurrent rehabilitation has been implemented since operations have ceased and all rehabilitation completed, and the mine plans to commence with decommissioning after the necessary Environmental Authorisations have been received. Therefore, a decommissioning and closure application will be lodged with the North-West Department of Mineral Resources (DMR).

Decommissioning and closure of the Anref mine includes the biophysical areas:

- Waste rock dumps,
- Slimes dam,
- Access roads, and
- Opencast quarries.

The priority unwanted events rated as high after completion of the environmental risk assessment are summarised in the table below.

Table 1: Summary of significant environmental impacts (negative)

GEOLOGY	
Mine activities - quarries: Mining of the material leads to the extraction of the ore body; therefore, the impact on the geology will be permanent.	H

SURFACE AND GROUNDWATER	
Mine activities: Various activities on the mine could have resulted in soil, surface water and groundwater pollution. The significant activities sources of pollution will be due to seepage and surface water run-off from the slimes dam and the WRDs. The mine has no available surface water or groundwater quality data; therefore, the extent of this pollution (if any) cannot be determined.	H

Mitigation measures have been identified in the Environmental Risk Report. A final rehabilitation assessment was also conducted as part of this application for a closure certificate, with proposed corrective actions identified where necessary.

The financial provision according to the previous quantum calculation, completed in June 2017, is **R 841,785.81**, including P&G and contingency, but excluding VAT. This costing was calculated based on concurrent rehabilitation that has been completed on the mine. This liability budget will be used to complete final corrective or remedial actions as identified in the rehabilitation assessment, as well as to address any concerns raised by the farmer utilising the land.

The Public Participation Process (PPP) will involve engagement with the current land user, as well as neighbours, to determine whether any issues exist that need to be addressed by the mine. This report will be updated subsequent to the conclusion of the PPP.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

REFERENCES

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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 (bio-physical, 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 Impacts

Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's activities, products or services.

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.

Integrated Development Plan (IDP)

A plan aimed at the integrated development and management of a municipal area as contemplated in the Municipal Structures Act (Act 117 of 1998).

Interested and affected parties (IAPs)

A person or an association of persons with a direct interest in a proposed development or existing operation, or who may be affected by such a proposed development or existing operation.

Land use

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

Local community

The communities that live within the same local municipality as that in which the mine is located

Local Economic Development (LED)

The process by which public, business and nongovernmental sector partners work collectively to create better conditions for economic growth and employment generation

Local municipality

A local municipality that shares municipal executive and legislative authority in its area with a district municipality within whose area it falls and which is described in section 155 (1) of the Constitution as a category B municipality.

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.

Portable skills

Technical skills that can be used in a variety of production and operational settings such as welding, plumbing, computer skills, etc. Although the term "portable skills" apply to both generic and technical, the term "portable skills" will be used in this regard to identify technical skills that are transferable across contexts.

Public Participation Process

A process of involving the public in order to identify needs and address concerns, in order to contribute to more informed decision-making relating to a proposed project, programme or development.

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.

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.

Sustainable development

The integration of social, economic and environmental factors into planning, implementation and decision making so as to ensure that mineral and petroleum resources development serves present and future generations.

Technical skills (or "top-up" skills)

Enhance the workers' occupational performance and which are transferable within the Mining Sector such as skills in rock breaking, production, machine maintenance, health and safety, etc. For further reference the term "Sector Transferable Skills" will be used.

Topography

Topography, a term in geography, refers to the "lay of the land" or the physio-geographic characteristics of land in terms of elevation, slope and orientation.

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

DEA	Department of Environmental Affairs
DMR	Department of Mineral Resources
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EMP	Environmental Management Programme
GN	Government Notice
I&AP	Interested and Affected Party
IWULA	Integrated Water Use License Application
IWWMP	Integrated Water and Waste Management Plan
LOM	Life of Mine
mamsl	meters above mean sea level
MPRDA	Mineral and Petroleum Resource Development Act
NEMA	National Environmental Management Act, Act 107 of 1998 as amended
PPP	Public Participation Process
R	Regulation
SLP	Social labour plan
SOER	State of the Environment Report

1 APPLICANT AND ENVIRONMENTAL ASSESSMENT PRACTITIONER

1.1 Details of the applicant

Table 2: Applicant details

Name of Applicant	Imerys (Pty) Ltd: Anref Andalusite Mine
Postal Address	Sanlameerzicht, 259 West Street, Centurion, 0157
Telephone No.	+27 (0)12 643 5880
Fax No.	+27 (0)12 643 1966
Farm name and portion on which the activities take place	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
Co-ordinates of operation	25°35'58.14"S, 26°20'37.09"E

1.2 Details and expertise of the EAP

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

Tel No.: (012) 807 7036

Fax No.: (012) 807 1014

E-mail address: jan@shangoni.co.za / emma@shangoni.co.za

Table 3: EAP qualifications

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.

2 PROJECT BACKGROUND

2.1 Introduction

Shangoni Management Services (Pty) Ltd was appointed by Imerys (South Africa) (Pty) Ltd. to conduct the process pertaining to application for a closure certificate for its mining activities at Anref Mine (hereafter Anref). The project entails compiling a final rehabilitation, decommissioning and closure plan in line with the requirements as stipulated in Government Notice Regulation 1147 (GN R No. 1147), as promulgated on the 20th November 2015. The final product is required to meet the requirements of the NEMA EIA Regulations, 2014.

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 GN R No. 1147.

2.2 Mine background

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, and the mine plans to commence with decommissioning after the necessary Environmental Authorisations have been received.

2.3 Project background

This project will include the compilation of a rehabilitation plan, as well as final rehabilitation, decommissioning and closure plan for Anref. The financial provisioning for the mine will also be reviewed as per the financial provisioning regulations, GN. R No. 1147. The Financial provisioning report for Anref was included in this report, refer to Appendix 3, while the Annual Rehabilitation Plan has been attached as Appendix 4.

The Rehabilitation Plan drafted in 2013 (Shangoni Management Services, 2013) contains some information related to closure objectives and goals. The following documentation was supplied by Imerys and has been considered in the compilation of this plan:

- Rehabilitation Plan, (2013);
- Rehabilitation progress photographs.

The process commenced with the revision of the Financial Provisioning for Anref. A report was compiled containing all the information relevant to closure costs, assumptions made for costing and the cost of premature closure. This information is discussed in this document as part of Section 11. The rehabilitation plan was compiled next, using the assumptions set forth in the financial provisioning report. The rehabilitation plan contains the information required to plan for the annual rehabilitation activities at Anref, specifically maintenance activities on rehabilitated areas. The rehabilitation plan has been attached to this document as Appendix 4.

2.4 Mine locality

2.4.1 Location and Regional Setting of the Mine

Anref Mine is located west from the town of Groot Marico, which is 25km east of Zeerust. 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.

Figure 1 below provides an overview of the location of the mine with regards to the surrounding area and road network, while figure 2 illustrates the mine layout.

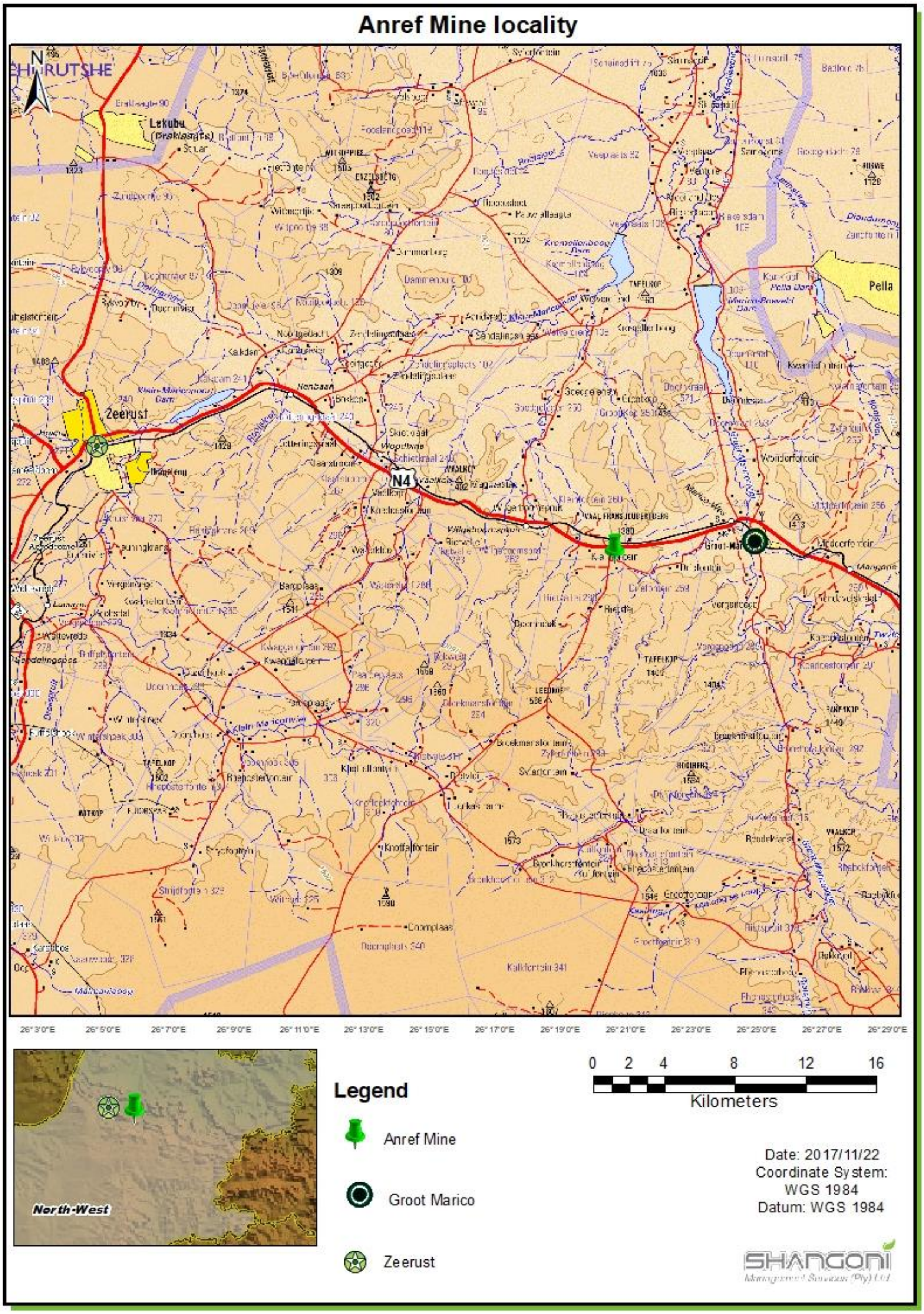

Figure 1: The location and regional setting of Anref

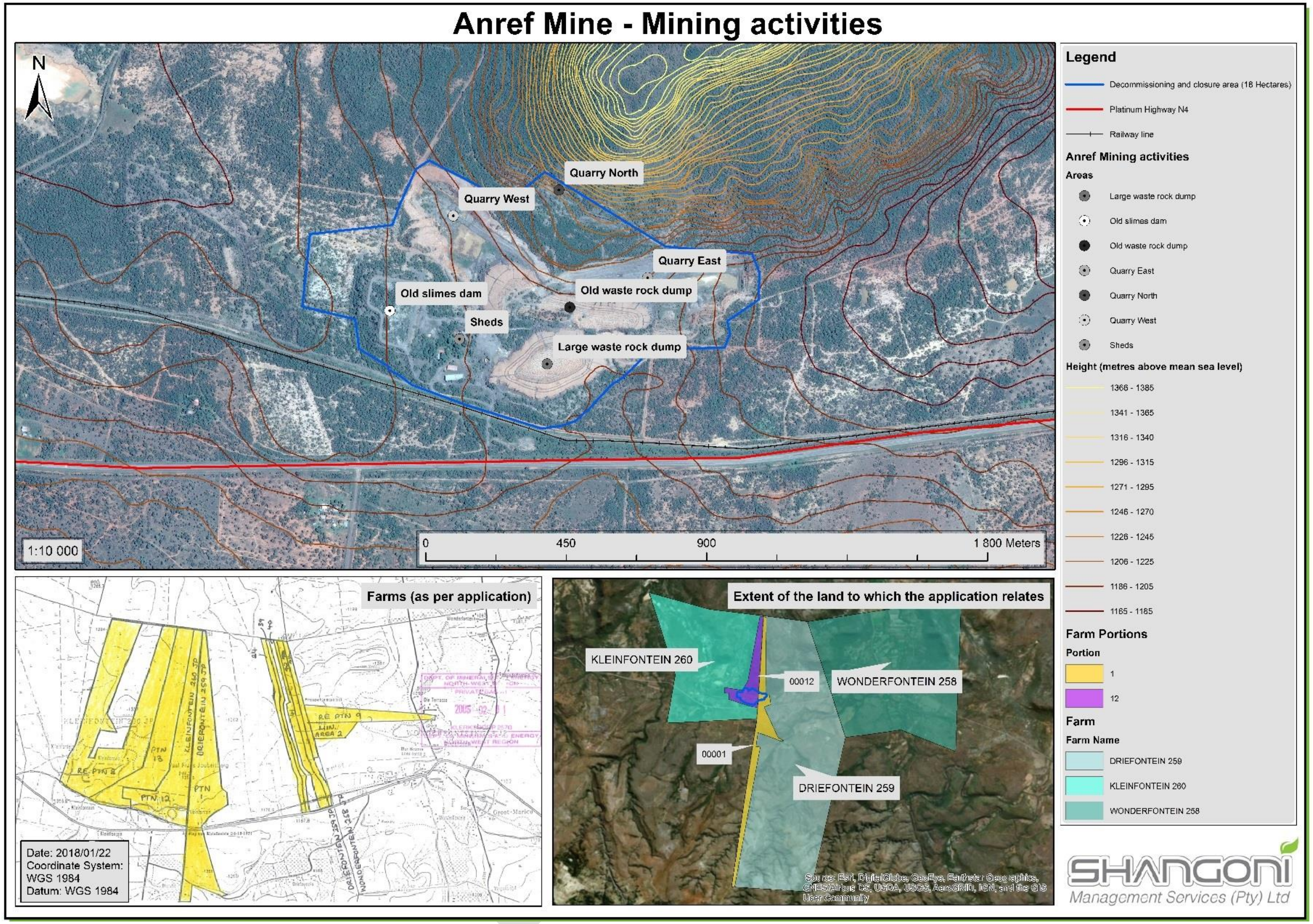

Figure 2: Layout of the mine

2.4.3 Surface Rights, Mineral Rights and Mining Rights Holder

The mineral and surface rights are held by Imerys.

2.4.4 Land Tenure and Use of Immediately Adjacent Land

The neighbouring land is used for game farming, cattle grazing and crops.

2.5 LOM

Mining ceased at Anref and rehabilitation has been completed.

2.6 Process and operation description

The mineral mined was andalusite. There were 5 quarries. No drilling or blasting took place. There was no plant; the ore was transported from the site by haul truck to Rhino Minerals in Thabazimbi. The waste rock dumps (WRDs) have been shaped and seeded, while vegetation established on the slimes dam. There are access roads on the area to and from the quarries and mine residue. There are two sheds at the mine entrance used by a farmer for agricultural activities.

3 CLOSURE REQUIREMENTS

3.1 Legal Requirements

Various South African Acts, together with all regulations published thereunder, are applicable to mine closure, including the following:

- The Companies Act 71 of 2008;
- The Income Tax Act 58 of 1962;
- The Value-Added Tax Act 89 of 1991;
- The National Environmental Management Act 107 of 1998 (NEMA);
- The Mineral and Petroleum Resources Development Act 28 of 2002 (MPRDA);
- The Mineral and Petroleum Resources Royalty Act 28 of 2008 (MPRRA);
- The Mining Titles Registration Act 16 of 1967 (MTRA);
- The National Water Act 36 of 1998 (NWA);
- The National Environmental Management: Air Quality Act 39 of 2004 (NEMAQA);
- The National Environmental Management: Waste Act 59 of 2008 (NEMWA);
- The National Environmental Management: Biodiversity Act 10 of 2004 (NEMBA);
- The National Environmental Management Protected Areas Act 57 of 2003 (NEMPA);
- The Mine Health and Safety Act 29 of 1996 (MHSA);
- The Explosives Act 29 of 1956 (EA);
- The Hazardous Substances Act 15 of 1973 (HSA);
- The Labour Relations Act 66 of 1995 (LRA); and
- The Basic Conditions of Employment Act 75 of 1997 (BCEA).

The above-mentioned list of legislation is not exhaustive and relates to aspects of corporate governance, labour, as well as health, safety and environmental (SHE) management. Provincial and local legislation may also contain legal requirements pertaining to aspects related to mine closure, depending on the locality of the project and the nature of activities to be undertaken as part of the closure process.

The environmental legal requirements for closure pertaining specifically to this final rehabilitation, decommissioning and mine closure plan is prescribed in NEMA, the MPRDA and the regulations published thereunder. Many additional compliance requirements originate from the other Acts listed above, such as notifications and licensing or permit requirements. This discussion is, however, limited to the environmental legal requirements for closure as applicable to the compilation of this final rehabilitation, decommissioning and mine closure plan and is by no means a complete summary of all applicable legal requirements.

In terms of section 43(1) of the MPRDA, the holder of a prospecting right, mining right, retention permit or mining permit remains responsible for any environmental liability, pollution or ecological degradation, and the management thereof, until the Minister has issued a closure certificate to the holder concerned.

An application for a closure certificate must be made to the Regional Manager in whose region the land in question is situated within 180 days of the occurrence of the lapsing, abandonment, cancellation, cessation, relinquishment or completion contemplated in section 43(3) and must be accompanied by the prescribed environmental risk report. The environmental risk assessment (ERA) process to be followed during the development of the mine closure report is prescribed in Section 60 of the regulations published under the new MPRDA (GN 527, 23 April 2004).

The following regulations regarding closure have been published under the MPRDA:

Principals for mine closure under Regulation 56 stipulates that the holder of a prospecting right, mining right, retention permit or mining permit must ensure that the closure process is incorporated throughout Life of Mine, environmental risks and impacts, including residual and latent risks, must be quantified and adequately managed. Furthermore, safety and health requirements should be met according to the Mine Health and Safety Act of 1996, disturbed land should be rehabilitated for sustainable use and all operations have to be closed cost effectively and efficiently.

An application for a closure certificate should be accompanied by the following, according to Regulation 57:

- A Closure plan as contemplated in Regulation 62;
- An environmental risk report according to Regulation 60; and
- A final EMP performance assessment.

Section 24P (1) of NEMA requires that "*An applicant for an environmental authorisation relating to prospecting, exploration, mining or production must, before the Minister responsible for mineral resources issues the environmental authorisation, comply with the prescribed financial provision for the rehabilitation, closure and ongoing post decommissioning management of negative environmental impacts.*" The Financial Provisioning Regulations, 2015 was published in GN R1147 in GG 39425 of 20 November 2015. In terms of Regulation 2, "*The purpose of these regulations is to regulate the determination and making of financial provision 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 impacts that may become known in the future*." There is an extended transitional period of 39 months after the commencement of these Regulations for alignment of the review, assessment and adjustment of financial provision, as well as the submission of certain documentation, with these regulations.

In terms of regulation 6 of the Financial Provisioning Regulations, 2015, "*An applicant must determine the financial provision through a detailed itemisation of all activities and costs, calculated based on the actual costs of implementation of the measures required for-*

a) annual rehabilitation, as reflected in an annual rehabilitation plan;

b) final rehabilitation, decommissioning and closure of the prospecting, exploration, mining or production operations at the end of the 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."

3.2 Corporate requirements

Imerys has incorporated environmental focus into their sustainable development programme. The company works to reduce their environmental impact and use natural resources efficiently through the adoption of management systems for the main environmental aspects of their activities.

The company has further development a post mining rehabilitation protocol that requires operations to prepare their quarries' future and describes the restoration methods that will be applied during the site's operating life and when it closes.

3.3 Principle components of the Closure Plan

The Closure Plan consists of the following components:

- Closure objectives and rehabilitation plan;
- Closure and decommissioning plans;
- Risk assessment; and
- Financial provisioning required to implement the above plans.
- Appendix 4 of the Financial Provision Regulations, 2015 under the NEMA, 1998, lists aspects that must be included in Closure Plans. Table 3 indicates the sections where information has been provided as part of this Closure Plan:

Table 4: Contents of a Closure Plan in terms of Appendix 4 of the NEMA Financial Provision Regulations, 2015

(a) details of– (i) the person or persons that prepared the plan; (ii) the professional registrations and experience of the preparers;	Section 1
(b) the context of the project, including– (i) material information and issues that have guided the development of the plan;	Section 2 - Project background Section 3 – Closure legislation and other requirements

(ii) an overview of— (aa) the environmental context, including but not limited to air quality, quantity and quality of surface and groundwater, land, soils and biodiversity; and (bb) the social context that may influence closure activities and post-mining land use or be influenced by closure activities and post-mining land use;	Section 4 – State of environment Section 7 – Physical, bio-physical and social closure assessment
(iii) stakeholder issues and comments that have informed the plan;	Section 7.3 – Social closure assessment
(iv) the mine plan and schedule for the full approved operations, and must include– (aa) appropriate description of the mine plan; (bb) drawings and figures to indicate how the mine develops; (cc) what areas are disturbed; and (dd) how infrastructure and structures (including ponds, residue stockpiles etc.) develops during operations;	Section 6 – Land use Section 7 – Physical, bio-physical and social closure assessment
(c) findings of an environmental risk assessment leading to the most appropriate closure strategy, including– (i) a description of the risk assessment methodology including risk identification and quantification, to be undertaken for all areas of infrastructure or activity or aspects for which a holder of a right or permit has a responsibility to mitigate an impact or risk at closure; (ii) an identification of indicators that are most sensitive to potential risks and the monitoring of such risks with a view to informing rehabilitation and remediation activities; (iii) an identification of conceptual closure strategies to avoid, manage and mitigate the impacts and risks; (iv) a reassessment of the risks to determine whether, after the implementation of the closure strategy, the residual risk has been avoided and / or how it has resulted in avoidance, rehabilitation and management of impacts and whether this is acceptable to the mining operation and stakeholders; and (v) an explanation of changes to the risk assessment results, as applicable in annual updates to the plan;	Section 8 – Closure risk profile Section 10 – Residual and latent risks
(d) design principles, including– (i) the legal and governance framework and interpretation of these requirements for the closure design principles;	Section 5 – Closure vision, principles, objectives and criteria

(ii) closure vision, objectives and targets, which objectives and targets must reflect the local environmental and socio-economic context and reflect regulatory and corporate requirements and stakeholder expectations; (iii) a description and evaluation of alternative closure and post closure options where these exist that are practicable within the socioeconomic and environmental opportunities and constraints in which the operation is located; (iv) a motivation for the preferred closure action within the context of the risks and impacts that are being mitigated; (v) a definition and motivation of the closure and post closure period, taking cognisance of the probable need to implement post closure monitoring and maintenance for a period sufficient to demonstrate that relinquishment criteria have been achieved; (vi) details associated with any on-going research on closure options; (vii) a detailed description of the assumptions made to develop closure actions in the absence of detailed knowledge on site conditions, potential impacts, material availability, stakeholder requirements and other factors for which information is lacking;	
(e) a proposed final post-mining land use which is appropriate, feasible and possible of implementation, including─ (i) descriptions of appropriate and feasible final post-mining land use for the overall project and per infrastructure or activity and a description of the methodology used to identify final post-mining land use, including the requirements of the operations stakeholders; (ii) a map of the proposed final post-mining land use;	Section 6 – Land use
(f) closure actions, including─ (i) the development and documenting of a description of specific technical solutions related to infrastructure and facilities for the preferred closure option or options, which must include all areas, infrastructure, activities and aspects both within the mine lease area and off of the mine lease area associated with mining for which the mine has the responsibility to implement closure actions; (ii) the development and maintenance of a list and assessment of threats and opportunities and any uncertainties associated with the preferred closure option, which list will be used to	Section 9 – Closure management plan

identify and define any additional work that is needed to reduce the level of uncertainty;	
(g) a schedule of actions for final rehabilitation, decommissioning and closure which will ensure avoidance, rehabilitation, management of impacts including pumping and treatment of extraneous water ─ (i) linked to the mine works programme, if greenfields, or to the current mine plan, if brownfields; (ii) including assumptions and schedule drivers; and (iii) including a spatial map or schedule, showing planned spatial progression throughout operations;	Section 9 – Closure management plan
(h) an indication of the organisational capacity that will be put in place to implement the plan, including─ (i) organisational structure as it pertains to the plan; (ii) responsibilities; (iii) training and capacity building that may be required to build closure competence;	Section 9 – Closure management plan
(i) an indication of gaps in the plan, including an auditable action plan and schedule to address the gaps;	Section 13 – Knowledge gaps and recommendations
(j) relinquishment criteria for each activity or infrastructure in relation to environmental aspects with auditable indicators;	Section 5 – Closure vision, principles, objectives and criteria
(k) closure cost estimation procedure, which ensures that identified rehabilitation, decommissioning, closure and post-closure costs, whether on-going or once-off, are realistically estimated and incorporated into the estimate, on condition that─ (i) cost estimates for operations, or components of operations that are more than 30 years from closure will be prepared as conceptual estimates with an accuracy of ± 50 percent. Cost estimates will have an accuracy of ± 70 percent for operations, or components of operations, 30 or less years (but more than ten years) from closure and ± 80 percent for operations, or components of operations ten or less years (but more than five years) from closure. Operations with 5 or less years will have an accuracy of ± 90 percent. Motivation must be provided to indicate the accuracy in the reported number and as accuracy improves, what actions resulted in an improvement in accuracy; (ii) the closure cost estimation must include—	Section 12 – Closure cost

(aa) an explanation of the closure cost methodology; (bb) auditable calculations of costs per activity or infrastructure; (cc) cost assumptions; (iii) the closure cost estimate must be updated annually during the operation's life to reflect known developments, including changes from the annual review of the closure strategy assumptions and inputs, scope changes, the effect of a further year's inflation, new regulatory requirements and any other material developments; and	
(l) monitoring, auditing and reporting requirements which relate to the risk assessment, legal requirements and knowledge gaps as a minimum and must include─ (i) a schedule outlining internal, external and legislated audits of the plan for the year, including─ (aa) the person responsible for undertaking the audit(s); (bb) the planned date of audit and frequency of audit; (cc) an explanation of the approach that will be taken to address and close out audit results and schedule; (ii) a schedule of reporting requirements providing an outline of internal and external reporting, including disclosure of updates of the plan to stakeholders; (iii) a monitoring plan which outlines─ (aa) parameters to be monitored, frequency of monitoring and period of monitoring; (bb) an explanation of the approach that will be taken to analyse monitoring results and how these results will be used to inform adaptive or corrective management and/or risk reduction activities; and	Section 11 – Closure monitoring
(m) motivations for any amendments made to the final rehabilitation, decommissioning and mine closure plan, given the monitoring results in the previous auditing period and the identification of gaps as per 2(i).	Section 13 – Knowledge gaps and recommendations

4 STATE OF ENVIRONMENT

4.1 Geology

Anref is situated on Andesite and Shale associated with the Transvaal Supergroup. The mining right area is located on the south-eastern limb of the Bushveld Complex. The farms all contain rocks from the Pretoria Group and the stratigraphy from south to north is as follows:

- Timeball Hill Formations: Contains shale and the andalusite bearing hornfels.
- Boshoek Formation: this formation of quartzites overlay the Timeball Hill formation and forms a prominent ridge in the area

The crystal sizes of the Anref deposit carries fine grained crystals that will deliver a final product of 0 – 1 mm size fraction. The gang material is exceptionally soft and lends itself towards physical beneficiation with a high yield.

4.2 Regional Climate

The information contained in this section of the report was taken from the following source:

- Rehabilitation Plan, Shangoni Management Services, 2013.

The climate of the North-West Province is characterized by well-defined seasons with hot summers and cool sunny winters. The rainy season usually occurs from October to March. The mean annual rainfall (MAR) for the area is between 400-600mm in some areas and 600-800mm in other areas of the site. Mean maximum temperature for the area is 31-33^{o}C and mean minimum is 2.1-4^{o}C. The maximum summer temperature is 29.3-31^{o}C, maximum winter temperature is 21.9-24^{o}C, minimum summer temperature is 15.3-17.4^{o}C and minimum winter temperature is 7.5-10^{o}C surrounding the Groot Marico River and 5.6-7.4^{o}C away from the river. The average long-term temperature is 18-21^{o}C. Evaporation for the area is moderately high with 2,001-2,200mm/a. Frost appears between May and September. The area is classified as a semi-arid zone. Moisture availability is moderate and moderate to severe.

4.3 Topography

The information contained in this section of the report was taken from the following source:

- Rehabilitation Plan, Shangoni Management Services, 2013.

The area in general is described as low hills or ridges for northern part of the site and rolling or broken plains or plateaus with low relief for the southern part of the site. The topography of the site steepens north-west and lowers where the Groot Marico River is situated. The topography has been changed by the quarry activities, creating a depression and the waste rock dumps (WRDs) and slimes dam creating convex areas.

4.4 Soil

The information contained in this section of the report was taken from the following source:

- Rehabilitation Plan, Shangoni Management Services, 2013.

The area is divided into three general soil patterns. Part 1 is described as LP2; Soils with minimal development, usually shallow on hard or weathering rock, with or without intermittent diverse soils. Part 2 is described as CM; Red, massive or weakly structured soils with high base status. Part 3 is described as NT; Deep, well drained, dark reddish soils having a pronounced shiny, strong blocky structure (nutty), usually fine (red structured soils). In addition, one or more of vertic and melanic soils may be present. The area disturbed by mining activities falls mostly within the soil patter described as CM, with the area north of the quarries described as LP2. The whole site has approximately 450mm deep soil. Water-holding capacity for is a low 21-40mm and north of the quarries a medium 41-60mm.

Rainfall erosivity over the whole site is a moderate 301-400mm. The site has mostly a very low predicted soil loss with some patches having a low predicted soil loss. The area is moderate susceptible to water erosion, with an increase in erosion susceptibility north of the quarries. The area has loamy sands present with 15-30% clays and is therefore moderately susceptible to wind erosion.

Swelling clays are low to moderate. The swelling clays as a group have relatively high natural fertility and resilience against nutrient depletion, particularly members with high swell-shrink potential. These cracking clays take in water readily when dry but exhibit high runoff when wet and expanded. They retain water very strongly and release it to plant roots very slowly. The swelling clays are covered by sealing topsoil, though naturally fertile, suffer from susceptibility to surface sealing, slow water infiltration, drought and susceptibility to erosion.

The site has no saline or sodic soils. In saline soils, the restricting effect of the osmotic pressure of the salts on water uptake by plant roots may affect the growth of non-salt tolerant plants. Sodicity results in adverse structure in soils.

The natural structure of topsoil generally provides an indication of the susceptibility to surface sealing, unfavourable water intake characteristics and low aggregate stability. Subsoil structure generally provides an indication of permeability to water, air and roots. These effects may be enhanced or modified by topsoil clay content and thickness of the materials. The area has soils with structure somewhat favourable to arable land use if climate permits.

There are no beneficial water-retaining layers in the root zone. This group of soils with impeded drainage has the advantage that the impeding layer is situated below a relatively deep rooting zone. The rooting zone commonly has favourable physical properties, allowing penetration and exploitation by plant roots. As a result, these soils have importance to agriculture.

The site has a moderate natural soil organic carbon content of 0.6 to 1mm. Soil organic carbon is a simple measure of the complex phenomenon of soil organic matter content. The latter is a complex combination of the humified remains of plants, microbes and other soil fauna. Soil organic matter commonly enhances almost the complete range of desirable soil properties, e.g. crumb structure, aggregate stability, water-holding capacity, resilience against crusting and compaction, cation exchange capacity and nutrient status, particularly N availability and soil biological activity. Soil carbon stands in relation to soil nitrogen, the ratio between C and N being an important determinant of the build-up or decomposition of carbon.

The natural soil pH is 5.5 to 6.4, somewhat acid. Soil acidity is a detrimental chemical condition of the soil, reducing crop growth and yield. It is commonly measured on the pH scale. Strongly acid soils have pH (H_2O) values below 5.5. A pH (H_2O) determination only measures active acidity, or the intensity of soil acidity, and not the reserve or total amount of acidity. Low pH conditions lead to poor nutrient status: nutrients such as calcium and magnesium (cations) are replaced by acid components and leached out; other nutrients such as phosphate and molybdate (anions) are rendered unavailable through fixation; the cation exchange capacity is lowered; root growth is restricted; nutrient cycling by soil microbes may be reduced.

The area has a moderately susceptible to acidification soil sub-dominant. The leaching status of soils is a factor in natural fertility, susceptibility to nutrient depletion, secondary acidification, agricultural input costs and rangeland nutrition and palatability. The area falls within the class Calcareous; which are non-apedal soils reacting with 10% hydrochloric acid.

4.5 Natural Vegetation

The information contained in this section of the report was taken from the following source:

- Rehabilitation Plan, Shangoni Management Services, 2013.

The area falls within the vegetation unit classified by Mucina and Rutherford (2006) as Zeerust Thornveld (SVcb 3) and north of the quarries as Dwarsberg-Swartruggens Mountain Bushveld (SVcb 4). The Zeerust Thornveld vegetation is described as deciduous, open to dense short thorny woodland, dominated by Acacia species with herbaceous layer of mainly grasses. The Dwarsberg-Swartruggens Mountain Bushveld is described as having variable vegetation structure depending on the slope, exposures, aspect and local habitat with various trees and shrub layers often with dens grass layer.

4.6 Animal Life

The information contained in this section of the report was taken from the following source:

- Rehabilitation Plan, Shangoni Management Services, 2013.

Cattle belonging to the local farmers are found on site. No endangered or rare species have been observed near the mine.

4.7 Surface Water

The information contained in this section of the report was taken from the following source:

- Rehabilitation Plan, Shangoni Management Services, 2013.

Anref is located in the quaternary catchment area A31E and A31B, a part of the Crocodile (west) Marico Water Management Area. The Crocodile River is a major tributary of the Limpopo River. The Pienaars, Apies, Moretele, Hennops, Jukskei, Magalies and Elands rivers are the major tributaries of the Crocodile River. The upper portion of the catchment, south east of Hartbeespoort Dam, is located in the Gauteng Province. The north and north-east corners lie in the Limpopo Province whereas the central or western sections fall within the North West Province. The total area of the Crocodile River Catchment is 29 400 km².

For the Marico area, the Marico and Crocodile Rivers form the headwaters of the Limpopo at their confluence. The flow in the Marico River (MAR 126 million m³/year) is highly variable and intermittent. There are two major storage reservoirs that regulate the flow in the Marico River, namely the Marico Bosveld Dam in the upper catchment and the Molatedi Dam further down-stream. There are several other dams, such as the Klein Maricopoort and Sehujwane Dams, from which water is mainly used for irrigation along the Marico River, particularly downstream of Marico Bosveld Dam. The Ngotwane River (MAR 14 million m³/year) is a tributary of Limpopo River. It flows into Botswana before turning and joining the Limpopo River.

For the Crocodile area, the natural surface Mean Annual Runoff (MAR) is approximately 646 million m³/annum. Stream-flow reduction due to invasive alien vegetation has not been considered to have a large impact on water availability in this catchment. More survey work in co-operation with Working for Water would need to be conducted to confirm this assumption. The Crocodile River system is regulated by 9 major dams, which are the Rietvlei, Hartbeespoort and Roodekopjes dams in the Crocodile, Roodeplaat and Klipvoor dams in the Apies/Pienaars, Olifantsnek, Bospoort, Lindleyspoort and Vaalkop dams in the Elands River area.

4.8 Groundwater

The information was taken from the eWISA Website.

The Crocodile (west)/Marico Water Management Area (Marico):

Groundwater in Marico & Upper Ngotwane area is an abundant source of water because of the geology. Groundwater is important at two levels, that is there are high yielding dolomitic aquifers and local groundwater sources are available for rural water supplies. Overall, the available groundwater resources within the catchment are under-utilised, although this clearly depends both on the groundwater occurrence and the demand. Even weaker groundwater occurrence areas can often provide more than 25 litres per person per day. Groundwater is the main source for rural water supplies.

The Crocodile (west)/Marico Water Management Area (Crocodile):
Groundwater resources are available throughout the entire catchment, but in varying quantities depending upon the hydrogeological characteristics of the underlying aquifer. Globally it is estimated the overall groundwater recharge to the catchment amounts to some 260 million m/annum assuming recharge of approximately 2% of the mean annual rainfall of approximately 450mm. Some 125 million m3 of groundwater is used annually, theoretically therefore, up to 135 million m3/annum of annual recharge is still available for exploitation. Away from the urban areas of Johannesburg and Pretoria many parts of the Crocodile West catchment are heavily populated and widespread rural communities are a feature of the area, including the districts of Moretele I, Odi I and Odi II north and NW of Pretoria, Bafokeng and Mankwe north of Rustenburg. Groundwater is the main source of water supply to the rural communities except for the Odi I and Moretele I where reticulated supplies are available for the more densely populated southern parts of the districts. There is extensive use of the groundwater resources of the dolomite aquifer NE of Johannesburg, south of Pretoria and NW of Krugersdorp where large abstraction for irrigation, domestic, industrial and municipal supply is practised.

4.8.1 Groundwater table and use

The depth of the groundwater table has not been determined. Neighbouring farmers utilise groundwater via boreholes for irrigation, however, no further information is available regarding volumes and quality, as the mine did not impact on groundwater.

4.9 Air Quality

Apart from this mine and the nearby town, there is no identifiable source of air pollution within the vicinity of the mine. Heavy vehicles do hauling of the mining product to the market. The use of dirt roads during the winter months is a source of dust pollution, but due to the infrequency and low volume of traffic pollution levels are limited.

Further dust particle pollution can be caused by abnormally strong winds. Air pollution due to fires does not normally occur, but may temporary cause pollution in case of a serious fire.

4.10 Noise

Vehicles active on the mining site are the most significant sources of noise pollution. Vehicles moving on the main road are a normal occurrence and therefore no added significant impact in this regard is experienced. No complaints from neighbours in this regard have been received in the past.

4.11 Sites of archaeological and cultural interest

The information contained in this section of the report was taken from the following source:

- Rehabilitation Plan, Shangoni Management Services, 2013.

Owing to the environment of Groot Marico, it has been a preferred place of settlement of people from early times to the historical period. During the site investigation, Iron Age sites were identified. Furthermore, several historical period sites were identified. No Stone Age period sites or rock art sites were identified. No heritage resources were identified on the impacted area that will be rehabilitated.

4.12 Visual Aspects

The waste rock dump is visible from the N4.

4.13 Socio-economic structure

4.13.1 Social structure

Ngaka Modiri Molema District Municipality had a total population of 842 698 in 2011 (Stats. S.A. Census). the population of the district is made up of African, 0.9% Asian, 1.6% Coloured, while whites make up 3.7%, and other 0.2%.

Approximately 61% of the population of Ngaka Modiri Molema District Municipality is made up of people aged from 15 to 64 years. This group represents the economically active section of the population. About 33% of the population is made up of children aged 14 and less, while 6% is made up of the older generation, who are aged 65 and above.

51% of the population of Ngaka Modiri Molema District Municipality is made of females while males make up 49%. In terms of actual numbers, there were 413 399 males and 429 300 females in the district in 2011.

4.13.2 Water supply

Molatedi-Gabarone Water Supply scheme is located in the extreme northern parts of the Zeerust Local Municipality. This scheme provides water to the Derdepoort and Kopfontein border post communities through local water treatments at both these settlements. It also supplies water to Gabarone in Botswana.

- Ngotwane Water Supply scheme is located in the Ramotshere Moiloa Local Municipality within the NMMDM. This scheme provides water to the communities of Ga-Seane, Lobatleng, Makgwanana, (Rietgat), Tsholofelo and Driefontein. The total number of households serviced by this water scheme is approximately 2000.

- Motswedi Water Supply scheme is located in the Ramotshere Moiloa Local Municipality. It abstracts water from the Sehujwane Dam thereafter water is treated at the Motswedi water treatment works. This scheme supplies water to the communities of Reagile, Borakolalo, Motswedi, Gopane East, Gopane West and Sebalagane. The total number of households serviced by this water supply scheme is approximately 4 480.

4.13.3 Economic profile

Finance and business services are the largest contributors to the economy of the district at 7.6% and 6.6% respectively. Furthermore, mining and community/social infrastructure only contribute 3% and 5.1% respectively to the economy of the district.

The major structural issues that have contributed to high unemployment and poverty in the area include persistent low economic growth, retrenchments from mining due decline in mining and insufficient diversification of the economy.

5 CLOSURE VISION WITH UNDERLYING PRINCIPLES AND OBJECTIVES

5.1 Closure vision statement

The closure vision for Anref is to return the mining right area to a landform that is suitable for potential grazing and wilderness.

5.2 Principles in support of the vision

The mine closure principles that will govern the process are derived from the mine closure policy of the Department of Minerals Resources, namely:

- The safety and health of humans and animals are safeguarded from hazards resulting from mining operations.
- Environmental damage or residual environmental impacts are minimised to such an extent that it is acceptable to all involved parties.
- The land is rehabilitated to, as far as is practicable, it's natural state, or to a predetermined and agreed standard or land use which conforms to the concept of sustainable development.
- The physical and chemical stability of the remaining structures should be such that risk to the environment is not increased by naturally occurring forces to the extent that such increased risk cannot be contended with by the installed measures.
- The optimal exploitation and utilisation of South Africa's mineral resources are not adversely affected.
- Mines are closed efficiently and cost effectively.
- Mines are not abandoned but closed in accordance with this policy.

The closure plan has been compiled keeping the above-mentioned principles in mind.

5.3 Closure objectives and outcomes

The proposed end-use for this site is cattle or game farming/grazing. Large portions of the area are already utilised by cattle farmers making use of the quarry to the east for livestock watering. All rehabilitation activities should be conducted with the end land use in mind. The list below contains the closure objectives.

Topography

1. During the decommissioning phase, all slopes need to be finished to the prescribed 1:3 slope.
2. Reduce the visual impact of the altered topography by a process of sloping, benching and rehabilitation.

Soils

1. The re-introduction of the topsoil will return the land to its previous land capability.
2. Remove contaminated soil.

Land capability and land use

1. The land will be returned to cattle/game farming or utilised for other purposes that may become viable in the time of operation.
2. The decommissioning process must take the final use into account in order to achieve a sustainable use.

Natural vegetation

1. 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.
2. Special care should be given to:
   - Quality of vegetation;
   - Any noxious plants and exotic plants that have established themselves and that have to be removed; and
   - Any signs of erosion.

Animal life

1. Animal life will start returning throughout the process of continuous rehabilitation and it is important that disturbance in rehabilitated areas be limited to the minimum.

Surface water

1. Landscaping should facilitate surface runoff and result in free draining areas.

Air quality

1. To remove any forms of dust generation due to mining activities.

The following objectives were identified for the different mining areas:

1) Old slimes dam

a) Although the slimes dam walls are very steep, it is already well vegetated and further disturbance will not add value.

2) Large waste rock dump

a) Visually, the southern side wall is the most significant as it is visible from the national road. The objective is to decrease the height and reduce the slope in order to successfully re-vegetate.

b) Material from the waste rock dump will also be used to fill the depression to the north of the WRD and the eastern quarry.

c) The mine may also consider selling some of the waste rock material to use during construction or upgrading of roads.

3) Topsoil stockpiles east and west

Material from the topsoil stockpiles will mainly be used for final sloping and cover to promote vegetation growth. Unused topsoil will be sloped into low lying cavities to allow gradual topography with free drainage.

4) Quarry east

a) Benches will be sloped using cut and fill techniques.

b) The water body to the east will remain intact while the floor to the west of this quarry will be filled with material from the north and south slopes.

c) Rocky contours are proposed within main drainage lines to reduce runoff velocity and prevent siltation of the water body.

5) Quarry west

a) Benches will be sloped using cut and fill techniques.

b) The water body will remain intact with sloping of the surrounding high walls limited to the current footprint of the water body.

c) Prevention of siltation is again proposed using rocky bund walls within the main drainage lines towards the water body.

d) Final slopes around both quarries should allow at least one section with safe and easy access for animals to reach the water.

6) Quarry north

a) The only objective for the northern quarry is to make it safe by sloping the benches using cut and fill techniques.

6 LAND USE

6.1 Pre-mining land use

The land was used for grazing prior to any mining activities and is currently use for grazing. No data is available to draw any workable conclusion as to the pre-mining agricultural productivity of the mining area. The main structures on the mining area prior to mining were two farming related structures. These structures were not used as part of the mining activities but utilised by farmers. No additional structures were constructed on site.

6.2 Impact statement

The mining area was approximately 68 ha in size. Mining ceased in 2008 and the site has been rehabilitated. The rehabilitated areas are used by a local farmer for cattle grazing.

The risk assessment conducted as part of the closure plan provides information regarding the significant impacts related to the mining activities. (See Appendix 1).

6.2.1 Land Tenure and Use of Immediately Adjacent Land

The area has a high agricultural potential. The Agricultural Land Demarcation is applicable to this area. The area has a marginal potential for arable land. The grazing capacity ranges from 11 ha/AU (moderately high) to 25 ha/AU (moderately low) for the area. Around the Groot Marico River to the east of the site, the grazing capacity is more than 100ha/AU due to transformed rangelands. Irrigated land is only applicable around the Groot Marico River. The site itself has mostly a grazing potential for especially cattle.

Prior to mining the area, the site was used to graze mostly cattle. The Ramotshere Moiloa Spatial Development Framework (2014/2015) states that more than 90% of the municipal area consists of natural vegetation, with the next highest category as Agriculture (5.3%). Built-up areas constitute 2.1% of the municipal area while mining takes up only 0.1%. Additionally, water and wetlands take up 1.3% of the municipal area. Anref mine falls within the mining development framework.

6.3 Post-closure land use

6.3.1 Identified post-closure land use

The proposed end-use for this site is cattle or game farming/grazing. Large portions of the area are already utilised by cattle farmers making use of the quarry to the east for livestock watering. The area has a high agricultural potential and marginal potential for arable land.

6.3.2 Alternatives assessment

Alternatives have been identified for the project. These include:

a) Decommissioning and Closure

The mine stops mining, and processing of ore and begin with the physical removal of mining infrastructure and rehabilitation of the mining area. The decision followed as all mining has been completed, and also as a result of certain contributing factors, that include:

- Decrease in demand for the product (andalusite).
- Feasibility of mining in the area (specifically capital costs required with regards to transport of material to Rhino Andalusite Mine in Thabazimbi for processing).

The main aim of the decommissioning and closure plan is to provide the measures and time lines to rehabilitate the land, which was disturbed by mining activities, as practicably possible, to a land use which conforms generally to the principles of sustainable development.

b) The option of not implementing the activity, which is also referred as the no-go option will be to continue mining (or recommence with mining), which is not economically viable considering the decreased demand for andalusite and the challenges surrounding mining in the area (with regards to capital costs required to transport material to Rhino Andalusite Mine in Thabazimbi and that lack of material left to be mined). In addition, the fact that all the disturbed areas have already been rehabilitated reduces the incentive to continue or recommence mining (from an environmental perspective).

In general, the expected environmental impacts from the decommissioning and closure operation of the mine do not indicate that the proposed activities would have irreversible detrimental effects on the receiving environment.

The positive and negative implications of each alternative are also described in Table 5. A comparison is done below to assess the positive and negative implications of the proposed activities compared with the no-go alternative. This should provide a fundamental consideration of the feasibility of the project.

Table 5: Comparison of the proposed preferred activities and the no-go option

	Decommissioning and Closure	**No-go Option (Continue mining / recommence mining)**
Positive impacts	The mine will be rehabilitated, and the end land use will be cattle or game farming/grazing and livestock watering.	There will be limited social and economic benefits to the communities and economy if mining continues. This is however very limited due to the difficulty in mining the mineral and lack of processing – also limited economic

	Decommissioning and Closure	No-go Option (Continue mining / recommence mining)
		advantage due to andalusite market needs changing continuously and small volumes that can be mined.
Negative impacts	There will be no social and economic benefits to the communities and the economy.	There will be continued environmental impacts on the environment.

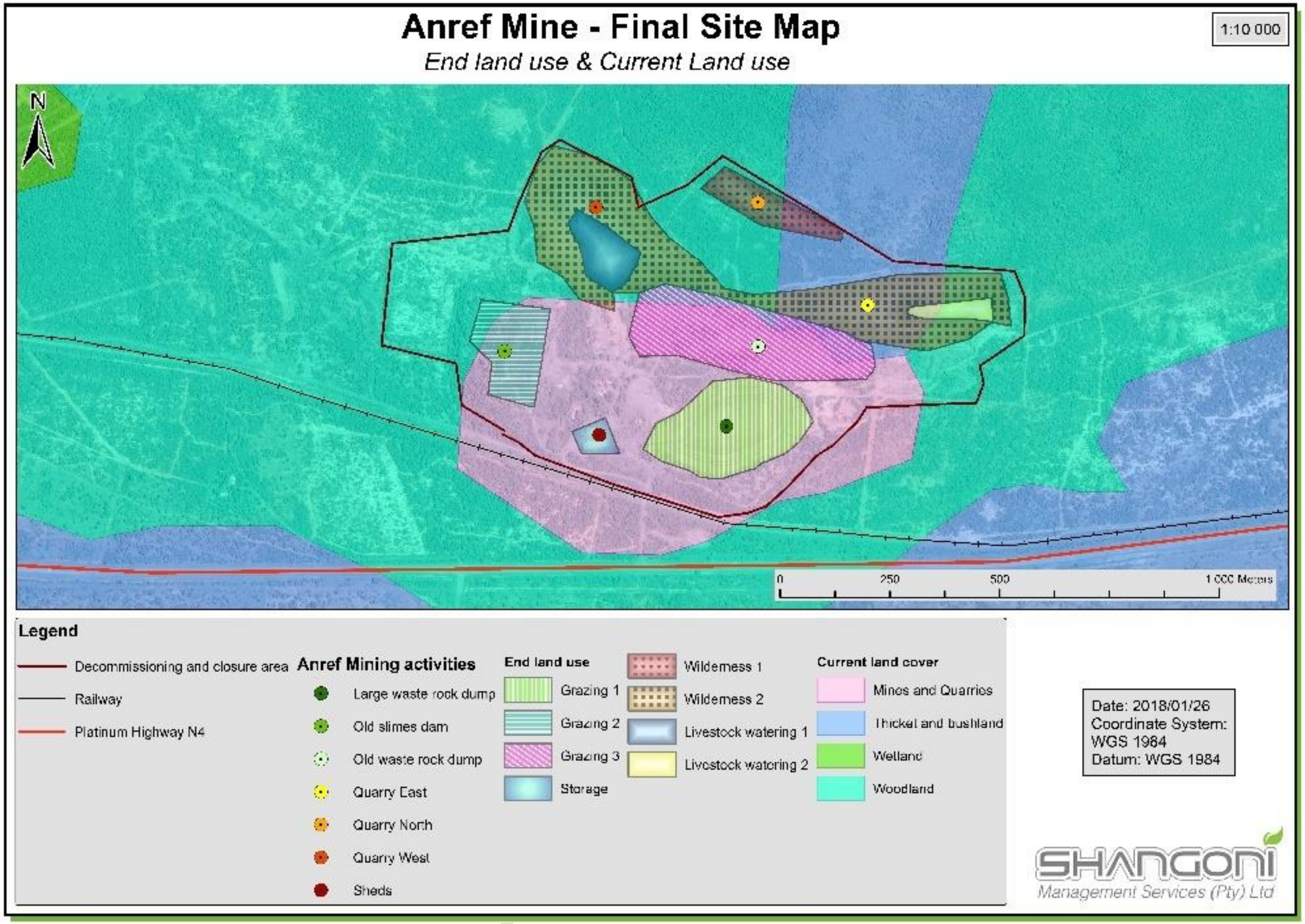

Figure 3: End land use compared to current surrounding land use

6.4 Zones of influence

The potential zone of influence has been determined for the various environmental components that could cause potential impacts, they have been listed below. These potential zones of influence are not definitive, as no specialist studies were conducted and subsequently no information was available to verify the potential zones.

Geology

The zone of influence on geology is limited to the quarry areas.

Topography

Topography of the affected mining area is affected by three main mining activities: Extraction of ore, WRDs and process slimes dam. There are three quarries where extraction of ore took place, resulting in local depressions with banked high walls to the north. WRDs and the slimes dam create unnatural elevated heaps that significantly alter the topography.

Visual

Abandoned quarries may impact on the visual quality of the area. Should the quarries extend further north there is the potential that the benches may become visible from the road to further impact on the visibility. The large WRD to the south creates a visual impact when driving past on the N4 highway. Visibility is mainly due to the height of the WRD and absence of vegetation cover.

Soil, surface- and groundwater

Various activities on the mine could have and can result in soil, surface water and groundwater pollution. The significant activities sources of pollution will be due to seepage and surface water run-off from the slimes dam and the WRDs. The mine has no available surface water or groundwater quality data; therefore, the extent of this pollution cannot be determined.

Biodiversity

Vegetation is destroyed in the quarries and the footprint of the WRDs. Vegetation that was established on the slimes dam was removed during re-mining of the slimes. Compacted soil areas where infrastructure is located as well as access roads are poorly vegetated.

Bare areas disturbed during mining activities will be prone to weed and invader establishment. The increase of weeds and invasive plant may lead to the decrease in indigenous vegetation numbers.

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7 CLOSURE ASSESSMENT

7.1 Physical closure assessment

The only infrastructure present on site are two sheds that are used by a farmer for agricultural activities.

7.1.1 Physical assumptions and criteria for closure

The two existing buildings will be used by farmers. Therefore, the decommissioning will not involve the demolition of buildings or structures.

All waste that is littered on the site must be removed, separated and disposed of in the appropriate drums or skips on the site. All old fencing, not to be used after closure, must be removed from site.

7.2 Biophysical closure assessment

The purpose of the bio-physical assessment is to determine the extent of the impact of mining on these components at post closure. Measures to minimise the impact will be identified as part of the operational and decommissioning phase. This will decrease the extent of the residual impacts.

7.2.1 Bio-physical evaluation

Bio-physical components on the mine include:

- Biodiversity;
- Protected habitats/ecosystems;
- Groundwater;
- Surface water;
- Air quality;
- Soil;
- Land capability and land use;
- Natural resources; and
- Topography/visual.

The following bio-physical element have been identified on site and have been included in the annual rehabilitation plan as well as the financial provision:

- East & west quarry.
- Two waste rock dumps (WRD’s).
- One slimes dam, originating from historical mining activities.
- Access roads between the quarries and WRD’s.

7.2.2 Bio-physical assumptions for closure

The following bio-physical assumptions have been made:

- A previously re-vegetated area on the slimes dam has been disturbed by re-working activities. This area was taken into consideration for the calculation of the financial provision.
- All the roads on the mining area will be ripped and re-vegetated.

7.2.3 Bio-physical standards and criteria for closure

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 grazing and 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.

7.3 Social closure assessment

A social closure evaluation has not been conducted for Anref. The mine does have existing communication channels and procedures with stakeholders such as the current land user (farmer), neighbouring farmers and government departments, through which information on the closure process will be shared, as required.

This section will be updated after conclusion of the public participation process, which will run between 2 July 2018 and 3 August 2018.

8 CLOSURE RISK PROFILE

8.1 Purpose and methodology

The primary purpose of this Issue Based Risk management process is to assess the risks associated with closure of the mine, to identify knowledge gaps and areas that require further action or improvement. The objective of this Risk Assessment is to address the effect of closure on the mine's Facilities, Activities, Processes, Equipment and Services. Appendix 1 contains the risk assessment conducted for Anref.

The scope of the risk assessment includes all decommissioning and post closure activities, to determine the level of residual and latent risks, as well as risks during operation of decommissioning – demolition and rehabilitation activities.

The risk assessment was divided into numerous topics, and each topic was assessed in terms of the impact the mine has on the topic during the decommissioning phase. Ratings of the risk was done according to the risk matrix defined in Appendix 1.

8.2 Risk assessment findings

The section below summarises the closure risk profile, as assessed during the compilation of this plan. The risks envisaged can be managed to ensure an acceptable end land use. Table 6 provides a summary of the priority unwanted events.

The mitigation measures (conceptual closure strategies) included in the risk assessment to avoid, manage and mitigate the impacts and risks, will be used to guide the closure actions discussed in Section 8 of the plan. These risks will be reassessed during the review of this plan, to ascertain whether the mitigation measures would be sufficient to avoid a potential residual impact (see Section 10). The full risk assessment attached in Appendix 1 provides an indication of whether the impact is acceptable to the mining operation and stakeholders. If the impact is not acceptable - a residual risk will remain.

Table 6: Summary of closure risks

ASPECTS AFFECTED	ACTIVITY	Impact description	SIGNIFICANCE (Pre-mitigation)	MITIGATION MEASURES (include monitoring)	SIGNIFICANCE (Post-mitigation)
Geology	Mining activities - Quarries	Mining of the material leads to the extraction of the ore body; therefore, the impact on the geology will be permanent. The extraction of ore took place from the various areas as described in the mining method.	H	• Only mine within the approved mining right area. Mining has ceased, and rehabilitation has been completed, subsequently the impact will not expand.	H
Topography	Mining activities	Topography of the affected mining area is affected by three main mining activities: Extraction of ore, WRDs and process slimes dam. There are three quarries where extraction of ore took place, resulting in local depressions with banked high walls to the north. WRDs and the slimes dam create unnatural elevated heaps that significantly alter the topography.	H	• During the decommissioning phase all slopes need to be finished to the prescribed 1:3 slope. Reduce the visual impact of the altered topography by a process of sloping, benching and rehabilitation.	M
Surface and ground water	Mining activities	Various activities on the mine could have resulted in soil, surface water and groundwater pollution. The significant activities sources of pollution will be due to seepage and surface water run-off from the slimes dam and the WRDs. The mine has no available surface water or groundwater quality data; therefore, the extent of this pollution (if any) cannot be determined.	H	• The re-introduction of the topsoil will return the land to its previous land capability and result in the water runoff to be deemed as clean water thus minimising the impact on surface water and ground water quality. • Remove contaminated soil as necessary. • Implement erosion control measures on slimes dam as identified in the rehabilitation plan.	H

ASPECTS AFFECTED	ACTIVITY	Impact description	SIGNIFICANCE (Pre-mitigation)	MITIGATION MEASURES (include monitoring)	SIGNIFICANCE (Post-mitigation)
Surface and ground water	Ponding of rainwater on rehabilitated areas	Ponding of water in the quarries as well as on the WRDs and slimes dam will occur. This may lead to seepage of minerals into the groundwater, and affect the stability of the side slopes, which in turn can impact vegetation establishment in these areas and may lead to erosion.	M	• Water in the quarries will remain for use by the farmer. • 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.	M
Land capability and use	Mining activities - Quarries	The main impact on the land capability is the quarries that will not be rehabilitated and with no proposed land use. Surrounding land use will not be affected significantly; however, the mining activities will have impacted on the landscape character.	M	• 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.	L
Vegetation	Disturbance of indigenous vegetation and alien vegetation establishment	Vegetation is completely destroyed in the quarries and the footprint of the WRDs. Vegetation that was established on the slimes dam was removed during re-mining of the slimes. Compacted soil areas where infrastructure is located as well as access roads are poorly vegetated. Bare areas, disturbed during mining activities will be prone to weed and invader establishment. The increase of weeds and invasive plant may lead to the decrease in indigenous vegetation numbers.	M	• Re-seeding bare areas and implementation of alien eradication programme. • Implementation of berms to allow for vegetation establishment and surface water management. • Erosion control measures to be implemented on slimes dam as per rehabilitation plan.	L

ASPECTS AFFECTED	ACTIVITY	Impact description	SIGNIFICANCE (Pre-mitigation)	MITIGATION MEASURES (include monitoring)	SIGNIFICANCE (Post-mitigation)
Visual	Mining activities	Abandoned quarries may impact on the visual quality of the area. The large WRD to the south creates a visual impact when driving past on the N4 highway. Visibility is mainly due to the height of the WRD and absence of vegetation cover.	H	• Implementation of the rehabilitation program, including re-vegetation of the WRDs.	L

9 CLOSURE MANAGEMENT PLAN

The information for this section was taken from the Rehabilitation Plan (Shangoni, 2013).

9.1 Closure organisational structure

The Imerys approach to mine closure is that Head Office oversees the final decommissioning and rehabilitation of an operation. Final rehabilitation is overseen by the Imerys Operations Director. Shaping, in-filling, spreading of topsoil and planting is implemented by the current farmer that utilises the land.

9.2 Rehabilitation standards and procedure

Figure 4 below indicates the current topography of the site with a general rehabilitation sloping strategy for the various activities and benches. A slope analysis was done using the available elevation data and displayed in the map below. The benches were not surveyed and is therefore not displayed correctly in the slope analysis. Figure 5 shows areas in orange and red that are steeper than the desired 18 degrees that forms the focus areas for sloping. It can also be seen from this analysis that even though side slopes around the tailings dam exceed the desired slope, it is well vegetated and does not need to be re-sloped. Representation of the hill slope to the north is distorted due to a lack of quality elevation data beyond the site activities.

Tables 7 and 8 below provide a summary of the footprints and volumes of the areas where earth moving activities should take place. These figures include the amount of material that should be moved, the footprints of the final disturbed areas, as well as the topsoil available to cover disturbed surfaces according to the soil replacement methodology. There is enough topsoil available to successfully cover all disturbed areas with the minimum required depth. The availability of topsoil to cover the disturbed area does not guarantee fertility of the soil to successfully re-vegetate the site.

Table 7: Approximate footprints and volumes

Area	Footprint (m^2)	Volume (m^3)
Current scenario		
Main waste rock dump	44 900	490 000
North waste rock dump	18 500	100 000
Disturbance footprint and volumes to be moved during rehabilitation		
Main waste rock dump	103 790	200 000
North waste rock dump	35 140	52 700

Table 8: Available Topsoil

Area	Footprint (m^2)	Volume (m^3)	Footprint available (m^2) (30cm deep)
Topsoil stockpile east	23 000	135 000	405 000
Topsoil stockpile west	6800	16000	48 000

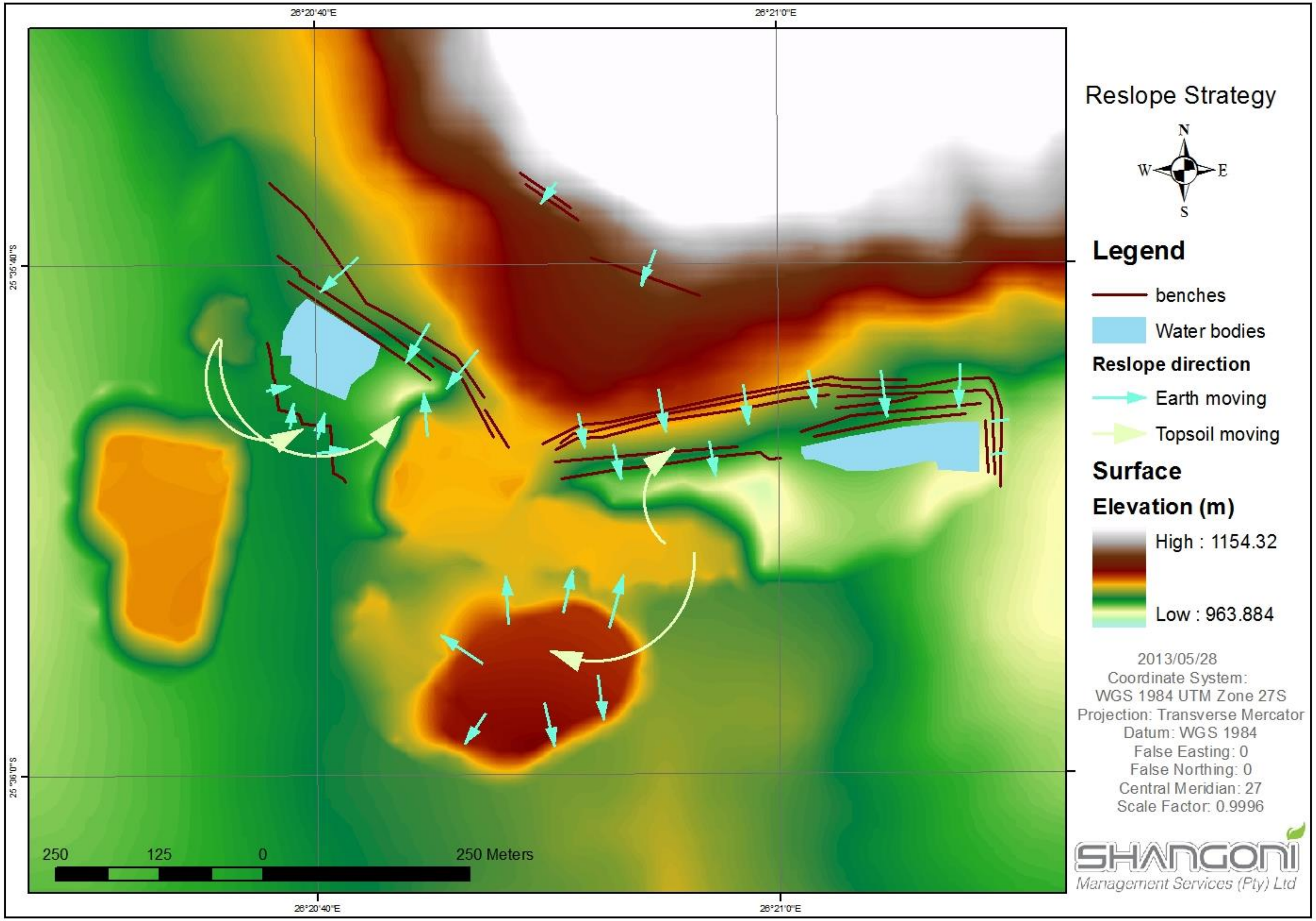

Figure 4: Sloping strategy

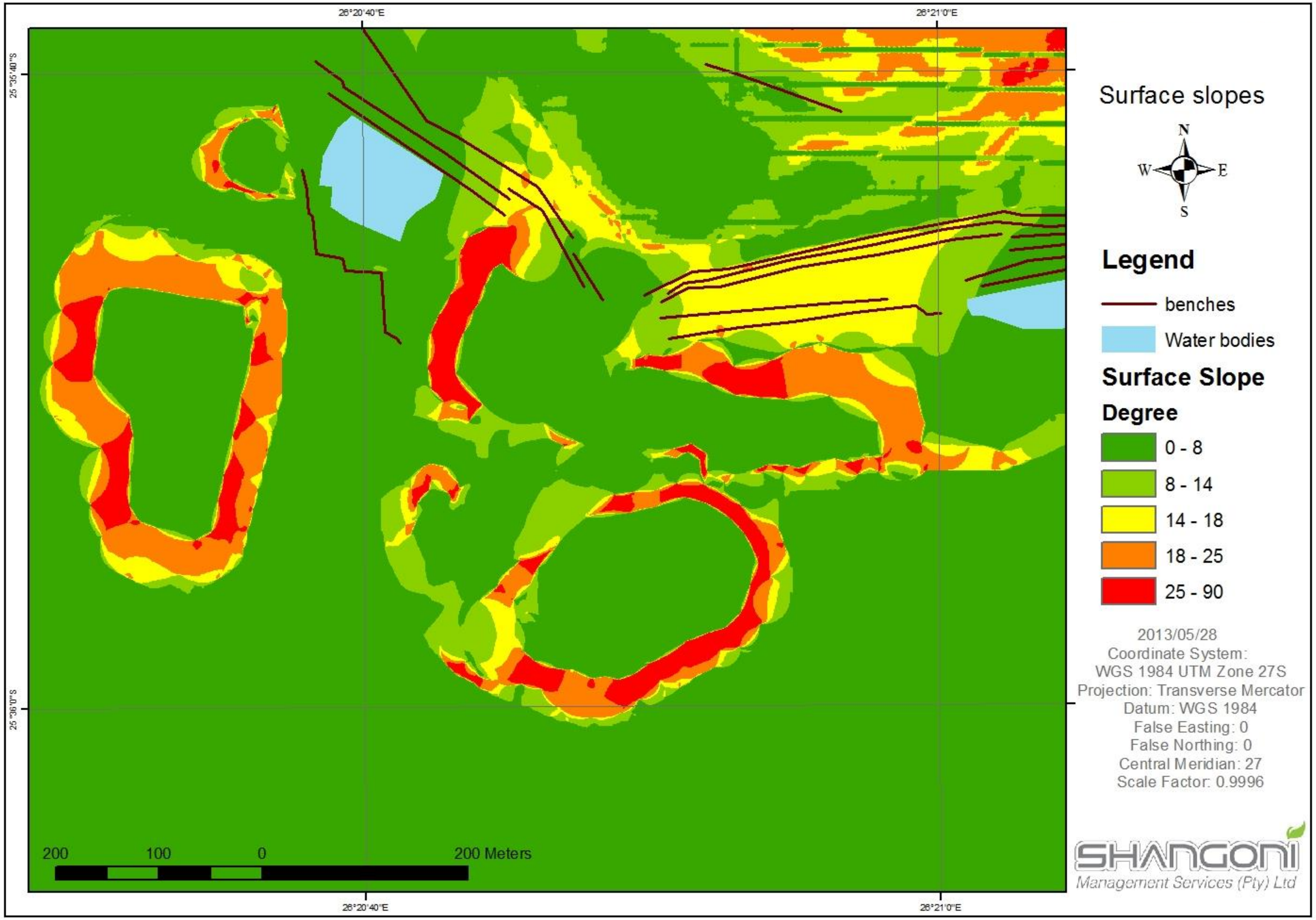

Figure 5: Slope analysis of current site

Figure 6 shows the new slopes for the desired rehabilitation. After sloping the surface areas, the volumes of cut and fill operations were calculated by comparing elevation models of the before and after sloping scenarios. Calculations were limited to main sloping areas by masking out the rest of the site. This is done to limit standard deviations of potential elevation inaccuracies on the rest of the site. The cut and fill activities are represented in Figure 7, also reflecting the approximate volumes of material to be cut/ filled. Note that this is only an approximate volume for earth moving activities as the final micro sloping should remove crests and provide paddocks as part of the drainage objectives. The use of topsoil at the various construction areas will also influence the volumes required to be moved.

Blue areas indicate where material will have to be cut and deposited (filled) in the areas marked as red. The volumes at the western quarry is almost equal with no net loss or gain, indicating that only existing material in the area can be cut and filled to reach the desired topography. At the eastern quarry and waste rock dump it is recommended that the waste rock be used to fill the quarry, and thereafter be spread to the north and south over the footprint indicated by the cut/fill footprint. Finally, the topsoil stockpile should be spread over the waste rock dump and quarry area before sloping both areas together. The volumes cut from the waste rock dump therefore represents material to be used in the fill sections for both waste rock dump and eastern quarry, while the cut material at the topsoil stockpile represents the minimum amount of topsoil to be spread over the re-sloped areas.

Figures 8 and 9 are profiles for the before and after scenarios along the crosscuts A_A and B_B indicated in Figure 7. Comparison of these profiles provides clear demonstration how the high slopes will be graded to create a more natural topography.

Paddocks should be made 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.

Appropriate fencing, bunding or other protection measures, including warning signs, should be provided as required for public safety purposes.

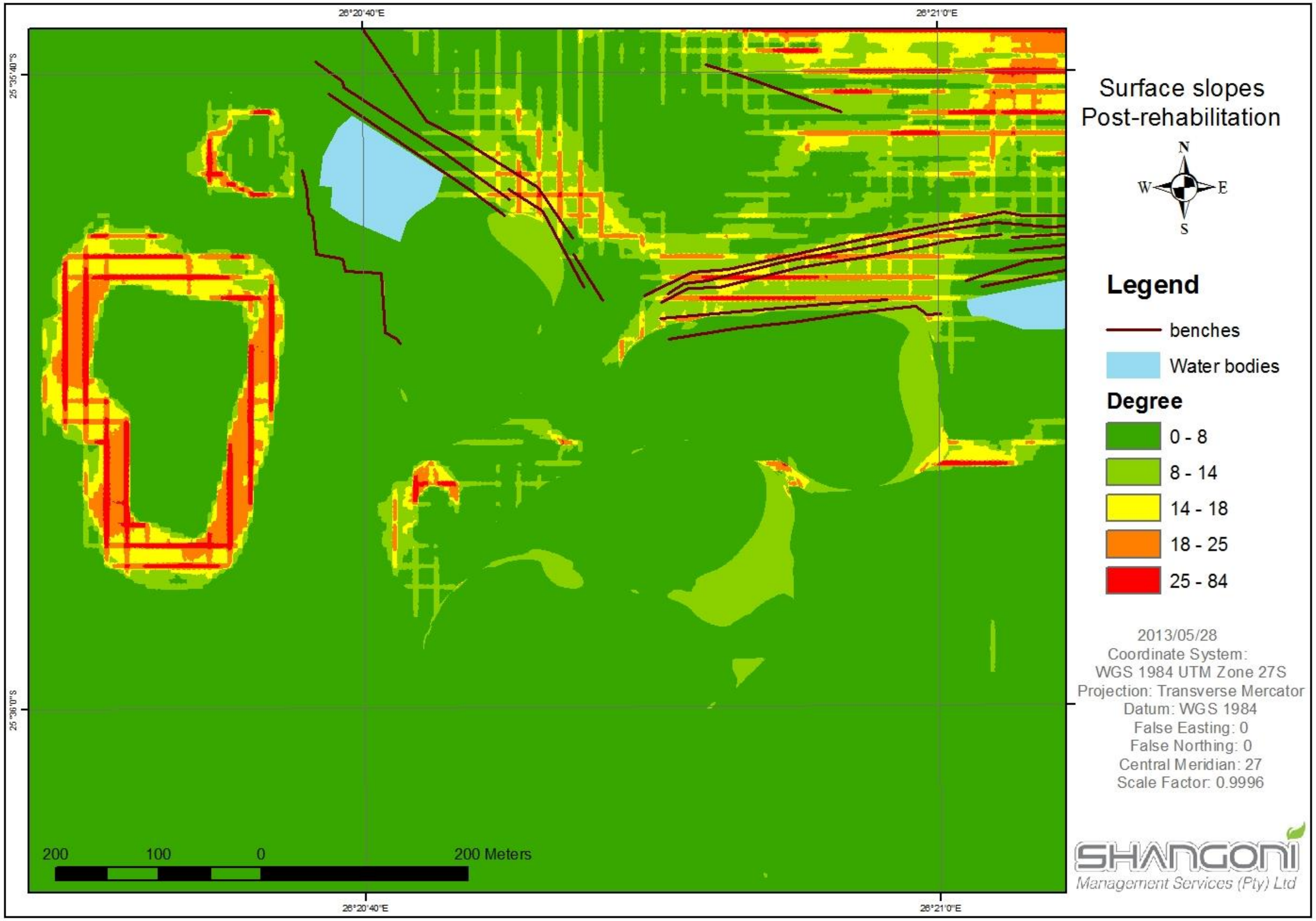

Figure 6: Slope analysis after rehabilitation

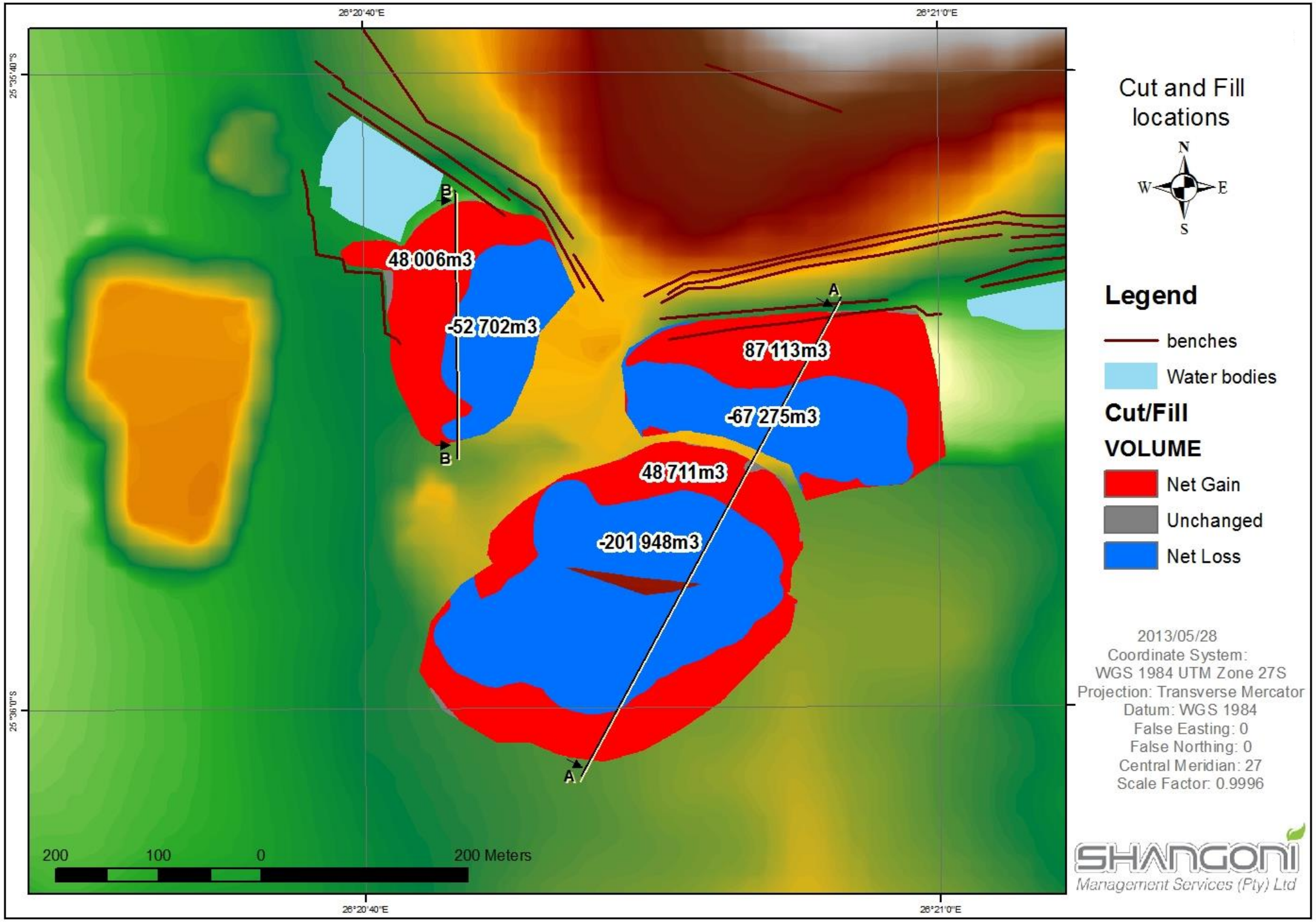

Figure 7: Cut and Fill locations and volumes

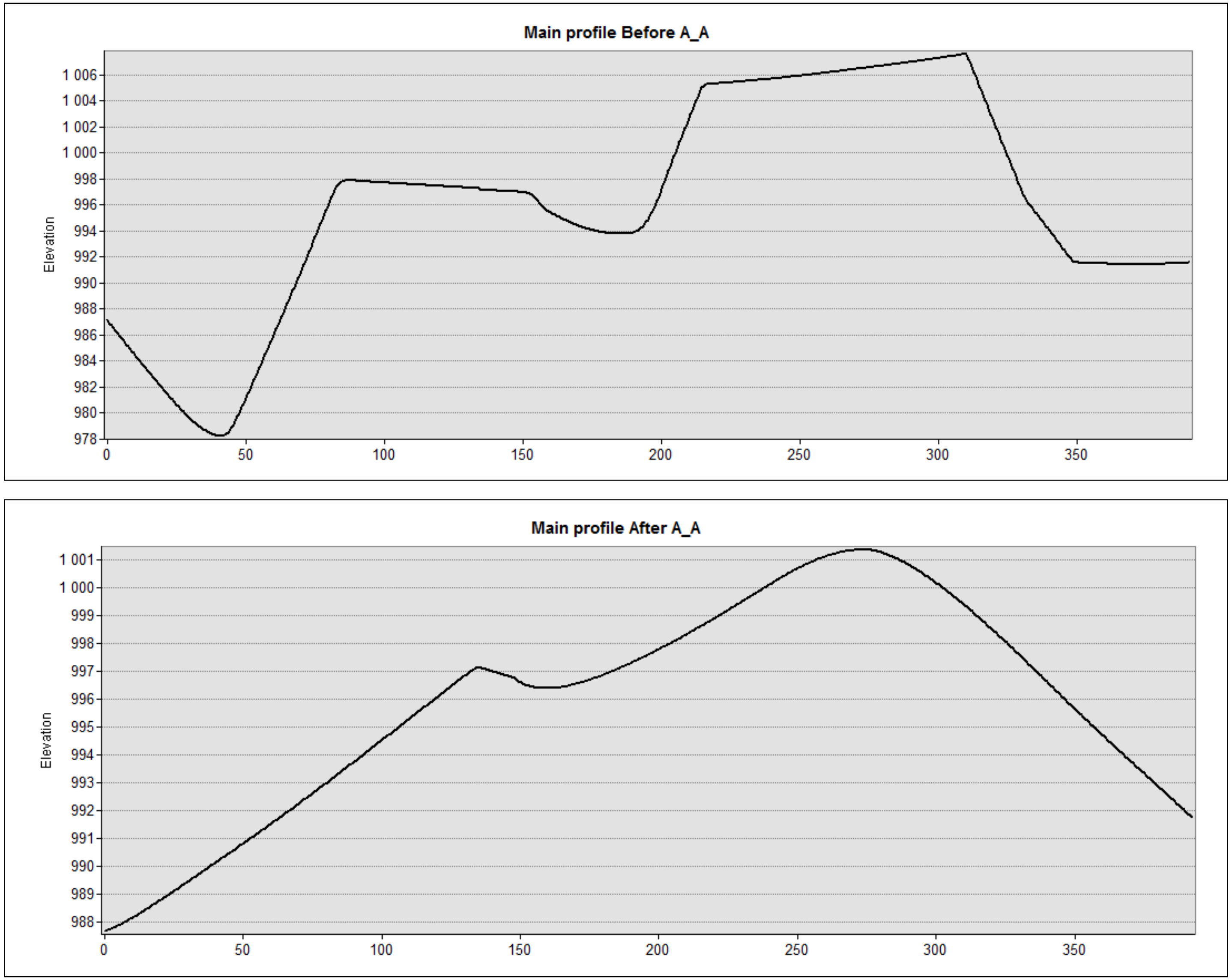

Figure 8: Before and after profiles of cross cut A_A

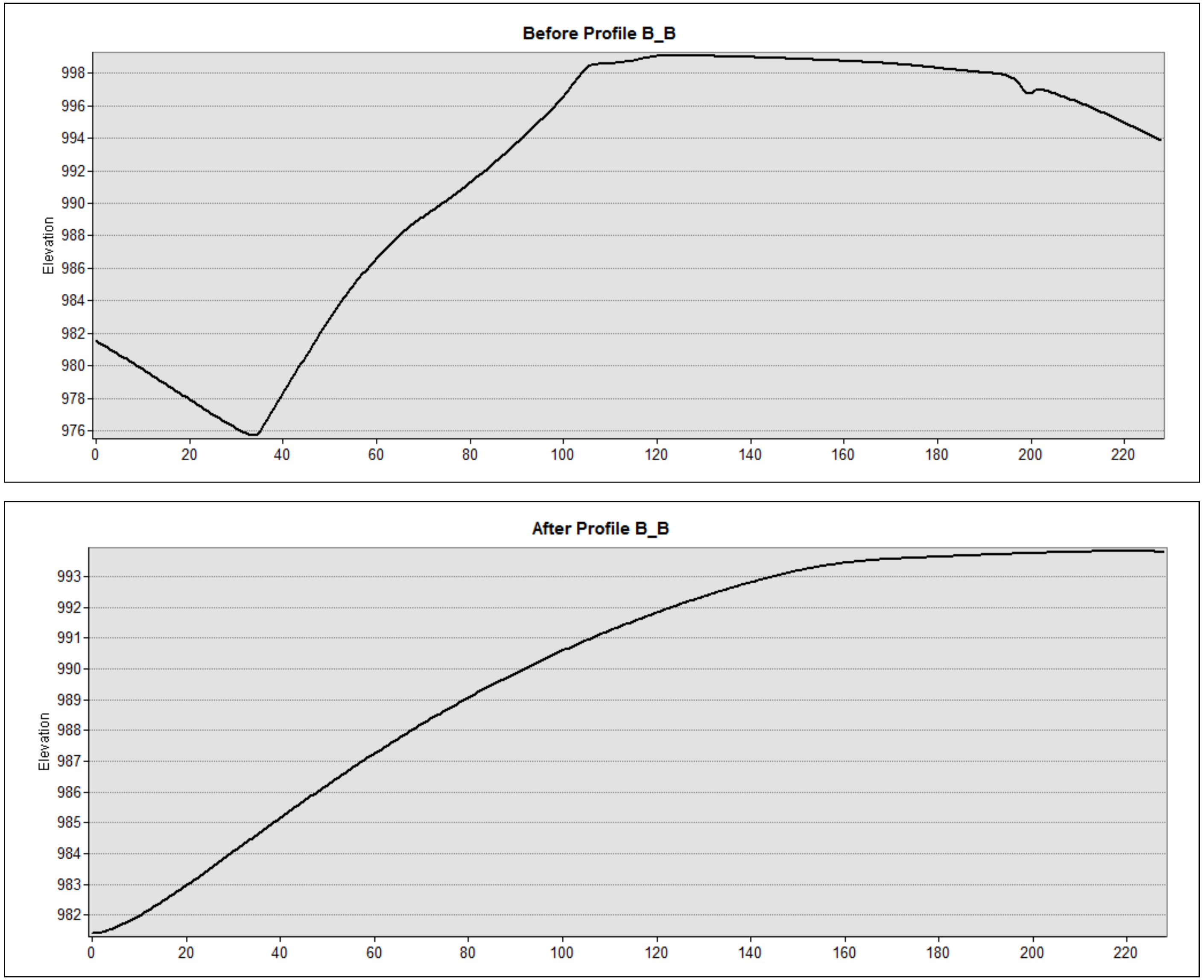

Figure 9: Before and after profiles of cross cut B_B

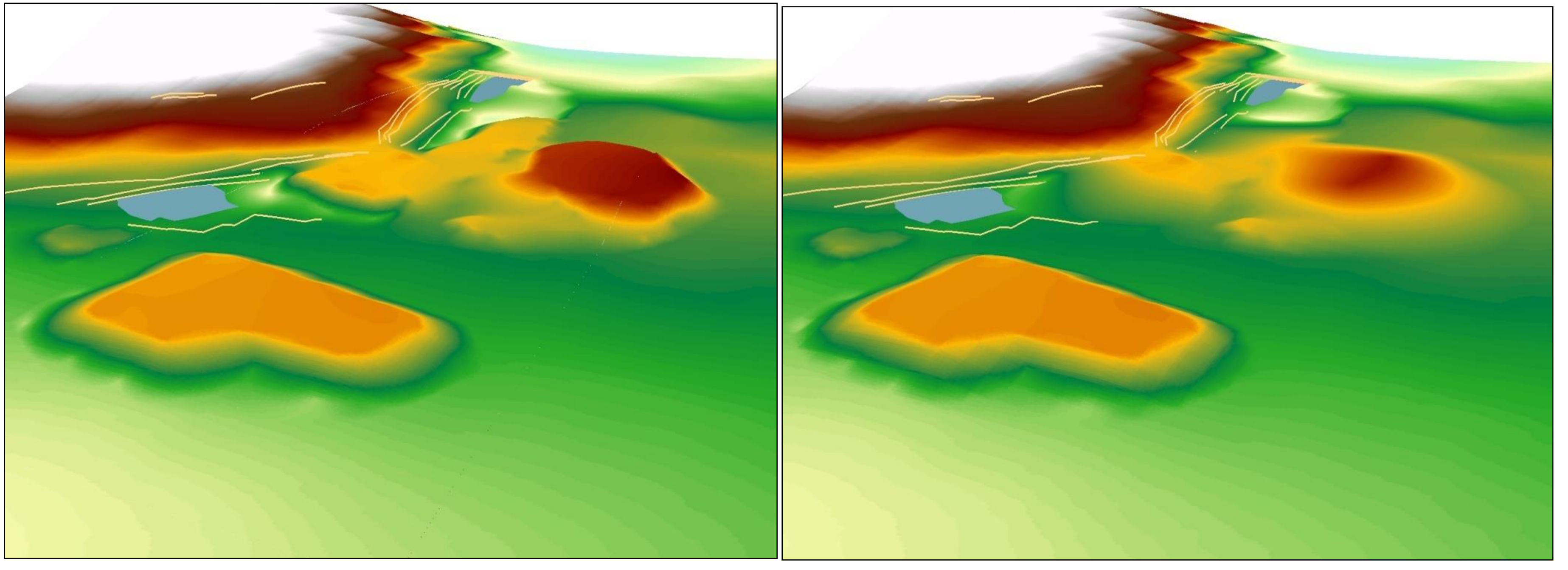

Figure 10: Northeast 3D view of surface elevation before and after sloping

9.2.1 Soil replacement

This section was compiled using the information from the EMP (2012) as well as information form 'Rehabilitation Recommendations after Alien Plant Control' (Campbell et al 2001). In the event of any soil contaminated by hydrocarbons, this must be removed, and placed in suitable skips. This amount will be very little if any. These skips must be removed and disposed of by an authorised contractor.

Once the final landform has been created, soil replacement can begin. The only area to be covered by topsoil will be the sloped WRD north of the N4. This will be done using the topsoil stockpile north-east of the WRD. This topsoil has been stockpiled for a few years, therefore it may be sterilised. Compaction is one of the most significant problems with replacement of soil. Compaction must be minimised by using the correct equipment. Too heavy machinery must not be used to replace the soil. Rather use a dozer than a grader. Soils should also only be moved when it is dry to minimise soil compaction. This may then lead to wind erosion or dust generation, and care should be applied. Provision should be made for the shrinkage, compaction or settlement of cover soil when calculating the amount of topsoil per area. it is preferred that a depth of 30cm topsoil be placed on the site.

If needed, a network of drainage lines will be incorporated on these dumps. These drainage lines will ensure clean water run-off on the rehabilitated areas. Avoid impoundments on subsidence hollows which will cause water logging of the topsoil.

9.2.2 Preparation for re-vegetation

This section was compiled using the information from the EMP (2012) as well as information from Rehabilitation Recommendations after Alien Plant Control' (Campbell et al 2001). Areas where soil has been compacted, the following steps need to be followed:

1. Break and loosen the soil crust with hand tools e.g. garden rakes for broadcast sowing;
2. Break and loosen the soil crust with sharp-pointed hoes or forks for row sowing.
3. In burned areas where wood ash is present, use the row-sowing method to ensure good soil-seed contact.

The pH of the soil is relatively low (5.5-6.4.) and although the free salt content is low, the lime content is low or absent. It is necessary to treat the soil with lime. To determine the lime requirements (amount of lime and how to apply), a specialist must be consulted.

Fertilizers are required where grass is to be planted on soils that are leached or eroded and that have low organic matter content. It is recommended that topsoil samples should be taken and analysed by a laboratory to determine the right fertilizers to be used. Fertilizers must be applied at the time of grass planting. It is very important to note that during the application, the dry fertilizer may not come into contact with the grass seed. To ensure this, the seed must be covered with soil before the application of fertilizer. Application should take place before or after good rains. Steps to be followed:

1. Broadcast the fertilizers over the sown area.
2. If the planting method is using sods, the fertilizer should be placed in holes.
3. If the planting method is using runners or tufts, the fertilizer should be placed in furrows.
4. Divide the fertilizer into two equal parts and use each portion to cover the entire area. Fertilizers should not come into direct contact with the seeds.

Phosphorous is important in root development and seedling establishment. The soil has moderate natural phosphorous content; therefore, application may be needed.

Nitrogen is needed in the largest amounts by grass species. The following reduce the amount of nitrogen in the soil:

1. Soils with low organic carbon content;
2. Leached and eroded soils; and
3. Intense burns.

The probability of the site having a high nitrogen value is low. At the following time periods, nitrogen may be applied to the soil:

1. At the same time of grass planting, this is during October for spring growing grasses and February / March for autumn growing grasses. At this time 30% of the required nitrogen must be applied.
2. Once the grass is established, this is February / March for spring growing grasses and October / November for autumn growing grasses. At this time 70% of the required nitrogen must be applied.

Potassium increases the cold tolerance of plants. The presence of wood ash after a fire adds some potassium to the soil in the form of potash.

Manure supplies all of the three above minerals / organic matter to the soils. Organic matters improve physical attributes of soil including water infiltration, water holding capacity, aeration, tilth, decrease in soil compaction, and chemical attributes such as cation exchange, etc. Poultry manure is three times higher in nitrogen and phosphorous than cattle manure. The following should be done when applying manure to soil:

1. Spread and work the manure into the soil to prevent loss of nitrogen to the air.
2. For cattle manure, 8t/ha for grass establishment must be applied.
3. For chicken manure, 2t/ha for grass establishment must be applied.
4. Chicken litter should be thinly spread. A high concentration can damage or even kill germinating grass seedlings.
5. Store manure in heaps and only for short periods to prevent loss of nutrients.
6. As manure may lead to bad odours, it is advised to use commercial fertilizers as well.

Organic matter is most important for the amelioration of the topsoil. Organic material must be applied to the topsoil as well as worked into the entire depth of the rooting zone.

9.3 Revegetation and alien control

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.

Refer to Section 5.2 of the Rehabilitation Plan (Appendix 4) for a detailed vegetation and alien control programme.

9.4 Closure success criteria

As final rehabilitation has already been implemented at Anref, it was deemed appropriate to include a final checklist to verify that all the objectives had been achieved. Table 9 below includes the checklist for the rehabilitation objectives per mining area, while Table 10 is a checklist for the biophysical closure objectives.

Table 9: Success criteria per mining area

Aspect	Closure objective	Success criteria	Further action required	Photograph (if applicable)
Old slimes dam	Although the slimes dam walls are very steep, it is already well vegetated and further disturbance will not add value.	Indigenous vegetation has established on the slimes dam rehabilitated surfaces. Alien species should not be dominating plant cover and indigenous species should be present. Water drainage flows naturally without pooling or flooding. Minimal erosion where water flows from drainage structures.	Biodiversity survey to verify that adequate vegetation cover has been achieved and that the balance between indigenous and alien species is acceptable. Mitigate areas where erosion is visible through redirecting storm water.	 
Large waste rock dump	Visually, the southern side wall is the most significant as it is visible from the national road. The objective is to decrease the height and reduce the slope in order to successfully re-vegetate.	The dump has been sloped per closure objectives. Vegetation has established on shaped slopes which limits visual impact.	Re-seed the dump, as seeds that were sowed may be washed away after storm events. After completion of this step, monitoring will be conducted until the end of 2018 to verify establishment of vegetation.	
	Material from the waste rock dump will also be used to fill the depression to the north of the WRD and the eastern quarry	N/A	N/A	
	The mine may also consider selling some of the waste rock material to use during construction or upgrading of roads.	N/A	N/A	
Topsoil stockpiles east and west	Material from the topsoil stockpiles will mainly be used for final sloping and cover to promote vegetation growth. Unused topsoil will be sloped into low lying cavities to allow gradual topography with free drainage.	Any remaining topsoil stockpiles have been sloped as per objective.	One topsoil stockpile was observed during the site visit (14 June 2017). This stockpile w.il be sloped as per objective.	

Aspect	Closure objective	Success criteria	Further action required	Photograph (if applicable)
Quarry east	Benches will be sloped using cut and fill techniques.	Benches have been sloped.	None.	
	The water body to the east will remain intact while the floor to the west of this quarry will be filled with material from the north and south slopes.	Infilling was done where required.	None.	
	Rocky contours are proposed within main drainage lines to reduce runoff velocity and prevent siltation of the water body.	Berms / sediment traps are installed where necessary to reduce sediment loads. No evidence of siltation of nearby natural drainage lines.	None.	
Quarry west	Benches will be sloped using cut and fill techniques.	Benches have been sloped.	None.	
	The water body will remain intact with sloping of the surrounding high walls limited to the current footprint of the water body.	The high-walls do not exceed the footprint of the water body.	None.	
	Prevention of siltation is proposed using rocky bund walls within the main drainage lines towards the water body.	Berms / sediment traps are installed where necessary to reduce sediment loads. No evidence of siltation of nearby natural drainage lines.	None.	
	Final slopes around both quarries should allow at least one section with safe and easy access for animals to reach the water.	Cattle and other fauna on site has safe access to the water.	None.	
Quarry north	The only objective for the northern quarry is to make it safe by sloping the benches using cut and fill techniques	Quarry is fenced off, restricting access.	None	

Table 10: Biophysical success criteria

Aspect	Closure objective	Success criteria	Further action required	Photograph (if applicable)
Topography	During the decommissioning phase, all slopes need to be finished to the prescribed 1:3 slope.	Dumps have been sloped as per closure objective and vegetation has established on shaped slopes which limits visual impact.	In-filling of erosion gulley's that may appear after storm events. Reshape, rip and seed areas.	
	Reduce the visual impact of the altered topography by a process of sloping, benching and rehabilitation.			
Soils	The re-introduction of the topsoil will return the land to its previous land capability.	Refer to Section 8.1.1	No	
	Remove contaminated soil.	Any contaminated soils have been removed.	No	
Land capability and land use	The land will be returned to cattle/game farming or utilised for other purposes that may become viable in the time of operation.	Rehabilitated areas have adequate carrying capacity to ensure it can be used for cattle grazing.	Apply corrective actions to improve sustainability of identified land-uses.	None
	The decommissioning process must take the final use into account in order to achieve a sustainable use.			
Natural vegetation	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.	Removal of invader plants as per the rehabilitation procedure.	

Aspect	Closure objective	Success criteria	Further action required	Photograph (if applicable)
	Special care should be given to: • Quality of vegetation; • Any noxious plants and exotic plants that have established themselves and that have to be removed; and • Any signs of erosion. Corrective measures need to be taken depending on the problems identified.	Monitoring according to year 1 template demonstrates that seeded species are establishing.	Re-seed bare areas.	
Animal life	Animal life will start returning throughout the process of continuous rehabilitation and it is important that disturbance in rehabilitated areas be limited to the minimum.	Potential fauna habitat should be present.	None. During the site visit, evidence of wildlife was found, such as *spoor* and droppings. A local farmer also uses certain areas of the mine for cattle grazing.	None
Surface water	Landscaping should facilitate surface runoff and result in free draining areas.	Berms were constructed to manage surface water runoff. Water drainage flows naturally without pooling or flooding. Minimal erosion where water flows from drainage structures.	In-filling of erosion gulley's that may appear after storm events. Reshape, rip and seed areas.	**Before**  **After (satellite image of infilling)** 
Air quality	To remove any forms of dust generation due to mining activities.	Vegetation has established on most areas limiting dust movement off site.	Re-seed bare areas	None

10 RESIDUAL RISKS

Potential residual impacts are defined as those environmental impacts that remain subsequent to the issuing of a closure certificate. All management actions are launched to limit the potential for residual environmental impacts. Various actions such as rehabilitation of the areas, assessing appropriate land uses and identifying practical closure objectives all work towards minimising this risk.

No specialist studies were conducted and subsequently no information was available to verify these potential residual risks. In areas where vegetation is to be established, regular inspections will be conducted to identify areas of erosion and corrective measures that need to be taken to arrest any signs of erosion.

The following residual risks were identified in the Rehabilitation Plan (Shangoni, 2013).

Geology and the mineral resource

Mining of the material leads to the extraction of the ore body; therefore, the impact on the geology will be permanent. The extraction of ore took place from the various areas as described in the mining method.

Topography

Topography of the affected mining area is affected by three main mining activities: Extraction of ore, WRDs and process slimes dam. There are three quarries where extraction of ore took place, resulting in local depressions with banked high walls to the north. WRDs and the slimes dam create unnatural elevated heaps that significantly alter the topography.

The quarries, WRD and slimes dam can after a period of time have slope stability issues. Rock fall could occur from the quarries and slumping from the WRD and slimes dam. This will change the topography of the area.

Animal life

It is a probability that the quarries will be a safety hazard to animals roaming in the area. If the area is used for grazing after closure, these quarries as well as the WRDs and slimes dam may be a safety hazard to cattle or game. Apart from the safety hazard, steep slopes will also cause access constraints for cattle and game farming.

Surface water and groundwater

Various activities on the mine could have and can result in soil, surface water and groundwater pollution. The significant activities sources of pollution will be due to seepage and surface water run-off from the slimes dam and the WRDs. The mine has no available surface water or groundwater quality data; therefore, the extent of this pollution cannot be determined.

Ponding of water in the quarries as well as on the WRDs and slimes dam will occur. This may lead to seepage of minerals into the groundwater, and affect the stability of the side slopes, which in turn can impact vegetation establishment in these areas and may lead to erosion.

Local farmers will use the quarry as livestock watering resource. There is no surface water quality data to determine whether this water falls within the target water quality guidelines for livestock limits for cattle.

Land capability, surrounding land use and landscape character

Surrounding land use will not be affected significantly; however, the mining activities will have impacted on the landscape character.

An impact the mine has on the land capability is safety of the areas that are not rehabilitated, specifically referring to the high walls of the quarries and steep slopes of the WRDs. All mining areas without vegetation cover impacts on the grazing capability.

Soil

Soil erosion could occur from the WRD and slimes dam if re-vegetation is not adequate.

Disturbance of indigenous vegetation and alien vegetation establishment

Vegetation is destroyed in the quarries and the footprint of the WRDs. Vegetation that was established on the slimes dam was removed during re-mining of the slimes. Compacted soil areas where infrastructure is located as well as access roads are poorly vegetated.

Bare areas, disturbed during mining activities will be prone to weed and invader establishment. The increase of weeds and invasive plant may lead to the decrease in indigenous vegetation numbers.

Visual aspects

Abandoned quarries may impact on the visual quality of the area. The large WRD to the south creates a visual impact when driving past on the N4 highway. Visibility is mainly due to the height of the WRD and absence of vegetation cover.

Community

The mine area is at present fenced off. After closure, residents may remove some fencing that may pose safety risks, e.g. injury or drowning risks.

11 CLOSURE MONITORING

11.1 Introduction

Monitoring of any rehabilitation is absolutely necessary to ensure that the integrity and performance of the rehabilitation method are still in line with the original objectives and purposes of the method. It is very important that monitoring takes place continuously throughout and after rehabilitation. The main goals behind a monitoring program are (van Deventer, 2009):

1. To meet legal requirements. Closure objectives must be specified upfront and accepted by all parties. Objectives must be prescribed for at least the following:
   - Erosion (surface stability).
   - Vegetation cover (species diversity, abundance).
2. Evaluating mine residue and vegetation quality. Dynamic assessment requires a monitoring system to provide a regular surveillance of mine residue and vegetation quality attributes or indicators.
3. Land management. The annual results of the monitoring program will determine the actions to be taken for the following year to ensure the site is improving in the direction of the stipulated end result.
4. Improving our understanding of new ecosystems. For the new ecosystem, the biological productivity, stocks and exchange of nutrients, and the regulation of other ecological processes need to be characterised, quantified, and modelled.

11.2 Monitoring

It is recommended that rehabilitation monitoring is implemented until the end of 2018. The following aspects should be monitored:

11.2.1 Vegetation monitoring

Vegetation establishment on new ecosystems or on disturbed systems should yield a self-sustaining community that is dynamic and able to change as the rehabilitated site ages and matures. The success of re-established plant community must be demonstrated through appropriate monitoring. The monitoring program has to quantify the established plant community in terms of:

1. Species abundance (diversity)
   a. Improvement on contact cover
   b. Canopy cover
   c. Rooting depth
   d. Reproductive performance - Sexual reproduction
2. Asexual reproduction
   a. Microbial activity and biomass
   b. Frequency – once a year

c. Remarks

The vegetation-monitoring programme must be developed for each case of implementation, without compromising the integrity of data gathered. A qualified ecologist with experience in assessment of rehabilitated plant communities must design the monitoring programme.

Monitoring of trees should be done with the monitoring of grasses. To monitor trees, it should be noted that the survival rate of trees and not its coverage is important. If trees continue to die in a certain area, this should be noted and a reason for this must be established. This can be done by consulting the tree supplier or a qualified person. Possible reasons can include:

1. Insufficient water;
2. Frost; and
3. Disease.

It is the objective to eradicate all alien plants during the control programme; however, it is very likely that alien vegetation will re-occur after such initial control. To combat this, an Alien Invasive Vegetation Control Programme is set out. There are five steps to this control programme. They are as follows: Alien vegetation monitoring must also be done after concurrent rehabilitation and the re-vegetation and removal of plants during concurrent rehabilitation has taken place.

Step 1: Information gathering

This first step is done to create a map, indicating the different infestation areas on the site. The following should be done to create such a map:

1. Alien plant infestations should be divided into control areas. To do this, natural or man-made barriers can be used. These barriers include roads, rivers and fences. These barrier areas should be numbered for record purposes.
2. A detailed alien plant survey should be done in each area. The following should be recorded –
   - All alien plant species present and their growth habit (shrubs, trees, coppice, saplings, seedlings),
   - Percent density of each alien plant species (75-100% is very dense, 50-75% is dense, 25-50% is medium dense, 5-25% is sparse and 0-5% is scattered),
   - The terrain.
3. Rank the areas into high, medium and low priority areas. This depends on the biodiversity, water yield and carrying capacity.
4. Identify suitable grass species for establishment and availability, according to land use aims.
5. Place all above information on a 1:1 000 map.

Step 2: Planning

This step is to establish integrated control strategies in each control (barrier) area as identified in Step 1. The following should be done:

1. List the required resources for each high priority control area (e.g. labour, herbicides, and equipment) and the current management practices on the property.
2. Evaluated and select appropriate control methods, using registered herbicides.
3. Calculate the costs for the high priority control areas.
4. Secure a long-term commitment to rehabilitation.

Step 3: Management

1. Draw up an Annual Plan of Operations (APO) for high priority control areas. This plan must be updated each year. It includes a budget for the required resources for control strategies during the first year. This determines the scale of work.
   a. 75% for follow-up work and rehabilitation of previously cleared areas'
   b. 20% for initial control of new area' and
   c. 5% for an emergency.
2. Establish an emergency fund to cope with catastrophes such as mass seeding generation, fire, flood, etc.
3. Allocate resources to high priority control areas.
4. Draw up timetables for control operations, including a "catch-up" for in case operations fall behind.
5. The plan must be flexible and adjusted as progress is made.

Step 4: Implementation

Train the labourers in correct control and grass planting methods.

Step 5: Record keeping

1. Keep simple records of daily operations, e.g. record of labour days, herbicide used, and volumes and equipment used.
2. Monitor progress with the control work (after first year) by recording information on maps.
3. The information from these records must be fed back into the budget to update and amend the APO for the following year.

11.2.2 Erosion

The primary objective of closure of any sloped area is to create a rehabilitated surface and topography that has the capacity to be stabilised under all environmental conditions e.g. severe rain events, veld fires, droughts etc. Erosion status of the rehabilitated land should be monitored and zones with excessive erosion should be identified for remedial action. Erosion can be quantified by insertion of marked stakes into the rehabilitated profile and recording the rate at which the stakes are uncovered. However, the norm is simply the recording of the existence of erosion in a particular location. Key objectives to improve surface stability are;

- Minimisation of surface erosion (wind and water); and

- Establishment of a plant community that is self-sustaining or any other cover material which comply to surface stability.

Achievement of these objectives should be demonstrated by monitoring of the rehabilitated areas. The key objective of surface stability monitoring lies in being able to demonstrate in a quantified manner the stability of surface rehabilitation works. The monitoring programme should be developed such that loss of soil can be quantified and the stability of the vegetated areas be assessed.

12 CLOSURE COST

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, as illustrated in Section 8.2 of this report. 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 11: 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

The complete financial provision calculation is attached to this document in Appendix 3.

13 RECOMMENDATIONS

13.1 Updating requirements of this plan

Considering that rehabilitation of Anref has been completed, this plan will be utilised as part of an application for a closure certificate. An audit was conducted on the 2013 rehabilitation plan as part of the application for a closure certificate to verify that all the recommended actions have been implemented.

13.2 Knowledge gaps

No specialist studies such as a land capability / biodiversity assessment was conducted to verify that the vegetation that has established is sufficient for the final land use, which is grazing. The following actions are recommended to address the gaps:

- The company should conduct a land function analysis (LFA) on the slimes dam and waste rock dumps to verify whether the rehabilitation actions that have been implemented was successful.
- The current land occupant (farmer) is satisfied with the rehabilitation measures that have been implemented.
- Implementation of maintenance as per the rehabilitation plan for a period of 2 years post-closure.

In general, the other expected impacts have been quantified and are understood based on historical data and information available.

13.3 On-site documents

Regulation 26(h) of the NEMA EIA Regulations states that the closure plan must be available on site and to any person on request.

APPENDIX 1: CLOSURE RISK ASSESSMENT REPORT

1. RISK ASSESSMENT CRITERIA

Step 1: Determine the **PROBABILITY** of the impact by calculating the average between the Frequency of the Aspect, the Availability of a pathway to the receptor and the availability of the receptor (thus: Sum of the three column scores below ÷ 3)

Frequency of Aspect / Unwanted Event	Score	Availability of pathway from the source to the receptor	Score	Availability of receptor	Score
Never known to have happened, but may happen	1	A pathway to allow for the impact to occur is never available	1	The receptor is never available	1
Known to happen in industry	2	A pathway to allow for the impact to occur is almost never available	2	The receptor is almost never available	2
< once a year	3	A pathway to allow for the impact to occur is sometimes available	3	The receptor is sometimes available	3
Once per year to up to once per month	4	A pathway to allow for the impact to occur is almost always available	4	The receptor is almost always available	4
Once a month - Continuous	5	A pathway to allow for the impact to occur is always available	5	The receptor is always available	5

Step 2: Determine the **MAGNITUDE** of the impact by calculating the average of the factors below (thus: Sum of all six column ratings below ÷ 6)

Source								**Receptor**			
Duration of impact	**Score**	**Extent**	**Score**	**Volume / Quantity / Intensity**	**Score**	**Toxicity / Destruction Effect**	**Score**	**Reversibility**	**Score**	**Sensitivity of environmental component**	**Score**
Lasting days to a month	1	Effect limited to the site. (metres);	1	Very small quantities / volumes / intensity (e.g. < 50L or < 1Ha)	1	Non-toxic (e.g. water) / Very low potential to create damage or destruction to the environment	1	Bio-physical and/or social functions and/or processes will remain unaltered.	1	Current environmental component(s) are largely disturbed from the natural state. Receptor of low significance / sensitivity	1
Lasting 1 month to 1 year	2	Effect limited to the activity and its immediate surroundings. (tens of metres)	2	Small quantities / volumes / intensity (e.g. 50L to 210L or 1Ha to 5Ha)	2	Slightly toxic / Harmful (e.g. diluted brine) / Low potential to create damage or destruction to the environment	2	Bio-physical and/or social functions and/or processes might be negligibly altered or enhanced / Still reversible	2	Current environmental component(s) are moderately disturbed from the natural state. No environmentally sensitive components.	2
Lasting 1 – 5 years	3	Impacts on extended area beyond site boundary (hundreds of metres)	3	Moderate quantities / volumes / intensity (e.g. > 210 L < 5000L or 5 – 8Ha)	3	Moderately toxic (e.g. slimes) Potential to create damage or destruction to the environment	3	Bio-physical and/or social functions and/or processes might be notably altered or enhanced / Partially reversible	3	Current environmental component(s) are a mix of disturbed and undisturbed areas. Area with some environmental sensitivity (scarce / valuable environment etc.).	3
Lasting 5 years to Life of Organisation	4	Impact on local scale / adjacent sites (km's)	4	Very large quantities / volumes / intensity (e.g. 5000 L – 10 000L or 8Ha– 12Ha)	4	Toxic (e.g. diesel & Sodium Hydroxide)	4	Bio-physical and/or social functions and/or processes might be considerably altered or enhanced / potentially irreversible	4	Current environmental component(s) are in a natural state. Environmentally sensitive environment / receptor (endangered species / habitats etc.).	4
Beyond life of Organization / Permanent impacts	5	Extends widely (nationally or globally)	5	Very large quantities / volumes / intensity (e.g. > 10 000 L or > 12Ha)	5	Highly toxic (e.g. arsenic or TCE)	5	Bio-physical and/or social functions and/or processes might be severely/substantially altered or enhanced / Irreversible	5	Current environmental component(s) are in a pristine natural state. Highly Sensitive area (endangered species, wetlands, protected habitats etc.)	5

Step 3: Determine the **SIGNIFICANCE** of the impact by plotting the averages that were obtained above for Probability and Magnitude in the table below.

ENVIRONMENTAL IMPACT RATING / PRIORITY					
	MAGNITUDE				
PROBABILITY	1 Minor	2 Low	3 Medium	4 High	5 Major
5 Almost Certain	Low	Medium	High	High	High
4 Likely	Low	Medium	High	High	High
3 Possible	Low	Medium	Medium	High	High
2 Unlikely	Low	Low	Medium	Medium	High
1 Rare	Low	Low	Low	Medium	Medium

2. RISK ASSESSMENT RESULTS

The aim of this section of this Risk Assessment Report is to provide information regarding the potential environmental impacts associated with the proposed activities related to mine closure and rehabilitation.

NO.	ASPECTS AFFECTED	ACTIVITY whether listed or not listed	POTENTIAL IMPACT: Impact description	POTENTIAL IMPACT: Specialist study reference	TIMEFRAME IN WHICH RISK IS LIKELY TO MANIFEST	DURATION OF IMPACT	SIGNIFICANCE If not mitigated: Probability	SIGNIFICANCE If not mitigated: Magnitude	SIGNIFICANCE If not mitigated: Significance	MITIGATION TYPE (modify, remedy, control, or stop) through e.g. noise control measures)	MITIGATION MEASURES (include monitoring)	SIGNIFICANCE If mitigated: Probability	SIGNIFICANCE If mitigated: Magnitude	SIGNIFICANCE If mitigated: Significance	ACCEPT ABLE RISK (Y/N)	COST (LINK TO FINANCIAL PROVISIONING, WHETHER MONITORING OR MITIGATION COSTS)
1	Geology	Mining activities - Quarries	Mining of the material leads to the extraction of the ore body; therefore, the impact on the geology will be permanent. The extraction of ore took place from the various areas as described in the mining method.	Rehabilitation Plan, 2013	Operational phase	Permanent	5	3	H	Control	• Only mine within the approved mining right area. • Mining has ceased, and rehabilitation has been completed, subsequently the impact will not expand.	5	3	H	Y	n/a
2	Topography	Mining activities	Topography of the affected mining area is affected by three main mining activities: Extraction of ore, WRDs and process slimes dam. There are three quarries where extraction of ore took place, resulting in local depressions with banked high walls to the north. WRDs and the slimes dam create unnatural elevated heaps that significantly alter the topography.	Rehabilitation Plan, 2013	Operational phase	Permanent	5	4	H	Remedy	• During the decommissioning phase all slopes need to be finished to the prescribed 1:3 slope. • Reduce the visual impact of the altered topography by a process of sloping, benching and rehabilitation.	3	3	M	Y	Included in maintenance cost No. 6 below
3	Surface and ground water	Mining activities	Various activities on the mine could have resulted in soil, surface water and groundwater pollution. The significant activities sources of pollution will be due to seepage and surface water run-off from the slimes dam and the WRDs. The mine has no available surface	Rehabilitation Plan, 2013	Operational, decommissioning phase	Short term	4	3	H	Control & Remedy	• The re-introduction of the topsoil will return the land to its previous land capability and result in the water runoff to be deemed as clean water thus minimising the impact on surface water and ground water quality. • Remove contaminated soil as necessary. • Implement erosion control measures on slimes dam as identified in the rehabilitation plan.	4	3	H	Y	n/a

NO.	ASPECTS AFFECTED	ACTIVITY whether listed or not listed	POTENTIAL IMPACT Impact description	Specialist study reference	TIMEFRAME IN WHICH RISK IS LIKELY TO MANIFEST	DURATION OF IMPACT	SIGNIFICANCE If not mitigated Probability	Magnitude	Significance	MITIGATION TYPE (modify, remedy, control, or stop) through e.g. noise control measures)	MITIGATION MEASURES (include monitoring)	SIGNIFICANCE If mitigated Probability	Magnitude	Significance	ACCEPT ABLE RISK (Y/N)	COST (LINK TO FINANCIAL PROVISIONING, WHETHER MONITORING OR MITIGATION COSTS)
			water or groundwater quality data; therefore, the extent of this pollution (if any) cannot be determined.													
4	Surface and ground water	Ponding of rainwater on rehabilitated areas	Ponding of water in the quarries as well as on the WRDs and slimes dam will occur. This may lead to seepage of minerals into the groundwater, and affect the stability of the side slopes, which in turn can impact vegetation establishment in these areas and may lead to erosion.	Rehabilitation Plan, 2013	Post closure	Medium term	4	2	M	Control	• Water in the quarries will remain for use by the farmer. • 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.	3	2	M	Y	n/a
5	Land capability and use	Mining activities - Quarries	The main impact on the land capability is the quarries that will not be rehabilitated and with no proposed land use. Surrounding land use will not be affected significantly; however, the mining activities will have impacted on the landscape character.	Rehabilitation Plan, 2013	Post closure	Permanent	5	2	M	Control	• 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.	3	1	L	Y	n/a

NO.	ASPECTS AFFECTED	ACTIVITY	POTENTIAL IMPACT		TIMEFRAME IN WHICH RISK IS LIKELY TO MANIFEST	DURATION OF IMPACT	SIGNIFICANCE If not mitigated			MITIGATION TYPE (modify, remedy, control, or stop) through e.g. noise control measures)	MITIGATION MEASURES (include monitoring)	SIGNIFICANCE If mitigated			ACCEPT ABLE RISK (Y/N)	COST (LINK TO FINANCIAL PROVISIONING, WHETHER MONITORING OR MITIGATION COSTS)
		whether listed or not listed	Impact description	Specialist study reference			Probability	Magnitude	Significance			Probability	Magnitude	Significance		
6	Vegetation	Disturbance of indigenous vegetation and alien vegetation establishment	Vegetation is completely destroyed in the quarries and the footprint of the WRDs. Some vegetation that was established on the slimes dam was removed during re-mining of the slimes. Compacted soil areas where infrastructure is located as well as access roads are poorly vegetated. Bare areas, disturbed during mining activities will be prone to weed and invader establishment. The increase of weeds and invasive plant may lead to the decrease in indigenous vegetation numbers.	Rehabilitation Plan, 2013	Post closure	Medium term	3	2	M	Control & Remedy	• Re-seeding bare areas and implementation of alien eradication programme. • Implementation of berms to allow for vegetation establishment and surface water management. • Erosion control measures to be implemented on slimes dam as per rehabilitation plan.	2	1	L	Y	R 254 851.94
7	Visual	Mining activities	Abandoned quarries may impact on the visual quality of the area. The large WRD to the south creates a visual impact when driving past on the N4 highway. Visibility is mainly due to the height of the WRD and absence of the vegetation cover.	Rehabilitation Plan, 2013	Post closure	Permanent	5	3	H	Remedy	• Implementation of the rehabilitation program, including re-vegetation of the WRDs.	3	2	L	Y	n/a

APPENDIX 3: FINAL EMP PERFORMANCE ASSESSMENT

APPENDIX 3: FINANCIAL PROVISIONING REPORT

APPENDIX 4: REHABILITATION PLAN