63 Wessel Road, Rivonia, 2128 PO Box 2597, Rivonia, 2128 South Africa
Tel: +27 (0) 11 803 5726 **Fax:** +27 (0) 11 803 5745 **Web:** www.gcs-sa.biz

Environmental Management Programme Amendment Application
De Beers Consolidated Mines Limited
Voorspoed Diamond Mine, Free State Province

Amendment Application Report

Version – Final Draft

September 2021

De Beers Consolidated Mines Limited

GCS Project Number: 20-0195

DMR Reference: FS 30/5/1/2/3/2/1 (12) EM

Client reference: De Beers Voorspoed Amendment

GCS (Pty) Ltd. **Reg No:** 2004/000765/07 Est. 1987
Offices: Johannesburg (Head Office) | **Durban** | Gaborone | Lusaka | Maseru | Windhoek | Ostrava
Directors: AC Johnstone (CEO) | A Gunn (COO) | A Wilke | M Van Rooyen | W Sherriff (Financial) N Marday (HR)
Non-Executive Director: B Wilson-Jones
www.gcs-sa.biz

Environmental Management Programme Amendment Application
De Beers Voorspoed Mine, Free State Province

Final Draft

August 2021

DOCUMENT ISSUE STATUS

Report Issue	Amendment Application Report: Final Draft		
GCS Reference Number	20-0195		
Client Reference	De Beers Voorspoed Amendment		
Title	Environmental Management Programme Amendment Application De Beers Voorspoed Mine, Free State Province		
	Name	**Signature**	**Date**
Author	Georgina Wilson	[signature]	August 2020
Co-Author	Janice Callaghan	[signature]	August 2021
Document Reviewer	Magnus van Rooyen	[signature]	August 2021
Director	Andrew Johnstone	pp [signature]	August 2021

PURPOSE OF THIS DOCUMENT

The Applicant (De Beers Consolidated Mines Proprietary Limited / DBCM) seeks the removal of three conditions from the Environmental Management Programme Report approval letter issued by the Free State Regional Branch of the Department of Mineral Resources and Energy (DMRE) pertaining to the Voorspoed Mine EMPr submitted in 2010 related to backfilling of the final void created resulting from diamond mining activities at the Voorspoed Mine, Free State Province

The three conditions were included in an EMPr amendment approval letter issued by the Free State DMRE[1] on 22 July 2010 (Reference number: FS 30/5/1/2/3/2/1 (12) EM- **Appendix A**), in response to an EMPr amendment application lodged by DBCM in 2010. The purpose of the 2010 amendment application was to extend the Voorspoed mining right area to include a section of the resource which was not included in the originally authorised mining footprint. Since the 2010 amendment application, which resulted in the inclusion of these conditions, was submitted merely to incorporate an additional mining area to the Voorspoed Mine, no change to the activities taking place at the Voorspoed Mine requiring the imposition of backfilling conditions were anticipated. DBCM never considered backfilling in respect of the Voorspoed Mine and the option to backfill was not included in the 2010 amendment application (or any of the previous EMPr documentation) submitted to the DMRE for approval. As a result, the impacts associated with the backfilling of the open pit at the Voorspoed Mine were neither considered nor assessed and the backfilling condition was imposed by the DMRE in the absence of any feasibility (technical, environmental, social, financial, and legal) or other investigations or commitment from DBCM

GCS Water and Environmental Consultants Proprietary Limited (GCS) were appointed by DBCM as the independent Environmental Assessment Practitioner to compile and submit the reports contemplated in regulation 31 of the National Environmental Management Act (Act No. 107 of 1998) (NEMA): Environmental Impact Assessment (EIA) Regulations (2014), as amended in support of this application to amend the aforesaid amendment approval letter issued by the DMRE on 22 July 2010 for the removal of the three backfilling conditions.

Voorspoed Mine is currently in the decommissioning/closure phase and is no longer operational. During the operational phase of the mine, the conventional open pit, blast, load and haul method was used to mine kimberlite ore for diamonds. The result is an open void approximately 900 m in diameter with a depth of approximately 240 m, from which ore and waste material were removed. The waste rock was placed on a waste rock dump and the waste from the mineral processing plant was place on fine and coarse discard dumps.

[1]Previously referred to as the Department of Mineral Resources

The Voorspoed Mine Final Closure Plan (Redco and Uvuna Sustainability, 2019a **Appendix C**), states that the preferred closure option is for the void to be left open to allow pitlake levels to rebound over time and create what is referred to in this report as a “pitlake”. It is proposed that the terrain and waste rock dumps surrounding the open pit will be rehabilitated according to the Voorspoed Final Rehabilitation Plan (Redco and Uvuna Sustainability, 2019b – **Appendix D**).

A report compiled by Golder Associates Africa Proprietary Limited (Golder) in 2019[2] (Technical Evaluation of the Risks, Impacts and Management Requirements into Pit Backfilling Versus Current Mine Plan (Pitlake)- **Appendix F**) and referred to in this report as the “Golder Report, 2019”, investigated the feasibility and risks associated with the pitlake closure option, in comparison with the backfilling closure option. The proposed closure cover design was used to model the unsaturated flow through the respective waste facilities and it was found in all three cases a reduction of infiltration of more than 90% (Golder, 2020).

The Golder Report recommends that in terms of economic and environmental considerations, the pitlake option "*is probably the best option due to the lower cost (landform rehabilitation included in the overall mine rehabilitation program) and environmental aspects (i.e. limit runoff from surrounding unprotected land and prohibit migration of contaminated water to the surrounding environment)*". The report further recommends that backfilling the pit "*is not recommended due to extraordinary costs of backfilling activity, the creation of a potential pollution footprint (i.e. remaining foot print of the current waste rock dump) and the potential impact on the surrounding environment due to polluted groundwater migration from the saturated backfilled excavation as early as ~32 years after closure towards surrounding users*".[3]

Golder undertook further investigations in 2021 into the closure of the Voorspoed Mine and the proposed establishment of a pitlake. This included long term geochemical modelling that found, after an initial deterioration (40 years) the pit water quality will progressively improve due to the various geochemical processes including sorption and precipitation (Golder, 2021, Appendix K).

[2]Golder Associates Africa (Pty) Ltd, Technical Evaluation of the Risks, Impacts and Management Requirements into Pit Backfilling Versus Current Mine Plan (Pitlake)-Voorspoed Diamond Mine, February 2019.
[3] Golder Report, page 87.

A further study commissioned in 2019 (WRC) indicated that pitlakes can serve as a sustainable closure option for South African pit mines. The findings of this study indicate that pitlakes can be environmentally sustainable if they are designed and managed correctly, and this will eliminate the surface discharge of water into the catchment. Should the pitlake be suitably designed, it forms a local piezometric sink and the final water level elevation will stabilise below the surrounding natural groundwater elevation. Correctly designed pitlakes offer an environmentally sustainable closure option for open pit mines in South Africa.

Given that the original EMPr (2005 EMPr) for the mine (Metago, 2005- **Appendix B**) and the closure EMPr and Final Basic Assessment Report (Centre for Environmental Management (CEM), 2019- **Appendix G**) assessed the impacts of the mine assuming that closure would include a pitlake, it is considered that the impact assessments currently in place are unlikely to require amendment, should this application be granted.

This amendment application report serves to motivate for the removal of the three conditions that were included in an EMPr amendment approval letter issued by the Free State DMRE on 22 July 2010 (Reference number: FS 30/5/1/2/3/2/1 (12) EM- **Appendix A** and it will be made available for public participation in accordance with Regulation 32 of the NEMA: EIA Regulations (2014), as amended.

CONTENTS PAGE

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

ABBREVIATIONS AND ACRONYMS

CARA	Conservation of Agricultural Resources Act (Act 43 of 1983)
CEM	Centre for Environmental Management
CRD	Course Residue Deposit
DBCM	De Beers Consolidated Mines Proprietary Limited
DFFE	Department of Forestry, Fisheries and the Environment
DMRE	Department of Mineral Resources and Energy
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment, GNR 982 of 4 December 2014, as amended
EMPr	Environmental Management Programme
FBAR	Final Basic Assessment Report
FRD	Fine Residue Deposit
GCS	GCS Water and Environmental Consultants Proprietary Limited
Golder	Golder Associates Africa Proprietary Limited
LoM	Life of Mine
I&APs	Interested and Affected Parties
MPRDA	Mineral and Petroleum Resources Development Act (Act 28 of 2002)
NEMA	National Environmental Management Act (Act 107 of 1998)
NEM:AQA	National Environmental Management: Air Quality Act (Act 39 of 2004)
NEM:BA	National Environmental Management: Biodiversity Act (Act 10 of 2004)
NEM:WA	National Environmental Management: Waste Act (Act 59 of 2008)
NWA	National Water Act (Act 36 of 1998)
WRC	Water Resource Commission
WRD	Waste Rock Dump

1 INTRODUCTION

1.1 Project Overview

The Applicant (De Beers Consolidated Mines Proprietary Limited (DBCM)) wishes to remove the following three conditions that relate to backfilling of the final void created as a result of diamond mining at the Voorspoed Mine, from the EMPr amendment approval letter issued by the DMRE in relation to the Voorspoed EMPr (Amended 2010 EMPr):

- Condition (d): "*All mine waste (suitable for rehabilitation) must be taken back to the excavation area for backfilling purposes. Rehabilitation of the mining area must be done concurrently with mining activities (whenever and wherever possible)*";
- Condition (f): "*Dump structures must not be left on the surface, this includes topsoil stockpiles, overburden stockpiles, waste rock stockpiles, tailings dumps and slimes dams*"; and
- Condition (g): "*All excavations must be backfilled to the natural surface level; if a bulk factor exists it must be accommodated on the total area of disturbance*".

The above three conditions were included in an EMPr amendment approval letter issued by the (then) Free State Department of Mineral Resources (now the Department of Mineral Resources and Energy (DMRE)) on 22 July 2010 (Reference number: FS 30/5/1/2/3/2/1 (12) EM- **Appendix A**), in response to an amendment application submitted by DBCM in terms of section 102 of the Minerals and Petroleum Resources Development Act (No. 28 of 2002) (MPRDA).

The purpose of the section 102 amendment application submitted in 2010 was to extend the Voorspoed Mining right area to include a Portion of the Farm Morgenster 772 (formerly known as Subdivision 2 of the Farm Morgenster 772) to incorporate a small portion of Kimberlite ore body which was not geographically aligned with the western boundary of the originally authorised mining footprint. In requesting this amendment, no change to the mine's closure objectives were envisaged or requested.

The DMRE approved this amendment to the mining area in an EMPr amendment approval letter dated 22 July 2010, subject to the conditions specified above. The effect of these conditions was to completely change the closure objective for the mine from an open pit, as previously approved by the DMRE in the initial 2005 EMPr for the mine, to a pit that is completely backfilled with waste rock material. As the 2010 amendment application did not anticipate any change to the activities taking place at the Voorspoed Mine, the impacts associated with the backfilling of the open pit were neither considered nor assessed and the backfilling condition was imposed by the DMRE in the absence of any feasibility (technical, environmental, social, financial, and legal) or other investigations in support thereof.

Currently Authorised Closure Activities

The 2005 EMPr makes provision for the following closure activities:

- Topsoil stripped in the construction phase will be used for rehabilitation.
- The pit is expected to flood after closure.

The following closure objectives have been identified:

- Rehabilitate the land to its pre-mining land use, if possible. If this is not possible, rehabilitate to a stable condition i.e. where erosion and pollution are under control.
- Restore as much of the project area as possible to a condition consistent with the above objective.
- Ensure the area is left in a condition at an acceptable level of risk to public health and safety.
- Reduce the need for post closure intervention as far as practicably possible, such as in the form of monitoring or ongoing remediation.

The Closure Objectives are based on the following Principles:

- Legal compliance;
- Continuous, inclusive (internal and external) stakeholder engagement;
- Structural and ecological stability of the landforms;
- Protection of the slopes against erosion;
- Pollution control (ground and surface water);
- Clean and dirty water separation;
- Concurrent rehabilitation;
- Mitigating the visual impact of the waste rock dump and residue disposal facilities;
- A post closure land use with no long-term liabilities;
- Mitigate and, where appropriate, remediate adverse social impacts;
- Portable skills; and
- The Mine is closed efficiently, peacefully and cost effectively.

In terms of the 2010 EMPr amendment approval letter, mine closure comprises the use of all mine waste stored on the surface of the mine to backfill the open void. This will be followed by rehabilitation of the surface area.

Proposed Amendment

This proposed amendment application reports details and motivates for the removal of the three conditions that were included in an EMPr amendment approval letter issued by the Free State DMRE on 22 July 2010 (Reference number: FS 30/5/1/2/3/2/1 (12) EM- **Appendix A i.e.** that mine closure will consist of implementing the pitlake option which entails leaving the final void open and the rehabilitated waste dumps will remain on the surface.

No additional Listed Activities in terms of the NEMA: EIA Regulations (2014), as amended will be triggered in respect of the proposed amendment. In addition, it must be noted that an Environmental Authorisation ("**EA**") was issued on 17 February 2020 approving the closure of the operations (Reference number: FS 30/5/1/2/3/2/1 (012) EM). This EA also includes a complete backfill obligation and is currently under appeal, as described in more detail further below.

1.2 Authorisations Related to the Project

The following list is a summary of the authorisations currently held by DBCM in respect of the Voorspoed Mine, and which are related to this amendment application. (Please note, other, non-related authorisations have not been included in this list):

- An EMPr for the Voorspoed Mine which was approved in 2005 (Metago, Reference: 181-010- **Appendix B**) and the mining right which was approved in 2006 (2005 EMPR).
- An amendment to the above EMPr to authorise an alteration to the Voorspoed Mining Area which was approved by the DMRE on 22 July 2010 (Reference number: FS 30/5/1/2/3/2/1 (12) EM- **Appendix A**). The current amendment application relates to this 2010 amendment where the DMRE approval letter required DBCM to backfill the open pit by imposing the three impugned backfilling conditions in the approval letter).
- An EA for decommissioning and closure granted by the DMRE on 17 February 2020 (Reference number: FS 30/5/1/2/3/2/1 (012) EM) ("**Closure EA**"). The Closure EA was granted subject to a condition requiring DBCM to backfill the open pit. DBCM lodged a limited appeal against the backfilling condition included in the Closure EA ("**Closure EA Appeal**") in terms of which it seeks the DMRE's decision to impose this condition to be set aside and for it to be substituted by the preferred pitlake option. The Closure EA Appeal was lodged with the then Department of Forestry, Fisheries and the Environment (DFFE) on 17 March 2020 and is pending as at the date of this report.

1.3 Amendment Application Process

This amendment application process consists of the following steps, in line with the requirements of the NEMA: EIA Regulations (2014), as amended:

1. Submission of Application Form on 10 March 2020;
2. Consultation meeting held on 5 August 2020 with the Free State DMRE;
3. Compilation of draft Amendment Application Report (this report);
4. 30-day public participation process associated with the documentation that is prepared through the application process (still to be completed);
5. Finalisation and submission of Amendment Application Report to the Free State; and
6. Decision on application to be issued by Free State DMRE.

The Free State DMRE acknowledged receipt of the amendment application in correspondence dated 16 March 2020 (see Confirmation Letter- **Appendix I**). The application timeframes were suspended on 7 March 2020 and then resumed on 5 June 2020 in terms of regulations that were gazetted by the Minister of Forestry, Fisheries and the Environment in relation to the Covid-19 pandemic. The Free State DMRE subsequently issued further correspondence to DBCM dated 2 September 2020 in terms of which it indicated its decision to suspend the EMPr amendment application process, until such time that the Closure EA Appeal has been finalised, due to the interrelatedness of the two administrative processes.

DBCM has elected to continue with the related public participation process and prepare this report, pending the outcome of the Closure EA Appeal. The objective of implementing the public participation process is to ensure that there will then not be an additional time lag to finalise this EMPr Amendment Application before it can be finally decided, after the Closure EA Appeal is decided. DBCM's proposal to implement the public participation process, pending finalisation of the Closure EA Appeal has been communicated to the Free State DMRE. DBCM is cognisant of and understands the Free State DMRE's position that it will not finally process / decide this EMPr Amendment Application until such time as the Closure EA Appeal is decided.

1.4 Report Contents

This document serves as the draft Amendment Application Report for Interested and Affected Party (I&AP) and the Free State DMRE to review and comment on. It describes the background, scope and impacts of the proposed amendments, as well as the process to be followed. Regulation 32 of the NEMA: EIA Regulations (2014), as amended specifies the information which must be included in this report. Table 1-1 below details these requirements and indicates the relevant sections within the report in each respect.

Table 1-1: Contents of the Amendment Application Report and relevant section in this report.

REQUIREMENT	SECTION IN THIS REPORT
The Applicant must within 90 days of receipt of the application for amendment by the competent authority, submit a report reflecting:	
(1) (a) (i) An assessment of all impacts related to the change;	**Section 7**
(ii) Advantages and disadvantages associated with the proposed change;	**Section 7**
(iii) Measures to ensure avoidance, management and mitigation of impacts associated with such proposed change; and	**Section 8**
(iv) Any changes to the EMPr	**Section 8**
which report -	
(aa) had been subjected to a PPP process which had been agreed to by the competent authority and which was appropriate to bring the proposed change to the attention of potential and registered I&APs including organs of state which have jurisdiction in respect of any aspect of the relevant activity and the competent authority, and	**Section 9**
(bb) reflects the incorporation of comments received including any comments of the competent authority, or	**Section 9**
(1) (b) a notification in writing that the report will be submitted within 140 days of receipt of the application by the competent authority as significant changes have been made or significant new information has been added to the report which changes or information was not contained in the report consulted on during the initial PPP contemplated in sub-regulation (1)(a) and that the revised report will be subjected to another public participation process of at least 30 days.	To be completed after the PPP

2 PROJECT DETAILS

2.1 Applicant

The details of the Applicant are provided in **Table 2-1** below.

Table 2-1: Details of the Applicant.

ITEM	DETAILS
Company Name	De Beers Consolidated Mines Proprietary Limited
Company Representative	Petrus Jordaan
Contact Persons	Petrus Jordaan
Telephone No.	056 -216 8466/0846094365
Facsimile No.	N/A
E-mail Address	Petrus.Jordaan@debeersgroup.com / Hans.Kgasago@debeersgroup.com
Postal Address	The De Beers Group of Companies Voorspoed Mine P.O Box 1964 Kroonstad 9500

2.2 Environmental Assessment Practitioner

GCS has been appointed as the independent EAP by DBCM to undertake this Amendment Application on behalf of the Applicant. The contact details of the EAP are provided in **Table 2-2** and the EAP's CV is attached as **Appendix J**.

Table 2-2: Details of the EAP.

ITEM	DETAILS
Company Name	GCS Water and Environmental Consultants Proprietary Limited
Company Representative	Magnus van Rooyen
Telephone No.	+27 (0)11 803 5726
Facsimile No.	+27 (0)11 803 5745
E-mail Address	magnusvr@gcs-sa.biz
Postal Address	PO Box 2597, Rivonia, 2128

GCS has no conflict of interest related to the contents of this Report. GCS has no personal financial interests in the property and/or activity being assessed in this report. GCS has no personal or financial connections to the relevant property owners, developers, planners, financiers or consultants of the property or activity, other than fair remuneration for professional services rendered for this Report to the Competent Authority. GCS declares that the opinions expressed in this Report are independent and a true reflection of their professional expertise. As such GCS meets the requirements of an Independent EAP as per the NEMA: EIA Regulations (2014), as amended.

2.3 Project Location

The Voorspoed Mine is owned by DBCM, and is located in the Free State Province of South Africa. The Voorspoed Mine is situated approximately 30 km north of Kroonstad on the farms Voorspoed No. 2480, Voorspoed No. 401, Geldenhuys No. 1477 and Morgenster No. 772 (see **Figure 2-1** and **Figure 2-2**). It is located within the Ngwathe and the Moqhaka Local Municipalities and the Fezile Dabi District Municipality.

The mining right in respect of the Voorspoed Mine was granted to DBCM by the DMR on 5 September 2006. The right was granted for a period of 15 years ending in October 2023. Mining operations commenced at the Voorspoed Mine on 4 November 2008 and the mine was anticipated to be operational for a period of 12 to 15 years, with a projected LoM until 2021. Voorspoed is currently in the decommissioning and closure phase. Notwithstanding the anticipated LoM, mining operations at the Voorspoed Mine ceased prematurely in December 2018. This was due to a range of factors, including pit slope instability and complex geology.

During the operational phase, the mine used the conventional open pit blast, load and haul method to remove waste rock and kimberlite ore from the single open pit. Waste rock was removed from the pit and placed on a waste rock dump (WRD), while ore was stockpiled next to the primary crusher before being treated.

In the treatment plant, ore was crushed, scrubbed and screened to recover diamonds. Crushed ore was fed into a Dense Medium Separation plant (DMS), where diamond-bearing kimberlite ore (with a high specific gravity) were separated from lighter, non-diamond-bearing ore. Two residue streams were created by the DMS plant. The crushed non-diamond-bearing ore was disposed of on the Coarse Residue Deposit (CRD). The fine diamond bearing ore emanating from the crushing and scrubbing process was pumped to and disposed of on the Fine Residue Deposit (FRD) facility.

Following the decision to cease production, DBCM explored a divestment process with the view to securing a suitable operator to acquire and operate the Voorspoed Mine along with its assets and liabilities as a going concern. The DMRE also participated in the proposed divestment process, which consisted of a comprehensive bidding process in which proposals were received from 20 bidders. Pivotal to this sale process was the identification of an operator with the right empowerment credentials, technical ability, access to funding, the ability to comply with environmental and other regulatory requirements and the ability to contribute to the socio-economic development of the Kroonstad region and the Fezile Dabi District Municipality. The sale process, which was initiated in November 2017, was unsuccessful in identifying a suitable operator that complied with these requirements.

As a result, DBCM's board of directors took a decision to proceed with the decommissioning and closure of the Voorspoed Mine.

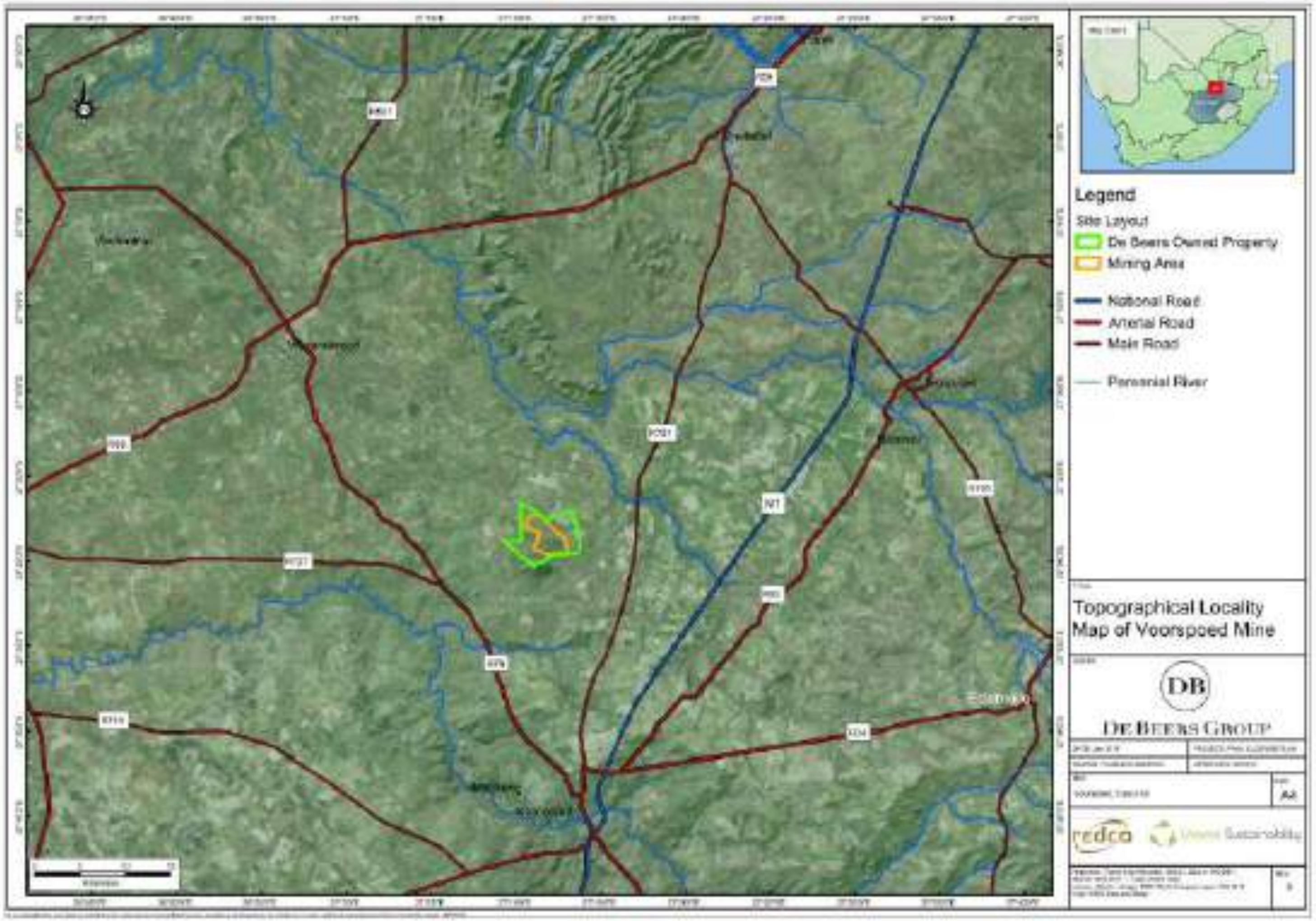


Figure 2-1: Locality of De Beers Voorspoed Mine (Redco & Uvuna Sustainability, 2019).

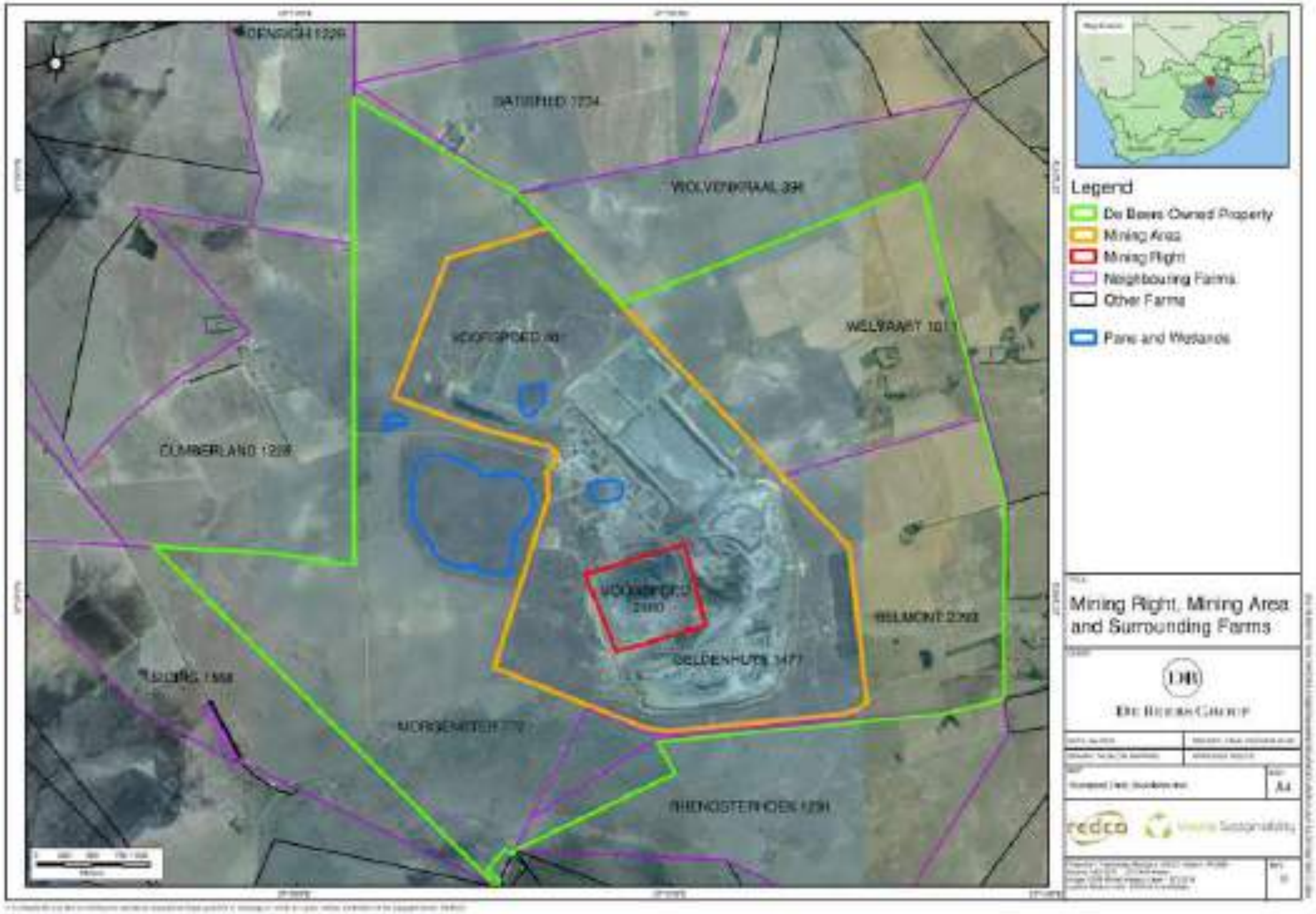


Figure 2-2: Voorspoed Mining Right Area (red), mine area (orange) and surrounding farms (Redco & Uvuna Sustainability, 2019).

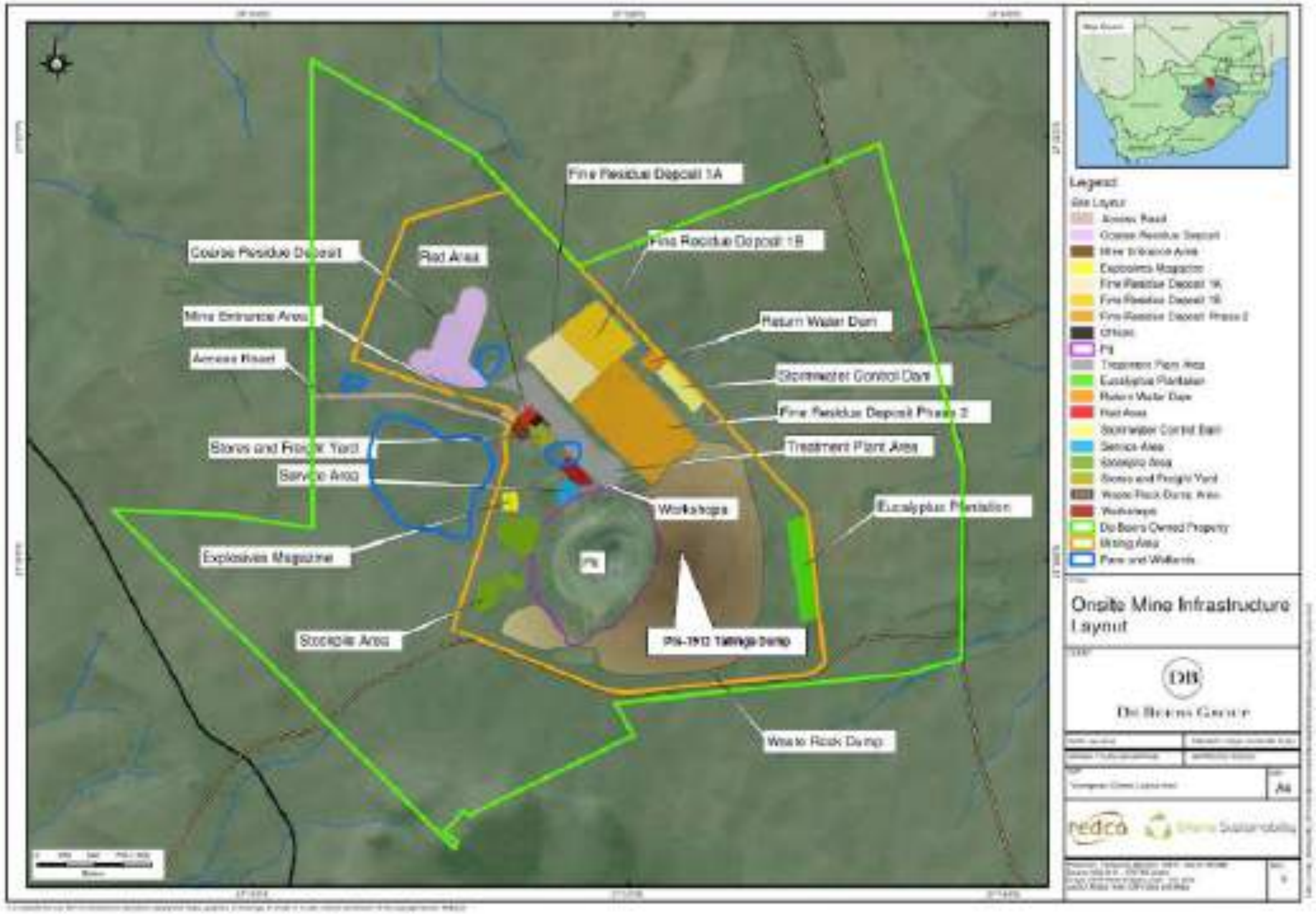


Figure 2-3: Voorspoed Mine onsite mine infrastructure (Redco & Uvuna Sustainability, 2019).

3 SCOPE OF PROPOSED AMENDMENTS

3.1 Description of Proposed Amendments

The Applicant (DBCM) wishes to remove three conditions in the DMRE EMPr amendment approval letter (Reference number: FS 30/5/1/2/3/2/1 (12) EM) relating to the 2010 EMPr amendment which imposed the requirement to backfill the final void left by diamond mining at the Voorspoed Mine.

3.1.1 Substantive Amendments

Deletion of the following three conditions from the in the DMRE EMPr amendment approval letter for the Amended 2010 EMPr (approved by the Free State DMRE on 22 July 2010 (Reference number: FS 30/5/1/2/3/2/1 (12) EM):

- Condition (d): "*All mine waste (suitable for rehabilitation) must be taken back to the excavation area for backfilling purposes. Rehabilitation of the mining area must be done concurrently with mining activities (whenever and wherever possible)*";
- Condition (f): "*Dump structures must not be left on the surface, this includes topsoil stockpiles, overburden stockpiles, waste rock stockpiles, tailings dumps and slimes dams*"; and
- Condition (g): "*All excavations must be backfilled to the natural surface level; if a bulk factor exists it must be accommodated on the total area of disturbance*".

As the original 2005 EMPr (Metago, 2005) and closure EMPr and FBAR (CEM, 2019) were compiled under the assumption that backfilling would not take place and that the pit would be left to rewater over time, no changes to the current Amended 2010 EMPr will be required. The sole intention of this amendment application is to delete the three backfilling conditions included in the scope of the EMPr amendment approval letter.

3.1.2 Listed Activities Triggered

No new Listed Activities as per the NEMA: EIA Regulations (2014), as amended will be triggered by this amendment of the EMPr.

3.1.3 Additional Authorisations Triggered

Due to the nature of the proposed closure option, a Water Use Licence will be triggered and DBCM will submit a Water Use Licence application in due course as part of its broader decommissioning and closure process.

4 LEGAL FRAMEWORK

4.1 Amendment Process Requirements

In terms of Regulations 31 and 32 of the NEMA: EIA Regulations (2014), as amended, DBCM is applying for a substantive amendment (commonly referred to as a Part 2 application) to the Amended 2010 EMPR that was approved in respect of the Voorspoed Mine by the Free State DMRE on 22 July 2010. Regulation 31 of the EIA Regulations states that: "*An environmental authorisation may be amended by following the process prescribed in this Part if the amendment will result in a change to the scope of a valid environmental authorisation where such change will result in an increased level or nature of impact where such level or nature of impact was not (a) assessed and included in the initial application for environmental authorisation; or (b) taken into consideration in the initial environmental authorisation; and the change does not, on its own, constitute a listed or specified activity.*"

The legislation outlined in **Table 4-1** is also applicable to activities at the Voorspoed Mine, however, the proposed amendments will not trigger any listed activities under the NEMA: EIA Regulations (2014), as amended, as explained above. Therefore, it is appropriate for the applicant to follow a Regulation 31 amendment process, rather than obtain an Environmental Authorisation in accordance with NEMA.

Table 4-1: Legislation applicable to Activities at Voorspoed Mine.

LEGISLATION/GUIDELINE	OBJECTIVE & RELEVANCE
LEGISLATION	
Constitution of the Republic of South Africa of 1996	Provides inter alia the right to an environment that is not harmful to human health or wellbeing, and to have the environment protected through ecologically sustainable development while promoting the prevention of pollution and ecological degradation and promoting conservation.
Mineral and Petroleum Resources Development Act (Act 28 of 2002) (MPRDA), as amended	Main legislative provision for the granting of mineral rights, relinquishment of such rights and associated closure liabilities after successful closure and rehabilitation. Section 43 of the Act enforces the need for every mine to apply for a closure certificate upon completion of the activity. Section 43(1) states that "The holder of a prospecting right, mining right, retention permit, mining permit, or **previous holder of an old order right or previous owner of works that has ceased to exist, remains responsible for any environmental liability, pollution, ecological degradation, the pumping and treatment of extraneous water, compliance to the conditions of the environmental authorisation and the management and sustainable closure thereof**, until the Minister has issued a closure certificate in terms of this

	Act to the holder or owner concerned" (own emphasis).
Mineral and Petroleum Resources Development Regulations, published under Government Notice R527 in Government Gazette 26275 of 23 April 2004 and as amended (MPRDA Regulations)	Provides for the substantive regulations to give effect to the provisions of the Mineral and Petroleum Resources Act. Includes several provisions relating to mine closure and rehabilitation- regulation 56 of these Regulations sets out the principles for mine closure as follows: "In accordance with applicable legislative requirements for mine closure, the holder of a prospecting right, mining right, retention permit or mining permit must ensure that - (a) the closure of a prospecting or mining operation incorporates a process which must start at the commencement of the operation and continue throughout the life of the operation; (b) risks pertaining to environmental impacts must be quantified and managed pro-actively, which includes the gathering of relevant information throughout the life of a prospecting or mining operation; in accordance with the provisions of the National Environmental Management Act, 1998, the Financial Provision Regulations, 2015 and the Environmental Impact Assessment Regulations, 2014; (c) the safety and health requirements in terms of the Mine Health and Safety Act, 1996 (Act No. 29 of 1996) are complied with; (d) residual and possible latent environmental impacts are identified and quantified; in accordance with the provisions of the National Environmental Management Act, 1998, the Financial Provision Regulations, 2015 and the Environmental Impact Assessment Regulations, 2014; (e) the land is rehabilitated, as far as is practicable, to its natural state, or to a predetermined and agreed standard or land use which conforms with the concept of sustainable development; in accordance with the provisions of the National Environmental Management Act, 1998, the Financial Provision Regulations, 2015 and the Environmental Impact Assessment Regulations, 2014; and (f) prospecting or mining operations are closed efficiently and cost effectively."
Regulations pertaining to the financial provision for prospecting, exploration, mining or production operations GN R1147 in Government Gazette 39425, 20 November 2015, as amended.. **Note**: In accordance with the transitional arrangements of these Regulations, DBCM does not currently need to comply with these Regulations for the Voorspoed Mine.	The main set of regulations pertaining to the provisions of finances for the closure and rehabilitation of mine sites, throughout the lifecycle of the mine. These regulations set out the requirements for an applicant or holder of a right or permit to determine and make financial provision to guarantee the availability of sufficient funds to undertake rehabilitation and remediation of the adverse environmental

	impacts of prospecting, exploration, mining or production operations.
National Environmental Management Act (Act 107 of 1998) (NEMA)	Framework law giving effect to the constitutional environmental right. Provides the framework for regulatory tools in respect of environmental impacts, including mining and mine closure. In terms of Section 24(2)(a) of NEMA the Minister may publish a list of activities which may not commence without environmental authorisation. Section 24F(1)(a)&(b) states that: “Notwithstanding any other Act, no person may - (a) commence an activity listed or specified in terms of section 24(2)(a) or (b) unless the competent authority or the Minister responsible for mineral resources, as the case may be, has granted an environmental authorisation for the activity; or (b) commence and continue an activity listed in terms of section 24(2)(d) unless it is done in terms of an applicable norm or standard.” Accordingly, the NEMA EIA Regulations requires that an environmental authorisation is issued before a listed activity can be commenced with. Sections 24P, 24Q, 24R and 24S are relevant to mine closure. Section 24P of NEMA sets out the requirements for financial provision for remediation of environmental damage, Section 24Q refers to the monitoring and performance assessments required for those holding an environmental authorization, Section 24R speaks specifically to environmental authorisation for mine closure and Section 24S establishes that residue stockpiles and deposits should be managed according to NEM:WA. Section 28(1) states that “Every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment”.
NEMA Environmental Impact Assessment (EIA) Regulations: GNR 982, 983, 984 in GG 38282 of 4 December 2014, as amended	Lists certain activities which require an environmental assessment and authorisation before they may be undertaken.
National Environmental Management: Waste Act (Act 59 of 2008) (NEM:WA), as amended	Regulates inter alia the duty of care, management, transport and disposal of waste including mining waste such as residue deposits and residue stockpiles. This Act regulates the rehabilitation of contaminated land and waste disposal facilities including mining waste facilities.
National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEM:BA)	Regulates the protection of biodiversity and the management of invasive species, including the use of alien and invasive species on mining sites. Section 73 speaks to duty of care with respect to listed invasive species and states that “A person authorised by permit in terms of section 71(1) to carry out a restricted activity involving a

	specimen of a listed invasive species must take all the required steps to prevent or minimise harm to biodiversity".
Conservation of Agricultural Resources Act 43 of 1983 (CARA)	Controls utilisation of natural agricultural resources and promotes conservation of soil, water resources and vegetation as well as the control of weeds and invader plants.
National Environmental Management: Air Quality Act 39 of 2004 (NEM:AQA)	Regulates activities which may have a detrimental effect on ambient air quality including certain processes and dust generating activities such as tailings deposition.
National Water Act 36 of 1998 (NWA)	Regulates the protection of the water resources and the use of water, including on inter alia mining areas. The Act contains provisions relevant to mine closure with regard to water resource protection form pollution and environmental degradation. Section 19(1) states that "An owner of land, a person in control of land or a person who occupies or uses the land on which – a) any activity or process is or was performed or undertaken; or b) any other situation exists, which causes, has caused or is likely to cause pollution of a water resource, must take all reasonable measures to prevent any such pollution from occurring, continuing or recurring."
Regulations of Use of Water for Mining and Related Activities aimed at the Protection of Water Resources: GNR 704 in GG 20119 of 4 June 1999	Regulates the use of water on mining areas and introduces controls to prevent and mitigate the pollution of water resources within mining areas. In addition, regulates the management of residue deposits and residue stockpiles so as to prevent water resource pollution. Regulation 9 of GN 704 stipulates certain requirements regarding the temporary or permanent cessation of a mining activity and states the following: "(1) Any person in control of a mine or activity must at either temporary or permanent cessation of operations ensure that all pollution control measures have been designed, modified, constructed and maintained so as to comply with these regulations, (2) Any person in control of a mine or activity must ensure that the in-stream and riparian habitat of any water resource, which may have been affected or altered by a mine or activity, is remedied so as to comply with these regulations, (3) On either temporary or permanent cessation of a mine or activity the Minister may request a copy of any surface or underground plans as required in terms of the Minerals Act, 1991."
GUIDELINES	

Best Practice Guidelines for Water Resource Protection in the South African Mining Industry (Department of Water Affairs, 2006): Series A: Best Practice (BP) Guidelines • A1.1: Small Scale Mining Practices, August 2006; • A1: Small Scale Mining, August 2006; • A2: Water Management for Mine Residue Deposits, July 2008; • A3: Hydrometallurgical Plants, July 2007; • A4: Pollution Control Dams, August 2007; • A5: Water Management for Surface Mines, July 2008; Series G: BP Guidelines • G1: Storm Water Management, August 2006; • G2: Water and Salt Balances, August 2006; • G3: Water Monitoring Systems, July 2007; • G4: Impact Prediction, December 2008; • G5: Water Management Aspects for Mine Closure, December 2008; Series H: BP Guidelines • H1: Integrated Mine Water Management, December 2008; • H2: Pollution Prevention & Minimization of Impacts, July 2008; • H3: Water Reuse & Reclamation, June 2006; and • H4: Water Treatment, September 2007.	Guidelines describing best practice for protection of the water resource.

5 NEED AND DESIRABILITY OF THE ACTIVITY

As per the 2005 EMPr (Metago, 2005), the socio-economic benefits of the mine were forecasted to include:

- Provision of employment.
- A large capital investment and substantial offshore revenue generation.
- A large amount of money paid out locally in the form of the company payroll (approximately R 530 million over the LoM).

- Significant amounts of money to be paid to the government in the form of taxes (approximately R1 193 million over the LoM) and;
- Creation and support of service sector jobs, the procurement of large quantities of consumables annually and the outsourcing of service provision to local service providers.

As per the Voorspoed Closure EMPr associated with the Closure EA the need and desirability of closure can be summarised as:

- Slope instability and complex geology resulted in a negative impact on the mine's finances and LoM, causing the mine to cease operations in 2018, as opposed to 2021 when closure was expected.
- After production ceased, attempts were made to find a suitable buyer for the operation, with the assistance of Standard Bank as well as the DMR (now called DMRE). More than 50 parties were approached, including other diamond mine operators in the country. The sale process, which was initiated in November 2017, was unsuccessful in identifying a suitable operator that complied with these requirements.
- As the mine scaled down processes in preparation for closure, the number of employees, as well as equipment usage, was reduced. Concurrent rehabilitation was undertaken during this period.
- After operations cease, there would be a 4-year period of active closure and rehabilitation. If the Final Rehabilitation Plan (Redco and Uvuna Sustainability, 2019b- **Appendix D)** is implemented, the mine will be rehabilitated by the end of 2022.
- However, a decision was taken at the end of 2019 to defer certain closure activities for 2 - 3 years, as further work was required to improve the closure cost estimate to an "Execution" ready level and to address uncertainty regarding post-closure monitoring requirements. Certain rehabilitation activities were thus deferred to January 2023.

- Following active closure, environmental monitoring will be undertaken for at least another 5 years (2030) before the closure certificate will be applied for. The mine's closure objectives, which are in line with all legal requirements, can only be achieved through a workable and practical decommissioning and mine closure. Without proper mine closure, the infrastructure and unrehabilitated mine residue deposits will remain, and the open pit will remain easily accessible. None of the land will be available for farming activities. Any environmental pollution occurring because of the current status of the mine land would continue without mitigation. In addition, the mine owner remains responsible for any environmental liability, potential pollution, ecological degradation, the pumping and treatment of extraneous water, compliance to the conditions of the environmental authorisation and the management and sustainable closure of the mine. Therefore, it is imperative that a feasible and sustainable mine closure plan be approved.

The mine has formally entered its Closure Phase and a Closure EA was granted on 17 February 2020 by DMRE therefore, the need and desirability in respect of closure has already been assessed. The section below will include DBCM's motivation for the preferred pitlake closure option.

- A decision was taken by DBCM at the end of 2019 to defer certain closure activities for 2 - 3 years, as further work is required to improve the closure cost estimate to an "Execution" ready level and to address uncertainty regarding post-closure monitoring requirements.

6 MOTIVATION FOR THE PROPOSED AMENDMENT

The EMPr amendment approval letter issued by the Free State DMRE in 2010 includes specific conditions which require DBCM to backfill the void left by mining activities. These conditions were imposed by the DMRE following an application to amend the 2005 EMPR to only incorporate an additional mining area.

The backfilling conditions were imposed even though:

(i) neither the 2005 EMPr nor the 2010 EMPr amendment application contemplated backfilling;

(ii) the impacts associated with the backfilling of the pit had not been assessed; and

(iii) no change to the activities taking place at the mine requiring the imposition of backfilling obligations were anticipated. Therefore, the requirement to backfill the pit at the mine was unilaterally imposed by the DMRE in terms of the 2010 EMPR amendment approval letter. There was no consensus or consultation with DBCM about imposing the requirement to backfill the pit.

The backfilling option was never been considered by DBCM. This is indicated in the original 2005 EMPR (Metago, 2005) in the following sections:

- *Section 6.3.3.3 (Long-term Stability [of residue stockpiles]): "Long-term stability of the residue disposal facilities and the waste rock dump have been addressed during their design. The assumptions upon which the designs are based will be periodically reviewed during the development of the facilities and again at closure to ensure their stability in the long term."*
- *Section 6.3.4 (Rehabilitation of Dangerous Excavations): "It is anticipated that the open pit will be left open for possible continued mining in the future. Provision for an access control berm and a fence with access gate around the pit at closure has been made in the estimate of the closure costs."*
- *Section 5.2.1.1.: "Approximately 55 million tons of kimberlite ore will be removed from the Voorspoed Mine pit during the LoM. The open pit from which the ore was removed will remain as a void in the geology. The void will fill with water. Approximately 20 million tons of the kimberlite resource will remain in the ore body and could potentially be exploited in future."*

The Voorspoed Mine Final Closure Plan (Redco and Uvuna Sustainability, 2019a -**Appendix C)** states that the development of a pitlake is the most feasible closure option, based on the findings of the Golder Report (2019). The Final Rehabilitation Plan (Redco and Uvuna Sustainability, 2019b –**Appendix D)** and End Land Use Plan (NEKA Sustainability Solutions, 2017-**Appendix E**) also indicate that a pitlake will be the most viable final closure option for the mine. These documents were included as appendices to the FBAR (Centre for Environmental Management (CEM, 2019) compiled to apply for the Closure EA.

The FBAR (CEM, 2019) assessed both closure options (backfill or pitlake) and concludes that "*In terms of economic and environmental considerations, the preferred scenario of allowing the open pit to fill under natural recharge conditions is the best practicable environmental option, due to the acceptable cost associated with rendering the open pitlake safe and the decommissioning and rehabilitation of the mining area*."[4]

[4] FBAR, page 37

There were no assessments of the impacts of backfilling activities, nor planning for these activities, at any time during the planning or operation of the Voorspoed mine.

The DMRE inexplicably and unilaterally imposed the backfilling conditions on DBCM in terms of the Amended 2010 EMPR (FS 30/5/1/2/3/2/1 (12) EM).

The viability of implementing backfilling was assessed in the Golder Report (Golder, 2019), and it was concluded that backfilling is not environmentally, socially or financially feasible. On this basis, DBCM concluded that the development of a pitlake would be the preferred closure option for the open pit at Voorspoed Mine. All the impacts below relate to the closure phase of the mine, as the mine is no longer operational.

According to the Final Voorspoed Mine Closure Plan (Redco and Uvuna Sustainability, 2019a), the preferred closure option for the excavation, a circular feature measuring approximately 900 m in diameter with a depth of approximately 310 m, is for it to be left open to rewater over time. The terrain surrounding the pit excavation will be rehabilitated according to mine's Final Closure Plan (Redco and Uvuna Sustainability, 2019a) and Final Rehabilitation Plan (Redco and Uvuna Sustainability, 2019b).

Contrary to what is outlined in these documents (as well as the EMPr (Metago, 2005) and Closure EMPr and FBAR (CEM, 2019)), the conditions imposed by the DMRE in the Amended 2010 EMPR (FS 30/5/1/2/3/2/1 (12) EM) require that the mine excavations be backfilled by material currently stored on the waste facilities (WRD, CRD and FRD).

The Voorspoed Closure EMPr and FBAR (CEM, 2019), Final Mine Closure Plan (Redco and Uvuna Sustainability, 2019a), Final Rehabilitation Plan (Redco and Uvuna Sustainability, 2019b) and End Land Use Plan (NEKA Sustainability Solutions, 2017) also support the implementation of the pitlake as a viable closure option.

7 IMPACT ASSESSMENT OF PROPOSED AMENDMENT

7.1 Impact Assessments Previously Undertaken

The original 2005 EMPr (Metago, 2005) included an assessment of the impacts of the mine. It was concluded that the impacts could be mitigated to an acceptable level, and that the benefits of mining of the Voorspoed mine would outweigh any negative impacts. The impacts in **Table 7-1** below have been extracted from the 2005 EMPr and were all assessed under the assumption that the void would be left open at closure. The phases are referred to as "Co" (Construction), "O" (Operational), "D" (Decommissioning) and "Cl" (Closure).

Table 7-1: Assessment of impacts from original 2005 EMPr (Metago, 2005).

PHASE	IMPACT	SIGNIFICANCE WITHOUT MITIGATION	SIGNIFICANCE WITH MITIGATION
O, D, Cl	Removal of a resource: "While the geology of the Voorspoed ore body will be permanently changed by mining, the changes in geology will not have significant negative impacts on the health and welfare of people, the well-being of surrounding plant and animal communities and the condition of other natural resources."	Not assessed, no mitigation possible. No significant impacts.	
O, D, Cl	Hazardous excavations	M	L
Co, O, D	Loss of topsoil resource	H	L
Co, O, D, Cl	Erosion	H	L
Co, O, D	Soil contamination	M	L
Co, O, D, Cl	Loss of arable land	H	M
Co, O	Blasting hazards and damage to structures by blasting vibrations	H	L
Co, O, D	Road disturbances and mine traffic	M	L
Co, O, D, Cl	Rerouting of secondary road	H	M
Co, O, D, Cl	Failure of mine residue deposits	M	L
Co, O, D	Loss of biodiversity and ecological function (vegetation)	H	M
Co, O, D	Loss of biodiversity and ecological function (animal life)	M	L
Co, O, D, Cl	Compliance with GN 704 Regulations	M	L
Co, O, D, Cl	Pollution of surface water	M	L
Co, O, D, Cl	Reduction in the catchment of dams downstream of the site	M	L
Co, O, D	Consequences on the mine and associated works of floods exceeding the design flood in magnitude	L	L
Co, O, D	Potential for groundwater contaminant transport from the fines residue disposal facility	M	L
Co, O, D	Decrease in the availability of groundwater for surrounding groundwater users	M	L
Co, O, D, Cl	Potential for poor quality leachate from residue deposits	H	M
Not specified	Pitlake water balance: "The pit will reflood after mine closure. The lake is likely to become saline. The lake should have little potential to pollute the surrounding area though, since the maximum water level in the lake should be below the level of the shallow regional ground water aquifer, preventing pollution from the pitlake from entering the ground water aquifer. Dissolved metals are unlikely to be a problem from a toxicological point of view, based on the analysis of samples taken from the pit. Monitoring will be necessary to confirm the rate of inflow into the pit and to re-evaluate the pollution potential after closure if required."	Not assessed	

PHASE	IMPACT	SIGNIFICANCE WITHOUT MITIGATION	SIGNIFICANCE WITH MITIGATION
Co	Compliance with guideline values and the potential for human health impacts	M	L
O	Compliance with guideline values and the potential for human health impacts	H	L
Cl	"The potential for impacts during the closure phase are dependent on the extent of demolition and rehabilitation efforts during closure and on features which remain namely, the fine- and coarse residue facilities and the waste rock dump. It is believed that the potential for fugitive dust impacts due to the residue facilities will be negligible through comprehensive rehabilitation prior to closure being granted for these facilities."	Not assessed	
Co, O, D	Noise disturbance to neighbouring residents	L	L
Co, O	Disturbance of archaeological or cultural sites	M	L
Co, O	Disturbance of graves	L	L
Co, O, D, Cl	Negative visual impact	H	M
Co, O, D	Positive socio-economic impacts - economic benefits from the mine development	H+	H+
D, Cl	Negative socio-economic impacts - Economic Impact of Mine Closure	H	M
D, Cl	Negative socio-economic impacts – impact on farmworker employment	L	L
Co	Loss of grazing land: "The farms comprising Voorspoed Mine are currently being leased to a neighbouring farmer, who is utilising it for livestock grazing. While it is recognised that the land is owned by De Beers, the loss of the land could have a negative impact on the farmer's wider farming enterprise through a forced reduction in herd size."	Not assessed	
Co	Influx of mineworkers and jobseekers	M	L
Co, O	Management of jobseekers' expectations	H	L
Co, O	Management of stakeholders' expectations	M	L
Co, O, D, Cl	Impact on rural lifestyles	H	M
Co, O, D	Increase in crime levels	H	M

The 2005 EMPr is the most relevant to this amendment application. It was approved in terms of the MPRDA which included approval for closure and decommissioning activities at the mine. Due to the transitional arrangements associated with the enactment of the NEMA EIA Regulations in 2014, this EMPr is considered to be an Environmental Authorisation.

Subsequently an application for EA was lodged in 2019 that made provision for the closure and decommissioning activities associated with the operations. The Impact Assessment included in the FBAR (CEM, 2019) assessed both the pitlake and backfilling closure options. A summary of this Impact Assessment is included in **Table 7-2** below.

Table 7-2: Assessment of impacts from Closure EIA (CEM, 2019).

IMPACT	SIGNIFICANCE WITHOUT MITIGATION	SIGNIFICANCE WITH MITIGATION
Pitlake closure option AND backfill closure option		
Soil compaction due to movement of vehicles & equipment used	M	M
Reversal of soil compaction due to ripping of compacted areas to alleviate compaction	H+	H+
Soil pollution and contamination due to spillages of hydrocarbons, fertilisers and other contaminants used during decommissioning and rehabilitation activities	L	H+
Clean-up of polluted soils due to in-situ remediation of hydrocarbon contaminated areas	H+	H+
Reduced land use potential due to soil compaction and pollution, as well as loss of topsoil due to soil erosion during decommissioning and rehabilitation activities	M	M
Improved land use potential due to rehabilitation of mine residue deposits and disturbed areas, as well as reduction/ elimination of top soil losses due to reshaped land forms, water management features, improved vegetation cover & reduced surface water run-off	H+	H+
Increased surface water run-off due to an increase in bare areas during decommissioning and rehabilitation activities	L	L
Reduced surface water run-off due to retention of potential polluted surface run-off on rehabilitated mine residue deposits, as well as rehabilitation and post rehabilitation management and monitoring activities that rehabilitate soil disturbance, improve vegetation cover, increase water infiltration & reduce surface water run-off	H+	H+
Increased pollutant concentrations and silt in surface water run-off due to the pollutants used, as well as increased soil disturbance, decreased vegetation cover and increased water run-off during decommissioning and rehabilitation activities	M	L
Reduced surface water pollution due to retention of potential polluted surface run-off on rehabilitated mine residue deposits, as well as reduced silt loading due to rehabilitation activities to rehabilitate soil disturbance, improve vegetation cover, increase water infiltration & reduce surface water run-off	H+	H+
Increased generation of dust and fumes from machinery used, as well as increased soil disturbance and reduced vegetation cover during decommissioning and rehabilitation activities	L	L
Reduced generation of dust from the rehabilitated mining area due to rehabilitation and post rehabilitation management and monitoring activities that rehabilitate soil disturbance and improve vegetation cover	L	M+
Noise generated by machinery used during decommissioning and rehabilitation activities	L	L
Elimination of noise caused by the mining activities & equipment after decommissioning & rehabilitation	L	H+
Reduced vegetation cover and increased competition from weeds and invader plants that establish in disturbed areas during decommissioning and rehabilitation activities	L	L

IMPACT	SIGNIFICANCE WITHOUT MITIGATION	SIGNIFICANCE WITH MITIGATION
Improvement of natural vegetation due to rehabilitation and post rehabilitation management and monitoring activities that establish and maintain a vegetation cover similar to the natural comparable surrounding environment & control weed and invader plant invasions so that it will not outcompete the indigenous grass & tree species	M+	H+
Displacement of wildlife due to habitat destruction and transformation, restriction of wildlife movement, as well as potential snaring, hunting and killing of wildlife due to decommissioning and rehabilitation activities	L	L
Return of wildlife to new habitats in the rehabilitated areas created through the rehabilitation activities, as well as improved wildlife habitats due to the control of weeds & invader plants	H+	H+
Disruption and destruction of ecosystem services due to rehabilitation activities	H	M
Resumption and improvement of ecosystem services, improved water run-off volume and quality to the wetland and pans, as well as improved ecosystem integrity and functioning due to rehabilitation and post rehabilitation management and monitoring activities	H+	H+
Visual impacts caused by the demolishing and removal of buildings and structures, as well as earthworks during decommissioning and rehabilitation activities	Cannot be mitigated, not assessed.	
Reduction of visual impact of mining activities due to the rehabilitation and post rehabilitation management and monitoring of the mine residue deposits and mining area	H	H+
Negative social & socio-economic impacts due to job losses, reduced economic activity, loss of support for mine (CSI & LED) beneficiaries, as well as reduced levels of security and emergency response capacity during the decommissioning and rehabilitation activities	M	M
Positive social and socio-economic impacts through the creation of temporary employment opportunities, as well as economic benefits during decommissioning and rehabilitation	M+	M+
Additional impacts: pitlake closure option		
Potential long term groundwater pollution from unrehabilitated mine residue deposits	H	L
Reduced potential long-term groundwater pollution from rehabilitated mine residue deposits	M	M+
Wildlife injury and death caused by sliding/falling down the steep unrehabilitated slopes of the mine residue deposits and open pit, as well as drowning in the pitlake	H	L
Social impacts due to human injury and death caused by falling down the steep unrehabilitated slopes of the mine residue deposits and open pit, as well as drowning in the pitlake	H	L
Additional impacts: backfill closure option		
Potential long term groundwater pollution from unrehabilitated mine residue deposits, and increased long term groundwater pollution due to leaching of contaminants from the saturated groundwater mound in the backfilled pit, consisting of a semi-consolidated waste rock, for approximately 100 years post closure	H	H
Reduced potential long-term groundwater pollution from mine residue deposits due to the use of some of these for backfilling the pit & the rehabilitation of the remaining facilities	M	M+

IMPACT	SIGNIFICANCE WITHOUT MITIGATION	SIGNIFICANCE WITH MITIGATION
Complete elimination of the risk of human and animal injury or death from sliding/falling down the steep slopes of the open pit due to backfilling of the open pit	H+	H+

The Closure EA was granted on 17 February 2020.

7.2 Specialist Assessments

7.2.1 Technical Evaluation of the Risks, Impacts and Management Requirements into Pit Backfilling versus Current Mine Plan (Pitlake)

DBCM engaged Golder to conduct a technical evaluation of the risks, impacts and management requirements associated with backfilling the pit in comparison to the originally approved closure option (i.e. pitlake) for the Voorspoed mine (Golder, 2019). Three (3) scenarios were considered in this respect, as follows (also see **Figure 7-1**):

Scenario 1: **The Original Pitlake option**

The Original Pitlake option (according to the current Mine Plan), the option is to allow the open pit to recharge and the development of a pitlake under current conditions. The conditions are direct rainfall to the pit runoff from dirty footprint area, groundwater ingress and evaporation. Clean runoff is diverted around the pit using the waste rock dump and berms as barriers.

Scenario 2: **The Enhanced Pitlake development option**

The Enhanced Pitlake development option. In addition to the water ingress from the factors in Scenario 1, the runoff from the pit catchment area will be specifically engineered to run into the pit. This will result in enhanced runoff into the pit, encouraging development of a deeper pitlake over a shorter time during the rewatering period. This development would be supported by the final surface water management plan.

Scenario 3: **The Excavation backfill option**

The Excavation backfill option. This would entail using the current WRD as the main source of fill material, along with other waste material, to backfill the excavation to current ground elevation level. This is in line with the conditions imposed the DMRE approval of the Amended 2010 EMPR.

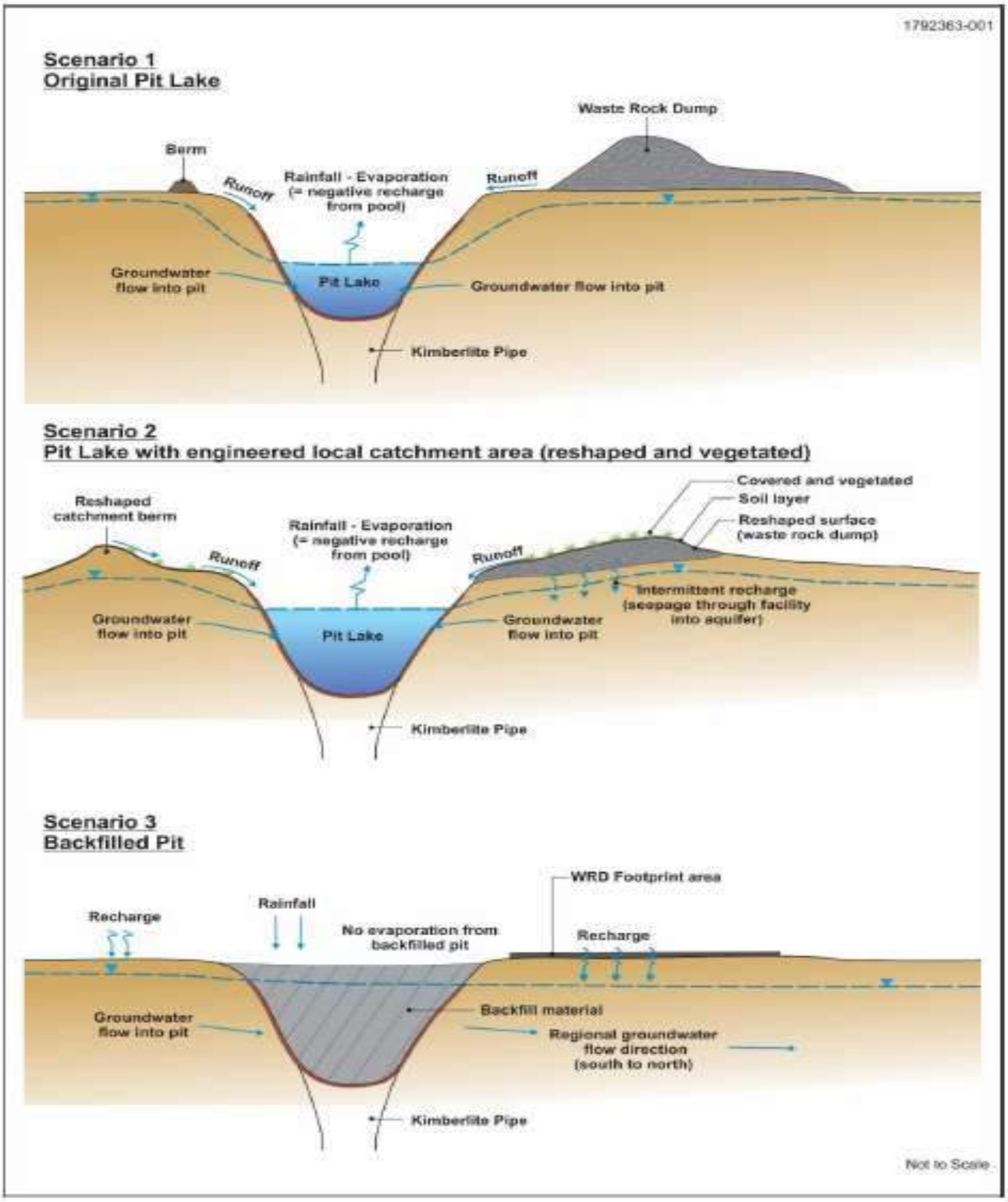


Figure 7-1: Proposed Voorspoed Mine pit closure scenarios (Golder, 2019).

The Golder Report concludes that Scenario 1 or 2 would be preferable closure options, resulting in the least environmental impact. Scenario 3 was not recommended, due to extraordinary costs, the creation of a pollution footprint and the potential impact on the surrounding environment- with specific reference to the impact on groundwater quality. The Golder Report weighed up the advantages and disadvantages of all three closure scenarios. Their findings are tabulated in **Table 7-3** below.

Table 7-3: Advantages and disadvantages of three closure scenarios (Golder, 2019).

SCENARIO 1: PITLAKE UNDER NATURAL CIRCUMSTANCES	SCENARIO 2: PITLAKE WITH ENHANCED DRAINAGE	SCENARIO 3: BACKFILLED PIT
Advantages		
• Low cost for option development • Groundwater quality largely within domestic and livestock limits, only selenium could be a problem for domestic use • Water level below natural ground level so pit will continue to act as a sink with no plume migration	• Higher cost for WRD reworking but still much less than backfilling • Groundwater quality largely within domestic and livestock limits, only selenium could be a problem for domestic and livestock use • Water level below natural ground level so pit will continue to act as a sink with no plume migration • Possible vegetation failure and soil erosion losses of the WRD will report to the pit and not to the environment	• Reuse of the post-closure WRD footprint • Increase in catchment yield • WRD will no longer pose a contamination risk, and the pit will no longer pose a safety risk
Disadvantages		
• Pit crest instability with associated break back, posing a safety risk requiring proper protection • Possibility of illegal mining taking place immediately post-closure • Continuous monitoring of WRD. Possible vegetation failure and soil erosion losses on the WRD would result in silt and other contaminants reporting to the environment	• Pit crest instability with associated break back, posing a safety risk requiring proper protection • Possibility of illegal mining taking place immediately post-closure although the period for water to fill the pit will be marginally shorter than for Scenario 1 • Reduction of catchment yield from the WRD	• WRD footprint waste classification and rehabilitation • Extreme cost to backfill and possible additional cost of abstraction and treatment of contaminated groundwater plume • Groundwater quality exceeds constituents of concern. Although the qualities within the pit improve after ±30 years the contaminants will have simply moved to the surrounds in a contaminated groundwater plume • Water level will rebound to the natural water table level and the contaminated groundwater plume will migrate down gradient to the surrounding aquifer system(s)

7.2.1.1 Water Impacts

This section provides and assessment of the possible impacts on the water regime at the Voorspoed mine.

Groundwater Contamination

Backfilling of the pit as contemplated under Scenario 3 will entail moving material from the WRD into the void. This material mainly consists of waste rock extracted during the mining process. The exposure of rocks to environmental elements results chemical reactions, culminating in the concentration of potential constituents of concern (PCOCs) in the waste rock material and associated leachate. Backfilling with the WRD material would therefore result in significantly higher concentrations of PCOCs and a high concentration of chemical elements in the pit. These PCOCs and chemical elements will migrate to the surrounding groundwater via a pollution plume generated in the pit. Several aquifers are located within the catchment, including a fractured rock aquifer, weathered aquifer and alluvial aquifers associated with rivers and water bodies. The effects of groundwater pollution would have negative consequences for agricultural activities in the area as some boreholes utilised by farmers would be impacted. The farmers and communities would no longer be able to use the boreholes that would be impacted by the pollution plume. The plume may be alleviated through implementation of water treatment measures (the construction of scavenger boreholes and abstraction of contaminated water for treatment) and by providing alternative source of clean water. The long-term costs of employing these mitigation measures are economically unsustainable.

Should the pit be allowed to re-water over time, there may be concern that groundwater sources will be impacted by poor quality water seepage emanating from the pitlake. **Table 7-4** indicates the constituents of the pitlake water which are likely to exceed the Water Quality Guidelines (WQG).[5] While some of these elements may pose a potential risk, recent pit water samples have shown an improvement to below acceptable thresholds for these elements (**Table 7-4**).

The pitlake water balance proves the pit water will not pollute the surrounding groundwater and aquifer as the pit will be designed as a terminal sink. In addition, there is adequate buffering capacity to mitigate leaching of contaminated water from pit, provided by calcite and alumino-silicate minerals present within the pit wall rock (Golder, 2019).

The geochemical behaviour of the pitlake was further investigated (Golder, 2021) and it was found that:

[5]South African Water Quality Guidelines, Volume 1: Domestic Water Use, Second Edition published by the Department of Water and Forestry

- For the base case minimum scenario modelling no constituents exceed the Resource Quality Objectives, or livestock or irrigation limits;
- For the base case mean scenario modelling sodium exceeds the irrigation limits, while manganese and molybdenum were close to the livestock limit, but not exceeding it;
- For the base case maximum scenario modelling TDS exceeds the livestock limits and sodium the irrigation limit, while manganese and molybdenum were close to the livestock limit, but not exceeding it.

As the pit will be designed and managed as a terminal sink, any migration of poor-quality water away from the pitlake will be mitigated by the evaporation substantially exceeding rainfall. The net groundwater flow gradient therefore permanently will be towards the pitlake. Regular monitoring must be implemented to determine the rate of inflow to the pit as well as to re-evaluate the pollution potential after closure.

Each of the scenarios potentially impact the groundwater resources in the receiving area but under the re-watering (pitlake) scenario, the negative impact is negligible when compared to that caused by the backfilling of the pit. The pollution plume generated in Scenario 3 (backfilling option) will contain significantly higher concentrations of PCOCs which pose a risk of contaminating surrounding water sources. In contrast, the sink effect anticipated in respect of the pitlake in Scenario 1 will prevent the pollution plume from migrating into the ground and surface water resources. Backfilling therefore poses a more significant contamination risk to adjacent and / or downstream groundwater users which will result in negative socio-economic impacts.

<u>Pitlake Water Quality</u>

The water in the operating lake was analysed in 2017 and 2018. The following elements exceeded the WQG (see **Table 7-4**):

- TDS (total dissolved salts) and nitrate (domestic and livestock WQG);
- Sodium and selenium (domestic and irrigation WQG);
- EC (electrical conductivity) and fluoride (domestic water use guidelines); and
- Molybdenum (irrigation and livestock WQG).

The water quality results from the pitlake water were compared to water quality results from a borehole located outside the zone of impact of the mine, which was considered representative of the ambient /background groundwater quality. A pitlake water sample was also collected in 2004 which is considered the baseline pitlake water quality. (collected in 2004, prior to DBCM's operation of Voorspoed mine).

This comparison yielded the following results:

- Background and baseline pit water exceeded the WQG limit for TDS, EC, calcium and sodium;
- Ammonia in background water exceeded the Water Quality Planning Limits (WQPL) for the Renosterspruit catchment, in which Voorspoed is located;
- Baseline pit water exceeded the WQG limit for chloride, aluminium, iron, magnesium, manganese and potassium (these constituents were below the limit in recent pit water samples);

The baseline groundwater quality exceeds the catchment WQO. As a result, these objectives should be reviewed. Sulphate, nitrite, and nitrate exceeded WQG limits in the most recent pit water samples but not in the baseline sample. The nitrate is likely a result of blasting residue and sulphate a result of exposed sulphide mineral oxidation (exposed by blasting activities in the pit).

It is important to note that further sampling was undertaken September 2021, as part of a monitoring programme that has been implemented. The results can be made available to all stakeholders on request.

Table 7-4: Pitlake water quality analysis.

Constituent of Concern	Unit	2017 Sample	2018 Sample	Pit Baseline (2004)	Groundwater Background (2017)	Drinking WQG			WQPL for Renoster Catchments
						Domestic	Livestock	Irrigation	
pH	s.u	8.4	8.3	7.1	7.9	6-9	ng	6.5-8.4	*7.4-8.6*
Total Dissolved Solids	mg/l	1212	1152	1934	615	450	1000	ng	ng
Total Suspended Solids	mg/l	44	NA	NA	NA	ng	ng	50	ng
Electrical Conductivity	mS/cm	167	155	294	102	ng	ng	40	***70***
Sulphate	mg/l	456	492	44	27	200	1000	ng	ng
Chloride	mg/l	42	56	242	33	100	1500	ng	ng
Nitrate	mg/l	218	222	NA	NA	ng	100	ng	ng
Nitrate as N	mg/l	49	50	0.1	0.25	6	ng	ng	ng
Nitrite as N	mg/l	0.23	22	NA	NA	6	ng	ng	ng
Fluoride	mg/l	1.3	0.6	1.1	<0.3	1	2	2	ng
Ammonia	mg/l	***0.11***	NA	NA	***1.6***	ng	ng	ng	***0.072***
Ammoniacal Nitrogen as N	mg/l	0.09	NA	NA*	NA	1	ng	ng	ng
Total Alkalinity as $CaCO_3$	mg/l	104	84.7	1403	480	ng	ng	ng	ng
Aluminium	mg/l	<0.020	0.020	18.2	NA	0.15	5	5	ng
Antimony	mg/l	0.003	0.007	NA	NA	ng	ng	ng	ng
Arsenic	mg/l	0.0133	0.024		<0.0025	0.01	1	0.1	ng
Barium	mg/l	0.026	0.037	NA	NA	ng	ng	ng	ng
Boron	mg/l	0.243	0.407	NA	0.047	ng	5	0.5	ng
Cadmium	mg/l	<0.0005	0.0005	NA	<0.0005	5	10	10	ng
Calcium	mg/l	20	43	95	53	32	1000	ng	ng
Chromium	mg/l	<0.0015	<0.001	0.08	<0.0015	ng	ng	ng	ng
Cobalt	mg/l	<0.002	0.0008	NA	NA	ng	1	0.05	ng
Copper	mg/l	<0.007	0.017	0.09	<0.007	1	0.5	0.2	ng
Iron	mg/l	<0.02	0.018	23	0.54	0.1	10	5	ng
Lead	mg/l	<0.005	<0.001	0.38	<0.005	0.01	0.1	0.2	ng
Magnesium	mg/l	1.2	2.0	49	49	30	500	ng	ng
Manganese	mg/l	0.003	0.014	1.9	NA	0.05	10	0.02	ng
Mercury	mg/l	<0.001	0.0001	NA	<0.001	0.001	0.001	ng	ng
Molybdenum	mg/l	0.20	0.19	NA	NA	ng	0.01	0.01	ng
Nickel	mg/l	<0.002	0.003	NA	<0.002	ng	1	0.2	ng
Potassium	mg/l	4	6.1	58.6	2.8	50	ng	ng	ng
Selenium	mg/l	0.047	0.065	NA	<0.003	0.02	50	0.02	ng

Silicon	mg/l	7.201	0.939	NA	NA	ng	ng	ng	ng
Sodium	mg/l	360	286	432	53	100	2000	70	ng
Uranium	mg/l	<0.005	0.001	NA	NA	ng	ng	0.01	ng
Zinc	mg/l	<0.003	0.006	0.25	<0.003	3	20	1	ng

The pitlake water balance has been calculated, and it is anticipated that this 're-watering' scenario under current climatic conditions will be a long-term process (the filling period being 180 years; Golder 2021). The pitlake will become more saline due to evapo- concentration of salts (Golder 2021). The long-term geochemical modelling (220 years after achieving steady state) indicates that surface sorption, reactions within the oxic zone, the combination of precipitation and dissolution reactions will all influence the pitlake quality. The long-term quality indicates that although quality initially deteriorate (up to 40 years) they then progressively improve over the next period of 360 years due to the combination of geochemical processes (Golder, 2021).

Recharge

The implementation of backfilling as described for Scenario 3 will result in a more rapid rebound of water levels in the pit to pre-mining conditions. This is mainly due to the reduction in the volume of the void and correspondingly, the volume of water required for the pit water levels to rebound. Recharge of groundwater to pre-mining conditions under Scenario 1 (the pitlake option) would be much slower due to the larger volumes of water in the open void. Rapid return to pre-mining water levels with a backfilled and capped pit would result in the backfilled pit being unable to act as a terminal sink. This will result in the re-establishment of the pre-mining groundwater levels and gradients and the migration of potentially contaminated water away from the pit area into surrounding aquifers. Should Scenario 1 (the pitlake option) be implemented, the pit would act as a groundwater sink, thus minimising the migration of contaminated water away from the pit to adjacent aquifers and other groundwater dependent ecosystems (Golder, 2019).

Surface Water Runoff

The implementation of Scenario 1 (pitlake option) would result in the rehabilitated WRD being left on the surface. The waste rock materials in the WRD contain several soluble elements which may impact on the quality of surface runoff water which will report into the pit. However, as stated in the Golder Report (2019), dissolved metals are unlikely to have a high negative toxicological impact. In addition, rehabilitation and post-rehabilitation management and monitoring activities will result in improved soil quality/aeration and improved vegetation cover as modelled in the unsaturated flow modelling (Golder, 2020). This in turn will result in reduced surface water run-off volumes and seepage which results in groundwater recharge salt load from the capped and rehabilitated WRD. Reduction of surface water runoff can be further enhanced by:

- Constructing crest berm walls & paddocks to contain rainfall and runoff on rehabilitated mine residue facilities;
- Constructing toe paddocks at seepage points around mine residue facilities to capture seepage & prevent siltation of the northern pan;
- Constructing water control berms/drains on decommissioned plant & infrastructure footprint areas;
- Reinstating affected surface drainage lines & catchment areas to direct non-contaminated surface runoff to pans; and
- Maintaining & managing all rehabilitated areas in accordance with success criteria.

Additional options to mitigate this risk would be the addition of a cover of the WRD and returning the water as clean runoff to the environment. The measures described above would furthermore prevent potential long-term groundwater pollution from mine residue deposits.

If the pitlake scenario is implemented, it will be necessary to implement a monitoring programme to confirm the rate of inflow into the pit and sample the pitlake to determine water quality and stratification.

7.2.1.2 Financial Impacts

If this amendment application is not granted, DBCM would be compelled to implement the backfilling conditions in fulfilment of the conditions imposed by the DMRE. The excessive cost of backfilling the pit (approximately R3.9 billion) renders this option both impractical and economically unfeasible. Scenario 1 (the pitlake option) was estimated to cost approximately R39 708 813 and Scenario 2, approximately R53 470 228.

The cost of backfilling is therefore disproportionate to the economic value which could be gained from the backfilled area (e.g. creation of grazing capacity for 10 head of cattle), as well as the economic benefits derived from the mining operations throughout the Voorspoed LoM. For these reasons, backfilling was not considered in any amendment applications made by Voorspoed, as well as the original EMPr (Metago, 2005) and all closure documents.

7.2.2 Closure/Decommissioning Basic Assessment Report and EMPr

The advantages and disadvantages of the backfilling option from an environmental perspective are summarised in the Voorspoed mine Closure EMPR and FBAR (CEM, 2019) as follows:

Advantages of backfilling of the pit

- Backfilled pit will reduce risk to human/animal safety

- 70 additional ha of land will be available for grazing after rehabilitation (this will be able to sustain approximately 10 head of cattle)
- The grazing potential of the rehabilitated WRD footprint will be marginally higher than the WRD rehabilitated in-situ
- The removal of the WRD will remove the potential for groundwater pollution plume from the WRD

Disadvantages of backfilling of the open pit

- The significantly higher cost of backfilling is disproportionate to the profits received from mining throughout the mine's life as well as the benefits gained from backfilling
- Backfilling may result in the potential release of polluted water from the backfilled pit into the aquifer, affecting surrounding ground water users
- The potential release of polluted water from the backfilled pit into the aquifer would result in the need for long-term monitoring and or treatment and thus, create long-term responsibility and liability
- The FRD and CRD would remain on the surface and although rehabilitated, may result in groundwater contamination plumes beneath them

The following section also summarises the advantages and disadvantages of the pitlake option from an environmental perspective, as indicated in the Voorspoed mine Closure EMPR and FBAR (CEM, 2019):

Disadvantages of not backfilling and the establishment of a pitlake

- The open pit will remain in the landscape after closure, which may pose a risk to human/animal safety. However, measures will be taken to reduce this risk.
- Leaving the pit open to re-water will result in 70 ha of potential grazing land lost
- The grazing potential of the WRD rehabilitated in-situ will be slightly lower than its rehabilitated footprint would have been
- All the residue deposits (WRD, FRD and CRD) would remain on the surface and although rehabilitated, may result in groundwater contamination plumes beneath them

Advantages:

- The measures taken during decommissioning and closure will be sufficient to achieve the closure objectives of sustainability and a positive legacy. They will also be sufficient to achieve the specific closure objectives of restoring as much as possible of the mining area to a condition consistent with the pre-determined post closure land use objectives, ensuring that the area is left in a condition that poses an acceptable level of risk to public health and safety and reducing the need for post closure intervention, either in the form of monitoring or on-going remedial work, as far as is practicably possible.
- The cost of the pitlake option is approximately 100 times less than the backfilling option (i.e. R4 billion vs R40 million), making it more proportionate to the benefits received from mining and from the post-mining land use.

7.2.3 Best Practice - Pitlakes as a Sustainable Mine Closure Option

In 2019, the Water Research Commission (WRC) funded a research study, undertaken by GCS, to investigate the viability of pitlakes as a sustainable open pit mine closure option in South Africa (Project Number K5/2577/3). A report compiled in this respect assessed four coal mine pitlakes across South Africa, with varying characteristics (i.e. age, depth, etc.). The study concluded that if pitlakes are correctly designed and surface discharge into the pitlake is appropriately managed, pitlakes can be considered as environmentally sustainable mine closure options. [6]

The study indicates that pitlakes studied tended to be alkaline, with elevated TDS (mainly sodium and sulphate) in comparison to background catchment water quality. The pitlakes were able to support life in the form of chlorophyll-a, phytoplankton and bacteria (other life forms were not specifically investigated).

The study also found that surface area is one of the most important characteristics determining the sustainability of pitlakes, as a larger surface area results in increased evaporation. Increased evaporation allows the pitlake to remain in negative water balance (more water leaves the pitlake than enters it) and thus, discharge into the catchment is prevented. The volume of surface water runoff allowed to enter the pitlake also affects its sustainability. Surface runoff therefore needs to be correctly managed to prevent discharge of the pitlake caused by storm events.

Pitlakes tend to have a negative water balance in South Africa, where evaporation exceeds the sum of direct rainfall and groundwater inflow. This also considers runoff into the pitlake which can be managed on closure. As a result, the Voorspoed pitlake will act as terminal sink,

[6] An Investigation to Determine if South African Coal Mine Pitlakes Are A Viable Closure Option, page 222

resulting in a net groundwater gradient into the pitlake. As a result, there will be no risk of contamination of the aquifers if the pitlake is left as a terminal sink.

The WRC study proposes some design options which could enhance water quality and ensure minimal environmental degradation, in the context of pitlakes. As a result of the study, a guideline for the development of coal mine pitlakes in South Africa was produced (WRC, 2019. Reference K5/2577/3).

A suitably designed pitlake will form a water sink and uncontrolled discharges from the mining operations are avoided.

In addition, a pitlake will alleviate the cost of long-term water treatment which will result in

- CAPEX and OPEX coast of a water treatment plant
- Consumption of energy over the long term
- A carbon footprint
- The need for the disposal of brine from the water treatment plant

The preferred pitlake option is also in line with emerging international and South African best practice relating to mine closure, in terms of which pitlakes have been increasingly identified as viable and sustainable mine closure alternatives. While in the past regulators generally preferred either partial or complete backfill of pits as a closure option, it is now a generally accepted position that this option is often not cost effective or even environmentally desirable.[7]

Furthermore, in 2019, the International Council on Mining & Metals published the "*Integrated Mine Closure Good Practice Guide, 2nd Edition*" ("**Good Practice Guide**")[8], which echoes the sentiments of the above article. The Good Practice Guide states that, "*while pitlakes may present certain residual risks at closure, they also offer substantial benefits (unlike many other mine closure options which ultimately sterilize the mining area*)". With proper management relating to the change in land type from terrestrial (pre-mining) to aquatic (post-mining), pitlakes can present numerous beneficial opportunities post closure. By integrating social, environmental, and economic viewpoints and factors, pitlakes can be used in a variety of activities, including the irrigation of agricultural land. Water management will need to be determined according to the characteristics of the pitlake and the surrounding area, in line with the over-arching notion of sustainability. Diamond mines commonly produce

[7] Opportunities for Sustainable Mining Pitlakes in Australia, CD McCullough and MA Lund, accessed at https://www.researchgate.net/publication/225472002_Opportunities_for_Sustainable_Mining_Pit_Lakes_in_Australia.

[8] IMMC "Integrated Mine Closure Good Practice Guide" *2nd Edition* (2019).

deep pits and therefore have the potential to form pitlakes. Most open pit kimberlite diamond mines are steep sided and more or less circular, and the chemistry of groundwater associated with kimberlite deposits has an impact on the quality of the pitlake. In Canada, pitlakes are used as post-closure options in diamond mines. It has been shown that groundwater entering the mine is likely to have a chemistry similar to that of the nearby surface water body or will alternatively be a mixture of deeper groundwater and lake water. This same study states that "*groundwater associated with the kimberlite rock itself is unlikely to pose major problems from a water quality point of view*" and "*water associated with kimberlite rock should have very low concentrations of trace metals*".[9]. This was supported by water quality studies at Voorspoed by Golder (2019 and 2021)

Pitlakes are also commonly used in Australia, largely due to the growth in open cut mining over the last few decades. There, they are often perceived as beneficial to local communities, as well as the natural environment, depending on the quality of the water in the pitlake.[10] Significant effort has thus been expended on investigating and examining these pitlakes and their water quality, thereby promoting effective management.

As a result of these international developments, complete backfills of open pits have become rare globally due to the excessive costs, as well as possible contamination issues that are generally associated with backfill material. This concern has been highlighted in respect of the backfilling closure option, which poses significant and long-term groundwater contamination risks.

The use of pitlakes as a mine closure and rehabilitation method is a relatively new concept in South Africa, with recent studies showing that they may well be viable long-term solutions for a variety of mines on a case-by-case basis. For example, correctly designed pitlakes offer a passive water treatment option. This is important as mines that use active water treatment are energy intensive, using energy (mostly from the national grid) which could be used more effectively elsewhere in South Africa. Where water quality is suitable, pitlakes can be used as a water resource to supply communities after mine closure, such as for community agriculture projects.

The pitlake closure option also aligns with the Draft National Mine Closure Strategy ("**Draft Strategy**") gazetted in GNR 446 of 21 May 2021, which sets the scene for a shift away from the classic mine closure objective i.e. returning the land to its pre-mining state (which can be impractical), to focussing on the development of opportunities for a sustainable

[9] Harris L *et al* "Creating Lakes from Open Pit Mines: Processes and Considerations, Emphasis on Northern Environments" *Canadian Technical Report of Fisheries and Aquatic Sciences* (2009).
[10] Kumar R *et al* "Water Resources in Australian Mine Pitlakes" *Water in Mining Conference* (2009).

transitional economy post cessation of mining activities. The Draft Strategy is underpinned by the view that the concept of mine closure has been redefined in the global mining industry, to embrace the concept of handing over pre-determined and defined post-mining land use with concurrent economic diversification, as opposed to just closure and rehabilitation, when the operational stage of a mine ceases and decommissioning is complete. The pitlake option therefore presents an opportunity for the consideration of asset transformation opportunities including eco-tourism and extending the benefits of concepts such as captive power and water generation, as contemplated in the Draft Strategy.

7.2.4 Unsaturated Flow Model of Voorspoed Mine Residue Dumps

Golder undertook the unsaturated flow transport modelling for the various waste residue deposits to determine the current recharge from these facilities, as well as the likely recharge once capped and rehabilitated with various vegetative covers (Golder, 2020 Appendix L).

The study objectives were (Golder, 2020)

- The objective of the unsaturated flow modelling task is to provide an estimation of infiltration that can be expected from the waste residue facilities with and without the inclusion of cover designs, the facilities being:
    - Waste Rock Dump (WRD);
    - Fine Residue Dump (FRD); and
    - Coarse Residue Dump (CRD)
- The infiltration estimates are, in turn, utilised within the numerical groundwater flow modelling, to estimate infiltration (seepage) and plume migration.

The study included the in-field permeability measurements conducted for the various facilities, as well as representative samples being collected for laboratory analyses. The field permeability measurements included several samples of the FRD had a very low permeability.

Laboratory analyses on 3 CRD samples, 3 WRD samples and 11 FRD samples included (Golder 2020):

- Particle size distribution; (PSD)
- Bulk and dry density, gravimetric water content and porosity; and
- Soil Water Characteristics Curve (SWCC) to derive material properties for the model input.

The moisture content for the CRD and WRD were between 6% and 11%, while the FRD recorded moisture contents between 24% and 34%. Porosity values were reported as 21% to 27% for the CRD, 48% to 54% for the WRD and 41% to 60% for the FRD.

The PSD tests identified the CRD as sand to loamy sand material, the WRD as sandy clay material and the FRD as loam textured material.

The fitted SWCCs were used to derive the characteristics for the unsaturated flow modelling.

The numerical modelling was performed utilising the Hydrus1D as modelling code. The cover and vegetation design were used in accordance with the closure report (Redco and Uvana Sustainability, 2019). Three primary scenarios were modelled:

- Scenario A (WRD);
- Scenario B (CRD); and
- Scenario C (FRD).

Several secondary scenarios were modelled for each primary scenario, and those applicable were reported on. The secondary scenarios distinguished between the various aspects (slopes and top) as well as vegetation options for each facility.

The largest reduction in infiltration for the facilities was for the waste rock dump (from 83% to about 3%). The modelling of the CRD indicated a reduction from 24.7% (uncovered) to less generally than 0.5%. The FRD reduced from 6.8% (no cover) to less than 0.5% for the various cover scenarios.

It was concluded that grass only scenarios generally fared better than a combination of trees and grass (due to root penetration through the cover). Runoff calculations were also performed for the various scenarios and are reported on.

The modelling found reduction of infiltration for the various cover designs as follows:

- WRD a 92% reduction in infiltration;
- CRD to 98% reduction on the top and near total reduction on the slopes; and
- FRD a reduction of 95%.

7.2.5 Voorspoed Geochemical Pitlake Model

Golder undertook the geochemical modelling of the Voorspoed pitlake (Golder, 2021 attached as Appendix K). The modelling looked at the period of initial rebound of ground water in the pit till the steady state water level is reached (180 year period) and the period thereafter till 400 years after closure. The steady state level is below the pre mining groundwater levels

The objectives of the study were (Golder, 2021):

- A review of earlier studies completed, and which are applicable to the Voorspoed pitlake.
- Develop a geochemical model based on the conceptual understanding of the Voorspoed pitlake under post closure conditions, which incorporates the pit water

balance and chemistry of all pit water contributors (i.e., surrounding dumps, groundwater, and rainfall etc.).

- Use an industry accepted modelling code (geochemical model) to predict the evolution of the Voorspoed pitlake water quality for up to 400 years post closure.
- Utilise local water quality guidelines, as set out local and national regulators, as a mechanism to evaluate the predicted Voorspoed pit water quality.

The modelling utilised the following approach:

- Hydrological water balance model utilising GOLDSIM and taking into account the groundwater inflows as modelled as part of the hydrogeological numerical modelling providing a monthly timestep for the simulation period of 400 years;
- Hydrogeochemcial modelling utilising PHREEQC for prediction of the pitlake water quality considering all relevant geochemical processes including:
  - Surface sorption
  - Reactions within the oxic zone e.g. CO_2 interaction; and
  - Reactions within deeper than the oxic zone e.g. precipitation and dissolution reactions.

The relative contribution of the material making up the pit wall was considered to determine the likely impact on the pitlake chemistry, as well as the results of the geochemical testing of the various residue facilities.

Seven scenarios in total were modelled, the first three evaluating the minimum, mean and maximum concentrations for the model, with the latter 4 looking at the model sensitivity to specific factors which were:

- Mean atmospheric CO_2 concentration;
- Absence of precipitation reactions;
- The impact of better than expected FRD inflow; and
- The relative impact of rainfall TDS to the overall pit water quality.

The geochemical modelling found the following:

- The minimum scenario exceeded none of the water quality guidelines;
- The mean scenario exceeded the irrigation limits for sodium, manganese and molybdenum were close to livestock limits, but did not exceed them;
- The maximum scenario indicated that sodium exceeded irrigation limits (for the entire period) and TDS exceeded livestock limits (for 20 and 50 year simulations only);
- The variability of CO_2 was found not to have a significant change in TDS or any of the other analytes;

- The exclusion of precipitation processes was found to lead to an increase for TDS (approximately 10%), calcium, alkalinity and aluminium, with no change for other analytes;
- The pitlake quality was found to be sensitive to the FRD quality, utilising a lower figure significantly improved the overall water quality;
- The rainfall TDS was found to be an insignificant factor in the overall long term pitlake water quality.

It is recommended that the pitlake be left as a terminal sink, and not utilised for irrigation or livestock, based on the modelling results.

8 ENVIRONMENTAL MANAGEMENT PROGRAMME

The impacts of the pitlake closure option were assessed as part of the original 2005 EMPr as well as the Voorspoed mine Closure EMPr and FBAR in 2019. Therefore, there will be no additional impacts or corresponding mitigation measures required for the proposed amendment. The content of the 2005 and 2019 EMPrs will also not be required to change.

Table 8-1 outlines the mitigation measures identified for the potential activities and impacts, based on the 2019 Closure EMPr. The closure plan is in the process of being updated.

Table 8-1: Impact Management Actions (CEM, 2019)

Activity	Potential Impact	Mitigation Type	Implementation Time Period	Compliance with Standards
Clear infrastructure from site & dismantle steel structures	• Soil compaction due to movement of vehicles & equipment used	• Remedy through rehabilitation actions	• Commence decommissioning as soon as possible after receiving the authorisation, followed by earthworks and rehabilitation, once decommissioning and earthworks have been completed. • Undertake post rehabilitation management and monitoring activities periodically after rehabilitation until mine closure	• Soil compaction alleviated
Demolish & remove structures, walkways & paved areas				
Remove culvert structures from roads & decommission trenches				
Remove salvageable equipment & material and mobile buildings				
Dispose of inert concrete & building rubble in crusher void				
Shape the area to fill excavations and be free draining				
Construct waste rock barriers at top of open pit access ramps				
Erect security fence around open pit outside of indicated ZOR				
Construct trench & enviroberm around pit outside security fence				
Reshape steep slopes of WRD, CRD & FRD				
Cover roads, plant & building footprints & disturbed areas with soil				
Cover slopes & top areas of MRDs with cover material and soil				

Confirm final alignment & construct water control berms/drains				
Construct crest berm walls & paddocks on MRD facilities				
Construct toe paddocks at seepage points around MRD facilities				
Reinstate surface drainage lines & catchment areas to pans				
Rip roads, plant & building footprint areas to alleviate compaction				
Rip top areas & slopes of MRDs to alleviate compaction				
Clear infrastructure from site & dismantle steel structures	• Soil pollution and contamination due to spillages of hydrocarbons, fertilisers & other contaminants used	• Prevent and minimise through controlling decommissioning & rehabilitation activities • Remedy during rehabilitation	• Commence decommissioning as soon as possible after receiving the authorisation, followed by earthworks and rehabilitation, once decommissioning and earthworks have been completed. • Undertake post rehabilitation management and monitoring activities periodically after rehabilitation until mine closure	• Soil pollution prevented & minimised • Hydrocarbon contaminated soil remediated in-situ
Demolish & remove structures, walkways & paved areas				
Erect security fence around open pit outside of indicated ZOR				
Construct trench & enviroberm around pit outside security fence				
Shape the area to fill excavations and be free draining				
Reshape steep slopes of WRD, CRD & FRD				
Cover roads, plant & building footprints & disturbed areas with soil				
Cover slopes & top areas of MRDs with cover material and soil				

Confirm final alignment & construct water control berms/drains				
Conduct bio-remediation of hydro carbon contaminated areas				
Ameliorate growth medium, based on analysis thereof				
Seed rehabilitated areas				
Apply follow-up fertiliser where specified				
Control weeds & invader plants				
Maintain & manage all rehabilitated areas				
All activities causing soil compaction, soil pollution and soil loss indicated above & below	• Reduced land use potential due to soil compaction and pollution, as well as loss of topsoil due to soil erosion	• Remedy through rehabilitation actions to replace soil cover where required, alleviate soil compaction & pollution and minimise soil loss	• Commence decommissioning as soon as possible after receiving the authorisation, followed by earthworks and rehabilitation, once decommissioning and earthworks have been completed. • Undertake post rehabilitation management and monitoring activities periodically after rehabilitation until mine closure	• Effective soil cover ensure the agreed land capability • Soil compaction alleviated & soil pollution remedied • Limited erosion that will not deteriorate to large dongas
Ameliorate growth medium, based on analysis thereof				
Seed rehabilitated areas with indigenous grass and tree seeds				
Apply follow-up fertiliser on rehabilitated areas where specified				
Control alien weeds & invader and indigenous encroacher plants				
Fence rehabilitated areas to control grazing & protect rehabilitation				
Stimulate vegetation on rehabilitated areas by grazing				
Create and maintain firebreaks to prevent & control veld fires				

Maintain & manage all rehabilitated areas				
Reshape steep slopes of WRD, CRD & FRD Cover roads, plant & building footprints & disturbed areas with soil Cover slopes & top areas of MRDs with cover material and soil Fill hollows to make all areas, except the pans, free draining & aligned with natural drainage patterns Construct crest berm walls & paddocks on MRD facilities Confirm final alignment & construct water control berms/drains Construct toe paddocks at seepage points around MRD facilities Reinstate surface drainage lines & catchment areas to pans Maintain & manage all rehabilitated areas	• Increased surface water run-off due to vegetation clearance and soil disturbance	• Prevent and minimise through restricting soil disturbance & vegetation clearance • Implement storm water control measures • Remedy during rehabilitation	• Commence decommissioning as soon as possible after receiving the authorisation, followed by earthworks and rehabilitation, once decommissioning and earthworks have been completed. • Undertake post rehabilitation management and monitoring activities periodically after rehabilitation until mine closure	• Water control measures contain run-off on rehabilitated FRD and does not spill more than once in 100 years • Water control measures • contain run-off on other rehabilitated mine residue deposits • Gabion waterway show no signs of undercutting, excessive sedimentation or subsidence • Clean runoff volumes to pans are close to original • Wetland adjacent to mining area reconnected hydraulically to the downstream pan system
All activities causing soil compaction & pollution indicated above Construct crest berm walls & paddocks on MRD facilities Confirm final alignment & construct water control berms/drains Construct toe paddocks at seepage points around MRD facilities	• Increased pollutant concentrations and silt in surface water run-off due to the pollutants used, as well as increased soil disturbance, decreased vegetation cover and increased water run-off	• Prevent and minimise through restricting vegetation clearance & soil disturbance • Implement storm water control measures • Remedy during rehabilitation	• Commence decommissioning as soon as possible after receiving the authorisation, followed by earthworks and rehabilitation, once decommissioning and earthworks have been completed.	• Water control measures capture and evaporate seepage in toe paddocks • Sediment transport limited to toe of mine residue deposits and does not reach the northern or southern pans, as well as the

Ameliorate growth medium, based on analysis thereof Seed rehabilitated areas with indigenous grass and tree seeds Apply follow-up fertiliser where specified Control alien weeds & invader and indigenous encroacher plant Stimulate vegetation on rehabilitated areas by grazing Create and maintain firebreaks to prevent & control veld fires Maintain & manage all rehabilitated areas			• Undertake post rehabilitation management and monitoring activities periodically after rehabilitation until mine closure	wetland adjacent to the mining area
Disposal of mine residues in mine residue deposits on surface All activities to shape, cover & rehabilitate mine residue deposits Maintain & manage all rehabilitated areas	• Potential long term groundwater pollution from unrehabilitated mine residue deposits	• Control groundwater pollution & remedy through earthworks & rehabilitation, as well as post-closure pumping and treatment	• Commence decommissioning as soon as possible after receiving the authorisation, followed by earthworks and rehabilitation. • Undertake post rehabilitation management and monitoring activities periodically after rehabilitation until mine closure	• Limited ground water pollution
All activities causing soil compaction & pollution indicated above Ameliorate growth medium, based on analysis thereof Seed rehabilitated areas with indigenous grass & tree	• Increased generation of dust and fumes from machinery used, increased soil disturbance and reduced vegetation cover	• Prevent and minimise during decommissioning and rehabilitation • Remedy dust generation through rehabilitation actions	• Commence decommissioning as soon as possible after receiving the authorisation, followed by earthworks and rehabilitation.	• Limited generation of dust

Seeds Apply follow-up fertiliser where specified Stimulate vegetation on rehabilitated areas by grazing Create and maintain firebreaks to prevent & control veld fires Maintain & manage all rehabilitated areas			• Undertake post rehabilitation management and monitoring activities periodically after rehabilitation until mine closure	
All activities causing soil compaction & pollution indicated above Ameliorate growth medium, based on analysis thereof Seed rehabilitated areas with indigenous grass & tree seeds Apply follow-up fertiliser where specified Create and maintain firebreaks to prevent & control veld fires Maintain & manage all rehabilitated areas	• Noise generated by machinery used	• Prevent and minimise by restricting working hours • Eliminate through decommissioning and rehabilitation actions • Prevent future noise through ongoing management and monitoring	• Commence decommissioning as soon as possible after receiving the authorisation, followed by earthworks and rehabilitation. • Undertake post rehabilitation management and monitoring activities periodically after rehabilitation until mine closure	• No noise after decommissioning and rehabilitation
All activities causing soil compaction & pollution indicated above Ameliorate growth medium, based on analysis thereof Seed rehabilitated areas with indigenous grass & tree seeds Apply follow-up fertiliser where specified	• Reduced vegetation cover and increased competition from weeds and invader plants that establish in disturbed areas	• Prevent and minimise during decommissioning and rehabilitation by restricting vegetation clearance & implementing invader plant control measures • Remedy through rehabilitation actions	• Commence decommissioning as soon as possible after receiving the authorisation, followed by earthworks and rehabilitation, once decommissioning and	• Vegetation cover similar to surrounding natural environment • Improved vegetation species composition in wetlands • No tree & weed invasions in pans

Control alien weeds & invader and indigenous encroacher plants Stimulate vegetation on rehabilitated areas by grazing Create and maintain firebreaks to prevent & control veld fires Maintain & manage all rehabilitated areas			earthworks have been completed. • Undertake post rehabilitation management and monitoring activities periodically after rehabilitation until mine closure	• Tree & weed invasions controlled so that it does not • outcompete the natural grass & tree species • Firebreaks maintained to prevent & control veld fires from destroying the vegetation • Controlled grazing to agreed carrying capacity implemented
All activities causing soil compaction and pollution Construct security fence around pit, outside of indicated ZOR Construct trench & enviroberm around pit outside Ameliorate growth medium, based on analysis thereof Seed rehabilitated areas with indigenous grass & tree seeds Apply follow-up fertiliser where specified Fence the rehabilitated area to control grazing & protect rehabilitation works Control alien weeds & invader and indigenous encroacher plants Stimulate vegetation on rehabilitated areas by grazing	• Wildlife displacement due to habitat destruction & transformation, restriction of wildlife movement, and snaring, hunting & killing • Wildlife injury and death caused by sliding/falling down the steep slopes of the mine residue deposits & pit, as well as drowning in the pitlake	• Prevent and minimise during decommissioning and rehabilitation activities • Remedy through rehabilitation & management actions that recreate and maintain suitable habitats	• Commence decommissioning as soon as possible after receiving the authorisation, followed by earthworks and rehabilitation, once decommissioning and earthworks have been completed. • Undertake post rehabilitation • management and monitoring • activities periodically after rehabilitation until mine closure	• Wildlife returned to rehabilitated areas • Increase in wetland faunal species • Wildlife access deterred with security fence, as well as trench & enviroberm around the pit, outside the security fence • Trench and enviroberm • functional and stable

Create and maintain firebreaks to prevent & control veld fires				
Maintain & manage all rehabilitated areas				
All earthworks causing soil compaction, soil pollution and destruction of ecosystem services indicated above	• Disruption or destruction of ecosystem services	• Prevent and minimise during decommissioning & rehabilitation • Resume & improve ecosystem services through rehabilitation • Protect rehabilitated ecosystems through ongoing management & monitoring	• Commence decommissioning as soon as possible after receiving the authorisation, followed by earthworks and rehabilitation. • Undertake post rehabilitation management and monitoring activities periodically after rehabilitation until mine closure	• Ecosystem services resumed & improved
All decommissioning activities causing soil compaction & pollution indicated above All earthworks causing soil compaction and soil pollution indicated above	• Visual impact caused by the clearance of vegetation, as well as construction of ancillary buildings and structures	• Remedy during decommissioning and rehabilitation	• Commence decommissioning as soon as possible after receiving the authorisation, followed by earthworks and rehabilitation. • Undertake post rehabilitation management and monitoring activities periodically after rehabilitation until mine closure	• Visual impacts of mining activities reduced to an acceptable level
All decommissioning activities causing soil compaction & pollution indicated above	• Social impacts due to human injury and death caused by sliding/falling	• Control through pit access control measures	• Commence decommissioning as soon as possible after	• Human access to pen pit deterred with waste rock barriers on the

Construct waste rock barriers / berms at top of remaining pit access ramps Erect security fence around open pit outside of indicated ZOR Construct trench and enviroberm around open pit outside of security fence	down the steep slopes of the mine residue deposits & pit, as well as drowning in the pitlake		receiving the authorisation, followed by earthworks and rehabilitation. • Undertake post rehabilitation management and monitoring • activities periodically after rehabilitation until mine closure	access ramps & security fence around the pit perimeter, with trench & enviroberm around the pit, outside the security fence • Trench and enviroberm functional and stable
All decommissioning & rehabilitation activities that result in further job losses, reduced economic activity loss of support for mine beneficiaries (CSI & LED), as well as reduced levels of security and emergency response capacity	• Negative social & socio-economic impacts due to further job losses, reduced economic activity, loss of support for mine beneficiaries, as well as reduced levels of security and emergency response capacity	• Control and remedy through social impact management measures • Communicate & execute retrenchment, redeployment & reskilling processes in line with SLP commitments • Develop & implement a post retrenchment plan to support employees with the potential impacts on their wellbeing and quality of life post mining • Maintain proportion of procurement from local enterprises & reduce over time as the needs for goods & services decreases • Support suppliers & service providers to find opportunities outside the Mine • Assess the financial sustainability of SMMEs	• Implement social impact management measures related to employment, procurement & social support prior to decommissioning & sustain these until mine closure. • Commence decommissioning as soon as possible after receiving the authorisation, followed by earthworks and rehabilitation, once decommissioning and earthworks have been completed. • Undertake post rehabilitation management and monitoring activities periodically after rehabilitation until mine closure	• Minimal adverse impacts on social fabric and socio- economic conditions, as far as reasonably practicable

		that are funded & supported, develop & implement action plans to support those that require further support • Assess impact on CSI/LED beneficiaries, inform them of the Final Mine Closure Plan and develop an exit strategy framework for CSI and LED interventions		
All decommissioning & rehabilitation activities that result in further job losses, reduced economic activity loss of support for mine beneficiaries (CSI & LED), as well as reduced levels of security and emergency response capacity	• Negative social & socio-economic impacts due to further job losses, reduced economic activity, loss of support for mine beneficiaries, as well as reduced levels of security and emergency response capacity	• Develop & implement a security plan for decommissioning & rehabilitation and communicate this to neighbouring landowners and stakeholders. • Develop a traffic management plan for decommissioning & implement in collaboration with community stakeholders & law enforcement agencies.	• Implement social impact management measures related to employment, procurement & social support prior to decommissioning & sustain these until mine closure. • Commence decommissioning as soon as possible after receiving the authorisation, followed by earthworks and rehabilitation, once decommissioning and earthworks have been completed. • Undertake post rehabilitation management and monitoring activities periodically after rehabilitation until mine closure	• Minimal adverse impacts on social fabric and socio- economic conditions, as far as reasonably practicable

All decommissioning activities, earthworks, rehabilitation activities and post rehabilitation management and monitoring activities that result in creation of temporary jobs & modified economic activity	• Positive social impacts due to job creation etc.	• Create temporary employment opportunities, as well as economic benefits during decommissioning and rehabilitation	• Commence decommissioning as soon as possible after receiving the authorisation, followed by earthworks and rehabilitation. • Undertake post rehabilitation management and monitoring activities periodically after rehabilitation until mine closure	• Optimal positive impacts on social fabric and socio- economic conditions

As per the 2019 Closure EMPr, a post rehabilitation and closure monitoring programme that addresses the monitoring objectives, scope and frequency is included in the Final Closure Plan (2019) and in Table 8-2 below. In some instances, the monitoring frequency has not been specified in specialist reports. It is recommended that the specialists contracted to conduct monitoring surveys and analysis should revise and recommend a detailed monitoring plan and frequency, based on results and risk presented by the monitoring data, prior to the implementation of the programs. Annual monitoring reports will be compiled, indicating the trends of the monitoring results according to the mentioned outcomes and standards and as a minimum include the following topics:

- Introduction with reasons for the report, linked to conditions of approval
- Results of the monitoring programme, with analysis and interpretation of the data, with reference to the outcomes and standards included in the EMPr
- Proposed remedial actions and action plan
- Review of the suitability, adequacy, and effectiveness of the monitoring programme
- Conclusions

EMPr audits are to be compliant with Regulation 34 of the EIA Regulations and will be conducted by an independent person with the relevant environmental auditing expertise until closure.

The environmental audit report will determine the following:

- the ability of the EMPr, and where applicable the closure plan,
- to sufficiently provide for the avoidance, management and mitigation of environmental impacts associated with the undertaking of the activity on an ongoing basis
- to sufficiently provide for the avoidance, management and mitigation of environmental impacts associated with the closure of the facility;
- the level of compliance with the provisions of environmental authorisation, EMPr and where applicable the closure plan

An EMPr and Closure Plan Audit Report will be submitted to the DMRE annually until closure is achieved. Should the findings of the environmental audit report indicate insufficient or ineffective mitigation of environmental impacts associated with the undertaking of the activity; or insufficient levels of compliance with the Closure EA or EMPr and the closure plan, the applicant will submit recommendations to amend the EMPr or closure plan in order to rectify the shortcomings identified in the environmental audit report, when submitting the environmental audit report to the competent authority, such recommendations will have been subjected to a public participation process.

Within 7 days of the date of submission of an environmental audit report to the DMRE, all potential and registered interested and affected parties will be notified of the submission of the report. The report will also be made available to all interested and affected parties on request.

Table 8-2: Proposed Monitoring Programme (CEM, 2019)

Activity	Impacts Requiring Monitoring	Functional requirements for monitoring	Roles and Responsibilities	Monitoring and reporting frequency
Mine residue deposits, earthworks, rehabilitation & post rehabilitation management activities	Groundwater quality	<u>Monitoring objectives:</u> • Evaluate groundwater pollution levels • Assess compliance with legal conditions, standards & other requirements • Ensure groundwater is fit for current & future land uses, consistent with specified environmental outcomes & standards, i.e. a post closure land use with no long-term liabilities • Evaluate the chemical stability of the MRD facilities to ensure that environmental risks can be controlled by the remediation measures • Refine closure strategies and determine remediation methods, if required	Rehabilitation manager	<u>Monitoring frequency:</u> • Quarterly during the decommissioning-closure phase • Biannually in the post-closure phase
		<u>Monitoring scope:</u> • Water level & water quality from 18 boreholes (13 on the mining area & 5 around the mining are) Physic-chemical parameters (pH, conductivity, Total Dissolved Solids, Total Alkalinity) • Major cations (Ca, Mg, Na, and K) • Major anions (Cl-, F-, SO42- & NOX) • Metals & trace metals (Fe, Cr, Se, Pb, Mn, Al, Zn • Others determined by ICP-OES • Less parameters in the post-closure phase		<u>Reporting frequency:</u> • Annually
Mine residue deposits, earthworks, rehabilitation & post rehabilitation activities	Groundwater quality	<u>Monitoring objectives:</u> • Initiate a programme to generate hydrological data that will be used as a baseline dataset for future planning	Rehabilitation manager	

		and to confirm the numerical modelling and predictions modelled during the mine closure study.		
		Monitoring scope: • Upgrade the groundwater transport contamination model every 5 years, using the latest monitoring data.		Reporting frequency: Every 5 years
Mine residue deposits, decommissioning, rehabilitation & post rehabilitation management activities	Surface water control	Monitoring objectives: • Evaluate surface water pollution levels • Assess compliance with legal conditions, standards & other requirements • Ensure surface water is fit for current & future land uses, consistent with specified environmental outcomes & standards, i.e. a post closure land use with no long-term liabilities • Evaluate the chemical stability of the MRD facilities to ensure that environmental risks can be controlled by the remediation measures • Refine closure strategies and determine remediation methods, if required	Rehabilitation manager	Monitoring frequency: • Quarterly during the decommissioning-closure phase • Biannually in the post-closure phase
		Monitoring scope: • Surface water quality from 3 surface water monitoring sites • Physic-chemical parameters (pH, conductivity, Total Dissolved Solids, Total Alkalinity) • Major cations (Ca, Mg, Na, and K) • Major anions (Cl-, F-, SO42- & NOX) • Metals & trace metals (Fe, Cr, Se, Pb, Mn, Al, Zn • Others determined by ICP-OES • Less parameters in the post-closure phase		Reporting frequency: • Annually

Mine residue deposits, decommissioning, rehabilitation & post rehabilitation management activities	Surface water control	Monitoring objectives: • Evaluate the structural & ecological stability of the landforms • Evaluate the success of control measures to protect the slopes against erosion Monitoring scope: • Monitor stability of water control structures for long-term stability, e.g. scouring especially after intense rain events and increased erosion • Monitor & inspect sediment control structures & identify reduced capacities due to sedimentation • Monitor condition of low lying areas constructed on the top of dumps & other flat areas • Identify unwanted concentration of runoff over large areas	Rehabilitation manager	Monitoring frequency: • Annual monitoring for a 5 year period Reporting frequency: • Annually
Earthworks, rehabilitation & post rehabilitation management activities	Rehabilitation/revegetation success	Monitoring objectives: • Evaluate the success of restoring as much as possible of the mining area to a condition consistent with the pre-determined post closure land use & to a final, sustainable end land-use • Assess compliance with legal conditions, standards & other requirements • Evaluate the success of the vegetation to protect the slopes against erosion • Evaluate the achievement of a post closure land use with no long-term liabilities Monitoring scope: • Monitor vegetation on rehabilitated areas in terms of species diversity, plant density, vegetation structure,	Rehabilitation manager	Monitoring frequency: • Bi-annual monitoring for a 5 year period Reporting frequency: • Annually

		species abundance, vegetation cover & dormancy • Monitor soil coverage of vegetation • Monitor extent and severity of erosion • Identify footpath creation during utilisation of area		
Earthworks, rehabilitation & post rehabilitation management activities	Aquatic ecology	Monitoring objectives: • Assess compliance with legal conditions, standards & other requirements • Evaluate the achievement of a post closure land use with no long-term liabilities	Rehabilitation manager	Monitoring frequency: • Bi-annual monitoring for a 5 year period
		Monitoring scope: • Conduct aquatic biodiversity studies within the pans & wetland adjacent to the mining area to assess the wetland vegetation and animal life		Reporting frequency: • Annually
Earthworks, rehabilitation & post rehabilitation management activities	Alien invasive plant control success	Monitoring objectives: • Assess compliance with legal conditions, standards & other requirements • Evaluate the achievement of a post closure land use with no long-term liabilities	Rehabilitation manager	Monitoring frequency: • Annual monitoring for a 5 year period
		Monitoring scope: • Extent of alien plant invasions across • Voorspoed site • Effectiveness of eradication programme • Determination of priority areas		Reporting frequency: • Annually
Earthworks, rehabilitation & post rehabilitation management activities	Air quality	Monitoring objectives: • Evaluate the success of measures to control dust • Assess compliance with legal conditions, standards & other requirements	Rehabilitation manager	Monitoring frequency: • Bi-annual monitoring for a 5 year period

		• Evaluate the achievement of a post closure land use with no long-term liabilities		
		Monitoring scope: • Continuation of exiting dust monitoring programme to monitor & measure fall-out dust • Existing monitoring programme to be • modified as determined by the specialist		Reporting frequency: • Annually
Unstable geology	Open pit stability	Monitoring objectives: • Assess compliance with legal conditions, standards & other requirements • Evaluate the achievement of a post closure • land use with no long-term liabilities, i.e. long- • term stability of the pit access control • measures	Mine closure manager	Monitoring frequency: • Bi-annual monitoring for a 5 year period
		Monitoring scope: • Monitor the open pit ZoR		Reporting frequency: • Annually

9 PUBLIC PARTICIPATION PROCESS

9.1 Previous Stakeholder Engagement

Public participation was conducted as part of the Basic Assessment process conducted in applying for the decommissioning EA, in late 2019. The appendices of the associated FBAR included the Voorspoed Mine Final Closure Plan (Redco and Uvuna Sustainability, 2019a), the Voorspoed Mine Final Rehabilitation Plan (Redco and Uvuna Sustainability, 2019b) and the Proposed End Land Use Plan for Voorspoed Diamond Mine (NEKA Sustainability Solutions, 2017). I&APs were provided with an opportunity to comment on the closure plan throughout the Basic Assessment process, in compliance with the public participation requirements prescribed under the EIA Regulations.

The comments included in Table 9.1 below are extracted from the Voorspoed Closure EMPR and FBAR and an indication of the EAP's responses has also been provided in each respect.[11] These comments have been identified from the previous public participation process as most relevant to the purpose of this amendment application, to motivate the removal of the DMRE's conditions related to backfilling.

Table 9-1: Comments from the FBAR relating to the pit closure option.

I&AP	Date of comments received	Issues raised	EAP's response
Department of Mineral Resources and Energy	2019/03/01	Requested a copy of the communication regarding the mine closure to the Section 52 Board	Included in the BAR
		Decommissioning cannot proceed without the necessary EA. The partial/temporary removal of some of the valuable components of the processing plant is debated, with the caution to not take the plant out of active service permanently.	Included in the BAR
		Also involve the Chief-Director mine safety in the decommissioning process.	This has been done, as the Chief-Director is an important stakeholder in the decommissioning and mine closure process. Struggled to source the contact details for the relevant person.

[11] "Summary of the comments and issues raised by interested and affected parties, as well as EAP's (applicants) responses to these", page 58 of the FBAR

DWS Chief Director: Water Quality Regulation	2019/06/04	What will the impact be of the preferred pit closure option and the formation of the pitlake?	Specialist studies have shown that: • the pitlake will form very slowly (180 years filling period, Golder 2021) and the surface will always remain (approximately 40-75 m) below the ground level and never decant into the receiving environment. The quality of the pit water has elevated TDS levels, which initially increases (40 years) and thereafter decreases as a result of recharge and the various geochemical processes including sorption and precipitation (Golder, 2021). No acid drainage will be generated. • if the pit is back-filled, it could create a matrix of soil and rock that could facilitate the upward mobility of the polluted water and result in the decanting thereof into the receiving environment (Golder, 2019).
DWS Chief Director: Water Quality Regulation	2019/10/02	Taking into consideration the gaps in information identified, the Chief Directorate: Water Quality Regulation does not support closure of the mine, as proposed.	This statement does not relate to the application under consideration to decommission the mine infrastructure, not to close the mine. In addition, it does not seem to provide clear reasons for the decision, apart from the generic reference to the gaps in the information identified.
		Use of the pit water for irrigation is not supported, since the pit water exceeds the South African Water Quality Guidelines for domestic, irrigation and livestock use.	Agreed. This is also reflected in the End Land Use options considered. The pit will be left as a terminal sink to the groundwater environment.
DWS Chief Director: Water Quality Regulation	2019/10/02	A model that describes the current and post closure pit water quality must be developed.	Models to describe the pit water quality have been developed and included in several specialist reports from Golder Associates, i.e. Voorspoed Mine Summary of Surface and Groundwater Study for Mine Closure (October 2017) and Voorspoed Diamond Mine, Technical Evaluation of the Risks, Impacts and Management Requirements into Pit Backfilling Versus Current Mine Plan (Pitlake) (February 2019). The latest study (Golder, 2021) utilised internationally accepted geochemical modelling codes (PHREEQC) to simulate the current and future water quality during the initial filling, as well as

			further period until 400 years after closure.
DWS Chief Director: Water Quality Regulation	2019/10/02	A geotechnical study must be conducted to determine the stability of the pit wall. This is necessary in order to identify the potential impacts on the land adjacent to the pit. It is also important in determining how the eroded side-wall material may contribute to further deterioration of the pit water quality. Further collapse of the pit side-walls may lead to the collapse of the fencing surrounding the pit, which poses a risk to public safety and animals.	The decision to not extend the Life of Mine (LoM) primarily considered geotechnical studies to determine the stability of the pit wall. The identification of the preferred pit closure options with the associated cost calculations were also primarily based on such studies. Voorspoed Mine will be requested to make such a studies available for the Department's consideration. The geochemical modelling (Golder, 2021) has taken into account the contribution of the various materials in the pit wall and residue deposits to the long term water quality evolution of the pitlake.
DWS Chief Director: Water Quality Regulation	2019/10/02	According to the EMPr, backfilling was a requirement for the mine. However, it has been indicated that the mine is not in a position to backfill the pit due to unforeseen circumstances.	This statement is not true. The decision to not backfill the pit has been motivated in the BAR with regard to the potential for long term groundwater pollution if this is done, as well as the cost thereof that is orders of magnitude more than the other closure options and disproportionate to the benefits associated with implementing such an option.
DWS Chief Director: Water Quality Regulation	2019/10/02	An impact prediction model must be developed in terms of the Department of Water Affairs and Forestry (DWAF) Best Practice Guidelines (BPG) G4 (Impact Prediction) to indicate the potential groundwater pollution impacts should the pit be backfilled.	Models to describe the pit water quality have been developed and included in two specialist reports from Golder Associates, i.e. Voorspoed Mine Summary of Surface and Groundwater Study for Mine Closure (October 2017) and Voorspoed Diamond Mine, Technical Evaluation of the Risks, Impacts and Management Requirements into Pit Backfilling Versus Current Mine Plan (Pitlake) (February 2019). It is not clear if these models are inadequate or what is further required.
		Baseline groundwater quality data must be provided.	Baseline groundwater quality data has already been provided in the specialist report Voorspoed Mine Summary of Surface & Groundwater Study for Mine Closure, Golder Associates (Oct 2017)

DWS Chief Director: Water Quality Regulation	2019/10/02	Groundwater monitoring must be conducted quarterly for five years after cessation of mining operations and reported on an annual basis.	This is in line with the groundwater monitoring commitments in the Environmental Management Programme and Closure Plan.
DWS, Geohydrology	2019/10/02	The specialist studies are acceptable as they have gone into details regarding the geohydrological status of the mine and also looked at possible impacts on the resource as well as providing the mitigation measures to all the anticipated impacts.	Acknowledge comment
		The impact to the groundwater resource is mostly from the dump sites as indicated on the geochemical analyses diagrams; but the contaminant transport model indicates that contamination will not exceed sulphate limits on the neighbouring farms post mine closure.	Acknowledge comment
DWS, Geohydrology	2019/10/02	The groundwater monitoring program is adequate and acceptable. The Department supports the recommendation to develop three (3) surface water monitoring sites.	This is in line with the groundwater monitoring commitments in the Environmental Management Programme and Closure Plan.
		Groundwater monitoring should be done as follows: • Groundwater levels should be monitored on a monthly basis during the Decommissioning-Closure Phase and biannually in the post-closure phase. • Groundwater quality should be sampled and analysed by an accredited laboratory, using the correct scientific methods to avoid alien and cross contamination. • Analyses should include major cations (i.e.: Ca, Mg, Na & K), major anion (i.e. Cl, F & SO4), Physic-chemical determinants (i.e. conductivity, pH, TDS	

		and Total Alkalinity), as well as metals & trace metals (i.e. Fe, Cr, Se, Pb, Mn, Al & Zn).	
DWS, Geohydrology	2019/10/02	A programme should be initiated to generate hydrological data that will be used as a baseline dataset for future planning and to confirm the numerical modelling and predictions modelled during the mine closure study.	Included in the groundwater monitoring commitments in the Environmental Management Programme and Closure Plan.
		A transport contamination model should be upgraded at least every 5 years, using the latest monitoring data.	Included in the groundwater monitoring commitments in the Environmental Management Programme and Closure Plan.
Department of Agriculture	2019/04/12	The slope of the remaining rehabilitated residue deposits should facilitate farming activities.	This is in line with the preferred End Land Use.
M George Koba	2019/08/20	Can the pit water be provided to the community as a sustainable water source?	*Response by PJ Jordaan (on behalf of the Mine):* Unfortunately it is not safe to access the water, the pit walls have already failed. Also, the quality of water in the pit is not good. Furthermore, the water level in the pit will never reach above a certain point, since the evaporation rate is much higher than the water inflow rate. It is thus not a sustainable water source.
M George Koba	2019/08/20	The mine pit is unsafe for people and animals. How will access into the pit be prevented?	*Response by PJ Jordaan (on behalf of the Mine):* Several mitigation measures are in place to prevent access into the mine pit, i.e. there is no road leading into the pit, since the pit walls have already failed; a high quality fence will be put up around the pit; a berm and trench will be constructed outside the fence to prevent accidental driving to the pit; an outside perimeter fence will also be put up; and security guards are currently monitoring the pit area. In future, cameras and alarms will monitor the area for movement.
Nico Palm	2019/08/19	Does the Mine have a plan in place to deal with illegal Miners (Zama-Zamas)?	*Response by PJ Jordaan (on behalf of the Mine):* The Mine recognises the potential threat that illegal Miners may pose and has thus made provision for this in

			the closure plan in the following manners: 1. All diamonds have been mined from the pit, thus there are no reason/incentive to enter the pit; 2. The access ramps to the pit have already failed and can not be used to access the pit; 3. The pit will be filled with water; 4. The pit will be fenced with a ClearVu security fence restricting access; and 5. Security guards will monitor access to the pit until the rehabilitation plan is implemented. Thereafter, security cameras and alarms will be installed to notify the Mine of any trespassers in future.

9.2 Proposed Stakeholder Engagement

A public participation process in respect of the amendment application will be conducted in accordance with regulation 34 of the EIA Regulations.

Therefore notice will be issued to all I&APs' including those on Voorspoed's Stakeholder Database, notifying them of DBCM's intention to amend the 2010 EMPR to remove the conditions detailed in the DMR letter and inviting I&APs' to submit comments. In addition, as the DWS was the only party to object to the pitlake closure option, it is recommended that a meeting must be convened with DWS, the DMRE and the DBCM's mine closure team with the view of further discussing DWS' position in respect of the proposed pitlake option.

Additionally, we have included correspondence which was issued to several organs of state which makes provision for the pitlake as a sustainable mine closure option, to be assessed on a case-by-case basis (**Appendix H**). This correspondence forms part of a study currently being undertaken by GCS and Coaltech, which is intended to motivate for an amendment to the South African mining legislative framework to promote pitlakes as a sustainable mine closure option.

10 EAP RECOMMENDATIONS AND CONCLUSION

The risks and benefits associated with the pitlake closure option have been thoroughly assessed, both at the commencement of DBCM's operations at Voorspoed Mine in terms of the 2005 EMPR (Metago, 2005) and at closure, in terms of the FBAR (CEM, 2019). Thus, the removal of the backfill conditions from the amended 2010 EMPR (FS 30/5/1/2/3/2/1 (12) EM) <u>will not present any additional impacts which have not already been assessed.</u>

The investigation undertaken by Golder and Associates (2019) indicates that the backfilling option is not feasible for Voorspoed Mine, given the material environmental and financial implications of this undertaking. The further long term geochemical modelling (Golder, 2021) has shown that the long-term water quality will stabilise and improve. The study undertaken by GCS on behalf of the WRC (2019), as well as the Best Practice Guidelines developed by the International Council on Mining & Metals (2019) also concludes that pitlakes can form part of a sustainable mine closure plan, if designed correctly.

The advantages and disadvantages of the pitlake closure option are:

- Advantages:
  - The measures taken during decommissioning and closure will be sufficient to achieve the closure objectives of sustainability and a positive legacy. They will also be sufficient to achieve the specific closure objectives of restoring as much as possible of the mining area to a condition consistent with the pre-determined post closure land use objectives, ensuring that the area is left in a condition that poses an acceptable level of risk to public health and safety and reducing the need for post closure intervention, either in the form of monitoring or on-going remedial work, as far as is practicably possible.
  - The cost of implementing the pitlake option is approximately 100 times less than the backfilling option (i.e. R4 billion vs R40 million), making it more proportionate to the benefits received from mining and from the post-mining land use.
- Disadvantages:
  - The open pit will remain in the landscape after closure, which may pose a risk to human/animal safety. However, measures will be taken to reduce this risk. These include implementation of access control measures and construction of security fence, storm water trench and an enviro berm outside the provided Zone of Relaxation (ZOR), in conjunction with adequate monitoring and maintenance standards on an ongoing basis.
  - Leaving the pit open to rewater will result in 70 ha of potential grazing land lost (which provides grazing capacity for only 10 head of cattle).
  - The grazing potential of the WRD rehabilitated in-situ will be slightly lower than its rehabilitated footprint would have been.
  - All the residue deposits (WRD, FRD and CRD) would remain on the surface and although rehabilitated, may result in groundwater contamination plumes.

In addition, as there will be no additional impacts because of the proposed changes to the amended 2010 EMPR (as all impacts have already been assessed), there will be no additional mitigation measures required.

On the basis that the pitlake closure option does not present any fatal flaws, the EAP finds it reasonable to recommend that the backfilling conditions (d, f and g) contained in the 2010 EMPR amendment approval letter dated 22 July 2010, be excluded from the scope of the amended 2010 EMPR.

Please note that this draft Amendment Application Report is subject to change following additional consultation with the relevant authorities and I&APs.

11 EAP UNDERTAKING

I, Magnus van Rooyen, as the appointed Environmental Assessment Practitioner, declare that:

- I act as the independent environmental assessment practitioner in this application;
- I have expertise in conducting environmental impact assessments, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I will take into account, to the extent possible, the matters listed in Regulation 14 of the Regulations when preparing the application and any report relating to the application;
- I undertake to disclose to the applicant and the Competent Authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the Competent Authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the Competent Authority, unless access to that information is protected by law, in which case it will be indicated that such information exists and will be provided to the Competent Authority;
- I will perform all obligations as expected from an environmental assessment practitioner in terms of the Regulations;
- I am aware of what constitutes an offence in terms of Regulation 48 and that a person convicted of an offence in terms of Regulation 48(1) is liable to the penalties as contemplated in Section 49B of the Act; and
- I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Regulations.

Signature of the EAP:

Name of Company: GCS Water and Environmental Consultants (Pty) Ltd

Date: 2020/11/09

12 REFERENCES

Centre for Environmental Management, 2019. Voorspoed Mine Final Basic Assessment Report and Environmental Management Programme and Closure Plan for Decommissioning.

De Beers Consolidated Mines, 2017. Air Quality Report 2017, Document No. VO-ENV-DR-015 Rev 02.

De Beers Consolidated Mines, 2019. Dust Fall-Out Report 2019, Document No. VO-ENV-DR-015 Rev 02.

Department of Water and Forestry. 1996. South African Water Quality Guidelines, Volume 1: Domestic Water Use, Second Edition.

Golder Associates Pty Ltd, 2019. Technical Evaluation of the Risks, Impacts and Management Requirements into Pit Backfilling Versus Current Mine Plan (Pitlake).

Golder Associates (Pty) Ltd, 2020. Unsaturated flow model of Voorspoed Mine Residue Dumps.

Golder Associates (Pty) Ltd, 2021. De Beers Consolidated Mines – Voorspoed; Geochemcial Pitlake Model.

Harris L et al. 2009. “Creating Lakes from Open Pit Mines: Processes and Considerations, Emphasis on Northern Environments” Canadian Technical Report of Fisheries and Aquatic Sciences.

IMMC 2019. “Integrated Mine Closure Good Practice Guide” 2nd Edition.

Kumar R et al. 2009. “Water Resources in Australian Mine Pitlakes” Water in Mining Conference.

McCullough, CD and Lund, MA. No date. Opportunities for Sustainable Mining Pitlakes in Australia. Accessed at https://www.researchgate.net/publication/225472002_Opportunities_for_Sustainable_Mining_Pit_Lakes_in_Australia.

Metago Environmental Engineers (Pty) Ltd, 2005. Environmental Management Programme for Voorspoed Diamond Mine.

NEKA Sustainability Solutions, 2017. Voorspoed Mine End Land Use Plan.

NLA (Newtown Landscape Architects CC). 2004. Voorspoed Diamond Mine Near Kroonstad, Free State Visual Assessment.

Redco and Uvuna Sustainability, 2019a. Voorspoed Mine Final Closure Plan.

Redco and Uvuna Sustainability, 2019b. Voorspoed Mine Final Rehabilitation Plan.

Water Research Commission. 2019. An Investigation to Determine If South African Coal Mine Pitlakes Are A Viable Closure Option. Volume1.

APPENDIX A

Amended 2010 EMPR FS 30/5/1/2/3/2/1 (12) EM and EMPR amendment approval letter dated 22 July 2010 (which imposes the backfilling conditions)

mineral resources

Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

From: Directorate: Mineral Regulation: Free State Region
Enquiries: Mr. C. Tshisevhe
E-Mail:chris.tshisevhe@dmr.gov.za
Cnr Bok and Stateway Street, The Strip Building, First and Second Floors, Welkom, 9459
Private Bag X33, Welkom, 9460
Tel: (057) 391 1300, Fax: (057) 357 6003

Sub Directorate: Mine Environmental Management **Ref: FS 30/5/1/2/3/2/1(12) EM**

The Directors
De Beers Consolidated Mines Limited
Private Bag X1
SOUTHDALE
2135

Dear Sir/Madam.

Please find an approved amended Environmental Management Programme for your operation. Kindly note that the Environmental Management Programme stipulates Environmental Management and copy of which should always be available on site.

APPROVAL OF AN AMENDMENT TO THE APPROVED ENVIRONMENTAL MANAGEMENT PROGRAMME (EMPR) IN TERMS OF SECTION 39(6) FOR EXTENTION OF THE MINING AREA APPLIED FOR IN TERMS SECTION 102 OF THE MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT, 2002 (ACT 28 OF 2002) FOR DE BEERS CONSOLIDATED MINES LIMITED (KNOWN AS VOORSPOED MINE); IN RESPECT OF THE FARMS VOORSPOED 401, VOORSPOED 2480, GELDENHYS 1477 AND MORGENSTER 772; ALL SITUATED IN THE MAGISTERIAL DISTRICT OF KROONSTAD: FREE STATE REGION.

You are hereby informed that the amended Environmental Management Programme for the De Beers Consolidated Mines Limited has been approved under the following conditions:

CONDITIONS

a.) All mining activities must take place in accordance with the approved Environmental Management Programme.
b.) Mining activities are not allowed within 1:50 year flood line or 100m from the edge of the river whatever is the greatest, without the necessary authorization from Department of Water Affairs.

c.) The De Beers Consolidated Mines Limited is responsible for all surface disturbances on the mining area, which includes all historical mining and prospecting activities.

d.) All mine waste (suitable for rehabilitation) must be taken back to the excavation area for backfilling purposes. Rehabilitation of the mining area must be done concurrently with mining activities (whenever and wherever possible).

e.) Mine waste will not be allowed to be deposited in natural drainage lines or erosion gullies.

f.) Dump structures must not be left on the surface, this includes topsoil stockpiles, overburden stockpiles, waste rock stockpiles, tailing dumps and slimes dams.

g.) All excavations must be backfilled to the natural surface level. If a bulk factor exists it must be accommodated on the total area of disturbance.

h.) A surveyed plan must be submitted every year to the Regional Manager that indicates:

- The positions, footprints and volumes of all topsoil stockpiles, overburden dumps, waste rock dumps and slimes dams (Any structure that is above the natural surface).
- The positions, surface areas and depths of all open pits.
- The positions and surface areas of all rehabilitated areas (please indicate the status of rehabilitation-backfilled, profiled/landscaped, top soiled, vegetated or monitoring and managing.

i.) The financial provision for rehabilitation purposes must be upgraded or revised on an annual basis according to the surveyed plan which indicates the progress in rehabilitation (see section 41 of the MPRDA, 2002 (Act 28 of 2002) and regulation 55 of the Regulations to the said Act)

j.) The monitoring and performance assessment of the Environmental Management Plan must be conducted on a continuous basis. A Performance Assessment Report must be compiled and submitted to this department; Mine Environmental Management section on an annual basis: i.e. every 12 months (see regulation 55 of the Regulations to the MPRDA, 2002 (Act 28 of 2002).

k.) Any project, expansions or additional infrastructure must be addressed through an amendment of the approved Environmental Management Programme and should be submitted to the Regional Manager: Mineral Regulation for approval, before they commence. This approval may be amended at any stage if deemed necessary.

l.) Should any archaeological artefact be exposed during the mining activities in the vicinity of its finding it must be stopped. Under no circumstances shall any artefact be destroyed. Such object must be marked and fenced off, and South African Heritage Resource Agency must be contacted as soon as possible. The recommendation of the Heritage Impact Assessment conducted by Dr Julius CC Pistorius should be adhered to.

m.) This approval does not purport to absolve your company from its common law obligations towards the surface rights holder or any other affected party.

n.) You are expected to familiarise yourself with the provisions of the following Acts as they are applicable and relevant to your approved EMPR and operation

- The National Water Act 1998, (Act 36 of 1998), with particular reference to the sections pertaining to mining or mining in the proximity of dams and their catchments areas, rivers, marshes, streams, pans and other water courses.

- The Environmental Conservation Act (Act 73 of 1989). Your attention is specifically directed to the requirements of section 20 of the above-mentioned Act.

- The Atmospheric Pollution Prevention Act, 1965 (Act 45 of 1965), with particular reference to the sections pertaining to the liberation of dust, and other emissions, created by mining activities, into the atmosphere.

- The Conservation of Agriculture Resources Act, 1983 (Act 43 of 1983), with particular references to the sections pertaining to soil conservation.

- The National Heritage Resources Act (Act No 25 of 1999), with particular reference to the protection of all historical and pre-historical cultural remains.

- The Mine Health and Safety Act (Act 29 of 1996) as well as other applicable law regarding noise management and control.

- The National Environmental Management Act, 1998 (Act 107 of 1998), with particular reference to section 2 of the Act.

o.) All persons concerned must be made fully conversant with the terms of this approval, copies of which must be readily available to them.

Yours faithfully

....

REGIONAL MANAGER: MINERAL REGULATION
FREE STATE REGION
DATE: 22/07/2010

ACKNOWLEDGEMENT OF RECEIPT:..............................
DATE: 22/07/2010

ALL CORRESPONDENCE SHOULD BE ADDRESSED TO THE REGIONAL MANAGER DEPARTMENT OF MINERAL RESOURCES : FREE STATE REGION

APPENDIX B

Environmental Management Programme (EMPr) for Voorspoed Mine, Metago, 2005 (Reference: 181-010)

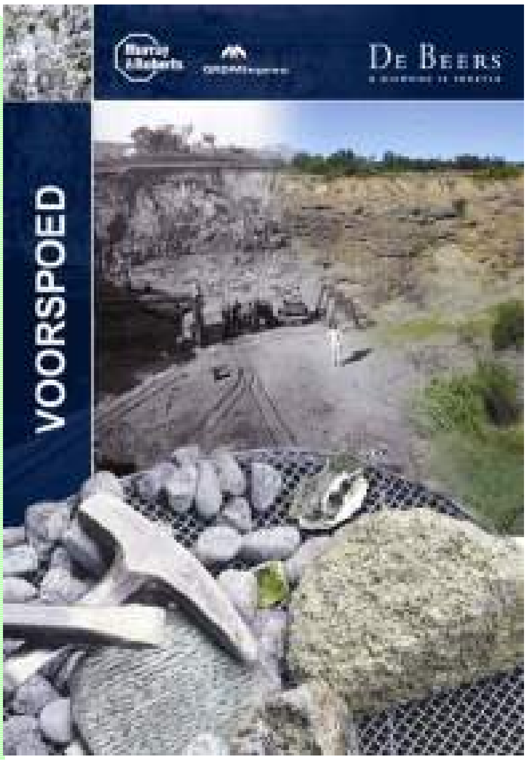
metago

Environmental Engineers (Pty) Ltd

ENVIRONMENTAL MANAGEMENT PROGRAMME FOR VOORSPOED DIAMOND MINE

Prepared For

De Beers Consolidated Mines Limited



PROJECT NUMBER 181-010
Final Revision
March 2005
Volume 1 of 2
Main Report

ENVIRONMENTAL MANAGEMENT PROGRAMME FOR VOORSPOED DIAMOND MINE

PROJECT NUMBER 181-010
Final Revision
March 2005
Volume 1 of 2
Main Report

DOCUMENT INFORMATION

Confidentiality	Public Document
Title	Environmental Impact Assessment Report and Environmental Manangement Programme for Voorspoed Diamond Mine
Project Manager	Wilhelm Alheit
Author	Wilhelm Alheit
Reviewer	Jane Joughin
Client	De Beers Consolidated Mines Limited
Electronic File Name	R_181-010_EIA Report for Voorspoed Diamond Mine_R3_2005-03-22
Date last printed	2005/03/22
Date last saved	2005/03/22
Comments	
Keywords	Environmental Impact Assessment, Environmental Management Programme, Diamond Mine, Voorspoed, De Beers, M&R GRD Minproc JV
Project Number	181-010
Report Number	Volume 1 of 2 – Main Report
Status	Final
Issue Date	March 2005
Document Identification Bar Code	

1. EXECUTIVE SUMMARY OF THE EMP

1.1. INTRODUCTION

An environmental management programme (EMP) has been prepared for Voorspoed Diamond Mine (Voorspoed) by means of an environmental impact assessment (EIA) process. This is a summary of the EMP.

1.2. BACKGROUND TO THE EMP

De Beers Consolidated Mines Limited (De Beers) proposes to mine Voorspoed, a diamond bearing kimberlite pipe resource. Voorspoed is in the Free State Province, located approximately 30 km north of Kroonstad on the farms Voorspoed 2480, Voorspoed 401, Geldenhuys 1477 and Morgenster 772.

The EMP for the Voorspoed Mine has been compiled by Metago Environmental Engineers (Pty) Ltd (Metago) on behalf of De Beers. De Beers will submit the EMP to the Free State Department of Minerals and Energy (DME) by De Beers to seek approval under the Minerals and Petroleum Resources Development Act (Act 28 of 2002).

If the EMP is approved, it will be legally binding.

De Beers intends to regularly review, refine and update the EMP and to audit compliance with the EMP in accordance with the Minerals and Petroleum Resources Development Act Regulations (R527 of 23 April 2004).

1.3. PROJECT DESCRIPTION

Historical background

The Voorspoed kimberlite deposit was discovered in 1906. The Voorspoed Diamond Mining Company mined the pipe as an open pit operation from 1906-1912. During this period approximately 4,2 million tons of kimberlite ore were mined, and approximately 920 000 carats of diamonds were recovered. As mining progressed below the weathered kimberlite, the mine experienced extreme difficulty with the mining and the recovery of diamonds from the un-weathered and extremely hard kimberlite material.

De Beers Consolidated Mines Limited (De Beers) bought the mine from the Voorspoed Diamond Mining Company in 1912, after which the mine was closed.

Main components of the mine

Voorspoed Mine will be an open pit diamond mine. Mining will commence in the existing open pit located at Voorspoed 2480. The final dimensions of the open pit after 15 years of mining will be approximately 400 m deep with a diameter of 1200 m at surface.

The main components of the proposed open pit mining operation are summarised below:

- The open pit.
- The waste rock dump.
- The treatment plant.
- The coarse resource facility.
- The ultra fines facility.
- Water management facilities.
- A water pipeline from the existing weir at Junction on the Renoster River to the mine.
- Bulk ESKOM power supply.
- A helipad.
- Offices, stores and change houses.
- Workshops, vehicle wash bays, vehicle refuelling bays and fuel storage tanks.
- An explosives magazine.
- A sewage treatment plant.
- A diversion of secondary road S156 south of the mine pit and blasting zone.

LIFE OF THE MINE

The life of mine is planned from 2006 to 2021. If both ramp up and closure are included the life of mine is 15 years, 12 of which would be at full production. If the required environmental approvals are obtained and the results of the feasibility study are positive, construction will commence in August 2005.

MINE STAFF

The mine will create about 500 jobs in the construction phase and employ about 378 permanent staff in the operational phase. During the operational phase approximately 8 contractor companies may provide an additional 80 jobs to contractor employees.

There will be three shifts per day in the construction and operational phases.

Mining method

The Voorspoed resource will be mined as an open pit, utilising normal drill and blast techniques. Waste rock and kimberlite ore will be blasted, loaded and hauled from the pit using conventional truck and shovel methods. To access the kimberlite ore waste rock will be removed from the pit and deposited on a waste rock dump located along the south eastern pit boundary

Mineral processing plant and ultra fines facility

Kimberlite ore will be stockpiled adjacent to the plant for treatment. The kimberlite ore will be crushed and processed in the plant with the purpose of recovering the diamonds. The plant will be designed to process 4 million tonnes of kimberlite ore annually. It will operate 24 hours/day, seven days a week. The diamond extraction process is primarily physical as opposed to chemical: the kimberlite ore will be crushed, screened and washed to liberate the diamonds. Ferrosilicon (FeSi), a non-hazardous substance (in the quantities and under the conditions used) will be used in the dense media separation treatment process to separate out diamond bearing material. The plant will generate the two mine residue streams: coarse treated kimberlite that will be disposed of on the coarse resource facility, and treated kimberlite fines (silt and clay) that will be disposed of on the ultra fines facility.

Access road and mine roads

The mine will be accessed from the west via the S 156 gravel road from the R76 between Kroonstad and Viljoenskroon, and from the east via the S 169 gravel road from the R721 between Kroonstad and Vredefort. Sections of the S 169 gravel road from the R721 to be used by De Beers will be upgraded to an all-weather gravel road as required, in consultation with the provincial roads authority. A section of the existing gravel road S 156 falls within the extent of the final pit and would have to be rerouted. The proposed rerouting will be to the south of the pit, outside of the blasting zone.

Power lines

Eskom will bring a new power line from the Grootkop – Mercury 132 kV line into the project area to supply power to the mine.

Domestic waste disposal

No facilities for the disposal of domestic and industrial waste will be developed on the mine site. The mine will dispose of waste through contractors at suitable permitted waste sites.

Stormwater management infrastructure

Stormwater management infrastructure at the mine (with the exception of the waste rock dump) has been planned and will be designed to comply with Government Notice 704 Regulations (GN 704) (promulgated in terms of National Water Act 36 of 1998).

The mine infrastructure will be located outside of the 1:100 year floodline and at least 100 m from the wetland on Voorspoed 401. Clean runoff will be diverted away from the sites of mine infrastructure. Rain falling on mine infrastructure sites will be channelled in dirty water collection facilities. All dirty water holding facilities will be designed for the 1:50 year storm event.

Storm water management infrastructure around the waste rock dump

Rain falling on the waste rock dump will be channelled to a collection sump from where it will be pumped to the plant for recycling. The sump will be designed to capture and recycle the 1 in 2 year storm, but will overflow on to the drainage lines of the neighbouring property during bigger rainfall events.

The waste classification study of the mine residues found that there is a potential risk for increased salinity levels / high total dissolved solids (TDS) in the seepage from the waste rock dump. The concern is not related to the runoff from the waste rock dump during rainfall, as the surface water runoff would not be in contact with the waste rock for long enough for salinity to build up. This should result in low salinity and TDS levels in the surface water runoff during rainfall events.

However, some of the rain falling on the waste rock dump will infiltrate it. The waste rock dump will act as a sponge, attenuating the infiltrated rainfall and gradually releasing it as toe seepage after a rainfall event. This seepage water would be in contact with the waste rock for longer, increasing the opportunity for salinity and TDS to build up in the seepage water. The approach to pollution control at the waste rock dump is therefore:

- To capture the attenuated water flow / toe seepage from the waste rock dump and to recycle this (potentially polluted) water back to the process plant. Should this water contain elevated TDS and salinity levels, the salts will end up on the ultra fines facility, which acts as a salt sink for the mine water balance.

- To capture the surface runoff from the waste rock dump and recycle it back to the mine, allowing the runoff from major storm events to overflow into drainage lines on neighbouring property.

Water supply to the mine

The Koppies Dam was identified as the preferred water source for plant makeup water, and borehole water at the site as the preferred source for potable water. A study conducted by the Department of Water Affairs and Forestry found that the Koppies Dam could provide a sustainable water source for the mine if the mine purchases the equivalent of approximately 800 hectares of irrigation water rights from the Koppies Government Water Scheme. Negotiations for options to purchase water rights from Koppies Dam are ongoing.

Water from the Koppies Dam would be released into the Renoster River and abstracted at the weir at Junction, from where it will be piped approximately 18 km southwards to the Voorspoed Mine. Agreements with landowners have to be obtained for the pipeline servitude.

Groundwater may provide a backup water supply to the mine, should the assurance of supply from Koppies Dam prove unsatisfactory. Groundwater exploration work was conducted on regional groundwater structures in the vicinity of the mine, which included the Malmani dolomite aquifer located to the north of the Renoster River, a regional fault located approximately 5 km south of Voorspoed Mine, and boreholes located at Witkop Colliery, approximately 10 km north of Voorspoed Mine. Agreements with landowners and permissions from regulatory authorities would have to be obtained to exploit regional groundwater structures.

A water balance has been prepared for the mine and will be refined on an ongoing basis during the life of the mine.

Consideration of alternatives

Numerous alternatives were considered for the sites of mine infrastructure, including the sites of the plant, the fine and coarse residue storage facilities and the waste rock dump. Environmental factors were key considerations in the identification of the preferred sites. A detailed review of the alternatives that have been considered is presented in the EMP.

1.4. EIA PROCESS UNDERTAKEN TO COMPLETE THE EMP

The interested and / or affected parties (IAPs) who have been involved in the EIA process include: landowners in the project area; non-landowning residents in the project area; farmers' unions; regulatory and municipal authorities and potential service providers to the mine from the Kroonstad region.

Issues raised by regulatory authorities and IAPs during the scoping phase pertain to:

- Loss of biodiversity and ecological function - the development occurs near sensitive habitats and wetlands;
- Participation in local conservation initiatives;
- Availability of water for the mine;
- impacts on water quality and availability;
- The need for water use licences and compliance with GN 704 on water use by mines;
- The gravel roads in the project area not being designed for heavy vehicle traffic;
- Influx of labour to the area and proliferation of informal settlement;
- Aesthetic impacts on the rural environment;
- Job creation, a desire for preferential employment of locals;
- Socio-economic upliftment in the project area;
- Dust pollution from mining activities.

The EIA process undertaken to complete the EMP is outlined in Table 1. The EIA project team members are identified in Table 2.

Table 1 Stages of the Environmental Impact Assessment

Purpose	Main activities
Scoping stage (May to July 2004)	
• Identify regulatory authorities and other IAPs and involve them in the scoping process. • Determine the issues on which attention needs to be focused. • Input into project planning decisions through the exploration of alternatives. • Identify any fatal flaws.	• Initial planning with the project team. • Background information document sent to regulatory authorities and interested and affected parties (IAPs). • Meeting with regulatory authorities (06 May and 09 July 2004). • Meetings with IAPs (24 June and 28 June 2004). • Meeting with the Free State Department of Tourism, Economic and Environmental Affairs (DTEEA) to discuss alternative sites for the fine residue disposal facilities and potential impacts on wetlands (20 September 2004). • Compilation of terms of reference for the detailed investigations.
Detailed investigations (July to August 2004)	
• Describe the affected environment. • Define potential impacts. • Give management and monitoring recommendations.	• Specialist investigations (see • **Table** 2 for a list of specialist investigations).
Reporting (September 2004 to February 2005)	
• Compile the EIA Report & EMP. • Refine the EIA Report & EMP through consultation with IAPs and authorities.	• Compilation of the draft EIA Report & EMP. • Review and refinement of the draft EIA Report & EMP by the Voorspoed project team. • Courier of the draft EIA Report & EMP to authorities for review (early November 2004). • Provision of IAPs with a summary of the findings (early November 2004). • Draft EIA Report & EMP made available to IAPs for review at three locations (early November 2004). • Feedback meeting with IAPs (end November 2004). • EIA Report & EMP review meeting with authorities (end November 2004). • Follow up meeting with DTEEA to discuss the proposed final site infrastructure layout and potential impacts on wetlands (7 February 2005). • Compilation of the final EIA Report & EMP (December 2004 - February 2005). • Submission of the final EIA Report & EMP to regulatory authorities (March 2005).

Table 2: EIA PROJECT TEAM

Specialist study	Contact
Air quality	Hanlie Enslin - Airshed
Climate & Hydrology	George Papageorgiou & Georgia Vagis - Metago
Ecology	Ivan Ginsberg & Geoff Lockwood – Delta Environmental Consultants
EIA compilation	Wilhelm Alheit & Zaheera Seedat – Metago
EIA review	Jane Joughin - Metago
Surface water	George Papageorgiou – Metago
Groundwater	Koos Vivier – Africa Geo-Environmental Services
Heritage resources scan	Julius Pistorius
Noise impact assessment	Francois Malherbe – Accoustic Consulting CC
Social impact assessment	Sue Brandt & Alex McNamara – Concession Creek Consulting
Soils and land capability	Garry Patterson – Institute for soil, climate & water
Traffic investigation	Tony Jooste – TFJ Engineering Services
Visual assessment	Graham Young – Newton Landscape Architects
Waste classification	Steffan Dill & Alistair James – Metago
Wetland ecology	Brian Colloty – Strategic Environmental Focus

1.5. ENVIRONMENTAL SETTING OF VOORSPOED MINE

Geology

Sub-horizontal sediments of the Ecca Group dominate the local surface geology in the vicinity of the Voorspoed site. Dolerite sills and dykes and a series of kimberlites have intruded the Ecca Group sediments.

The kimberlite pipe located at Voorspoed is an irregular, roughly oval shaped body with a maximum dimension of 490 by 350 m. The total area of the pipe at the base of the existing open pit is 12,5 ha.

Climate

The long-term average annual rainfall is 560 mm, of which approximately 80% falls from October to March. The average evaporation over the same period is 2085 mm. Temperatures vary from an average monthly maximum and minimum of 29,8ºC and 15,8ºC for January to 18,7ºC and –0,3ºC for July respectively.

Topography

The topography of the area is flat to slightly undulating, sloping gently to the north. There is a small koppie (Renosterkop) to the southeast of the project area, rising approximately 100 m above the surrounding land.

Soils and land capability

Most of the soils at Voorspoed mine are of moderate arable potential, consisting of Avalon soils with a depth of 0,5 to 1,2 m. Smaller sections of the site have soils of low arable potential or grazing potential. The existing open pit and residue dumps of the historical Voorspoed Mine takes up a small section of the site.

Land use

Since 1912 the land use in the vicinity of Voorspoed Mine has been agriculture. Dryland crops cultivated include maize, sunflower, wheat, sorghum and seed production. Currently Voorspoed Mine is used for livestock grazing.

Vegetation and animal life

Voorspoed is in a region where agriculture has transformed most of the original vegetation and animal life. However, habitats of conservation importance do occur around the mine:

- A wetland and two pans are located on Voorspoed. The wetland and pans have been disturbed through interference with their surface water drainage patterns, livestock grazing and sand winning. Due to the threatened nature of these ecosystems, they are of high conservation importance.

- Renosterkop, bordering on the southeast of the mine site, is a relatively undisturbed area that provides habitat for a wide variety of plants and animals.

De Beers has been careful to site mine infrastructure on land that has been disturbed by past agriculture and mining activity and has, thereby, avoided habitats of conservation value as far as possible. The final site layout has been developed to the north and east of the existing open pit, in order to avoid the sensitive environments of the wetland located to the northwest and Renosterkop located to the west of the existing open pit.

An exception is the southern pan located on Voorspoed 401. This pan is located within the blasting zone, between the proposed locations of the exit ramp from the open pit, the plant and the access ramp to the waste rock dump. Avoiding the pan would have required a sub-optimal site layout, significantly increasing the capital and operational expenditure required to mine the Voorspoed deposit. Considering the economic constraints and the highly degraded state of the southern pan (a drainage line dug into the pan had effectively prevented it from functioning as a pan), DTEEA gave De Beers permission to locate part of the plant infrastructure across the southern pan.

Surface water

Voorspoed is located on a watershed. Being situated on a watershed, and given the generally flat topography of Voorspoed, there are no clearly defined drainage courses at Voorspoed. During heavy rainfall events surface water would generally flow down gradient as sheet flow and not collect into channels. Three drainage lines do however originate from Voorspoed. These drainage lines are ephemeral and will only have flow periodically during and after heavy rainfall events.

Groundwater

A regional shallow aquifer related to the layered sedimentary Karoo rocks is found at Voorspoed. Static water levels in this aquifer ranged from 3 to 30 m below ground level for the boreholes surveyed within a 6 km radius of the Voorspoed site. Groundwater flow directions generally follow the topography from higher areas to lower lying areas.

The quality of groundwater varies. Of 14 groundwater samples taken in the vicinity of Voorspoed, eight were found to be within the recommended SABS limits for human consumption and six exceeded these limits.

Groundwater usage immediately downstream from the proposed development is used for stock watering and domestic purposes. Groundwater is the only source of water for the neighbouring farms.

Air quality

There are no major sources of air pollution existing in the project area.

Noise

The existing noise climate in the project area is quiet because of the remote setting, sparse population and general low level of mechanization. Potential noise sensitive environments in the project area are the farmsteads and farmworker communities on the adjacent farms Belmont, Welvaart and Urbannus, located east of Voorspoed Mine.

Sites of archaeological and cultural interest

The following sites of archaeological and historic interest of conservation value have been identified in the project area:

- The historical Voorspoed Mine, including a historical building.
- Two graveyards.

Visual aspects

The study area is characterised by generally flat to rolling rural land comprising cultivated lands and grassveld used for grazing. The area is dotted with groups of large blue gum trees, most often associated with farmsteads, roads or property boundaries.

A small hill, Renosterkop, is located to the southwest of the mine site. It protrudes approximately 80m above the surrounding landscape. Its vegetation is in a pristine state and provides habitat for a variety of animals and birds. It is a prominent natural feature, which is the focal point of most views in the area.

The aesthetic value of the area is considered to be moderate - the landscape exhibits positive character, but there is also evidence of alteration, degradation and erosion of features. The landscape is potentially sensitive to change (such as the proposed mining development) - change may be detrimental if it is inappropriately dealt with.

Social environment

The Free State Province has a relatively diverse economy, largely based on primary production of maize and gold. The provincial Gross Domestic Product has been in decline since 1995. The provincial population is fairly young and only a small percentage is economically active within the formal sector.

The proposed mine is located in the Ngwathe Local Municipality, close to the neighbouring Moqhaka Municipality, both of which fall within the Northern Free State District Municipality. As with the provincial profile, there are a large number of youth within the population profile of these two municipalities. Current unemployment levels, between 62% and 70% within the municipalities , compound concerns with regards to future employment.

Kroonstad is the nearest major town to the proposed mine and as such is likely to be a major supplier for the developing and operational mine, in terms of labour, goods and services. Kroonstad had an employment rate of 46% in 2001 with the wholesale and trade, financial, insurance, real estate and business service sectors employing the majority of these people.

The Integrated Development Programme (IDP) for the Northern Free State indicated its focus areas for the region are institutional, economic, social, infrastructural, spatial and environmental development. Key economic priorities include Local Economic Development and poverty alleviation, whilst the social development priorities involved improved health care, education, youth development, safety and security, welfare services and the management of HIV/Aids. Overall however, clear emphasis was placed on the provision of social services and infrastructural development within the regions' projects. The priorities for the local municipalities' IDPs are broadly aligned to the District's IDP with particular focus on infrastructure such as additional police stations, education facilities and health care facilities.

1.6. ENVIRONMENTAL IMPACTS AND MANAGEMENT MEASURES

The potential impacts of the mine, and the corresponding proposed management commitments, have been arranged under issue headings in Table 3. In addition, the issues have been arranged into three groups to distinguish the issues that are important for decision-making on the environmental approval of the project.

Most of the negative impacts of the mine can be reduced to acceptable levels through the proposed management, mitigation and monitoring measures. Management measures that are practical and that have been tested effectively elsewhere have been preferred for this project. A few impacts require careful monitoring to check that the management measures are effective and to ensure that additional remedial measures are implemented without delay if required.

De Beers will be legally bound to comply with the management commitments if the EMP is approved and will report to the DME on compliance with these commitments by means of environmental audits undertaken annually.

De Beers will also obtain the necessary water use licences from the Department of Water Affairs and Forestry (DWAF) and will comply with the conditions of approval of these, as well as GN 704. Annual water monitoring reports will be submitted to DWAF.

Ongoing environmental management and rehabilitation will be funded from working costs during the life of mine. Environmental management obligations remaining during the period of decommissioning to closure will be funded by means of a trust fund. A detailed closure cost estimate has been prepared for the mine and will be updated on an annual basis.

Table 3 SUMMARY OF IMPACTS AND MANAGEMENT MEASURES

Outline of impacts	Management measures
MOST IMPORTANT POSITIVE AND NEGATIVE IMPACTS	
Socio-economic benefits of the project The Voorspoed project will have significant positive socio-economic impacts on the local, regional and national economies for the reasons given below. • Provision of employment to a large number of people. • A large capital investment and substantial offshore revenue generation. • A large amount of money paid out locally in the form of the company payroll. • Significant payments to the government in the form of local, regional and national taxes and levies. • Creation and support of service-sector jobs, the procurement of large quantities of consumables annually and the outsourcing of service provision to local service providers. The positive impacts of the project will be enhanced further by means of a social investment programme to be established in the project area by De Beers.	In order to maximise the potential benefits to the local and the regional economy, local labour, service providers and good suppliers should be utilised wherever possible throughout the various phases of the life of the mine. The mine should also identify and provide assistance to suitable HDSA companies and small or medium sized enterprises (SMMEs) that currently, or in future, could provide local procurement to the mine. De Beers supports the principle of Black Economic Empowerment (BEE) through procurement of the services of BEE contractors and suppliers. It intends to identify and invite BEE companies to tender for the provision of services at Voorspoed Mine. De Beers will establish a local economic development programme as part of its Social and Labour Plan for Voorspoed Mine, to enhance the socio-economic benefits and mitigate the negative socio-economic impacts of the development.
Negative visual impacts The mine will detract from the aesthetic quality and sense of place of the project area.	Existing vegetation (other than exotic invaders) will be retained where possible. Rehabilitation will be undertaken as soon as possible in disturbed areas and at the waste rock dump and mine residue storage facilities. Rehabilitation will involve landscaping to create natural contours as far as is possible. Colours that complement the natural colours of the surrounding landscape will be used for mine infrastructure where possible. Lights will be positioned sensitively to avoid lighting up areas outside of the mine. High pole top flood and security lighting will be avoided.
Loss of arable land About 470 ha of arable land and 100 ha of grazing land will be disturbed by development of mine infrastructure. About 400 ha of arable land and 100 ha of grazing land covered by the mine residue deposits will not be returned to its pre-mining land capability.	The mine will rehabilitate land disturbed by mining to its pre-mining land capability where possible. The land covered by the mine residue storage facilities will not be returned to its pre-disturbance potential.

Outline of impacts	**Management measures**
Loss of biodiversity and/or ecological function The following plant and animal habitats of conservation value occur near to the sites of mine infrastructure and will require protection during the life of the mine: • The wetland and pans on Voorspoed 401. • Renosterkop. The mine infrastructure has been sited on land already disturbed by past mining and agriculture.	All mining-related activities will be confined to disturbed areas. Disturbance of habitats of conservation importance near to the mine site will be avoided through the following measures: • Mine staff will not be allowed to drive off-road into these habitats. • Fencing will be erected around these habitats during the construction phase to ensure the buffer zones are enforced. • Natural surface water flow to these areas will not be impeded. • Dirty water from mine surface infrastructure areas will be retained within the mine's storm water control system and prevented from flowing into these habitats. • Erosion will be prevented or controlled where vegetation has been disturbed. • Mine staff will not be allowed to hunt, collect plants or cut firewood in these habitats. Killing of animals that are perceived as dangerous, such as snakes will be discouraged. • Indiscriminate disposal of waste in these habitats will be prevented. • The spread of invasive plants into these habitats will be monitored and corrective action taken if required. • Dust pollution will be monitored and managed.
NEGATIVE IMPACTS REQUIRING CAREFUL MONITORING TO ENSURE THAT MANAGEMENT MEASURES ARE EFFECTIVE If monitoring indicates that additional measures are required, these will be implemented without delay.	
Deterioration of water quality as a result of seepage The seepage plume from the ultra fines facility may migrate beyond the mine site boundary, but no neighbouring boreholes outside mine site are impacted on from seepage during the life of the mine.	Employing paste-thickening technology as the fines residue disposal technique will reduce seepage from the ultra fines facility. Monitoring of water quality in boreholes surrounding the mine will be undertaken.
Deterioration of water quality as a result of dirty water discharges from the mine Runoff from the mine site and spills from dirty water holding facilities and pipelines could contaminate water resources downstream of the site in the absence of adequate control measures.	The mine will ensure that there are no releases of runoff and other dirty water from the site of mine infrastructure (with the exception of runoff from the waste rock dump). Water management infrastructure at the mine has been planned and will be designed to comply with GN 704. The mine water balance will be used on an ongoing basis to check that water holding facilities are operated so that they do not spill. The surface runoff from the waste rock dump will be collected and recycled back to the mine, allowing the runoff from major storm events to overflow on to the drainage lines on neighbouring properties. The waste classification predicts that this water should be of suitable quality for the current downstream water use (livestock watering). Surface water quality will be monitored downstream of the mine to confirm the predictions of this study and remedial action taken if required.

Outline of impacts	Management measures
Lowering of groundwater levels through mine dewatering A ground water drawdown cone will develop around the open pit. The zone of influence is predicted to be approximately 1,5 km. Only one neighbouring borehole (on Belmont 2390) will be affected by the dewatering. Other springs and water-supply boreholes in the project area will not be affected, as they are outside of the zone of influence of pit dewatering.	A hydro census has been undertaken in the project area. Water levels in boreholes in the project area will be monitored.
Disturbing noise Noise from the open pit mining operation and plant could be disturbing, particularly at night when the ambient noise levels are low.	De Beers will ensure there is no public exposure to disturbing noise. (Noise is defined as disturbing if it causes the ambient noise to increase by 7 dB or more. The acceptable limit for an increase in the ambient noise is considered to be 5 dB.) The mine residue storage facilities will be located between neighbouring residents and the main mining activities at the open pit and plant to act as noise screens / acoustic barriers. The screens will be designed, in consultation with a noise Noise suppression systems will be used where possible and equipment will be maintained to reduce the occurrence of excessive noise emissions. The mine will record and respond without delay to complaints about disturbing noise.
Negative socio-economic impacts Potential impacts include population influx and informal settlement and then a partial collapse in the economy of surrounding area at closure.	A community liaison forum will be established through which the mine and surrounding land users communicate on a regular basis to ensure that the mine is in a position to attend to any concerns promptly. A joint strategy will be developed with local authorities, the local police force and local land users to deal with informal settlement. De Beers intends introduce sustainable social benefits in the project area through its local economic development programme.
Rerouting of a section of secondary road S156 A section of road S156 falls within the blasting zone and the final extent of the open pit, and will have to be diverted to the south of Voorspoed mine, outside of the blasting zone.	The mine will plan re-routing of the secondary road so that the potential detour for the existing users of the road is minimised.
IMPACTS THAT CAN BE MANAGED READILY The management measures are not difficult to implement and are effective if implemented correctly.	
Hazardous excavations The open pits and access ramps can be classified as hazardous excavations.	Barriers will be used to ensure that no humans or animals fall into the excavations.
Loss of a soil resource Topsoil is a resource of high conservation value to current and future generations. It is a gene bank containing seeds of indigenous species. It is usually nutrient rich and has a good texture for plant growth. It is therefore an important medium for the successful rehabilitation of disturbed land. Furthermore, it is essential for the restoration of the land capability of disturbed arable land.	Topsoil will be stripped from the sites of mine infrastructure and residue disposal sites and will be used in the rehabilitation of disturbed land. The mine will observe the detailed topsoil conservation procedure presented in the EMP.

Outline of impacts	**Management measures**
Erosion All disturbed land at the site of the mine is susceptible to erosion. The erosion potential will be increased where vegetation cover has been removed, on steep slopes, along linear infrastructure and where there are concentrated discharges of water.	The mine will promote vegetation establishment on bare soil, the topsoil stockpiles and the ultra fines facility. Vegetation establishment will be undertaken as soon as is practical, with growing season and water availability being the primary constraints. Where disturbed areas cannot be revegetated during the life of the mine, appropriate measures will be taken to control erosion. The mine will ensure that erosion controls are included in the designs of linear infrastructure and points of water discharge. Energy dissipaters will be constructed at points where there are concentrated discharges of water to the environment.
Pollution of soils Soil can be contaminated from spills of construction materials, hydrocarbons, polluted water, process water and fine residue. Soil could also be contaminated by poor waste collection practices and use of unauthorised landfills for waste disposal.	Adequate sanitary facilities will be provided at sites away from the ablution blocks. Storage areas and vehicle maintenance areas will be surfaced and bunded. Vehicles will be regularly serviced according to a pre-planned maintenance programme. Pipelines will be monitored. An incident management system will be implemented. Pollution incidents with impacts beyond the mine boundaries will be reported to environmental regulatory authorities. Appropriate remedial measures will be identified in consultation with an appropriately qualified specialist and relevant regulatory authorities. The mine will observe the waste management procedure presented in the EMP.
Blasting hazards and damage to structures by blasting vibrations Buildings and other structures within 500m of the open pits could be affected by blasting. Ground vibrations and air blast could cause structures to crack, particularly where the structures have poor foundations. Fly rock from blasting can also be hazardous to humans and animals up to 500m from a blast. The air blast associated with blasting can startle humans and animals.	The mine will observe the legal requirements regarding blasting. Among the requirements are that the danger zone is cleared of people and livestock, an audible warning is given before the blast is fired and blasts are designed using recognized formulae and by an expert in the field of blasting so that no damage is caused by blasting vibrations. Blasting will be undertaken during daylight hours. The mine will undertake a thorough crack survey of the potentially affected structures. The mine will inform the surrounding community of its blasting programme.
Road disturbances and road traffic Public exposure to vehicle traffic on gravel roads and poorly maintained roads can be hazardous.	De Beers will upgrade the section of road S169 that will provide access to the mine from the provincial R721 road to an all-weather gravel road. The upgrade will be planned in consultation with the provincial roads department. Mine roads will be closed for public use. The mine will record and respond, appropriately and without delay, to any complaints about usage of roads by mine vehicles.
Failure of mine residue deposits It is highly unlikely that the ultra fines facility will fail. Should a slope failure occur, fines residue would flow eastwards toward the farm dam and the farmworker community and farmstead on Welvaart.	The ultra fines facility has been sited and planned and will be designed, operated, decommissioned and monitored in terms of the SABS Code of Practice (SABS 0286) for mine residue deposits, under the supervision of suitably qualified professional engineers.
Dust and other emissions Dust from bare ground, the ultra fines facility, the open pit workings and gravel roads could be a nuisance to the surrounding land users.	The mine will monitor fallout dust levels on surrounding land. Vegetation cover will be established on disturbed areas. Gravel roads will be watered or treated chemically to suppress dust. Conveyors will be covered.

Outline of impacts	Management measures
Disturbance of archaeological and historic sites Several archaeological and historic sites have been identified in the project area. Only a few are of conservation importance and these are unlikely to be disturbed by the mine.	All identified archaeological and historic sites will be registered with the South African Heritage Resources Agency (SAHRA). Disturbance of the sites will be avoided where possible. If not possible, a permit to disturb the sites will be obtained from SAHRA and information held in the sites will be conserved. Permits will be obtained from SAHRA for the demolition of structures older than 60 years.
Disturbance of graves Two graveyards could be affected by open pit mining.	Permits will be obtained for the relocation of graves from SAHRA in terms of Section 36 of the National Heritage Resources Act. The mine will discuss the possible relocation of the gravesites with the identified relatives and agree with them on an appropriate course of action. If a decision were reached to relocate the graves, permits will be obtained for the relocation of graves by SAHRA in terms of Section 36 of the National Heritage Resources Act (25 of 1999).

Potential impacts of the Voorspoed mine that could contribute to the cumulative impacts on a regional scale are considered further in Table 4.

Table 4 REVIEW OF POTENTIAL CUMULATIVE IMPACTS OF VOORSPOED MINE

Issue	Comment	Cumulative impact
Socio-economic benefits of the project	The Voorspoed project will add to the positive socio-economic impacts of mines in the region. Voorspoed is the only proposed diamond mine in the Kroonstad region.	Positive *(Contribution can be enhanced through a local economic development programme)*
Negative social impacts	Population influx and informal settlement could become a problem in the vicinity of the mine.	Negative impact. No significant cumulative impacts identified. *(Contribution by Voorspoed mine can be mitigated)*
Visual impacts	The physical presence of the mining operations and associated infrastructure will compromise the scenic attributes and aesthetic value of the area.	Negative impact. No significant cumulative impacts identified *(Contribution by Voorspoed mine post closure can be minimised by effective rehabilitation of the mine residue storage facilities)*

Issue	Comment	Cumulative impact
Loss of biodiversity and/or ecological function	The Voorspoed project has been planned so that there is minimum impact on biodiversity and ecological function in the project area. Infrastructure has been sited on land that has been disturbed by cultivation and forestry. De Beers has committed to avoiding disturbance of surrounding plant and animal habitats during the life of the mine. Crop cultivation and grazing have had an impact on biodiversity. Renosterkop is one of very few relatively pristine habitats remaining in the area. However, the wetland and pans could support an increased biodiversity if the mine rehabilitates these habitats.	Negative cumulative impact on loss of biodiversity and ecological function. *(The contribution by Voorspoed mine will be negligible, if sensitive habitats are avoided, as is planned.)*
Loss of arable l and decreased agricultural production	Most of the land at Voorspoed is arable. To avoid disturbance of plant and animal habitats of conservation importance, Voorspoed is choosing to site infrastructure on land disturbed by agriculture and mining. Furthermore, most of the water allocations in the Dwars River catchment have been acquired for mining and are, therefore, no longer available for irrigation farming.	Negative impact. No significant cumulative impacts. *(About 400 ha of arable land and 100 ha of grazing land will be permanently lost at the site of the Voorspoed mine residue storage facilities.)*
Lowering of water levels	The Voorspoed Mine will lower groundwater levels in the vicinity of the Voorspoed ore body when it is operational. The effect will be localised and only one borehole may potentially be affected. The groundwater levels will recover when mining stops.	Negative impact. No significant cumulative impacts. The impact of the Voorspoed mine on groundwater levels will be localised and temporary.
Deterioration in water quality	The Voorspoed Mine has been planned so that it will dirty water from the mine will not be released into the surrounding environment. The groundwater pollution plume from the ultra fines facility may migrate beyond the border of the mine site over the operational life of the mine. The use of paste thickening technology for disposal of the fine residue will however significantly reduce the seepage into groundwater from the ultra fines facility.	Negative impact – can be mitigated. No significant cumulative impacts. *(The contribution by Voorspoed mine is expected to be insignificant.)*
Deterioration in air quality	No major sources of dust pollution were identified in the area.	Negative impact – can be mitigated. No significant cumulative impacts.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF TEXT BOXES

LIST OF APPENDICES

LIST OF ACRONYMS

BID	Background Information Document to the Voorspoed EIA
CAPCO	Chief Air Pollution Control Office
DA	Department of Agriculture
DME	Department of Minerals and Energy
DTEEA	Free State Province Department Of Tourism, Environmental And Economic Affairs
DWAF FS	Department of Water Affairs and Forestry, Free State Province
De Beers	De Beers Consolidated Mines Limited
EIA	Environmental Impact Assessment
EMP	Environmental Management Programme
ha	Hectares
IAPs	Interested and / or affected parties
L/s	Litres per second
m	Metres
m^3/d; m^3/a	Cubic metres per day; cubic metres per year
mamsl	Meter Above Mean Sea Level
ppm	Parts per million
RTF	Resource tailings facility (Coarse residue/tailings disposal facility)
UFDF	Ultra fines disposal facility (Facility for the disposal of ultra fine residue [slimes] from the plant)
Voorspoed	The Voorspoed Diamond Mine

1. BRIEF PROJECT DESCRIPTION

1.1. INTRODUCTION

The Voorspoed kimberlite deposit was discovered in 1906. The Voorspoed Diamond Mining Company mined the pipe as an open pit operation from 1906-1912. During this period approximately 4,2 million tons of kimberlite ore were mined, and approximately 920 000 carats of diamonds were recovered. As mining progressed below the weathered kimberlite, the mine experienced extreme difficulty with the mining and the recovery of diamonds from the un-weathered, hard and competent kimberlite material.

De Beers Consolidated Mines Limited (De Beers) bought the mine from the Voorspoed Diamond Mining Company in 1912, after which the mine was closed.

Apart from sampling operations carried out between 1965 and 1967 and in 1979, no mining activities have taken place at the Voorspoed Mine (Voorspoed) since 1912. Further exploration and evaluation work was conducted in 1997.

The historical work justified further studies and in 2003 the Murray & Roberts – Minproc Joint Venture team, together with the De Beers Voorspoed project team, undertook a desktop study to investigate the possibility of reopening the Voorspoed Mine. The findings of the desktop study justified taking the study to a higher level and in 2004 a Prefeasibility Study was conducted, which indicated that a 4 million ton per annum open pit marginal mine would be viable. The Voorspoed Mine Feasibility Study was subsequently initiated on 16 July 2004 to develop a concept solution for a sustainable mining and processing operation at Voorspoed, supported by appropriate infrastructure, which would be capable of economic delivery to the De Beers strategic business plan. The scheduled completion date for the feasibility study is 20 May 2005.

As part of the Feasibility Study this Environmental Impact Assessment (EIA) Report and Environmental Management Programme (EMP) for the proposed Voorspoed Mine has been compiled by Metago Environmental Engineers (Pty) Ltd (Metago) on behalf of De Beers. The EIA Report and EMP will be submitted to the Department of Minerals and Energy (DME, Welkom Regional Office) by De Beers to obtain environmental approval in terms of Section 22 of the Minerals and Petroleum Resources Development Act (28 of 2002).

This EIA Report and EMP have been compiled to comply with the relevant requirements of the Minerals and Petroleum Resources Development Act Regulations. The reporting format used is the format specified in the Aide Memoire for compilation of EMPRs (DME, 1991). Chapters 1 to 4 of the EMP provide background information on the proposed mine and on the environmental setting of the mine. Chapter 5 records the assessment of the impacts of the mine. Chapter 6 is referred to as the "environmental management programme" (EMP) and it presents the mine's management commitments. A conclusion, references and information on other environmental permissions to be obtained are presented in Chapters 7 to 9. Appendices to the EIA Report and EMP are presented in Chapter 10.

The DME will involve other regulatory authorities with an interest in the environment in the decision to grant environmental approval. These regulatory authorities include the national Department of Water Affairs and Forestry (DWAF, Bloemfontein Regional Office), the national Department of Agriculture (Bloemfontein Regional Office), the Free State Department of Tourism, Environmental and Economic Affairs (DTEEA).

1.1.1. ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

The EMP has been developed through an EIA process. The EIA has been undertaken in three stages and is currently at the final stage, the reporting stage. The purpose of each stage and the activities during each stage are outlined in Table 1-1.

TABLE 1-1 EIA PROCESS

Purpose	Main activities
Scoping stage (May to July 2004)	
• Identify regulatory authorities and other IAPs and involve them in the scoping process. • Determine the issues on which attention needs to be focused. • Input into project planning decisions through the exploration of alternatives. • Identify any fatal flaws.	• Initial planning with the project team. • Background information document sent to regulatory authorities and interested and affected parties (IAPs). • Meeting with regulatory authorities (06 May and 09 July 2004). • Meetings with IAPs (24 June and 28 June 2004). • Meeting with DTEEA to discuss alternative sites for the ultra fines and coarse resource facilities and potential impacts on wetlands (20 September 2004). • Compilation of terms of reference for the detailed investigations.

Purpose	Main activities
Detailed investigations (July to August 2004)	
• Describe the affected environment. • Define potential impacts. • Give management and monitoring recommendations.	• Specialist investigations (see Table 1.1.3 for a list of specialist investigations).
Reporting (September to November 2004)	
• Compile the EIA Report & EMP. • Refine the EIA Report & EMP through consultation with IAPs and authorities.	• Compilation of the draft EIA Report & EMP. • Review and refinement of the draft EIA Report & EMP by the Voorspoed project team. • Courier the draft EIA Report & EMP to authorities for review (early November 2004). • Provide IAPs with a summary of the findings (early November 2004). • Make the draft EIA Report & EMP available to IAPs for review at three places (early November 2004). • Feedback meeting with IAPs (end November 2004). • EIA Report & EMP review meeting with authorities (end November 2004). • Compile the final EIA Report & EMP (December 2004). • Submit the final EIA Report & EMP to regulatory authorities (December 2004).

The EIA was undertaken in accordance with the Integrated Environmental Management (IEM) Guidelines, which were published by the national Department of Environmental Affairs and Tourism (DEAT) in 1992. The EIA process also followed the principles in the Environmental Impact Management (EIM) procedural guidelines (DEAT, 1998 and 2002) that are complementary to the environmental authorisation regulations in terms of the Environment Conservation Act (73 of 1989). The environmental approvals required for Voorspoed are listed in Table 1-2. The EIA Report and EMP will provide the baseline environmental information required for these approvals.

In addition, permits may be required from the South African Heritage Resources Agency (SAHRA) for the upgrading of the De Beers weir on the Renoster River, and the potential relocation of graves located at Voorspoed (at present it has not been determined whether relocation would be necessary).

TABLE 1-2 ENVIRONMENTAL APPROVALS REQUIRED FOR VOORSPOED

Activities	Authorisation / approval required
Mining (pit, process plant, residue disposal & associated infrastructure)	Approval under the Minerals and Petroleum Resources Development Act (Act 28 of 2002). Approval of an Environmental Management Programme for Voorspoed Mine needs to be obtained from the Free State Department of Minerals and Energy. This EMP document will be submitted to DME for approval. Once approved, the mine's management commitments detailed in the EMP will be legally binding.
All mine water uses including water abstraction from Renoster River.	Authorisation under section 21 of the National Water Act (Act 36 of 1998). A water use license (series of water use licenses) is required for all water uses of Voorspoed Mine from the Free State Department of Water Affairs and Forestry. A water use licence application will be prepared, with supporting design information as required, for submission to DWAF.
Change of land use (for mining as well as the servitude for water pipeline and power line from Renoster River to mine); construction on or near a wetland; explosives magazine; refuelling bay and diesel tanks; diversion of a secondary road; helipad; water abstraction from the Renoster River.	Environmental authorisation needs to be sought for Voorspoed Mine in terms of section 21 and 22 of the Environment Conservation Act (Act 73 of 1989) from the Free State Department of Tourism, Environmental and Economic Affairs. The Scoping Report for Voorspoed Mine will be updated with detail regarding the listed activities and submitted to DTEEA for approval.

1.2. NAME AND ADDRESS OF MINE, MINE OWNER AND MINE MANAGER/RESPONSIBLE PERSON

The proposed Voorspoed Mine (Voorspoed) is located approcimately 30km NNE of Kroonstad in the Free State Province on the farms Voorspoed 2480, Voorspoed 401, Geldenhuys 1477 and Morgenster 772. The mine property is owned by De Beers Consolidated Mines Limited (De Beers).

Responsible Person: Mr Bryan Bailie
The Project Manager
Voorspoed Diamond Mine Project
De Beers Corporate Headquarters
Private Bag X1
Southdale
2135
011 374 7000 (T)

Physical Address: The Farm Voorspoed 401
Kroonstad District
Free State Province

Postal Address: Project Manager: Voorspoed Diamond Mine
De Beers Corporate Headquarters
Private Bag X1
Southdale
2135
011 374 7000 (T)

1.3. NAME AND ADDRESS OF THE APPLICANT FOR A MINING RIGHT

Applicant: De Beers Consolidated Mines Ltd
The Secretary
36 Stockdale Street
P.O. Box 616
Kimberley
8300

1.4. NAME AND ADDRESS OF THE OWNER OF THE LAND AND THE TITLE DEED DESCRIPTION

Land owner: De Beers Consolidated Mines Ltd

The Secretary

36 Stockdale Street

P.O. Box 616

Kimberley

8300

Title Deed Description: The farms Voorspoed 401, Voorspoed 2480, Geldenhuys 1477 and Morgenster 772.

1.5. REGIONAL SETTING

Refer to Figure 1-1 for illustration of the regional setting of Voorspoed. The location of Voorspoed is described in Table 1-3.

TABLE 1-3 LOCATION OF THE VOORSPOED PROJECT

Province	Free State Province
Magisterial district	Kroonstad
Regional authority	Northern Free State District Council
Local authority	Ngwathe Local Municipality[1]
Farms comprising Voorspoed	Voorspoed 401, Voorspoed 2480, Morgenster 772, Geldenhuys 1477.
Farms in the project area neighbouring on Voorspoed	Belmont 2390, Welvaart 1011, Renosterhoek 1291, Wolvenkraal 396, Satisfied 1234, Welgelegen 793, Denbigh 1229, Cumberland 1228, Siding 1568.
Catchment	Heuningspruit, a tributary of the Renoster River in the Vaal River Basin
Topographic landmarks	Renosterkop to the southwest of the existing open pit at Voorspoed is a prominent landmark.

1.5.1. MAGISTERIAL DISTRICT AND RELEVANT DISTRICT MUNICIPALITY

Voorspoed is located in the Kroonstad Magisterial District, within the Ngwathe Local Municipality. Voorspoed is also located close to the Moqhaka Local Municipality border, in which Kroonstad, the major town in the vicinity of the mine, is located. Voorspoed lies within border of the Northern Free State District Municipality.

1.5.2. DIRECTION AND DISTANCE TO NEIGHBOURING TOWNS

Voorspoed is located approximately 30km NNE of Kroonstad. The mine is reached via secondary road S169 from the Kroonstad / Vredefort provincial tar road (R721), or secondary road S156 from the Vredefort / Kroonstad provincial tar road (R76).

[1] The southwestern portion of Voorspoed Mine (Morgenster 772) falls within the Moqhaka Municipal District. The remainder of Voorspoed Mine, where the open pit, plant and mine residue dumps are located (Voorspoed 401, Voorspoed 2480 and Geldenhuys 1477) fall within the Ngwathe Municipal District.

1.5.3. SURFACE INFRASTRUCTURE

The existing infrastructure in the vicinity of Voorspoed is indicated on Figure 1-2. The existing open pit and residue storage facilities are located on Voorspoed 2480. In addition to the roads mentioned above a railway line is located to the southwest of the mine (the railway line demarcates the boundary between the Moqhaka and Ngwathe Municipalities.

1.5.4. PRESENCE OF SERVITUDES

No servitudes are registered on Voorspoed.

1.5.5. LAND TENURE AND USE OF IMMEDIATELY ADJACENT LAND

Refer to Figure 1-2 for the location of neighbouring properties. The landowners of the neighbouring properties are given in Table 1-4. The land use of the neighbouring properties is farming. The farms comprising Voorspoed and the neighbouring farms are used for grazing and dryland agriculture. Maize, sunflowers, wheat, sorghum, and seed production are typical crops. Mr George Leonard and family have leased the farms comprising Voorspoed for farming purposes for the past 23 years. The farms comprising Voorspoed are currently used for grazing.

The following neighboring farms are currently inhabited:

- Mr Tal Leonard at Welvaart 1011.
- The Welvaart farmworker community at Welvaart 1011.
- Mr George Leonard at Labor (on Belmont 2390).
- The Belmont farmworker community at Belmont 2390.
- Mr Hugh Enslin at Urbannus 681.
- The Urbannus farmworker community at Urbannus 681.
- Mr Koos Prinsloo at Welgelegen 793.

TABLE 1-4 NEIGHBOURING PROPERTIES AND LANDOWNERS

Farm	Owner	Address
Belmont 2390	Mr George Leonard	P O Box 1445, Kroonstad, 9500
Welvaart 1011	Mr Tal Leonard	P O Box 630, Kroonstad, 9500
Urbannus 681	Mr Hugh Enslin	P O Box 1885, Kroonstad, 9500
Renosterhoek 1291	Mr Jan van Biljon	P O Box 29, Viljoenskroon 9520
Wolvenkraal 396	Ms Nila Dunhauser	B5, Villa Riviera, P O Box 90, Parys, 9585
Satisfied 1234	The Leonard Family	P O Box 630, Kroonstad, 9500
Welgelegen 793	Mr Koos Prinsloo	P O Box 837, Kroonstad, 9500
Denbigh 1229	Roelf Camfer	P O Box 321, Viljoenskroon, 9520
Cumberland 1228	The Leonard Family	P O Box 630, Kroonstad, 9500
Siding 1568	Mr Manie Lombaard	P O Box 591, Kroonstad, 9500

1.5.6. THE NAME OF THE RIVER CATCHMENT IN WHICH THE MINE IS SITUATED

Voorspoed is situated in quaternary catchment C70H, in the catchment of the Heuningspruit River, which is a tributary of the Renoster River, which is part of the Vaal River System.

1.6. DESCRIPTION OF THE PROPOSED PROJECT

1.6.1. MINERAL DEPOSIT

The Voorspoed mineral resource is an irregular, roughly oval shaped body totalling approximately 13 ha in surface area. Resource information obtained from drilling extends to approximately 400 m below the surface. At this depth the ore body area is approximately 8 ha. The southern portion of the ore body engulfs a basalt raft measuring 5 ha at surface. The resource extends beyond a depth of 400 m which may be accessed through an extended open pit operation or via an underground mining operation. (This EMP only address mining operations up to a 400m-depth, the planned final depth of the open pit. Authorisation for mining operations beyond 400 m would require a separate EIA and EMP Amendment.)

A resource tailings facility (RTF) from the historical Voorspoed Mine is also present. The RTF will be processed, since the facility is located within the boundary of the final open pit.

1.6.2. MINE PRODUCT

Product: Diamonds.

Waste products: Open pit, waste rock dump, resource tailings facility (RTF) and ultra-fines facility (UFDF).

1.6.3. ESTIMATED RESERVES

The estimated reserves of the Voorspoed mineral resource comprise approximately 75 million tons of kimberlite ore, which would yield approximately 14 million carats at 19,10 carats per 100 ton (up to a depth of 400 m).

1.6.4. PROPOSED MINING METHOD

Voorspoed Mine will be an open pit diamond mine. Mining will commence in the existing open pit located at Voorspoed 2480. The final dimensions of the open pit after 14 years of mining will be approximately 400m deep with a diameter of 1200 m at surface.

Waste rock and kimberlite ore will be blasted, loaded and hauled from the pit using conventional truck and shovel methods. A waste rock dump will be created along the pit boundary to receive waste rock removed from the pit to access the kimberlite ore.

The kimberlite ore will be stockpiled adjacent to the plant for treatment. In the plant the kimberlite ore will be crushed and processed with the purpose of recovering the diamonds.

The plant will create the two mine residue streams: coarse treated kimberlite that will be disposed of on the coarse resource facility, and treated kimberlite fines (silt and clay) that will be disposed of on the fine residue disposal dump.

The main components of the proposed open pit mining operation are summarised below:

- The open pit.
- The waste rock dump.
- The plant.
- The coarse resource facility.
- The ultra fines disposal facility.
- Water management facilities.
- A water pipeline from the existing De Beers weir on the Renoster River to the mine.
- A helipad.
- Offices, stores and change houses.
- Workshops, vehicle wash bays, vehicle refuelling bays and fuel storage tanks.
- A sewage treatment plant.
- Electrical overhead line.

1.6.5. PLANNED PRODUCTION RATE

At full production 4 million ton of kimberlite ore will be processed per annum.

1.6.6. PLANNED MINE LIFE

The life of mine extends to the year 2021. If both ramp up and closure are included the life of mine is 15 years, 12 of which would be at full production. The Voorspoed project timeline is as follows:

Feasibility study	July 2004 – April 2005
Detailed design[2]	May 2005 – Aug 2005
Site construction	August 2005 – July 2007

[2] Subject to the following approvals: De Beers Consolidated Mines Limited Board approval, environmental approvals as detailed in Table 1-2 on page 1-4.

Cold and hot commissioning	August 2007 – December 2007
Operational commissioning	January 2008 – July 2008
Commence mining	August 2008 – 2021
Decommissioning	2021 - 2022

FIGURE 1-1 REGIONAL LOCALITY MAP

FIGURE 1-2 VOORSPOED TOPOGRAPHICAL MAP

2. DESCRIPTION OF THE PRE-MINING ENVIRONMENT

2.1. GEOLOGY

2.1.1. REGIONAL GEOLOGY

Sub-horizontal sediments of the Ecca Group dominate the local surface geology in the vicinity of the Voorspoed site. Dolerite sills and dykes and a series of kimberlites have intruded the Ecca Group sediments. Near the surface, the Volksrust Formations of the Ecca Group consists of fine-grained mudrock and siltstone. The Volksrust Formation represents fine-grained sediments that are characterised as massive carbonaceous rich mudrock with very little internal structures. Dolerite sills intrude the sediments on the northern side of the pipe. Deeper down the Vryheid Formation of the Ecca Group consists of more variable and coarse-grained sediments, ranging from mudrocks and coal to siltstone, sandstones and conglomerates. The main lithological units expected at Voorspoed are summarised in Table 2-1 and illustrated in Figure 2-1. (Harvey, 2004)

The kimberlite pipe located at Voorspoed is an irregular, roughly oval shaped body with a maximum dimension of 490 by 350m. The total area of the pipe at the base of the existing open pit is 12,5 ha. The Voorspoed pipe comprises a variety of kimberlites of different age, formed during consecutive eruptive events. A large raft and small xenolith of Karoo basalt occupies the southeastern parts of the pipe. A small xenolith of the Volksrust Formation sediments occurs in the northern sector of the pipe. An isometric view of the Voorspoed pipe is provided in Figure 2-2.

TABLE 2-1 SUMMARY OF MAIN LITHOLOGICAL UNITS IN THE VOORSPOED SEQUENCE

MAJOR UNIT	DESCRIPTION
Overburden	OB: Topsoil, ferricrete and calcrete
Kimberlite	TKB: Undifferentiated Tuffaceous kimberlite breccia
	CBX: Contact breccia
	HK: Hypabyssal kimberlite
Dolerite	Dolerite: Dolerite
Basalt	Basalt: Massive basalt
	Basamyg: Amygdaloidal basalt
	BASBX: Brecciated basalt

MAJOR UNIT	DESCRIPTION
Volksrust	VO: Mudstone and siltstone
Vryheid	VRM: Mudrock
	VRSL: Silstone
	VRS: Bioturbated white sandstone with carbonaceous laminations
	VRSS: Sandstone and shale
	VRSSC: Sandstone, shale and conglomerate
	VRVS: Varved shale
	VRVSC: Varved shale grading downwards into conglomerate

2.1.2. PRESENCE OF DYKES, SILLS AND FAULTS

Dolerite sills and dykes intruded the shales and mudrocks of the Ecca Group that occurs in the vicinity of Voorspoed. Kimberlite dykes and pipes were the most recent intrusions. Figure 2-3 indicates the presence of faults in the surface geology in the vicinity of Voorspoed.

FIGURE 2-1 NORTH EAST VIEW OF MAIN LITHOLOGICAL UNITS AT VOORSPOED

FIGURE 2-2 ISOMETRIC VIEW OF THE VOORSPOED PIPE LOOKING NORTH EAST

FIGURE 2-3 ENVIRONMENTAL FEATURES ON AND AROUND THE VOORSPOED SITE

2.2. CLIMATE

2.2.1. A BRIEF DESCRIPTION OF THE REGIONAL CLIMATE

The proposed project area falls within the Highveld Climate Zone, as defined by Schulze (1974). Temperatures in this climatic zone are generally high, with moist wet summers and dry winters. The long-term average annual rainfall is 560 mm, of which approximately 80% falls from October to March. The average evaporation over the same period is 2 085 mm. Temperatures vary from an average monthly maximum and minimum of 29.8ºC and 15.8ºC for January to 18.7ºC and -0.3^{o}C for July respectively. Frost is likely to form over the months of May to September. Generally winds are light except for short periods during thunderstorms.

2.2.2. MEAN MONTHLY AND ANNUAL RAINFALL

The average monthly precipitation shown in Table 2-2 is based on rainfall figures for the Welvaart Weather Station from 1957 to 2003 (No. 04013837, Latitude: 27^{o} 38' Longitude: 27^{o} 21', 1341 mamsl). This site is adjacent to Voorspoed Mine, approximately 3 km northeast of the open pit.

TABLE 2-2 AVERAGE RAINFALL AND STANDARD DEVIATION STATISTICS

Month	Average rainfall per month (mm)	Standard deviation from normal (mm)	Number of rain days per month	Number of months used in calculation
Jan	95.2	54.1	6.1	41
Feb	60.5	41.3	4.1	44
Mar	66.5	45.3	4.4	44
Apr	43.8	33.9	3.1	44
May	17.1	24.7	1.4	45
Jun	5.8	10.2	0.5	46
Jul	4.5	8.4	0.4	45
Aug	10.7	17.1	1	46
Sep	17.6	24.2	1.5	46
Oct	60.3	46.5	4.5	47
Nov	78.6	50.5	5.5	47

Month	Average rainfall per month (mm)	Standard deviation from normal (mm)	Number of rain days per month	Number of months used in calculation
Dec	85.8	58.4	5.8	47

2.2.3. MAXIMUM RAINFALL INTENSITIES PER MONTH

From the South African Weather Bureau data the highest intensity rainfall per month recorded for the Welvaart weather station was 291.4 mm in January 1923. The maximum 24-hour storm rainfall depths for a given return period are given in Table 2-3.

TABLE 2-3: 24-HOUR STORM RAINFALL DEPTHS

Return period / recurrence interval (yr)	24-hour rainfall depth (mm)
2	51
5	69
10	81
20	94
50	112
100	125
200	140

(For a mean annual precipitation of 568 mm)

2.2.4. MEAN MONTHLY, MAXIMUM AND MINIMUM TEMPERATURES.

Temperatures vary from an average monthly maximum and minimum of 29.8ºC and 15.8ºC for January to 18.7ºC and -0.3^{o}C for July respectively. The extreme high temperature that has been recorded is 34.8^{o}C and the extreme low –5.3Cº. The mean maximum and mean minimum temperatures according to the temperature data obtained from Welvaart weather station are listed in Table 2-4.

TABLE 2-4: MINIMUM AND MAXIMUM TEMPERATURES

Month	Mean (ºC)	Mean maximum (ºC)	Mean minimum (ºC)
January	23	30	17
February	23	29	17
March	21	28	15
April	18	26	11
May	15	23	7
June	12	20	3
July	12	21	3
August	14	23	5
September	18	27	9
October	21	29	13
November	22	29	15
December	23	30	16
Average	**19**	**26**	**11**

2.2.5. MONTHLY MEAN WIND DIRECTION AND SPEED

The wind speed and direction depicted in Table 2-5 and Table 2-6 have been obtained from the Kroonstad Weather Station (No. 03653988, Latitude 27.63° South, Longitude 27.23° East, 1434 mamsl), the closest weather station to Voorspoed Mine monitoring wind speed and direction. The prevailing winds are easterly and northerly with an average speed of 4m/s.

TABLE 2-5 AVERAGE WIND DIRECTION AND SPEED FOR KROONSTAD

Wind Direction	Calm	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Frequency (%)	3	11	10	9	9	15	5	2	2	3	3	4	4	7	3	5	5
Average Wind Speed (m/s)	0	4	4	5	5	4	3	3	3	3	3	3	4	4	4	4	4

TABLE 2-6 MEAN MONTHLY WIND DIRECTION AND SPEED FOR KROONSTAD

MON	Calm	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
	f	ff ss	ff ss	ff ss	ff ss	ff ss	ff ss	ff ss	ff ss	ff ss	ff ss	ff ss	ff ss	ff ss	ff ss	ff ss	ff ss
JAN	2	11 04	11 05	13 05	11 05	15 05	4 04	2 04	2 03	3 03	2 03	2 03	3 03	7 04	3 03	5 04	6 04
FEB	2	11 04	9 04	12 05	14 05	18 04	4 03	2 03	2 03	2 03	2 03	2 03	3 03	5 03	3 03	4 04	4 03
MAR	2	9 04	11 04	11 04	11 04	18 04	5 03	3 03	2 03	3 03	2 03	3 03	3 03	5 03	3 03	4 03	5 04
APR	3	11 04	10 04	9 04	8 04	16 04	6 03	3 03	2 03	4 03	3 03	3 03	3 03	6 03	3 03	5 03	4 04
MAY	6	9 04	8 04	7 04	7 04	14 03	8 03	3 03	2 02	4 02	3 03	5 03	5 03	8 03	3 03	4 03	3 03
JUN	6	10 03	9 04	6 04	5 03	14 03	8 03	3 02	2 02	4 03	3 03	6 03	5 03	8 03	3 03	4 04	4 03
JUL	5	10 04	10 04	7 04	6 04	15 04	8 03	3 03	2 02	4 03	3 03	5 03	4 03	7 03	4 03	4 04	4 04
AUG	3	12 04	11 05	7 05	6 05	13 04	6 03	3 03	2 02	4 03	4 03	6 03	4 04	7 04	4 04	5 04	4 05
SEP	2	13 05	10 05	7 05	6 05	14 05	4 04	2 03	2 03	4 03	3 03	5 04	5 04	8 04	4 04	6 05	5 05
OCT	1	12 05	11 05	10 06	10 06	14 06	4 04	2 03	2 03	3 03	2 03	4 04	4 04	7 04	4 04	5 05	6 05
NOV	1	12 05	11 05	11 06	9 06	13 05	4 04	2 03	2 03	3 04	3 03	4 04	4 04	7 05	4 04	5 05	6 05
DEC	1	14 05	12 05	11 05	10 05	12 05	3 04	2 04	2 03	2 03	2 03	2 03	3 04	7 04	4 04	7 05	7 05

ff = frequency (% of days); ss = wind speed in m/s

2.2.6. MEAN MONTHLY EVAPORATION

Potential S-pan evaporation figures recorded for the area are high and indicate that the area is a water scarce area. The average annual S-pan evaporation is 1 892 mm (Table 2-7) from the South African Weather Bureau data (Koppies Dam Station), which equals 1 590 mm when converted to lake evaporation. The WRC report quotes a mean annual S-Pan evaporation of 1 850 mm for the Kroonstad weather station. Potential evaporation figures therefore greatly exceed the mean annual precipitation.

TABLE 2-7 AVERAGE MONTHLY RAINFALL AND EVAPORATION

Month	Average Monthly S-Pan Evaporation (mm)	Average Monthly Lake Evaporation (mm)	Average Monthly Precipitation (mm)	Net Gain (+) or Loss (-) in precipitation (mm)
January	231.4	194.4	95.2	-99.2
February	186.6	164.2	60.5	-103.7
March	169.5	149.2	66.5	-82.7
April	123.9	109.0	44.0	-65.0
May	93.5	81.3	17.5	-63.8
June	71.5	60.8	5.7	-55.1
July	79.8	66.2	4.6	-61.6
August	115.8	93.8	10.8	-83.0
September	162.9	131.9	18.0	-113.9
October	207.6	168.2	61.3	-106.9
November	215.5	176.7	79.6	-97.1
December	234.0	194.2	86.0	-108.2
Totals	**1892.0**	**1589.9**	**549.7**	**-1040.2**

2.2.7. INCIDENCE OF EXTREME WEATHER CONDITIONS

The area may experience the following extreme weather events:

- Frost is common during the winter period.
- The area typically experiences rainfall in the form of showers and thunderstorms.
- Tornados may occur, but very infrequently.

2.3. TOPOGRAPHY

The topography of the area is flat to slightly undulating, sloping gently to the north. There is a small koppie (Renosterkop) to the southeast of the project area, rising approximately 100 m above the surrounding land. The topographical features of Voorspoed and the surrounding area are illustrated in Figure 1-2 Voorspoed topographical map.

2.4. SOILS

The information in this section is derived from the soil survey of Voorspoed undertaken by the Institute for Soil, Climate and Water (Appendix 4).

The parent material of the soils is mainly derived from the underlying Ecca sandstone and shale with dolerite sills. Most of the area consists of moderately deep to deep, brown, apedal to weakly structured sandy loam to sandy clay loam topsoils underlain by brown to yellow-brown, apedal sandy clay loam sub-soils on a mottled soft plinthite layer. Unconsolidated material with signs of wetness may often be found deeper down. The dominant soil forms is Avalon (Av). Small areas have been found were soft plinthite occurs higher in the profile. The soft plinthite horizon is an indication of a fluctuating water table in the subsoil in parts of the year, rising in summer and falling in winter. Usually, even at the end of the winter, the subsoil is moist.

Lower positions in the landscape are dominated by soils where plinthic material is found higher up in the profile, which means that water may occur closer to the surface, especially in the wetter parts of the year. The dominant soil form is Westleigh (We).

The lowest parts of the landscape, around vleis, dams and streams, are occupied by a dark brown, loam to clay loam topsoil horizon underlain by a brown to black, moderately to strongly structured, blocky clay loam subsoil, usually calcareous. Lighter grey, calcareous, unconsolidated material with signs of wetness often occurs deeper in the profile. The dominant soil form is Sepane (Se).

In isolated areas of the Sepane unit, the soil develops into dark, strongly structured, calcareous swelling clay soils of the Arcadia (turf) soil form with visible cracks and either a crusting or self-mulching (crumbly) soil surface. The texture of these soils is clay, with 45-55% clay. These soils are difficult to manage because of the heavy impermeable clay.

In the south west corner, rock and shallow soils occur, surrounded by moderately deep to deep, red and yellow-brown apedal to weakly structured sandy clay loam topsoil underlain by red and yellow-brown apedal sandy clay loam subsoils. Occasionally a soft plinthite horizon can be found deeper down. The dominant soil forms are Hutton (Hu) and Clovelly (Cv). These soils have a moderately high agricultural potential although they may be shallow in places.

A summary of the main soil characteristics is given in Table 2-8 and the geographic extent of the soil units is illustrated in Figure 2-4.

TABLE 2-8 SOIL MAPPING UNITS

Map unit	Dominant Soil form/family	Subdominant Soil form/family	Effective Depth (mm)	Description of mapping unit	Land Cap-ability
Av	Av2100, 2200	We2000, Pn2100	500 - 1200+	Brown to yellow-brown, apedal to weakly structured sandy loam to sandy clay loam topsoil on yellow-brown apedal, sandy clay loam subsoils on soft plinthite. Unconsolidated material with signs of wetness may often be found deeper in the profile.	Arable, moderate
We	We2000, 1000	Av2100, 2200, Pn2100	300 - 500	Dark brown to brown, apedal to weakly structured, loam to clay loam topsoil horizon on weakly structured, clay loam, soft plinthite subsoil.	Arable, low
Se	Se2220, 2210	Va2122, 2121, Ar1100	250 - 400	Dark brown, loam to clay loam topsoil horizon, on brown to black, moderately to strongly structured, blocky clay loam subsoil, usually calcareous. Lighter grey, unconsolidated material with signs of wetness is often found deeper in the profile.	Grazing
Hu	Hu2100	Bv2100, Cv2100	600 - 1200+	Reddish-brown to red, apedal to weakly structured, sandy clay loam topsoil on red, apedal sandy clay loam subsoils, on weathering rock or (occasionally) soft plinthite.	Arable, moderate
Cv	Cv2100	Oa2120, Tu2110, Hu2100	600 - 1200+	Brown to yellow-brown, apedal to weakly structured, sandy clay loam topsoil on yellow-brown, apedal sandy clay loam subsoils on weathering rock.	Arable, moderate
Ms	Ms2100	R	0 - 250	Brown, apedal loamy topsoil directly overlying hard rock. Rout outcrops also occur in this unit.	Grazing

FIGURE 2-4 SOILS MAP

2.5. PRE-MINING LAND CAPABILITY

The land capability units, their areas, soil potential classes are given in Table 2-9 and mapped in Figure 2-5.

TABLE 2-9 LAND CAPABILITY

Land Capability Class	Map Unit	Main limiting factor(s)
Grazing	Se, Ms	Heavy clay soils with very poor drainage (Se) or shallow, rocky soils with restricted rooting zone (Ms)
Arable, low	We	Shallow soils on soft plinthite with poor drainage
Arable, moderate	Av, Hu, Cv	Moderately deep in places, leading to restricted drainage
Dormant mine	Dm	Dormant mine – existing pit and residue storage facilities
Wetland	Wl	Clayey anaerobic soils
Wilderness	Wd	Koppie with rocks & shallow soil

Most of the study area comprises moderately deep to deep, yellow-brown, light-textured soils (**Av** map unit), with heavier or shallower soils in places, especially lower in the landscape. The agricultural potential of the **Av, Hu** and **Cv** units is good, based on the weak structure and good water holding capacity.

Drainage of the **We** unit may be less favourable in comparison to the Avalon soils, and the potential for crop production is somewhat less.

Because of their heavy texture and limiting structure, the heavy clay soils of the **Se** unit have a low potential for crop production. The Ms unit also has low potential, due to shallowness and rockiness.

FIGURE 2-5 LAND CAPABILITY MAP

2.6. LAND USE

2.6.1. PRE-MINING LAND USE

Voorspoed was briefly mined from 1906 to 1912.

2.6.2. HISTORICAL AGRICULTURAL PRODUCTION

Since 1912 the land use at Voorspoed has been agriculture. Dryland crops cultivated include maize, sunflower, wheat, sorghum and seed production. Crops are planted twice a year. Large portions of the mine site are used for livestock grazing.

2.6.3. EVIDENCE OF MISUSE

The grassland and vlei areas show signs of degradation, such as trampling by cattle and overgrazing (evident through a shift away from palatable to less palatable grass species). The wetland and pans have been impacted on by grazing as well as interference with the surface water flow to and from these bodies. Bluegum trees have been extensively planted on the southeastern portion of the site around the existing pit and mine residue storage facilities. These trees exhibit high evapo-transpirational rates, increasing the desiccation of the soil. Sections of the Renosterkop showed heavy infestations of Prickly Pear.

2.6.4. EXISTING STRUCTURES

A face brick residence with outbuildings is located close to the location of the open pit. Remains of a few buildings are also found on-site, including a compound for labourers and a historical building that may have served as a police station at the time when the historical Voorspoed Mine was operational.

A number of houses are located on neighbouring properties, approximately 2 km or further away from the existing open pit (see Section 1.5.5). Refer to Figure 2-3 for an illustration of the location of these houses with respect to the planned final pit extent and blasting zone.

2.6.5. LAND CLAIMS

Written confirmation has been received from the Regional Land Claims Commission, within the Department of Land Affairs (DLA) in the Free State Province that no land claims have been lodged on any of the affected farms (Voorspoed 401, Voorspoed 2480, Geldenhuys 1477 and Morgenster 772) as of 12th August 2004.

2.7. NATURAL VEGETATION/PLANT LIFE

The information contained in this section is derived from the Ecological Assessment of Voorspoed conducted by Ivan Ginsberg and Geoff Lockwood of Delta Environmental Consultants (Appendix 5).

According to Low and Rebelo (1996) the Voorspoed site can be classified as Veld Type 39: - Moist Cool Highveld Grassland *Cymbopogon–Themeda* Veld / *Eragrostis* Veld. Voorspoed lies on the western extremity of this veld type, and close to the contact with Veld Type 36: - Dry Clay Highveld Grassland (a dry *Themeda-Cymbopogon* veld characterised by dry, clayey, duplex soils); and Veld Type 37: Dry Sandy Highveld Grassland (also a *Cymbopogon–Themeda* veld, but on a sandy substrate).

With the exception of Renosterkop, the study site is a flat plain which drains away gently to the north. The area north of the existing pit is dominated by a vlei and associated hydromorphic grassland. Renosterkop is the only noticeable relief in the region and forms the southern boundary of the site. It is formed by the outcropping of a dolerite dyke, and weathering of this structure has contributed to the clayey soils of the lower areas through a catena process (which involves a movement of fertile clays from the Rhenosterkop to the plain). The koppie rises approximately 100 m above the surrounding plain and is home to a distinct flora and fauna.

2.7.1. DOMINANT SPECIES

2.7.1.1. Grassland

The grassland on Voorspoed is dominated by *Themeda triandra* (Redgrass), which thrives in the soil conditions found on-site that derived from the belt of dolerite intrusions located in the region. The presence of *Aristida congesta* (Three-awn grass) indicates the dry and overgrazed nature of the grassland. Other grasses recorded included *Eragrostis chloromelas* (curly leaf); *Eragrostis plana* (Tough Love Grass); *Eragrostis curvula* (Weeping Love Grass); *Eragrostis superba* (Sawtooth Lovegrass); *Cymbopogon plurinodis* (Turpentine Grass); *Setaria spacelata* (Bristle Grass); and *Heteropogon contortus* (Speargrass). Where areas had been disturbed, *T. triandra* was being replaced by *Eragrostis* species. Numerous forbs were also recorded on site.

Overgrazing of the grassland is evident from the presence of karoo elements such as *Stoebe vulgaris* (Bankruptcy Bush) recorded on site. Trampling and compaction by cattle is evident.

The grassland surrounding the wetland and to the southwest of the wetland (on Morgenster 772) may provide feeding and breeding habitat for some species of fauna discussed in Section 2.8. The grassland is dominated by ***Themeda triandra*** *(Redgrass)*. The dominant land use in this area has been cattle grazing, and signs of overgrazing, compaction and trampling are present. The habitat in this area will not be directly affected by mining activities, and if appropriate grazing measures are implemented during mining, the condition of this habitat may be improved.

2.7.1.2. Wetland and pans

Refer to Section 2.9.6.

2.7.1.3. Renosterkop

The southern boundary of the mine incorporates a section of Renosterkop. Renosterkop is the most prominent visual feature of the area around Voorspoed Mine. It rises approximately one hundred meters above the surrounding country and is home to a specialized and diverse vegetation characteristic of the highveld flora. Its topography, rocky nature and soils (richer, clayey soils which derive from the dolerite outcrop) give rise to a diverse plant community quite distinct from that on the surrounding plain. In addition, the vegetation on the Koppie is also relatively pristine and undisturbed compared to the surrounding farmland. Predominant species recorded on the koppie includes: *Acacia caffra* (Hook-thorn); *Rhus burchelli* (Karoo Kuni-bush); *Rhus leptodictya* (Mountain Karee); *Acacia karoo* (Sweet Thorn); *Grewia occidentalis* (Cross Berry); *Buddleja saligna* (False Olive); *Olea europaea subsp.africana* (African Olive); *Tarchonanthus camphoratus* (Camphor Tree); *Ehretia rigida* (Puzzle Bush); and *Cussonia paniculata* (Cabbage Tree).

2.7.2. ENDANGERED OR RARE SPECIES

According to the Southern African Red Data plant lists /SABONET forty-nine red data plants are listed as occurring in the Free State Province. Of these forty-five are classified as Not Evaluated (NE); one as Lower Risk (LR) and a further three as Vulnerable (VU). No red data plant species were recorded on site.

2.7.3. INTRUDER OR EXOTIC SPECIES

Sections of Renosterkop showed heavy infestations of *Opuntia ficus-indica* (Prickly Pear) (See plate 2). This plant is highly invasive and poses a threat to the biodiversity and ecological integrity of this area. *Tagetes minuta* (Khakibos) was observed colonizing the roadside and also on other disturbed sites. This species is not a serious problem however and its overall level of infestation is low. Bluegum trees (*Eucalyptus spp*.) have been extensively planted on the south-eastern portion of the site.

2.8. ANIMAL LIFE

2.8.1. COMMONLY OCCURRING SPECIES

2.8.1.1. Reptiles

A literature search generated a list of thirty reptile species – one tortoise, fourteen lizards and 15 snakes as possibly occurring on Voorspoed. These are listed in Appendix 2 of the Ecological Assessment of Voorspoed (Appendix 5).

2.8.1.2. Mammals

The following species were recorded during the three ecology site surveys: *Damaliscus dorcas* (Blesbuck), *Sylvicarpia grimmia* (Common Duiker); *Raphicerus campestris* (Steenbok); *Cynictis pencillata* (Yellow Mongoose) *Xerus inauris* (Ground Squirrel); Diggings and burrows of *Orycteropus afer* (Aardvark), *Hystrix africaeaustralis* (Porcupine) and *Pedetes capensis* (Springhare) were also observed during the survey. A list of mammals that could occur at the site was drawn up based on the species recorded during the ecology surveys, as well as input from local landowners and a literature search. The list is included as Appendix 3 of the Ecological Assessment of Voorspoed (Appendix 5).

2.8.1.3. Birds

The following species were recorded during the three ecology site surveys: Little Grebe (Dabchick), Black-headed Heron, Cattle Egret, Egyptian Goose, South African

Shelduck, Yellow-billed Duck, Black-shouldered Kite, Swainson's Spurfowl, Helmeted Guineafowl, Northern Black Korhaan, Three-banded Plover, Crowned Lapwing, Blacksmith Lapwing, Wood Sandpiper, African Snipe, Speckled Pigeon, Red-eyed Dove, Cape Turtle-Dove, Laughing Dove, Namaqua Dove, Grey Go-away-bird, Marsh Owl, Little Swift, Speckled Mousebird, White-backed Mousebird, Red-face Mousebird, African Hoopoe, Black-collared Barbet, Lesser Honeyguide, Rufous-naped Lark, Greater Striped Swallow, Rock Martin, Pied Crow, African Red-eyed Bulbul, Capped Wheatear, Familiar Chat, Ant-eating Chat, African Stonechat, Cape Robin-Chat, White-browed Scrub-Robin, Kalahari Scrub-Robin, Chestnut-vented Titbabbler, Long-billed Crombec, Zitting Cisticola, Rattling Cisticola, Neddicky, Tawny-flanked Prinia, Black-chested Prinia, Marico Flycatcher, Fiscal Flycatcher, Cape Wagtail, African Pipit, Buffy Pipit, Cape Longclaw, Common Fiscal, Brubru, Brown-crowned Tchagra, Bokmakierie, Pied Starling, Wattle Starling, Cape Glossy Starling, White-bellied Sunbird, Orange River White-eye, White-browed Sparrow-Weaver, Great Sparrow, Cape Sparrow, Southern Grey-headed Sparrow, Scaly-feathered Finch, Cape Weaver, Southern Masked-Weaver, Red-billed Quelea, Green-winged Pytilia, Jameson's Firefinch, Blue Waxbill, Violet-eared Waxbill, African Quailfinch, Pin-tailed Whydah, Long-tailed Whydah, Black-throated Canary, Yellow Canary, Streaky-headed Seed-eater.

The bird species listed in Appendix 1 of the Ecological Assessment of Voorspoed (Appendix 5) are recorded for grid-square 2727 AC. Suitable habitat has also been identified on site and these species are likely to occur.

2.8.2. ENDANGERED OR RARE SPECIES

2.8.2.1. Amphibians

The seasonally inundated wetland and pans at Voorspoed provide suitable habitat for several amphibian species. This includes a single threatened species – the Giant Bullfrog (*Pyxicephalus adspersus)*. No sign of this species was found during the ecology surveys in September 2003 and April 2004, although heavy rains in the area two days prior to the April survey had created conditions suitable for this species. Giant Bullfrogs breed in seasonally flooded depressions and pans and aestivate underground through the dry season. Frogs can survive underground for several years when droughts prevent the development of suitable breeding conditions and it is possible that this species does occur on site.

2.8.2.2. Butterflies and moths

No Red Data butterfly species are recorded from the Voorspoed area.

2.8.2.3. Mammals

The Red Data Book of the Mammals of South Africa: A Conservation Assessment (2004) was used to generate a list of possible Red Data species that could occur on site. Only species listed as Critically Endangered **(CR)**, Endangered **(EN)**, Vulnerable **(VU)** or Near Threatened **(NT)** as well as Data Deficient **(DD)** were included. One Endangered-, six Near Threatened-, and three Data Deficient species were identified as possibly occurring on site.

2.8.2.3.1. Mystromys albicaudatus – White-tailed Rat (EN)

The site falls within the extent of occurrence given for *Mystromys albicaudatus* in Friedmann Y. and Daly B. (eds.) 2004. This species favours dense grassland on sandy soils however and the combination of current agricultural activities, and also the soil-types present on site, makes it unlikely that this species occurs.

2.8.2.3.2. Hyeana brunnea – Brown Hyeana (NT)

No tracks, dung, or the characteristic scent-marking deposits of this species, were encountered during the site survey. Its presence on site has however been confirmed by local farmer, Mr. George Leonard, who even reported stock losses attributed to this species. Brown Hyaenas have apparently increased in the area in recent years, reportedly as a result of the decline in hunting activity. This nocturnal and retiring species is known to wander widely and has shown a remarkable ability to survive in close proximity to human activities.

2.8.2.3.3. Atelerix frontalis – South African Hedgehog (NT)

This species reportedly occurs on site – particularly in the relatively undisturbed habitats associated with the lower slopes of Renosterkop (George Leonard pers. com.). Elsewhere on site, the species' status is likely to have declined as a result of clearing through agricultural activity of the ground cover needed by this species for nesting.

2.8.2.3.4. *Miniopterus schreibersii* – Schreibers' Long-fingered Bat (NT)

Voorspoed falls within the extent of occurrence for this species and museum records exist from close to this area. This species utilises caves for roosting – habitat which is lacking on site, and hunts over savanna, shrub land and grassland. As such its status on site is likely to be a feeding visitor only.

2.8.2.3.5. *Myotis welwitschii* – Welwitsch's Hairy Bat (NT)

Voorspoed is located close to, or falls marginally within, the extent of occurrence for this species. It roosts in shrubs and trees and could therefore occur on Renosterkop.

2.8.2.3.6. *Rhinolophus clivosus* – Geoffroy's Horseshoe Bat (NT)

Voorspoed falls within the extent of occurrence for this species. This species utilises caves for roosting – habitat which is lacking on site, and hunts over savanna, shrub land and grassland. As such its status on site is likely to be a feeding visitor only.

2.8.2.3.7. *Amblysomus septentrionalis* – Highveld Golden Mole (NT)

Voorspoed falls within the extent of occurrence for this species and museum records exist from close to this area. This subterranean species favours damp clayey soils in bogs, marshes, peat lands and damp grasslands. Suitable habitat exists in the wetland area on Voorspoed 401 and it is therefore possible that this species occurs.

2.8.2.3.8. *Suncus infinitesimus* – Least Dwarf Shrew (DD)

Voorspoed is located close to, or falls marginally within, the extent of occurrence for this species. The Least Dwarf Shrew typically is associated with termitaria and, as such, could occur on site.

2.8.2.3.9. *Suncus varilla* – Lesser Dwarf Shrew (DD)

Voorspoed falls within the extent of occurrence for this species and museum records exist from close to this area. This species appears to be dependent on termitaria.

2.8.2.4. Birds

A total of nineteen Red Data species – six listed as Vulnerable **(VU)**, and thirteen, as Near Threatened **(NT)** are considered likely to occur on Voorspoed.

2.8.2.4.1. Ciconia nigra – Black Stork (NT)

This species breeds on ledges in mountainous country and wanders widely in search of suitable feeding areas. It may sporadically utilise the wetland areas on Voorspoed during high rainfall seasons but its status is likely to be that of a rare visitor or vagrant.

2.8.2.4.2. Leptoptilos crumeniferus – Marabou Stork (NT)

This species is only likely to occur as a rare vagrant on the site.

2.8.2.4.3. Mycteria ibis – Yellow-billed Stork (NT)

This species may sporadically utilise areas on Voorspoed during high rainfall seasons when the wetland is extensively flooded. The impoundments would provide longer-term feeding areas but the status of the Yellow-billed Stork is likely to be that of a visitor or vagrant.

2.8.2.4.4. Sagittarius serpentarius – Secretarybird (NT)

This species occurs on Voorspoed from time to time – typically foraging in the open grassland- and dry wetland areas. It was not recorded during the survey visits but suitable nesting habitat, in the form of isolated *Acacia spp.* trees in the grassland/ wetland, does exist on the site and this species could breed.

2.8.2.4.5. Gyps coprotheres – Cape Vulture (VU)

This species is likely to be recorded only rarely on Voorspoed, and then typically as foraging birds over-flying high above the site. Birds might feed on occasion if suitable carrion was available.

2.8.2.4.6. Polemeatus bellicosus – Martial Eagle (VU)

The status of this species has declined throughout South Africa and it is rare outside of the larger protected areas. Direct persecution and disturbance have been the main reasons for this decline. Martial Eagles will occur typically as a visitor or vagrant on Voorspoed – usually immature or sub-adult birds wandering in search of unoccupied territory. Suitable prey and nesting sites are present in the area and this species could therefore establish itself.

2.8.2.4.7. Circus ranivorus – African Marsh Harrier (NT)

Habitat on Voorspoed is currently marginal for this species but if cattle are withdrawn from the wetland area and grazing pressure is reduced, the area could possibly support African Marsh Harriers during prolonged wet cycles.

2.8.2.4.8. Circus pygargus – Pallid Harrier (NT)

This species is a rare, non-breeding, Eurasian migrant and may occasionally hunt over Voorspoed.

2.8.2.4.9. Falco peregrinus – Peregrine Falcon (NT)

This species requires steep cliffs for nesting – habitat which is lacking in the vicinity of Voorspoed. Birds recorded in the area are therefore likely to be transients, either nomadic sub-adult birds of the local race *Falco. p. minor* or adult or young birds of the migrant, european race *Falco p. calidris.*

2.8.2.4.10. Falco biarmicus – Lanner Falcon (NT)

This species breeds both on cliff ledges (not present on or near the site), and also in the nests of various crow species. Such nests can either be located in trees or in electricity pylon structures. It was not recorded during the survey visits but the possibility of it being resident on site cannot be ruled out.

2.8.2.4.11. Falco naumanni – Lesser Kestrel (VU)

Lesser Kestrels are non-breeding, summer migrants whose wintering grounds in South Africa are centred on the highveld of the Free State, northern Eastern Cape and North West Province. Large flocks, sometimes of thousands of birds, collect at communal roosts, typically in stands of exotic *Eucalyptus spp.* trees. Birds return to these roosts each summer and suitable sites exist on Voorspoed. There was however no indication - in the form of a build-up of faeces and regurgitated prey remains below the gum trees, that this species occurs in any numbers on Voorspoed. The timing of the two survey visits fell outside of the period that this species is present in South Africa and consequently it was not recorded on the site.

2.8.2.4.12. Anthropoides paradiseus – Blue Crane (VU)

This species is likely to occur as an irregular visitor on Voorspoed, particularly when the wetland areas are inundated. The removal of cattle from this area, and the resulting reduction in grazing pressure, could create suitable breeding habitat.

2.8.2.4.13. Eupodotis caerulescens – Blue Korhaan (NT)

This species favours open grassland but also feeds over cropland, fallow fields and pasture and its presence in the vicinity of Voorspoed cannot be ruled out. A related species – *Eupodotis afraoides*, the Northern Black Korhaan was recorded on both survey visits and appears to be common in the Voorspoed area. Niche-separation between the two species is not clearly defined but the presence of numbers of *Eupodotis afraoides on the site* suggests that the Blue Korhaan will not be common.

2.8.2.4.14. Rost*ratula benghalensis* – Greater Painted Snipe (NT)

This nomadic species is likely to occur sporadically on Voorspoed when the wetlands are inundated during periods of high rainfall. The impoundments would provide longer-term habitat for this species and a reduction in grazing pressure on the wetlands could also create suitable breeding habitat.

2.8.2.4.15. *Charadrius pallidus* – Chestnut-banded Plover (NT)

This species typically frequents brackish, endoreic pans (shallow water-bodies with no outflow and high evaporation) and similar open-shored water bodies. Its status on Voorspoed is therefore likely to be at best that of a very rare vagrant.

2.8.2.4.16. *Glareola nordmanii* – Black-winged Pratincole (NT)

The non-breeding range of this Palearctic migrant is centred on the grassland biome in southern Africa and it is likely that it occurs on Voorspoed from time to time.

2.8.2.4.17. Tyto capensis – African Grass Owl (VU)

This species was not recorded during the survey visits, despite a thorough search. Habitat was however marginal for Grass Owls during the survey.

2.8.2.4.18. Mirafra cheniana – Melodious Lark (NT)

This species favours grassland, particularly *Themeda triandra* – dominated grassland and potentially suitable habitat exists on site.

2.9. SURFACE WATER

2.9.1. SURFACE WATER QUANTITY

2.9.1.1. Catchment boundaries

The boundaries of the sub catchments occupied by Voorspoed are indicated on Figure 2-6. Water emanating from the mine would drain into farm dams, which eventually drain into the Heuningspruit River, a tributary of the Renoster River, part of the Vaal River System. The mine site is located on high ground almost on the surface watershed.

FIGURE 2-6 VOORSPOED SUB CATCHMENT BOUNDARIES

2.9.1.2. The mean annual runoff

According to the Water Research Commission Report 298/2.1/94 Voorspoed falls in quaternary catchment C70H. The mean annual runoff (MAR) for this catchment is 7,3 million m^3 and the catchment covers an area of $251km^2$. The area of Voorspoed where runoff will be captured and not released to the catchment (dirty water) is approximately $10,94km^2$. This represents a loss of approximately 318 $175m^3$ in the mean annual runoff, which equate to 4,36% of the MAR of catchment C70H.

2.9.1.3. Normal dry weather flow

Three drainage lines are found within the boundary of the mine:

- The western drainage line, downstream of the wetland located on Voorspoed 401, approximately 899m long, draining toward the farm dam on Grasvlakte 1887. The wetland and drainage line from it is ephemeral and will only have flow periodically during and after heavy rainfall events.

- The eastern drainage line downstream of the farm dam on the eastern border of Voorspoed 401, approximately 194m long, makes up the headwaters of a stream and drains towards the farm dam on Welvaart 1011. This drainage line is ephemeral and will only have flow periodically during and after heavy rainfall events. The drainage line is probably the result of the earthen wall of the farm dam and may not have existed as a clearly defined drainage line prior to the construction of the dam.

- The southern drainage line emanating from the northern slopes of Renosterkop on Morgenster 772, approximately 210m long, which make up the headwaters of a stream and drains toward the farm dams on Rhenosterkop 347. This drainage line is ephemeral and will only have flow periodically during and after heavy rainfall events.

The dams, pans and wetland located in the vicinity of Voorspoed are indicated on Figure 2-3. It is evident from Figure 2-6 that Voorspoed is located on a watershed. Being situated on a watershed, and given the generally flat topography of Voorspoed, there are no clearly defined drainage courses at Voorspoed. During heavy rainfall events surface water would generally flow down gradient as sheet flow and not collect into channels.

The southern and eastern drainage lines originating from Voorspoed have very small catchments. The wetland and the western drainage line downstream of it have a bigger catchment area since the northeastern slopes of Renosterkop drains toward the wetland. During heavy rainfall events the wetland will retain most of the water flowing into it, attenuating the flood intensity and gradually releasing water into the downstream drainage line. Provision has been made for a 100m buffer around the wetland and the drainage line below it. All infrastructure is located outside of this buffer zone. Given that Voosrpoed site is located on a watershed, at the headwaters of the stream, and considering the generally flat topography of the site, the provision of 100m buffers around the drainage line should be more than adequate (i.e. the calculated 1:50 and 1:100 year flood lines will be considerably smaller).

2.9.1.4. Flood peaks and volumes

Based on the Welvaart monthly rainfall records (using Smithers & Schulze 2000) the following 24-hour storm events have been determined for Voorspoed:

- 1:20 year 24 hour storm event: 94mm.
- 1:50 year 24 hour storm event: 112mm.
- 1:100 year 24 hour storm event: 125mm.
- Flood peaks were not calculated because no significant drainage channels are present at Voorspoed.

2.9.2. SURFACE WATER QUALITY

The surface water features described in Section 2.9.1 were dry during the period of specialist investigations for the Voorspoed EIA and no water samples could be collected for water quality analysis. Such samples should be collected during the rainy season of 2004-2005 to establish baseline surface water quality data.

2.9.3. DRAINAGE DENSITY OF AREAS TO BE DISTURBED

The 3 drainage lines described in Section 2.9.1.3 have a total length of 1 303m or approximately 1,3km. The surface area of Voorspoed is approximately 19 025 537m^2 or approximately 19,02 km^2. The drainage density is approximately 0,068 km per km^2.

2.9.4. SURFACE WATER USE

The surface water users immediately downstream of Voorspoed are located on the neighbouring properties Welvaart 1011, Cumberland 1228 and Rustig 850, indicated as points *B4i*, *B4ii* and *B4iii* on Figure 2-3. The drainage lines drain into farm dams on the farms Grasvlakte 1887 (via Cumberland 1228), Welvaart 1011 and Rustig 850 that are used as cattle watering points.

2.9.5. WATER AUTHORITY

The relevant water authority is the Department of Water Affairs and Forestry, Free State Province.

2.9.6. WETLANDS

The information contained in this section is derived from the Wetland Assessment of Voorspoed conducted by Strategic Environmental Focus (Appendix 6) and the Endorheic Pan Assessment of Voorspoed conducted by Strategic Environmental Focus (Appendix 7).

The following wetland ecosystems are found at the site (indicated on Figure 2-3):

2.9.6.1. Wetland

The ephemeral wetland located to the north east of the existing open pit is classified as a Hillslope wetland. The area of the wetland is approximately 29 ha in extent. At the outer boundary of the wetland grassland species such as Rooigras *(Themeda triandra)* dominates, while the centre of the wetland is dominated by species associated with moist soil conditions (*Setaria sphacelata* - obligate wetland species). Wetland plant species such as *Junctus* and *Scirpus* were observed after rains. These species are adapted not only to waterlogged conditions, but also to the ephemeral nature of these wetlands, remaining in the soil as seeds, bulbs and rhizomes during dry periods. The ephemeral nature of the wetland is due to the dry climate. Inundation of the wetland is likely only after heavy rainfall, which may occur any time during November to April.

The wetland is currently impacted on in the following ways:

- A local road network to the south diverts surface runoff from Renosterkop.

- An earth wall dam restricting surface flow to the wetland.
- Livestock watering and grazing, which reduces surface water and decreases plant cover and diversity.

This has resulted in an overall loss of surface water runoff to the wetland. Since water is the most ecologically sensitive aspect of the wetland, this has reduced the ecological integrity of the wetland.

2.9.6.2. Pans

Pans are depressions that collect and retain water from small localised catchments or basins. Two pans are located on the site north of the existing open pit. The pans are classified as Endorheic pans, which are among the most threatened aquatic habitats in the country. Endorheic pans have significant ecological value: these ecosystems support of a wide variety of plants and animals, including aquatic invertebrates, amphibians, reptiles, small and large mammals, local bird populations, and migratory birds.

The extent of the pans is approximately 12.3 ha (southern pan) and 7.7 ha (northern pan). These values indicate the maximum extent of the pan basins; the actual inundation would depend on the amount of rainfall the wetlands receive.

The pans are currently impacted on in the following ways:

- Blue gum trees have been planted within and around the southern pan.
- Sand winning has changed the southern pan from being endorheic to being a drainage line, reducing the frequency of inundation in this pan.
- Livestock watering affects the northern pan, which reduces the physical amount of water in the pan, and also results in trampling and overgrazing of the surrounding vegetation.

The ecological integrity of the southern pan has been severely impacted on. The ecological functioning of the northern pan has not been significantly affected and it still supports a variety of animal life.

2.9.6.3. Conservation importance

While the ecological integrity of the wetland and pans at Voorspoed has been compromised by the conditions described in the preceding sections, the conservation importance of these ecosystems is still considered high. In addition to its ecological function (supporting biodiversity), the Voorspoed wetland provides further ecological value to the surrounding area by acting as a natural filter (improving water quality), attenuating water flow and trapping sediment (thereby protecting downstream users from environmental degradation). Furthermore, the cumulative impact of the loss of wetland ecosystems throughout the country has made the conservation of the remaining wetland ecosystems an even higher priority. Due to the high conservation importance of wetland ecosystems the DTEEA has adopted a policy of zero wetland loss.

2.10. GROUND WATER

The information in this section is derived from the Geohydrological Specialist Investigation of Voorspoed Mine conducted by Southern Africa GeoConsultants (Appendix 11).

2.10.1. DEPTH OF WATERTABLE

Regional static water levels ranged from 3 m to 30 m below ground level for the boreholes surveyed within a radius of 6km of the Voorspoed site.

2.10.2. PRESENCE OF WATER BOREHOLES AND SPRINGS

A hydrocensus was conducted within a 6 km radius of the proposed development. The boreholes identified during the survey are detailed in Figure 2-7. Of the 32 boreholes identified:

- 17 boreholes were equipped and in use.
- 15 boreholes were not equipped and not in use.

Borehole depths ranged from 20 m to 200 m. Domestic and stock watering supply boreholes were drilled not deeper than 50 m while the mine exploration boreholes were drilled to depths of up to 250 m to 300 m.

No pump test results were available for any of the boreholes surveyed during the hydrocensus. Reports of blow yield results during drilling indicated that production boreholes can yield volumes of 50-80 m^3/day. This general expected yield could be higher in the presence of major structures such as faults or dolerite dyke intrusions.

FIGURE 2-7 BOREHOLES IN THE VICINITY OF VOORSPOED

Source: JJP Vivier (2004)

2.10.3. GROUND WATER QUALITY

Eleven ground water samples were taken during the hydrocensus survey and 3 samples were taken during the pump test analysis. Samples were analysed at ERWAT Laboratory (SANAS accredited) for chemical constituents detailed in Table 2-10 and Table 2-11. Water quality results were compared against the DWAF Target Water Quality Range for Domestic Use (TWQR) (1996) and the South African Standard for drinking water (2001). Values that exceeded the TWQR are shaded and values that exceeded the SABS standard for Class II (maximum allowable limit) water quality are indicated in **bold.**

The following results were obtained:

- 8 of the 14 samples are within the recommended SABS limits for human consumption and 6 exceed these limits.
- The average electrical conductivity value of ground water samples was 108 mS/ m with a minimum of 75 mS/ m and maximum of 294 mS/ m (Pit 1). The Electrical Conductance (EC) values from all the samples exceeded the DWAF TWQR of 70 mS/ m, with the maximum EC content observed in Pit1. Values from this sample were however below the upper limit for Class II water quality (SABS Standard).
- The pH levels of all the observed samples were within the pH range of 6.9 - 8.6, i.e. neutral pH.
- Elevated fluoride concentrations were detected in samples Pit 1 and Pit HB. These values were below the upper limit for Class II water quality.
- Nitrate concentrations in ground water samples ranged between 2 and 36 mg/L (VD BH4). Samples from BH12, BH13 and VD BH4 exceeded the SABS standard for Class II water quality (maximum allowable).
- Elevated sodium concentrations were detected in samples Pit 1, Pit HB, BH10, VD BH1, VD BH3 and VD BH4. Except for Pit 1, all samples were below the upper limit for Class II water quality.
- The iron concentration values obtained from all ground water samples within the Voorspoed Diamond Mine area exceeded the DWAF water quality guideline for domestic water use. Concentrations from Pit 1, VD-BH3 and VD-BH4 also exceeded the limit for Class II water quality. Iron concentrations in excess of 10

mg/L may lead to severe aesthetic effects (tasting). Chronic health effects may occur in young children and sensitive individuals.

- Manganese concentrations, which exceeded the Target Water Quality Range, (1996) were observed in samples Pit 1, VD BH1, VD BH3 and VD BH4. Elevated aluminium concentrations were also observed in Pit 1, VD BH3 and VD BH4.

TABLE 2-10 GROUNDWATER MACROCHEMISTRY RESULTS [SOURCE: VIVIER (2004)]

Site number	Date sampled	Onsite Offsite	In use Not in use	Ca mg/L	Mg mg/L	K mg/L	Na mg/L	F mg/L	SO_4 mg/L	NO_3 - N mg/L	Cl mg/L	Total Alkalinity mg/l $CaCO_3$	pH	Total Hardness mg/L	EC (mS/m)	TDS (mg/L)	DWAF Water Quality Classes
Pit1	28-Aug-03	On Site	Not in use	95.1	49.1	58.6	432.0	1.1	44	0.1	242	1403	7.1	439	294	1934	Class 3: Na
Pit HB	28-Aug-03	On Site	Not in use	5.3	1.6	3.7	175.5	1.1	80	0.1	59	293	8.2	20	97	540	Class 2: F
BH 4	28-Aug-03	Off site	In use	63.7	30.5	11.7	96.3	0.5	25	10.3	73	362	8.3	285	99	582	Class 2: NO3-N
BH 5	28-Aug-03	Off site	In use	53.9	43.7	15.2	71.2	0.4	22	10	59	320	7.9	315	93	508	Class 2: NO3-N; T Hard
BH 8	28-Aug-03	Off site	In use	24.9	29.9	14.0	87.5	0.5	15	2.5	24	348	7.9	185	75	408	Class 1: EC
BH 10	28-Aug-03	On Site	In use	56.5	29.3	14.5	108.4	0.4	42	15.6	42	326	7.7	262	88	552	Class 2: NO3-N
BH 12	28-Aug-03	Off site	In use	62	52.4	19.6	90.5	0.3	29	25	63	295	8.2	371	93	520	Class 3: NO3-N
BH 13	28-Aug-03	Off site	In use	44.6	52.0	21.3	55.0	0.3	29	23.2	28	261	8.6	325	78	416	Class 3: NO3-N
BH 15	28-Aug-03	Off site	In use	50.7	43.5	5.2	78.8	0.3	20	8.6	70	331	8.2	306	89	546	Class 2: T hard
BH 17	28-Aug-03	Off site	In use	64.4	45.7	12.3	59.1	0.2	22	2	44	338	7.6	349	83	472	Class 2: T hard
BH 30	28-Aug-03	Off site	In use	71.4	57.8	3.1	46.8	0.2	28	2.5	36	389	8	391	90	518	Class 2: T hard
VD BH 1	25-Sep-03	Off site	Monitoring	141.2	31.7	18.4	243.9	0.4	40	11	49	359	6.9	484	96	580	Class 2: Na; NO3-N T hard
VD BH 2	25-Sep-03	Off site	Monitoring	166.1	586.1	114.6	254.1	1.3	27	5.6	41	344	7.2	2828	82	450	Class 4: Mg
VD BH 3	25-Sep-03	Off site	Monitoring	14.3	14.9	21.2	249.6	0.7	99	1.5	151	406	7.2	97	136	490	Class 2: Na
VD BH 4	25-Sep-03	Off site	Monitoring	75.6	3.1	13.8	168.2	0.6	22	35.9	57	261	7.1	202	95	528	Class 3: NO3-N
Average				**99.30**	**158.95**	**42.00**	**228.95**	**0.75**	**47.00**	**13.50**	**74.50**	**342.50**	**7.10**	**902.75**	**102.25**	**512.00**	
Min				**14.30**	**3.10**	**13.80**	**168.20**	**0.40**	**22.00**	**1.50**	**41.00**	**261.00**	**6.90**	**97.00**	**82.00**	**450.00**	
Max				**166.10**	**586.10**	**114.60**	**254.10**	**1.30**	**99.00**	**35.90**	**151.00**	**406.00**	**7.20**	**2828.00**	**136.00**	**580.00**	
Stdev				**68.32**	**285.01**	**48.50**	**40.71**	**0.39**	**35.49**	**15.43**	**51.42**	**60.41**	**0.14**	**1293.86**	**23.39**	**55.40**	
Detection Limit				**NA**	**NA**	**NA**	**NA**	**NA**	**10.00**	**0.10**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	
DWAF Guideline (1996)				**32**	**30**	**50**	**100**	**1**	**200**	**6**	**100**	**NA**	**6 - 9**	**100**	**70**	**450**	
SABS Guideline				**300**	**100**	**100**	**400**	**1.5**	**600**	**20**	**600**	**NA**	**10**	**NA**	**370**	**2400**	

TABLE 2-11 GROUNDWATER METALS ANALYSIS

Site number	Date sampled	Onsite Offsite	In use Not in use	Fe mg/L	Mn mg/L	Cu mg/L	Zn mg/L	Cr mg/L	Cd mg/L	Pb mg/l	Al mg/L	DWAF Water Quality Classes
Pit1	28-Aug-03	On Site	Not in use	22.96	1.94	0.09	0.25	0.08	0	0.38	18.20	Class 4: Fe
Pit HB	28-Aug-03	On Site	Not in use	1.21	0.04	1.31	0.78	0	0	0.41	0.70	Class 2: Fe; Cu
BH 4	28-Aug-03	Off site	In use	0.37	0	0	0.30	0	0	0.31	0	Class 0
BH 5	28-Aug-03	Off site	In use	0.13	0	0	0.05	0	0	0.34	0	Class 0
BH 8	28-Aug-03	Off site	In use	0.11	0	0	0.07	0	0	0.37	0	Class 0
BH 10	28-Aug-03	On Site	In use	0.10	0	0	0	0	0	0.28	0	Class 0
BH 12	28-Aug-03	Off site	In use	0.28	0	0	0.05	0	0	0.33	0.20	Class 0
BH 13	28-Aug-03	Off site	In use	0.11	0	0	0.04	0	0	0.40	0	Class 0
BH 15	28-Aug-03	Off site	In use	0.29	0	0	0.04	0	0	0.29	0	Class 0
BH 17	28-Aug-03	Off site	In use	0.43	0	0	3.03	0	0	0.26	0	Class 0
BH 30	28-Aug-03	Off site	In use	0.13	0	0	0.12	0	0	0.16	0	Class 0
VD BH 1	25-Sep-03	Off site	Monitoring	0.71	0.06	0.39	2.54	0	0	0.19	0	Class 1: Fe
VD BH 2	25-Sep-03	Off site	Monitoring	2815.00	95.50	8	3.83	9.25	0	0.95	1016.00	Class 4: Fe; Mn
VD BH 3	25-Sep-03	Off site	Monitoring	23.40	0.18	0	0.12	0.05	0	0.17	15.20	Class 4: Fe
VD BH 4	25-Sep-03	Off site	Monitoring	5.56	0.16	0.11	0.82	0	0	0.31	3.20	Class 3: Fe
Average				**191.39**	**6.53**	**0.63**	**0.80**	**0.63**	**0.00**	**0.34**	**70.23**	
Min				**0.10**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.16**	**0.00**	
Max				**2815.00**	**95.50**	**7.53**	**3.83**	**9.25**	**0.00**	**0.95**	**1016.00**	
Stdev				**725.84**	**24.62**	**1.94**	**1.26**	**2.39**	**0.00**	**0.19**	**261.70**	
Detection Limit				**NA**	**0.03**	**0.03**	**0.03**	**0.03**	**0.04**	**NA**	**0.10**	
DWAF Guideline (1996)				0.10	0.05	1.00	3.00	NA	0.005	0.010	0.15	
SABS Guideline				2.00	1.00	2.0	10.00	0.50	0.01	0.10	0.50	

Source: Vivier (2004)

TABLE 2-12 LEGEND FOR GROUND WATER QUALITY CLASSES

Colour	Class	Water quality Classes (DWAF 1998)
Blue	0	Ideal – suitable for lifetime use
Green	1	Good – suitable for use, rare instances of negative effects
Yellow	2	Marginal – conditionally acceptable. Negative effects may occur in some sensitive groups
Red	3	Poor – unsuitable for use without treatment. Chronic effects may occur
Purple	4	Dangerous – totally unsuitable for use. Acute effects may occur
TWQR (DWAF 1996)		Total Water Quality Range
For each water quality constituent there is a No Effect Range. This is the range of concentrations or levels at which the presence of that constituent would have no known or anticipated adverse effect on the fitness of water for a particular use or on the protection of aquatic ecosystems. These ranges were determined by assuming long-term continuous use (life-long exposure) and incorporate a margin of safety.		
SOUTH AFRICAN STANDARD		Specification: Drinking Water
The classification (Class II) specifies a class of water that is considered to represent the minimum acceptable quality for drinking water for various maximum consumption periods. The clasification class II are closely comparable to the yellow clasification used to differentiate among water qualities available for drinking purposes described in **Quality of domestic water supplies - Volume 1: Assessment guide.*		
* Water quality classes (DWAF 1998)		

Source: Vivier (2004)

2.10.4. GROUND WATER USE

Groundwater usage immediately downstream from the proposed development is used for stock watering and domestic purposes. Groundwater is the only source of water for farms located away from the Heuningspruit. The closest neighbouring boreholes to sites B and C are BH 8 and BH19 respectively (refer to Figure 2-7). Borehole BH19 is destroyed and borehole BH8 is utilised for domestic purposes.

On Welvaart 5 boreholes are in use, of which 1 is used for domestic water supply, 1 for stock watering, and 3 for both domestic supply and stock watering. On the farm Belmont 2 boreholes are in use, both for domestic and stock watering. On the farm Cumberland 3 boreholes are in use for stock watering. At Rustig 1 borehole is in use for domestic and stock watering purposes, and at Voorspoed 1 borehole is in use for stock watering. For more detail on the hydrocensus results refer to Appendix A of the Geohydrological Specialist Investigation for Voorspoed Mine (Appendix 11 of this EIA Report).

2.10.5. GROUND WATER ZONES

The main hydraulic zones at Voorspoed are:

- A regional shallow aquifer related to the layered sedimentary Karoo rocks dominated by shale and mudrock of the Ecca Group. This aquifer is characterised by limited fracturing and has a general low permeability. The Ecca Group shale and mudrock is generally known for its moderately to low ground water potential in the absence of major intrusions and/or faulting.

- Faults and dolerite dyke intrusions with associated fracturing or fill material may form zones for ground water movement or barriers impeding ground water flow. Refer to figure 2.3 for an illustration of the main fault zones identified at the site.

- A localised deep aquifer occurs (100 – 400 m) that is defined by faulting and brecciated rocks associated with the kimberlite intrusions in the area. This aquifer is characterised by the nature and dimension of the volcanic pipe as well as by the dolerite dykes, fissures and sill intrusions found in depth. Exploration boreholes in and around the existing pit did not intersect significant quantities of ground water at great depth, and the results of geophysical exploration drilling (Packer testing) in the kimberlite pipe did not indicate that significant volumes of groundwater would be found at depth. Subsequent pump tests confirmed low yields (1,5 l/s) from the deep aquifer.

2.10.5.1. Pump testing of faults and shallow ground water aquifer

Five boreholes were drilled to investigate the hydraulic zones associated with dyke, fault or sill zones at Voorspoed. Pump tests were conducted in these boreholes to determine the aquifer transmissivity and storativity. The pump test information is summarised in Table 2-13. The boreholes tested yielded less than 1 L/s. The tests verified that the aquifer has a low permeability with transmissivity values that ranged between 0,1-5,5 m^2/day. The yields of the pump tests ranged between 0,18 – 0,88 L/s.

TABLE 2-13 PUMP TEST INFORMATION

BOREHOLE	LAT	LONG	DEPTH OF PUMP (MBGL)	STATIC WATER LEVEL (MBGL)	TEST DURATION (MIN)	AVERAGE ABSTRACTION RATE (L/S)	EARLY T (M^2/D)	LATE T (M^2/D)
VD - BH1	-27.39084	27.19708	41	12.74	800	0.88	5.5	2.8
VD - BH2	-27.38102	27.19571	26	4.97	115	0.32	0.1	0.1
VD - BH3	-27.39149	27.20907	41	9.55	107	0.19	0.1	0.1
VD - BH4	-27.39544	27.21410	41	13.36	120	0.47	2.5	0.6
VD - BH5	-27.38701	27.18732	-	-	-	-	-	-

2.10.6. AQUIFER CLASSIFICATION

According to the aquifer system management classification, the aquifer is classified as a sole source aquifer system with low vulnerability. The classification is based on the following considerations:

- The general aquifer is characterised by limited fracturing. Weathering in the mudrock occurs up to depths of 40-60 m below surface. The Karoo Ecca Group shale and mudrock is generally known for its moderately low groundwater potential in the absence of major intrusions and/or faulting. Pump tests conducted on newly drilled boreholes indicated yields of less than 1 L/s for the shallow (10-40m) to intermediate (40-100) m aquifer.

- The general water quality can be classified as Class 0 (ideal) to Class 1I (marginal), based on the DWAF criteria (Table 2-10 to Table 2-12). The Electrical Conductivity values varied between 75 mS/m and 136 mS/m.

- Groundwater usage immediately downstream from the proposed development is used for stock watering and domestic purposes. Groundwater is the only source of water for farms located away from the Heuningspruit.

- Groundwater does not directly contribute to the base flow of local streams in the direct vicinity of the mine. These streams and/or drainage lines are non-perennial and are only active during and after rain events.

- The weathered/fractured aquifer matrix has a low permeability and the numerical model simulations indicated that contaminant migration velocities would be in the order of 20 - 35 m per year. There are more permeable zones associated with fault/dyke zones along which contaminants may migrate faster. Based on this assessment, the aquifer vulnerability can be classified as low given that large-scale fault/dyke zones are absent.

2.10.7. GROUNDWATER FLOW MODELLING

A ground water flow model was developed to determine the performance of the aquifer system. The model was used to determine the groundwater flow balance, which showed that the recharge is in the order of 4 000 m^3/d with 3,98 m^3/d evaporated from the open pit and 1 700 m^3/d abstracted from 16 boreholes that are equipped in the catchment. The radius of influence of the existing open pit mine is in the order of 1 km to 1,2 km with steep hydraulic gradients of 2%. The pre-mining ground water flow directions are illustrated in Figure 2-9. The pre-mining phase conceptual ground water flow is graphically represented in Figure 2-8.

FIGURE 2-8 SCHEMATIC REPRESENTATION OF PRE-MINING CONCEPTUAL GROUND WATER FLOW

FIGURE 2-9 PRE-MINING GROUND WATER FLOW DIRECTIONS

2.11. Air Quality

The information in this section is derived from the Air Quality Impact Assessment conducted by Airshed Planning Professionals (

Appendix 10).

2.11.1. Scheduled Processes

The Voorspoed project activities do not include a scheduled process, as defined in the Atmospheric Pollution Prevention Act.

2.11.2. Baseline air quality assessment

No ambient air quality data was available for completion of the baseline investigation.

No major sources of pollution were identified. The main activities within the region include farming, small residential communities and business trade. Existing emissions source types include:

- Fugitive emissions from mining operations (old Lace Diamond Mine).
- Vehicle tailpipe emissions (the R76 running approximately 10 km to the south west of the mine, secondary road on the northern periphery of the mining property).
- Various miscellaneous fugitive dust sources (agricultural activities, wind erosion of open areas, vehicle entrainment of dust along paved and unpaved roads).

The nearest sensitive receptors identified include the farms of Belmont, Welvaart and Labor (refer to *B1* and *B2* on Figure 2-3).

2.12. Noise

The information and evaluation regarding noise impacts is derived from the noise impact study conducted to assess the noise impact that the mining operations will have on existing ambient noise levels in the environment (refer to Appendix 3). As part of the noise impact study the present ambient noise levels at Voorspoed were measured continuously over a period of three days. The ambient noise levels are very low both during the day and night, and were determined by agricultural activities, occasional local traffic and natural sounds.

2.13. SITES OF ARCHAEOLOGICAL AND CULTURAL INTEREST

2.13.1. TYPES AND RANGES OF HERITAGE RESOURCES WITHIN THE VOORSPOED SITE AND IN THE PERIPHERAL AREAS

The information in this section is derived from the Heritage Impact Assessment for Voorspoed conducted by Dr Julius Pistorius (Appendix 8). The archaeological and cultural survey of Voorspoed and the peripheral area (outside the site boundary) has revealed several types and ranges of heritage resources, as outlined in the National Heritage Resources Act (Act 25 of 1999). These resources include the following.

- Stone tools that date from the Stone Age.
- Stone walled settlements that date from the Late Iron Age that can be associated with the predecessors of the Sotho-Tswana.
- Remains associated with either the settlement of the earliest farmers (colonists) in the project area or with the Historical Voorspoed Diamond Mine, namely the Historical Building.
- Remains associated with the Historical Voorspoed Diamond Mine.
- Remains dating from the Relatively Recent Past, such as a facebrick building with its associated outbuildings, a compound for labourers and an explosives magazine.
- Six graveyards, of which at least four are historical.

Only the heritage resources within the Voorspoed site are discussed in more detail, as some of these heritage resources will be affected by the proposed new diamond mining activities.

2.13.2. TYPES AND RANGES OF HERITAGE RESOURCES WIHTIN THE VOORSPOED MINE SITE

The types and ranges of heritage resources discovered in within the Voorspoed Mine site include the following:

- A few loosely scattered stone tools collected from disturbed spots in the project area.
- Historical remains such as the Historical Building (HB01 indicated on Figure 2-3) that may have served as a police station at the time when the Historical Voorspoed Diamond Mine was operational.
- Remains that can be associated with some of the earliest diamond mining activities in the Free State, namely the Historical Voorspoed Diamond Mine and its associated workings.
- Two Graveyards which are both historical (GY01 and GY02 indicated on Figure 2-3).
- Remains dating from the Relatively Recent Past such as a facebrick residence with outbuildings, a compound for labourers and an explosives magazine.

2.13.2.1. Stone tools

A few scattered stone tools were observed in disturbed areas such as ploughed agricultural fields in the Voorspoed Diamond Mining Area. At least one of these tools dates from the Late Acheul, suggesting that it may be older than 250 000 years. More stone tools from different periods of the Stone Age may occur in the project area, some of which may be buried beneath the surface.

2.13.2.2. The Historical Building

A historical structure occurs near the existing mine infrastructure (HB01 indicated on Figure 2-3). According to spokespersons, this structure served as a police station many years ago. The origins, history and architectural detail of this building can only be established by means of further work.

Several large middens are associated with the structure. Pieces of glass, corrugated iron, bobwire and other material are visible in these deposits. These middens may have been associated with the original occupation of the historical building, or they may have derived from farm labourers who occupied the structure after it had been abandoned.

The structure has some historical significance. However, this structure is very dilapidated and structurally unsafe. It is highly unlikely that it could be restored to its former state.

2.13.2.3. The Historical Voorspoed Diamond Mine

The Historical Voorspoed Diamond Mine's history is outlined in Section 4.2.5 of Appendix 8). The mine and its workings have historical significance, as they are associated with the earliest diamond mining activities in the Free State Province and in South Africa.

The historical mine today consists of an open pit and several waste rock dumps. The open pit and some of the waste rock dumps are demarcated by an avenue of Blue Gum trees – probably planted at the time when mining operations commenced.

2.13.2.4. Graveyards

The informal graveyard indicated as GY01 on Figure 2-3 is located in the southern part of the project area, near Renosterkop. It consists of two parts, namely a larger, more formal section, which is fenced in, and a smaller section containing graves that are not demarcated by means of any fence. The two parts together may contain as many as 50 graves. The larger graveyard contains approximately 33 graves, and the smaller graveyard 13. Not all the graves are clearly visible. Several graves in the larger graveyard are overgrown with turpentine bushes. The majority of the graves do not have any headstones. The few headstones that occur have either been made of cement or of granite. Some graves are marked with small pieces of corrugated iron with writing in paint to identify the deceased. The graves in the smaller section of the graveyard look very much alike, as they are all covered with stones. They differ in appearance (decoration and make-up) from those in the larger section of the graveyard.

The informal graveyard indicated as GY02 on Figure 2-3 contains five or six graves which are in a poor state of repair. The graveyard may have been vandalised – although its neglected state may be entirely attributed to its being about 110 years old.

At least two of the graves have 'Blinkblaar Wag-'n-Bietjie' trees (Ziziphus) growing on them, and it is likely that these have been planted on the graves. Both trees are very old and may have been planted soon after the deceased were buried. (The thorn branches of the ’Wag-‘n-Bietjie’ would have prevented the graves from being disturbed, for example, by animals).

2.13.2.5. Remains from the Relatively Recent Past

Various spots or ‘sites’ that can be associated with human activities from the relatively recent past can be identified in the project area. These sites do not in all instances contain substantial remains and whenever such remains occur they are not necessarily of outstanding significance. The most conspicuous remains from the Relatively Recent Past in the project area include the following:

- A facebrick building with a pitched roof and associated outbuildings are located to the west of the open pit. This complex of structures includes a main residence and other structures, either built using bricks and cement or corrugated iron. The facebrick building may be almost sixty years old, but is still relatively modern. Several hundred similar houses would still be found in Kroonstad today. This structure, as well as some of the other outbuildings which have been altered substantially in more recent times, have no outstanding architectural or historical significance.

- The remains of a large number of cement houses with pitched corrugated iron roofs used by labourers still stand to the north of the open pit. These structures have no historical significance.

- Two face-brick buildings within a fenced-in area occur to the south-east of the open pit. Both buildings were built using light-brown clay bricks. One has a pitched corrugated iron roof, while the second is covered with a cement slab or roof. This structure has the words ‘explosive magazine’ painted on its door. The first building is barricaded with a thick cement wall and may also have served as an explosives magazine or as a room placed under high security. It is unlikely that these two structures were built at the time when the Historical Voorspoed Diamond Mine was operational, but rather some decades after the mine was closed.

- Other less conspicuous and insignificant remains dating from the more recent past occur directly to the north of the open pit. Here, trenches were dug in which maize and leaves were stacked to ferment in order to be used as fodder for cattle. Broken cement floors are also visible in this area. Sisal bush indicates earlier human activity in this area. A large section of cracked concrete floor can be seen in the Blue Gum plantation to the north of the labourers' quarters. This structure may have been associated with the original Historical Voorspoed Diamond Mine. These remains have not been mapped, as they do not have any historical or cultural significance any longer.

2.14. SENSITIVE LANDSCAPES

The sensitive landscapes at Voorspoed Mine are not discussed here since they are discussed in other sections as detailed in Table 2-14.

TABLE 2-14 SENSITIVE ENVIRONMENTS

Types of sensitive landscapes	Occurrence at Voorspoed	Sections where the impacts are discussed
Nature conservation or ecologically sensitive areas	The wetland and pans are of high conservation importance	2.9.6
Natural resources	Most soils at the mine site have moderate agricultural potential	2.4
Sites of outstanding natural beauty, panoramic views	Renosterkop	2.7.1.3
Sites of social significance	Historical building and graves	2.13.2

2.15. VISUAL ASPECTS

The information contained in this section is derived from the Visual Impact Assessment for Voorspoed conducted by Newtown Landscape Architects (Appendix 9).

2.15.1.1. Landscape character

The panoramas illustrated in Figure 2-10, Figure 2-11, Figure 2-12 and Figure 2-13 give an impression of the nature of the landscape in the vicinity of the proposed mine when viewed from a number of vantage points (the vantage points are indicated in Figure 2-14). The study area is characterised by generally flat to rolling rural land comprising cultivated lands and grassveld used for grazing. The area is dotted with groups of large blue gum trees, most often associated with farmsteads, roads or property boundaries.

A small hill, Renosterkop, is located to the southwest of the mine site. It protrudes approximately 80m above the surrounding landscape. Its vegetation is in a 'pristine' state and provides habitat for a variety of animals and birds. It is a prominent natural feature, which is the focal point of most views in the area.

The remnants of the old Voorspoed mining operation, a waste dump and plantations of blue gum trees are also evident in many views. View 13, Figure 2-13, is a panoramic view taken from within the mine site. It is evident that trees (a combination of indigenous and exotic) and other plant material have begun to 'colonize' the old spoil dump, the pit and its surrounding areas.

2.15.1.2. Sense of Place

The study area is much like any 'typical' Free State rural farming community as described above. The most striking characteristic, which gives the area a stronger sense of place, is the natural bush-covered hill, Renosterkop. The hill protrudes above the surrounding rolling topography and can be seen from distances of up to 10.0km to 12 km depending on vantage point. It creates a beautiful backdrop to many views, especially evident from the west and east and as the visitor moves closer to the koppie. These factors combine to evoke an emotional response in the visitor that adds a different, more natural sense to the 'harmonious' farm character of the rural landscape

However, the landscape also contains discordant elements that tend to distract from the overall unity and experiential quality of the landscape i.e. the presence of abandoned mining features (Lace and Voorspooed mines) and specifically the remnants of the spoil dumps. It is the form of the these dumps, especially the sharp side slopes, which tend to distract from the harmony of the scene along with the colour contrast of the exposed earth (View 8 Figure 2-12). This is evident even from distances of up to 8,0km, and confirms in the viewer, that the feature is man-made and not natural. It must however be pointed out that the vegetation which has established on the dumps, tends to 'soften' the appearance of them, and hence reduce their contrast and intrusion upon the surrounding landscape.

2.15.1.3. Aesthetic Value of the Visual Resource

Newtown Landscape Architects considered the overall visual quality of the study area as moderate: *"Where the landscape exhibits positive character but which may have evidence of alteration to /degradation/erosion of features resulting in areas of more* *mixed character. Potentially sensitive to change in general; again change may be detrimental if inappropriately dealt with and it may require special or particular attention to detail."* For a discussion of the criteria and methodology used to determine overall visual quality refer to Appendix A of the Visual Impact Assessment for Voorspoed

APPENDIX 9).

2.15.1.4. Views

Most distant views from within the zone of potential influence (the area from beyond which the potential impact of the mine will become insignificant due to distance and atmospheric 'distortion') towards the proposed mine, would be experienced by people traveling along the provincial road R721 east of the site (View 1 Figure 2-10). Views from the other provincial road, R76 west of the site will mostly be obstructed by a ridgeline beginning at Renosterkop that forms a visual divide to the south and southwest of the site.

Most middle distance views will be experienced from local farm roads and nearby farmsteads/labour housing. Many of these views are from a relatively low vantage point as is evident in Views 3, 7, 8, 9 in Figure 2-10, Figure 2-11 and Figure 2-12. Only the top of the mines features would be seen.

A few farmsteads occur in the vicinity of the Voorspoed mine and would experience close up views of the proposed mine. They occur to the immediate east of the mine and are the farmsteads, labour houses and a school associated with the farm Welvaart (owned by the Leonards). Further east are the farms, Urbanus and Blydskap (Egoli) with their associated farmsteads and labour housing. These views are also from low vantages points as is illustrated in Views 5 and 6 of Figure 2-11. The only elevated and open view of the area occurs from Renosterkop. It is illustrated in the simulation of View 11 in Figure 2-13. Refer to Figure 2-14 for the location of the roads and farmsteads/labour housing referred to above.

FIGURE 2-10 LANDSCAPE CHARACTER VIEWPOINTS 1 & 3

FIGURE 2-11 LANDSCAPE CHARACTER VIEWPOINTS 5, 6 & 7

FIGURE 2-12 LANDSCAPE CHARACTER VIEW POINTS 8, 9 & 10

FIGURE 2-13 LANDSCAPE CHARACTER VIEWPOINTS 12 & 13

FIGURE 2-14 VISUAL ANALYSIS

2.16. REGIONAL SOCIO-ECONOMIC STRUCTURE

The information in Section 2.16 is derived from the Socio-economic Impact Assessment Baseline Report compiled by DPR Projects (Appendix 1) and the Socio-economic Impact Assessment Report compiled by Concession Creek Consulting (Appendix 2).

Voorspoed is located approximately 30km north of Kroonstad, within the Free State Province and the Northern Free State District Council boundary. Voorspoed and the farms to the east of it are located within the Ngwathe Local Municipality, close to the border of the Moqhaka Municipality.

Overview – Free State Province

The Free State is a geographically important and economically diverse province located in the centre of South Africa. It is a vitally important agricultural hub for the country which accounts for the high number of employed people who work in this sector. In addition, the total number of people in the agricultural sector is in fact probably higher than is suggested by the figures, as these do not take into account casual and seasonal labour. Mining is also an important industry and a significant employer of men in the province, though fails to employ very many women, as is the unfortunate norm in the sector across South Africa. Despite these important industries, however, the Free State still has a large number of unemployed people, a problem exacerbated by the large numbers of people who are either too young to be employed, or are not economically active for some other reason ensuring levels of dependency remain high.

Overview – Ngwathe and Moqhaka Municipalities

The proposed Voorspoed Mine is located within Ngwathe Local Municipality. It is a highly economically depressed area with some 27% of households living on no formal income whatsoever and an unemployment rate of 26%. Many households appear to be leading very marginal existences. Moqhaka Municipality, on whose border the mine is situated, is also economically depressed though not to the same extent as Ngwathe. Household incomes, the employment rate and standards of living are generally higher in the Moqhaka Municipality.

Overview - Kroonstad

Kroonstad is the major town in the area around the proposed Voorspoed Mine. It has a large service sector and is a retail hub for the region. Household incomes in Kroonstad are generally much higher than in the surrounding areas and the level of unemployment is far lower. The large number of men in the economically active age group suggests that this is an area of immigration from the surrounding rural areas. A concern here is that even with a relatively low unemployment rate, a large number of the migrants may not find jobs, resulting in a high potential for social problems in the town.

2.16.1. POPULATION

2.16.1.1. Free State Province

The population of the Free State, as measured in 2001, was 2 733 776 people. This population level is likely to fluctuate due to of the provinces proximity to Lesotho, a traditional labour source for South Africa within its mining, manufacturing and agricultural sectors. In addition, labour migration on a weekly and monthly basis is prevalent between the province and neighbouring Gauteng. This fact may contribute to the slight imbalance in gender within the population profile, as the Free State comprises 48% males to 52% females.

TABLE 2-15: POPULATION BY AGE AND GENDER IN THE FREE STATE

Age Group	Male	Female	Total %
0-19	567 533	658 621	43
20-39	422 378	466 413	31
40-64	285 137	289 272	20
65+	49 555	84 867	5
Total	**1 324 603**	**1 499 173**	**100**

Source: Stats SA, Census 2001

Table 2-15 depicts a fairly young population in the Free State in 2001, with some 43% of the population below the age of 19. This is a matter for some concern as areas with very high numbers of youth are faced with supporting large numbers of non-economically active people. In addition, an employment crisis could occur when these young people enter the workforce and have to be employed.

Due to its proximity to Lesotho the dominant language in the Free State Province is Sesotho. Some 64% of the population speak Sesotho as their first language. The second most commonly spoken language is Afrikaans with smaller numbers of people speaking Xhosa, Setswana, Zulu and English. The vast majority of the population is classified as black Africans with the second largest group being white. There are also a number of small coloured and Indian communities.

2.16.1.2. Ngwathe and Moqhaka Municipalities

In 2001 the Moqhaka Local Municipality had a total population of 167 892, with an almost even split between males and females. The population of the Ngwathe Municipality totalled approximately 118 810 people in 2001, of whom 52% were female. The age breakdown of the population clearly shows that there are a large number of people under the age of 19. In fact, the youth are the single biggest grouping by age in the Municipalities. Although the combined number of people in the economically active age categories is still marginally higher, this large number of young people is cause for concern, as explained in the preceding section.

TABLE 2-16: PERCENTAGE POPULATION IN NGWATHE AND MOQHAKA LOCAL MUNICIPALITIES, 2001

	Ngwathe		**Moqhaka**	
Age Group	**Male %**	**Female %**	**Male %**	**Female %**
0-19	45	40	39	38
20-39	29	30	33	32
40-64	20	22	24	23
65+	6	8	4	7
Total:	**100**	**100**	**100**	**100**

Source: Stats SA Census 2001

2.16.1.3. Kroonstad

TABLE 2-17: DEMOGRAPHICS IN TERMS OF AGE AND GENDER OF KROONSTAD

Age Group	Male	%	Female	%	Total	%
0-19	3 896	31	3 607	31	7 503	31
20-39	4 629	37	3 355	29	7 984	33
40-64	3 106	25	3 295	29	6 401	27
65+	845	7	1 256	11	2 101	9
Totals	**12 476**	**100**	**11 513**	**100**	**23 989**	**100**

Source: Stats SA, Census 2001

Table 2-16 indicates the demographic profile of the town of Kroonstad. There is an even spread of people throughout the age groups with 60% of the population falling within the economically active age groups. The fact that some 31% of the population are below the age of 19 is a concern in terms of future capacity to both educate and employ this population. There are slightly more males (52%) than females (48%) in the population. The large numbers of males in the 20-39 age group indicates that Kroonstad may be a point of immigration from the surrounding rural areas. Very economically depressed areas often show a sudden drop in males within this age group as they leave in search of employment elsewhere. High levels of immigration may lead to severe problems, if the centre is unable to employ this number of people.

2.16.2. MAJOR ECONOMIC ACTIVITIES AND SOURCES OF EMPLOYMENT.

2.16.2.1. Free State Province

The Free State is a geographically important and economically diverse province located in the centre of South Africa. It is an important agricultural centre for the country, with a high number of employed people working in this sector. Mining is also an important industry and major employer in the province. Despite these important industries however the Free State still has a large number of unemployed people and this problem is made worse by the large numbers of people who are either two young to be economically active or are not for some other reason (e.g. students). Levels of dependency are high.

2.16.2.1.1. Gross domestic product of the Free State Province:

The GDPR is a measure of the total value of income generated in a region, or alternatively, the total of all value added activities regionally. Figure 2-15 depicts the average economic growth per province for the period 1995-2001.

The GDPR of the Free State Province has fluctuated a great deal over the last few years going through periods of large-scale growth and large-scale decline. Between 1996 and 1998 the Free State's GDPR decreased by 10% from 5% to –5%. From 1998 to 1999 the GDPR reversed from –5% to 7.5%, an increase of 12.5%. Since 1999 however it has taken another decline with the result that between 1995 and 2001 the GDPR of the Free State Province has been lower than that of South Africa as a whole and the Free State along with the North West Province were the only provinces in South Africa to have negative GDPR growth.

2.16.2.1.2. Sectoral contribution to Free State GDPR:

Figure 2-16 presents sectoral contributions to the GDPR of the Free State over the last 7 years. Whilst mining is a comparatively significant sector in terms of its contribution to GDPR in the province (over 10% in 2001), the sector's contribution had declined between 1995 and 2001 as a whole. The only sectors to demonstrate an increase in their contribution were manufacturing and community services, but even these contributions had tapered off between 2000 and 2001. The financial sector remained a dominant contributor to the GDPR, supported to some degree by the manufacturing and wholesale and retail trade sectors.

When considered at a national level, the mining sector within the Free State provided a minimal contribution to the sectors GDP. Table 2-18 further demonstrates the sectors' declining contribution (of 2.5%) over recent years to national GDP figures for mining.

TABLE 2-18: PERCENTAGE CONTRIBUTION BY PROVINCE TO NATIONAL MINING SECTOR GDP

Industry	1997	1998	1999	2000	2001
Western Cape	0.7	0.6	0.5	0.5	0.4
Eastern Cape	0.2	0.2	0.2	0.1	0.1
Northern Cape	6.6	6	7.3	5.8	5.7

Industry	1997	1998	1999	2000	2001
Free State	***10.9***	***10.3***	***10.6***	***9.4***	***8.4***
KwaZulu Natal	4.7	4.4	3.1	2.9	2.8
North West	35.8	35.2	34.1	37.4	35.7
Gauteng	6.8	7.7	6.2	6.3	5.3
Mpumalanga	20.7	20.3	19.7	18.9	20.7
Limpopo	13.7	15.3	18.5	18.6	20.9
Total	**100**	**100**	**100**	**100**	**100**

Source**:** Stats SA, South African Census, 2001

2.16.2.2. Moqhaka and Ngwathe local municipalities

As indicated in Table 2-19, agriculture is the largest employer in both the Ngwathe Municipality (27% of the working population) and the Moqhaka Municipality (22% of the working population).

TABLE 2-19: SECTORAL EMPLOYMENT IN NGWATHE AND MOQHAKA MUNICIPALITIES, 2001

Sector	Ngwathe %	Moqhaka %
Agriculture, hunting,	27	22
Mining and quarrying	<1	12
Manufacturing	8	7
Electricity, gas and water	<1	<1
Construction	4	3
Wholesale and retail trade	13	11
Transport, storage and	3	4
Financial, insurance, real	4	5
Community, social and	16	18
Private Households	21	13
Undetermined	5	5

Source**:** Stats SA, South African Census, 2001

2.16.2.3. Kroonstad

Table 2-20, indicating sectoral employment within Kroonstad, highlights the importance of Kroonstad as a service centre for the surrounding area. Large numbers of people are employed in the wholesale and trade sector, the financial, insurance, real estate and business services sector and the community, social and personal services sector. Mining on the other hand did not count as a significant employer in 2001 and is unlikely to have changed in the interim years.

TABLE 2-20: SECTORAL EMPLOYMENT IN KROONSTAD IN 2001

Sector	No	%	Sector
Agriculture,	322	4	Agriculture,
Mining and	23	<1	Mining and
Manufacturing	522	7	Manufacturing
Electricity, gas and	27	<1	Electricity, gas and
Construction	267	3	Construction
Wholesale and	1242	16	Wholesale and
Transport, storage	460	6	Transport, storage
Financial,	986	12	Financial,
Community, social	3209	40	Community, social
Private Households	381	5	Private Households
Undetermined	526	7	Undetermined

Source: Stats SA, South African Census, 2001

2.16.3. UNEMPLOYMENT ESTIMATE FOR THE AREA

2.16.3.1. Free State Province

As indicated in Table 2-21, a very high percentage of people (41%) were not economically active in 2001, with an additional 25% unemployed and seeking work at this time. As a result, a minority of persons with formal incomes (supplemented by some pensions) must support a large number (66%) of economically inactive people.

TABLE 2-21: EMPLOYMENT STATUS OF INDIVIDUALS IN THE FREE STATE

Category	2001	%
Employed	591 000	34
Unemployed, looking for	446 273	25
Not Economically active	715 420	41
Total	**1 752 693**	**100**

Source: Stats SA, South African Census, 2001

2.16.3.2. Moqhaka and Ngwathe Municipalities

The Ngwathe Municipality has a high unemployment rate with some 26% of the population classified as unemployed, while in Moqhaka one quarter of people between 15 and 65 were classed as unemployed (Table 2-22). More concerning is the fact that a large percentage of the population between the ages of 15 and 65 were classified as not economically active. This means that in total some 70% of the potentially economically active population of Ngwathe and some 62% of the population of Moqhaka are not in any sort of formal employment. While some of these people will have alternative sources of income, for example in the informal sector, seasonal farming and through government welfare grants, this is still likely to be insecure and indicates severe economic problems within the region.

TABLE 2-22: EMPLOYMENT STATUS IN NGWATHE AND MOQHAKA MUNICIPALITIES, 2001

	Ngwathe		Moqhaka	
Category	**Number**	**%**	**Number**	**%**
Employed	22 118	30	42 442	38
Unemployed	19 656	26	28 229	25
Not	32 885	44	41 283	37
Total	**74 659**	**100**	**34 672**	**100**

Source: Stats SA, South African Census, 2001

2.16.3.2.1. Household income

Given the high rate of unemployment and the large number of people who are not economically active in these two areas it is not surprising to see very low levels of household income (Figure 2-17). Some 21% of all households have no formal income at all while a further 12% earn less than R4 800 per annum (less than R500 per month).

Household income levels are higher in Moqhaka than in Ngwathe, with 15% of households having no income and 3% earning more than R307 201 in Moqhaka, compared to 27% with no income and less than 1% earning over R307 201 in Ngwathe.

2.16.3.3. Kroonstad

Table 2-23 indicates that Kroonstad residents enjoyed a formal employment rate of 46.4% in 2001. The 43.7% not economically active group includes people above the age of fifteen (15) who are still at school, those in tertiary education, the sick or disabled who cannot work and housewives. Thus, whilst the employment rate is fairly high there are still a large number of people being supported by the employed, as well as from pensions or informal incomes.

TABLE 2-23: EMPLOYMENT STATUS IN KROONSTAD 2001

Category	Number	%
Employed	7 964	46.4
Unemployed	1 688	9.8
Not economically active	7 504	43.7
Total	**17 156**	**100**

Source: Stats SA, South African Census 2001.

2.16.3.3.1. Household income in Kroonstad

Figure 2-18 represents levels of household income in Kroonstad for some six thousand five hundred and sixty eight (6 568) households in 2001. With a total population of twenty three thousand, nine hundred and eight nine (23 989) people, the average household size is three point seven (3.7). Household size, however, may vary considerably within the large population represented in this assessment. It must be noted that the figure below only refers to formal sources of income and as such income for many households is understated.

The statistics indicate a wide range of household incomes indicative of the fact that Kroonstad is both an area with large numbers of poor job seekers and the business hub of the immediate area. Some 6% of the population have no formal income at all, while a further 4% earn less than R4 800 per annum, or R400 per month. The majority of households earn between R19 000 and R76 000 per annum, while a substantial number (29%) earn between R76 000 and R307 000.

2.16.4. HOUSING AND ACCESS TO BASIC SERVICES

2.16.4.1. Free State Province

A summary of service provision levels experienced in the Free State province is provided in Table 2-24. Of particular concern is the fifth of the population that resided in informal settlements in 2001, as well as the poor sanitation provision in the province, with a total of 48% of the population having to utilise a non-ventilated pit latrine, a bucket latrine or having no sanitation whatsoever.

TABLE 2-24 SUMMARY OF SERVICE PROVISION LEVELS (PERCENTAGES) IN THE FREE STATE PROVINCE IN 2001

Service Description	Free State Province
Brick dwelling on separate stand	60%
Informal Settlement	20%
Traditional dwelling	7%
Flush toilet connected to sewerage system	45%
Bucket latrine	21%
Pit Latrine (Non-ventilated)	17%
No Sanitation	10%
Piped water inside dwelling	23%
Piped water inside yard	48%
Piped water on community stand <200m away	14%
Piped water on community stand >200m away	11%

Source: Stats SA, South African Census, 2001

2.16.4.2. Ngwathe and Moqhaka municipalities

Most households in Ngwathe and Moqhaka live in formal houses or brick structures. However, a significant number of people live in shacks, largely in squatter settlements or in some cases within another property. This situation is particularly worrying in Ngwathe, where 20% of residents lived in an informal settlement in 2001.

In terms of housing and access to basic services, Ngwathe is generally worse off than Moqhaka. This is true of sanitation facilities where less people have access to flush toilets and more make use of bucket latrines. A significant concern within both local municipalities is access to proper sanitation methods. Almost half of all Ngwathe resents (43%) and close to a third of Moqhaka residents (32%) had to make use of a non ventilated pit latrine, bucket latrine or had no access to sanitation whatsoever in 2001.

In terms of water supplies, the majority of people in Ngwathe (86%) have access to piped water through either a tap in their yard or dwelling. However, a number of people also have to walk considerable distances to a communal tap to get water. Very few people use other sources of water for example a spring, river or pool of stagnant water. A similar pattern is evident in Moqhaka where 84% of homesteads have access to piped water via either a tap in their yard or dwelling.

The majority of houses have an electricity connection used largely for lighting, heating and cooking. However, there are still many houses without electricity as well as a number of households that use electricity for light purposes only, utilising an alternative energy source for cooking and heating. Paraffin is a common source of power for cooking while coal and wood are popular for heating.

A comparative summary of service provision levels in the two local municipalities is provided in Table 2-25.

TABLE 2-25 SUMMARY OF SERVICE PROVISION LEVELS (PERCENTAGES) IN THE MOQHAKA AND NGWATHE LOCAL MUNICIPALITIES IN 2001

Service Description	Moqhaka	Ngwathe
Brick dwelling on separate stand	76%	65%
Informal Settlement	9%	20%
Flush toilet connected to sewerage system	64%	51%
Bucket latrine	17%	23%
Pit Latrine (Non-ventilated)	11%	13%
No Sanitation	4%	7%
Piped water inside dwelling	29%	23%
Piped water inside yard	54%	63%
Piped water on community stand <200m away	8%	7%
Piped water on community stand >200m away	6%	5%

Service Description	Moqhaka	Ngwathe
Energy source for cooking: electricity	53%	45%
Energy source for cooking: paraffin	29%	25%
Energy source for cooking: wood	11%	8%
Energy source for cooking: coal	2%	16%

Source: Stats SA, South African Census, 2001

2.16.5. SOCIAL INFRASTRUCTURE

2.16.5.1. Moqhaka and Ngwathe Municipalities

2.16.5.1.1. Education and Schools

The educational profile for both Moqhaka and Ngwathe is poor. Of particular concern is that at least 43% of Moqhaka and 48% of Ngwathe's adult populations could not be described as functionally literate and numerate (in possession of at least Grade 9) in 2001. A comparative summary of the educational levels in the two municipalities is provided in Table 2-26.

TABLE 2-26 EDUCATIONAL PROFILE FOR THE MOQHAKA AND NGWATHE MUNICIPALITIES IN 2001

Highest Educational Level Attained	Ngwathe	Moqhaka
No schooling	17%	10%
Some primary education	23%	23%
Completed primary education	7%	9%
Some secondary education	31%	32%
Grade 12 (matric)	16%	19%
Higher education	5%	6%

Source: Stats SA, South African Census, 2001. Educational categories as supplied by StatsSA.

Table 2-27 illustrates existing schools in the Moqhaka and Ngwathe municipalities (excluding farm schools). The number of schools in urban areas is provided according to set standards. No need is therefore experienced in this regard. The real need is experienced with regard to the infrastructure (buildings and classrooms) of the existing schools.

TABLE 2-27 SCHOOLS IN MOQHAKA AND NGWATHE MUNICIPALITIES

Local Municipal Area	Urban Area	Number of Primary Schools	Number of Secondary Schools	Teacher / Pupil Ratio
Moqhaka	Kroonstad	4	5	33.8
	Brentpark	1	1	32.8
	Maokeng	16	7	35.4
	Viljoenskroon	1		31.8
	Rammulotsi	6	4	34.6
	Steynsrus		1	31.2
	Matthwangtwang	3	1	23.6
Ngwathe	Parys	1	1	33.8
	Schonkenville	1		33.9
	Tumahole	10	4	36.2
	Vredefort	1	1	32.0
	Vredeshoop	1		29.4
	Mokwallo	3	2	36.8

Source: Northern Free State Integrated Development Plan

2.16.5.1.2. Medical services

District hospitals are available in Kroonstad (for Ngwathe Municipality) and in Parys (for Moqhaka Municipality). Table 2-28 illustrates the distribution of medical services and the ratio between these services and the population.

TABLE 2-28: DISTRICT PROVISION OF HOSPITALS, CLINICS AND COMMUNITY HEALTH CENTRES

Level	Moqhaka	Ngwathe
Hospital	Boitumelo Hospital	Parys Hospital Heilbron Hospital
Fixed Clinics	8 Fixed Clinics	10 Fixed Clinics
Community Health Centres	2 Community Health Centres	2 Community Health Centres
Ratio	Clinic / CHC Population Ration 1:17 987	Clinic / CHC Population Ration 1:11 882

Source: Northern Free State Integrated Development Plan

2.17. INTERESTED AND OR AFFECTED PARTIES

2.17.1. IDENTIFICATION OF INTERESTED AND / OR AFFECTED PARTIES

2.17.1.1. Parties that will be affected

During October 2003 a social survey was conducted on the farms directly bordering the proposed mining development (Belmont 2390 and Welvaart 1011). In addition to the farmers and their families, the survey also identified 16 farmworker households residing on these properties. Interviews were conducted to gather baseline information on the socio-economic situation of these farmworker communities. During the survey it was determined that the language of preference amongst the farmworker communities was South Sotho.

During April and May 2004 the social scan was expanded to include neighbouring farmers and tenants, specifically along the access roads to the mine (S156) and along the road between the mine and the weir on the Renoster River. Where possible these farmers were visited personally, however since all were not available when the fieldwork was conducted, telephonic and postal communication had to be relied on in some cases.

The local farmers are organised in through the Heuningspruit Farmers Association, as well as the Renosterkop Study Group (with an interest in conservation issues). Both these organisations have been invited to participate in the EIA.

2.17.1.2. Parties that have an interest in the project

The following regulatory authorities were identified in consultation with the Free State Department of Minerals and Energy (FS DME):

- The Free State Department of Water Affairs and Forestry (FS DWAF);
- Free State Department of Tourism, Environmental & Economic Affairs (FS DTEEA);
- Department of Agriculture, Free State Directorate.

Other authorities that may have an interest in the EIA were also contacted and invited to participate:

- National Department of Environmental Affairs and Tourism: Regional Air Pollution Control Officer – Free State;
- Free State Department of Land Affairs;
- South African Heritage Resources Agency;
- Free State Department of Health
- Free State Department of Public Works, Roads and Transport.

The following local authorities were contacted and informed of the proposed project and EIA process, and invited to assign representatives to participate:

- The Northern Free State District Council;
- Moqhaka local municipality;
- Ngwathe local municipality (Voorspoed Mine lies on the border between the two local municipalities).

The following non-governmental organisations that may have an interest in EIA were contacted and invited to participate:

- The Wildlife and Environment Society of South Africa;
- Earthlife Africa;
- Environmental Justice Network Forum.

The list of registered interested and / or affected parties for the Voorspoed EIA is included as Appendix 18.

2.17.2. PROCEDURE FOR PUBLIC INVOLVEMENT

2.17.2.1. Background information document

A background information document (BID) in the form of an information booklet was forwarded to all interested and / or affected parties (IAPs) on the public involvement database by post, e-mail or fax. A copy of the BID is included as Appendix 1 of the *Voorspoed Scoping Report* (Appendix 15 of this EIA report). The purpose of the BID was to provide IAPs with information on the proposed project and the EIA process.

2.17.2.2. Notification of scoping meeting

IAPs were notified of the public scoping meeting through direct contact with people in the IAP database and through advertisements and notices. All IAPs on the database were sent invitations to the public scoping meeting either by e-mail, fax, post or telephonically.

An advertisement was placed in The Citizen and Volksblad newspapers on 05 June 2004 as well as in the local Kroonnuus newspaper on 08 June 2004. Copies of the advertisements as it appeared in the newspaper are attached in Appendix 2 of the *Voorspoed Scoping Report* (Appendix 15 of this EIA report). Both Metago and De Beers received several responses to the advertisement prior to the public scoping meeting.

A poster (laminated A1 size) notification in English was erected on 14 June 2004 at the gates to Voorspoed Mine, on road S156.

2.17.2.3. Scoping stage meetings with regulatory authorities

2.17.2.3.1. Pre-application meeting

A pre-application meeting and site visit was scheduled in May 2004 with all the regulatory authorities identified in Section 2.17.1.2 to discuss the application. The purpose of the site visit was to familiarise regulatory authorities with the project and site area. The objectives of the meeting were to inform regulatory authorities of the proposed re-opening of the diamond mine at Voorspoed, the EIA process, and to hear and record comments on the development, EIA process and environmental permissions that may be required. The minutes of the meeting are included as Appendix 3 of the *Voorspoed Scoping Report* (Appendix 15 of this EIA report).

2.17.2.3.2. Scoping meeting

All regulatory authorities identified in Section 2.17.1.2 were invited to attend a scoping meeting on 7th July 2004. Metago provided feedback on the scoping process to date and the issues identified by IAPs. The authorities provided comment on the draft scoping report. Minutes of the meeting are included as Appendix 6 of the *Voorspoed Scoping Report* (Appendix 15 of this EIA Report).

2.17.2.4. Scoping stage meeting with IAPs

A general public scoping meeting was held on 24 June 2004 at the Kroonpark Convention Centre. The meeting and the preceding afternoon open session were well attended. Most IAP groups were represented. A record of the meeting is presented in Appendix 4 of the *Voorspoed Scoping Report* (Appendix 15 of this EIA Report). A focus group meeting for information sharing and issue scoping (facilitated by a translator) was held with the farmworker communities from the farms Belmont 2390, Welvaart 1011 and Urbannus 681 on 28 June 2004. Due to their language preference (South-Sotho) a separate meeting with these communities was appropriate, since facilitation of the general public meeting was in English and Afrikaans only. A record of the meeting is presented in Appendix 5 of the *Voorspoed Scoping Report* (Appendix 15 of this EIA Report).

2.17.2.5. Publication of the Scoping Report

Copies of the draft scoping report have been distributed to regulatory authorities for review, as well as the Moqhaka and Ngwathe local authorities and Northern Free State district municipality. Copies of draft scoping report have also been made available for public review at the Kroonstad and Tswelopele public libraries.

Copies of the final scoping report have been made available for review at the Kroonstad and Tswelopele public libraries.

2.17.2.6. Reporting stage meetings

2.17.2.6.1. Feedback meeting to present draft EMP to regulatory authorities

A feedback meeting was held on 11 November 2004 with all the regulatory authorities identified in Section 2.17.1.2 to discuss the draft EMP. Copies of the draft EMP were distributed to all regulatory authorities for review prior to the meeting. Minutes of the meeting is included as Appendix 16.

2.17.2.6.2. Feedback meeting to present draft EMP to IAPs

A feedback meeting was held on 24 November 2004 for all IAPs to discuss the draft EMP, preceded by an open session for information sharing. Copies of the draft EMP were made available for review prior to the meeting. Minutes of the meeting is included as Appendix 17.

2.17.2.7. Publication of the draft EMP report

Copies of the draft EMP report have been distributed to regulatory authorities for review, as well as the Moqhaka and Ngwathe local authorities and Northern Free State district municipality. Copies of draft EMP report have also been made available for public review at the Kroonstad and Tswelopele public libraries and at Mr George Leonard's farm Belmont.

Copies of the final EMP report will be made available for review at the Kroonstad and Tswelopele public libraries.

2.17.3. ISSUES RAISED BY THE REGULATORY AUTHORITIES

The main comments and concerns raised by regulatory authorities pertained to:

- The assessment and authority approval processes for the various environmental approvals for the mine. The processes will be integrated as far as possible. The environmental authorisations required are listed in Table 1 on page 12 of the *Voorspoed Scoping Report* (Appendix 15 of this EIA Report).

- A wetland specialist assessed the area indicated as a wetland on Voorspoed 401. The classification of the area as a wetland was confirmed and consequently the wetland is regarded as a "no-go" area in terms of infrastructure development by the project team. Surface infrastructure layout option 1 indicated on Figure 4 of the *Voorspoed Scoping Report* (Appendix 15 of this EIA Report) is therefore not considered a feasible infrastructure location alternative from an environmental point of view.

- Subsequent to the meeting DTEEA also raised concern over the presence of pans in the area under consideration for surface infrastructure option 3 indicated on Figure 4 of the Voorspoed Scoping Report (Appendix 15 of this EIA Report). [See Appendix 7 of the *Voorspoed Scoping Report* (Appendix 15 of this EIA Report)].

2.17.4. ENVIRONMENTAL ISSUES IDENTIFIED BY IAPS

Environmental issues may be:

- Definable impacts e.g. air pollution.
- The cause of an impact (e.g. seepage from the ultra fines residue facility).
- A generally expressed concern (e.g. social disruption of communities).

The environmental issues or questions identified by the authorities and IAPs during the scoping process is summarised in Table 2-29.

TABLE 2-29 ISSUES RAISED BY IAPS

Issues	Questions or Comments
Biophysical components	
Fauna	What will impacts of mining activities, specifically blasting, be on the wildlife and bird life using Renosterkop as habitat? What are the potential impacts of dust generated by the mine on vegetation and grazing animals? Could the mine assist in local nature conservation efforts for example of through fencing off Renosterkop?
Flora	How can the pristine environment on Renosterkop be protected? There has been a very conscious attempt by the Renosterkop farming community to do various things to improve nature conservation in the area. There is a serious concern that the mining activities will negatively impact on these attempts.
Groundwater	Concern was expressed by IAPs regarding the potential impacts of pit de-watering and seepage from the residue disposal dumps on the ground water quantity and quality on neighbouring properties. What chemicals will be used in the plant process that could potentially seep into ground water from the mine residue storage facilities? Could pit dewatering cut off ground water flow to neighbouring properties? What is the connection between the ground water aquifers found on the mine and neighbouring farms? Will farmers receive compensation (provision of alternative water) if their boreholes were affected by mining activities, and for how long? What will the effect of the mine's sewage plant be on ground water quality? What will be done with the treated sewage effluent? How will the mine's solid waste be disposed of?
Surface water	What will the impacts of mine infrastructure on surface hydrology be? How will the development affect dams down-stream of the mine site? What preventative measures will be in place to contain and clean up spillages of chemicals used within the plant or mine? Regarding the proposed source of makeup water for the plant (Koppies Dam) concern was expressed that there is not enough water in the dam to provide for the mine's needs, and that the dam is currently over allocated / utilised. Were filter press technology being considered for mine residue disposal due to its water saving potential? Mr Gunter (Gelukkopje 194) utilises water from the Heuningspruit River for irrigation agriculture. The confluence of the Heuningspruit and Renoster Rivers is just upstream of the De Beers dam. Mr Gunter expressed concern that water abstraction from the De Beers Dam will cause the water level in the river to drop, making it difficult or impossible to abstract water from the Heuningspruit.
Ecological systems	What will the impact of the mining development be on the wetland located on Voorspoed 401?

Issues	**Questions or Comments**
Topography	How will the mine residue storage facilities alter the local topography?
Air quality	What will the impacts of mining on air quality be?
Socio-economic components	
Noise	What standards are used for noise assessment in a rural area as opposed to an urban area? What level of noise impacts will be generated by the mine's trucks? Will the neighbouring farms be included in the noise impact assessment? How intense will the noise generated by blasting be?
Visual impacts	What will the impacts of the mine's lights at night be?
Traffic	What will be the preferred access route to the mine? Will the route be tarred or upgraded? Will an airstrip, helipad or both be used? Is the mine going to use its own transport to transport workers to and from the mine? The diversion of the road around the pit will have a negative effect on the neighbouring farmers. Are there alternatives?
Safety	How will the communities living along road S156 be affected by the increase in traffic to the mine?
Property value	Concern was expressed by neighbouring farmers that the mining development could negatively impact on the property values of their farms. There is also the concern that certain neighbouring farms will become unviable as an economic unit. Many improvements have been done on the farm Voorspoed over the years that the Leonard family has rented this land. Will they be compensated for this?
"Sense of place"	What will the impact of the development on the rural character of the landscape be?
Cultural sites	What facilities will be established at the mine site? Will recreational facilities be established at the mine site? Will a hospital or clinic be established at the mine?
Historical sites	How will the graves on the site be dealt with?
Possible effects on human health	Will there be a health risk to surrounding communities as a result of poor air quality?
Employment	Where will the mineworkers come from? How many people will be employed? Will employment opportunities be available to local people and to women? Will the mine invest in training and capacity building of local people? What percentage of employees will be at management level? Where will the recruitment office for the mine be located? How will IAPs be informed of the job application procedure through the recruitment office? Will people with no mining experience be able to work on the mine? Farmers expressed concern that they will lose workers with machine and equipment experience to the mine. Concern was expressed that some farm workers in Koppies may lose their jobs if farmers sell their water rights to De Beers.
Housing	Where will the mineworkers be housed? How will housing be obtained? What can be done to prevent illegal informal settlements developing on neighbouring farms? What can be done to prevent mineworkers from living in or renting rooms from neighbouring farmworker communities? Will the mine provide recreational facilities for its employees? Will the establishment of the mine require any villages or communities to be relocated?
Local economic	Will De Beers add value by cutting diamonds or export raw diamonds? Will

Issues	Questions or Comments
development	the IDP platform as set up by local municipalities be incorporated in the planning of the mine? How can the mine benefit local businesses? Can the mine contribute to local upliftment programs for issues such as nutrition and housing?
Crime	Could the mine lead to an increase in crime i.e. diamonds smuggling? Will the mine join the farm neighbourhood watch? Could the establishment of the mine lead to an increase in theft?
BEE	How will the mine identify equity partners and how will Kroonstad benefit from this? Will the mine support the development of SMEs, e.g. through a programme to train local youth in the art of diamond cutting and jewellery making?
Other significant environmental issues	
HIV / AIDS	Concern was expressed regarding the potential interactions between the mineworkers and local farmworker communities, specifically with regard to the risk of the spread of HIV infection.
Mine closure	What happens after the mine has reached its maximum potential and closure is imminent?
EMP	Will the mine still continue to operate if it is found noncompliant with the EMP?
Blasting	What will the effect of blasting be on land features and surface infrastructure surrounding the mine?
Procedural issues	How will the information and findings of the specialist studies be disseminated once all the studies have been completed? How can the specialists collect accurate and adequate data during such short interval time to study the area? How independent are the specialists and what recourse does the public have with regard to the process?

FIGURE 2-15: AVERAGE ANNUAL ECONOMIC GROWTH 1995 – 1991

Source: Stats SA, Discussion Paper: Gross Domestic Product Per Region 1995 – 2001

FIGURE 2-16: SECTORAL CONTRIBUTION TO FREE STATE GDP 1995 – 2001

Source: Stats SA, Discussion Paper: Gross Domestic Product Per Region 1995 – 2001

FIGURE 2-17: DERIVED INCOME IN NGWATHE AND MOQHAKA RESIDENTS, 2001

Source: Stats SA, South African Census, 2001

FIGURE 2-18: DERIVED HOUSEHOLD INCOME FOR KROONSTAD RESIDENTS, 2001

Source: Stats SA, South African Census 2001

3. MOTIVATION OF PROPOSED PROJECT

3.1. BENEFITS OF THE PROJECT

3.1.1. WHERE IT IS INTENDED THAT THE PRODUCT WILL BE SOLD

De Beers markets its entire production of rough diamonds through the Diamond Trading Company (DTC). DTC supplies more economically cuttable diamonds to the South African cutting and polishing industry than are actually mined in South Africa.

The Diamond Developing Company – Diamdel, a De Beers company, was established in 1986 to support, supply and develop the SA diamond industry. In 2003 Diamdel had 159 clients, an increase of 173% since 1992. Its clients, small cutters and polishers, employ 586 people, more than 25% of all jobs in the industry.

3.1.2. ESTIMATE OF THE EXPENDITURE TO BRING THE PROJECT INTO PRODUCTION

The total expenditure to bring the project into production is estimated at R 6 695 million.[1]

3.1.3. ESTIMATE OF THE TOTAL ANNUAL EXPENDITURE AT FULL PRODUCTION

Annual expenditure would be approximately R 560 million, based on a cost of R139.87 per ton treated and annual production of 4 million tons.

---

[1] Financial and employment estimates are taken from the Prefeasibility Study, and may be revised during the Feasibility and Design stages of the project. Estimates are dependent on the diamond price and exchange rates.

3.1.4. ESTIMATE OF THE EMPLOYEE STRENGTH AT FULL PRODUCTION

The estimated staff requirements of Voorspoed are as follows:

- Mining: 172 people
- Plant: 136 people
- Support: 70 people
- Total: 378 people

During the construction period an estimated contractor workforce of 500 people will be employed. During the operational stage approximately 8 contractors will supply services to Voorspoed on a regular basis. These 8 companies may provide employment to approximately 80 people.

These estimates are based on the prefeasibility study estimates and may need to be revised during the completion of the feasibility and design stages of the project.

3.1.5. ESTIMATE OF THE MULTIPLIER EFFECT ON THE LOCAL, REGIONAL AND NATIONAL ECONOMY

The Voorspoed project will have a significant positive socio-economic impact on the regional and national economies for the reasons given below:

- Provision of employment.
- A large capital investment and substantial offshore revenue generation.
- A large amount of money paid out locally in the form of the company payroll (approximately R 530 million over the life of mine).
- Significant amounts of money to be paid to the government in the form of taxes (approximately R1 193 million over the life of mine).
- Creation and support of service sector jobs, the procurement of large quantities of consumables annually and the outsourcing of service provision to local service providers.

3.2. CONSIDERATION OF PROJECT ALTERNATIVES

3.2.1. MINING METHOD

The Voorspoed resource will be mined in a conventional open pit manner, utilising normal drill and blast techniques.

Waste rock and kimberlite ore will be blasted, loaded by 250 t hydraulic face shovels into 150 ton haulage trucks, and hauled from the pit to the waste or run of mine stockpile. A waste rock dump will be created along the pit boundary to receive waste rock removed from the pit to access the kimberlite ore. The kimberlite ore will be stockpiled adjacent to the plant for treatment.

FIGURE 3-1 MINING SHELLS DIAGRAM

FIGURE 3-2 MINING SHELLS PLAN

3.2.2. MINERAL PROCESSING METHOD

The diamond extraction process is primarily physical as opposed to chemical: the kimberlite ore is crushed, screened and washed to liberate the diamonds. Ferrosilicon (FeSi), a generally benign substance (in the quantities and under the conditions used) is used in the dense media separation treatment process to separate out diamond bearing material. The plant process is described in more detail in Section 4.3.3.

Alternative technologies were considered to recover water from the fines residue: paste thickening and filter pressing.

Paste thickening has the potential for significant water savings, but limits the options for the infrastructure layout of the fines residue disposal facility. The thickened paste residue cannot be pumped over great distances (more than 2 km) without incurring significant costs for expensive pumping equipment. Conventional fines residue can be pumped at much greater distances (up to 6 km). Note that these distances are dependent on the character of the fines residue and the type of pumping systems used - these distances relate to pumping systems that were considered fit for purpose and cost-effective for Voorspoed.

Filter pressing can further increase the water recovery from the fines residue, and can be disposed of by conveyor together with the coarse residue stream. In addition to the increased water recovery, filter pressing of the fines residue has the benefit of doing away with the need for a separate fines residue disposal facility, decreasing the total footprint of the mine residue disposal dumps.

Test work was conducted to consider the suitability of the fines residue from the Voorspoed kimberlite for the above technologies.

3.2.3. TRANSPORT, POWER AND WATER SUPPLY ROUTES

The access roads to the mine are illustrated in **FIGURE 3-4**. Access to the mine will be from the west via the S 156 gravel road from the R76 between Kroonstad and Viljoenskroon, and from the east via the S 169 gravel road from the R721 between Kroonstad and Vredefort. A section of the existing gravel road S 156 falls within the extent of the final pit and would have to be rerouted. The proposed rerouting will be to the south of the pit, outside of the blasting zone. The proposed alignment of the rerouted S 156 is illustrated in **FIGURE 2-3** and **FIGURE 3-4**.

Power will be supplied to the mine by ESKOM from its Grootkop – Mercury 132 KV line. Power will be distributed at 11 kV, 3 phase, 50Hz. The powerline route is being determined by ESKOM, who will conduct a separate EIA for the powerline. The powerline will enter the mine from the eastern side, as indicated on Figure 4-1. The power lines and pylons will not cross the wetland on Voorspoed 401.

3.2.3.1. Water supply from Koppies Dam

The makeup water requirement for the process plant is approximately 2, 55 million m^3 per annum. This number includes all plant water uses, such as dust management systems and flocculant / coagulant make-up, as well as potable water use and contingency provision. This water will be sourced from the Koppies Dam. The location of the Koppies Dam relative to the mine is illustrated in Figure 1-1. Water will be released from the Koppies Dam into the Renoster River, and abstracted at the existing De Beers owned weir 76 km further downstream on the river. The weir is located approximately 20 km north of the mine. A pipeline will be constructed between the weir and the mine to transport the water to the mine. The preferred pipeline route is illustrated as alternative 1 in Figure 3-3.

FIGURE 3-3 ALTERNATIVE WATER SUPPLY ROUTES

FIGURE 3-4 TRANSPORT ROUTES

3.2.4. SOURCES OF WATER

During the mine's prefeasibility studies a number of potential water sources were identified:

The Koppies Dam was identified as the preferred water source for plant makeup water, and borehole water at the site as the preferred source for potable water. Regional groundwater structures were investigated in more detail as supplementary water sources.

The potential water loss to the Renoster River through seepage and evaporation, estimated to be as high as 40%-60%, has been identified as a significant risk for this water transport method. In order to address this risk two alternative or supplementary water sources were considered:

- Constructing a pipeline directly from the Koppies Dam to the mine. Should a decision be made to proceed with this option, additional public involvement and impact assessment work would have to be done.
- A hydrocensus within a 30km radius of the mine be undertaken to identify any potential bulk water supply sources not identified to date. Three regional features were identified for further investigational work, namely:
    a. The regional feature, some 6km South of Voorspoed.
    b. The regional Malmani Dolomite Aquifer north of the De Beers owned weir at Junction on the Renoster River.
    c. The groundwater aquifer in the vicinity of Witkop Colliery, approximately 10 km north of the mine.

Geohydrological investigations confirmed that the Malmani Dolomite Aquifer and the groundwater source at Witkop Colliery could be viable supplementary water sources for the mine. During the course of the feasibility study DWAF was approached to discuss the assurance of water supply from Koppies Dam. Concern regarding assurance of supply was expressed from the project team in response to the low dam levels observed at Koppies (as a result of drought conditions experienced in the region). DWAF Water Resource Planning (WRP), who developed the initial storage model for the dam, conducted a further set of analysis to model water supply from the Koppies Dam at a higher level of accuracy. Initial results of the modelling indicate that:

- Although the dam levels were very low, they were still within the range (although at the bottom end) predicted by the model (i.e. the model's predictions correspond to the observed dam levels).
- Providing for an estimated 50% losses to the Renoster River, Koppies Dam as sole water source can provide in the mine's water requirement at a 98% assurance level if De Beers acquire approximately 800 hectares of water rights from the dam.

The project is therefore proceeding on the basis of Koppies Dam as sole water source, with the water being transferred to the mine via the Renoster River, and piped from the weir at Junction on the Renoster River to the mine (refer to Figure 3-3 for the proposed pipeline route). Should problems with the assurance of water supply be experienced, groundwater sources may be developed to supplement the water supply. (Should a decision be made in future to develop regional groundwater resources, the public would be consulted as part of an EIA for the proposed water use.)

3.2.5. MINE INFRASTRUCTURE SITES

The surface infrastructure layout of the mine had to be designed within the constraints of Voorspoed being a marginal mine from an economic point of view. The site layout options therefore had to be optimised to reduce capital and operational costs.

3.2.5.1. Identifying general areas for mine infrastructure development

The general areas considered for the placement of mine surface infrastructure (illustrated in Figure 3-9) were:

- Northwest of the existing open pit on and around the wetland on Voorspoed 401 ("no go" area on Figure 3-9).
- West of the existing open pit between Renosterkop and the wetland ("avoid if possible" area on Figure 3-9).
- North of the existing open pit along the northeastern boundary of the site ("go" area on Figure 3-9).

The main considerations for identifying these general mine infrastructure location areas were:

1. *Areas of sufficient size* have to be identified to accommodate the footprint of the plant and the mine residue disposal facilities.

2. *The footprint of the mine has to be minimised.* Voorspoed is a marginal mine from an economical point of view and a compact, efficient site layout is a key requirement to keep operational costs down. Key variables in determining operational costs are the distances trucks have to haul waste rock and ore, the distances that fine residue and return water have to be pumped, and to a lesser extent the distances that coarse residue has to be conveyed.

From an economic point of view an optimal site layout would be:

- The waste rock dump located on the perimeter of the final extent of the open pit, within the blasting zone, thus minimising the distance that trucks have to travel to haul waste rock.
- The plant located just outside of the blasting zone, as close to the access ramp to the pit as possible.
- The fine and coarse residue storage facilities located as close to the plant as possible to minimise pumping and conveying distances. An important factor here is the maximum distance between the plant and the farthest point of the Ultra fines disposal facility, measured along the perimeter of the Ultra fines disposal facility (which represents the maximum pumping distance).

During the scoping stage of the EIA and in initial discussions with the regulatory authorities, the wetland located on Voorspoed was identified as a no-go area for development of mine infrastructure due to the conservation importance of the wetland. This ruled out the site layout option that had the fine and coarse residue storage facilities located on and around the wetland.

The site layout option which had the fine and coarse residue storage facilities located to the west of the existing open pit would have avoided the wetland, but would have had significant indirect impacts on the wetland by cutting off its surface water flow. In addition this option would have sited the mine infrastructure in close proximity to the pristine habitat of Renosterkop. The available surface area of this option is also limited, being squeezed between the wetland on the one side and Renosterkop on the other.

This left the area north of the open pit and along the eastern boundary of the site to explore. This area is big enough to accommodate all the mine residue disposal facilities, but has the following drawbacks:

- Two pans are located here, which are of high conservation importance.
- A number of geophysical faults are located here.
- This area places the development of mine infrastructure closest to the mine's neighbours on Belmont and Welvaart.

The faults were investigated as part of the geohydrological specialist investigations for the Voorspoed EIA. Boreholes were drilled into the faults and tested. Borehole tests yielded less than 1 L/s and verified that the aquifer has a low permeability and transmissivity. The faults need therefore not be considered a constraint to the placement of mine infrastructure.

Given the relatively small size of the pans, infrastructure development could take place around them.

Locating the mine infrastructure north of the open pit will increase the potential disturbance through nuisance factors such as noise and dust to the mine's neighbours located on Belmont and Welvaart. However, these communities and farmsteads are still located at least 500 m from the boundary of the mine. At this distance, with proper mitigation measures in place, it is likely that disturbance from mining activities will be within acceptable and legal limits.

The "go" area indicated on Figure 3-9 was therefore selected as the preferred zone for infrastructure development. The next section discusses the options for the plant and mine residue disposal facilities within this zone.

3.2.6. MINE RESIDUE DISPOSAL SITES

Within the general zone identified for mine infrastructure, the layout was determined as follows:

3.2.6.1. Plant and waste rock dump

The waste rock dump has to be located along the perimeter of the final extent of the pit to minimise the haulage costs of transporting the waste rock. The waste rock dump is located along the southern and eastern extent of the pit since the available space for the development of the plant and mine residue deposits are towards the north.

The plant is located north of the open pit, just outside of the blast zone, adjacent to the buffer zone around the wetland. This layout allows the maximum space towards the north and east for placement of the mine residue disposal facilities.

3.2.6.2. Fine and coarse residue storage facilities

Three alternative layouts were developed for the fine and coarse residue storage facilities, illustrated in Figure 3-5, Figure 3-6 and Figure 3-7. The preferred layout alternative is illustrated in Figure 3-7.

The main considerations for identifying these layout alternatives were:

1. *The footprint of the mine has to be minimised.*
2. *Reducing the amount of makeup water required for the plant is a high priority*. Opportunities for recycling water should be maximised. Various technologies for optimising water recovery and recycling within the plant were tested to determine their suitability to treat the Voorspoed kimberlite (refer to Section 3.2.2).

3.2.6.2.1. Layout options for a conventional fine residue disposal system

If a conventional fine residue disposal system were to be used, the fine residue storage facility should be located just north of the plant (refer to Figure 3-5). The fine residue storage facility is the main source of potential ground water contamination at the mine and it would be ideal to locate this facility as far from the borders of the property as possible, to reduce the probability of ground water contamination of neighbouring boreholes.

Locating the resource tailings facility on the eastern boundaries of the mine site has the advantage that the facility would act as a screen, reducing dust, noise and light emissions from the plant and fine residue storage facility.

Given the conservation importance of the pans, the alternative of moving the fine residue storage facility north of the northern pan had to be considered as well (refer to Figure 3-6). This option would have higher operational costs associated with it, given the increased pumping distances, but with a conventional fine residue disposal method this is still a reasonable alternative. The maximum pumping distance is still within acceptable limits (of the pumping system considered fit for purpose and cost-effective for Voorspoed).

The two layout options for a conventional fine residue storage facility were however not subjected to a detailed cost comparison, since test work confirmed that the most appropriate water saving technology to treat the Voorspoed fine residue was paste thickening.

3.2.6.2.2. Layout options for a paste thickening residue disposal system

Paste thickening is much more efficient at recovering water from the fines residue prior to disposal than conventional methods. Instead of slurry, the fines residue is disposed of as thick paste. This method of treatment and disposal of fines residue has been successfully tested at other De Beers mines.

With a conventional disposal system the walls as well as the inside of the fine residue storage facility are built out of fine residue. With a paste disposal system, paddocks are constructed by building containment walls with waste rock. The paste is then disposed of inside these paddocks.

This method of disposing of fines residue has a number of advantages:

- Since water is recovered from fines residue much more efficiently, a drier product is deposited on the fines residue facility, reducing the amount of seepage to groundwater and the potential for groundwater contamination.
- The fines residue takes up less volume (due to the water recovery) and because the paddock walls can be built higher with the waste rock, the overall footprint of mine residue storage facilities is smaller.
- The thickened paste does not flow as easily as conventional fines residue slurry. Combined with the containment walls constructed out of waste rock, a very stable fine residue storage facility is constructed.

Since the containment walls are constructed of waste rock, the fines residue storage facility for paste thickening should be located as close as possible to the access ramps to the open pit, in order to minimise the costs associated with the haulage of waste rock. The preferred layout for this residue disposal option is illustrated in Figure 3-7.

FIGURE 3-5 MINE RESIDUE DISPOSAL ALTERNATIVE 1

FIGURE 3-6 MINE RESIDUE DISPOSAL ALTERNATIVE 2

FIGURE 3-7 MINE RESIDUE DISPOSAL ALTERNATIVE 3

3.2.7. DOMESTIC AND INDUSTRIAL WASTE DISPOSAL SITES

No waste disposal site will be developed on site. All waste, general and hazardous, will be collected, separated and removed by a contractor for disposal in appropriately licensed solid waste disposal facilities

3.2.8. HOUSING SITES

All staff is to be housed in Kroonstad.

3.2.9. LAND USE OPTIONS AFTER REHABILITATION

With the exclusion of the surface of the mine residue storage facilities, the open pit and the storm water dams, the rest of the mine site will revert to its pre-mining land use. The land use would be agriculture. Dryland crops could be planted in the areas with arable soils, and grazing practised in the remainder. Refer to Figure 3-8

The mine residue storage facilities will revert to wilderness land use. The open pit will fill up with water. It will essentially be a dormant mine area, but given the magnitude of the open pit at its final extent the area around the mine might have tourism potential after mine closure.

FIGURE 3-8 POST CLOSURE LAND USE

3.2.10. LAND USE ALTERNATIVES TO THE MINING DEVELOPMENT

Should the mining development not go ahead, the land use alternative at Voorspoed will remain agricultural use: dry land crops and livestock grazing.

3.2.11. THE NO PROJECT OPTION

The no-project option implies that De Beers does not develop the Voorpsoed Mine. The advantages and disadvantages of this option are listed below.

- The Voorspoed ore body may never be mined. De Beers is a company with distinctive expertise in bringing diamond deposits into operation. Given the marginal nature of the Voorspoed kimberlite resource, it is unlikely that smaller mining companies would be interested or able to successfully mine the Voorspoed mineral deposit.

  - De Beers has made a substantial investment in the Voorspoed resource and will not be able to turn this to value for its shareholders. This can in turn impact on the perceived value of the company.

  - The socio-economic benefits of mining the Voorspoed ore body may never be realised. As outlined in Section 5.15, these benefits include:

  - Provision of employment to a large number of people.

  - A large capital investment and substantial offshore revenue generation.

  - A large amount of money paid out locally in the form of the company payroll.

  - Significant payments to the government in the form of local, regional and national taxes and levies.

  - Creation and support of service-sector jobs, the procurement of large quantities of consumables annually and the outsourcing of service provision to local service providers.

  - Development and implementation of a social-investment programme in the project area by De Beers.

- The main negative impacts of the project would not occur as outlined below.

- There would be no mining operation to detract from the scenic and aesthetic quality of the area. If the mine is developed, fine and coarse residue storage facilities, waste rock dump and open pit will remain will remain as permanent features in the landscape. Careful rehabilitation of disturbed land and the mine residue storage facilities will help to mitigate this impact.
- There would be no loss of arable land. About 530 ha of arable land would be permanently lost at the site of the mine residue storage facilities and open pit if the mine were developed. Currently, less than half the site is cultivated and the rest is utilised for livestock grazing.
- The risk of disturbance of plant and animal habitats of conservation importance in the vicinity of the ore body would be reduced. De Beers has planned the mine and sited mine infrastructure so as to avoid sensitive plant and animal habitats and wetlands. Management measures will however need to be implemented throughout the life of the mine prevent degradation of nearby sensitive habitats and wetlands.

All of the other impacts of the mine that have been identified are potential impacts that can be prevented or reduced to acceptable levels through management. While some of these require careful monitoring to check that the management measures are effective and to ensure that additional remedial measures are implemented without delay, if required, it is not appropriate to assign these as merits of the no-project option.

FIGURE 3-9 PREFERRED ZONE FOR INFRASTRUCTURE DEVELOPMENT

4. DETAILED DESCRIPTION OF THE PROPOSED PROJECT

4.1. SURFACE INFRASTRUCTURE

4.1.1. ROADS, RAILWAYS AND POWERLINES

Refer to Figure 4-1.

4.1.2. SOLID WASTE MANAGEMENT FACILITIES

4.1.2.1. Industrial and domestic waste disposal sites.

No domestic or hazardous waste disposal sites will be developed at Voorspoed.

4.1.2.2. Mine residue disposal sites.

Refer to Figure 4-1.

4.1.3. WATER POLLUTION MANAGEMENT FACILITIES

4.1.3.1. Sewage plant location

A sequencing batch reactor sewage plant with a capacity of 90 m^3 per day will be used. This type of system has a simplified operation and minimises effluent nitrogen levels.

The plant consists of 2 above ground tanks, which has the benefits of good denitrification of sewage, a better settling sludge and significantly longer periods between waste sludge removal.

Sludge would be disposed of on the fine residue storage facility or used as fertiliser in surface rehabilitation. The sludge would be aerobic, 45 days old and essentially mineralised material. It would be fully devoid of the volatile odorous products associated with septic tank anaerobic sludge.

The sewage plant would be located to the northeast of the plant (Refer to Figure 4-1).

4.1.3.2. Pollution control dams, paddocks and evaporation dams

Runoff from the surface of the mine residue storage facilities will be collected in storm water drains and trenches around the perimeter these facilities and diverted to the storm water control dams. The trenches lead to settling ponds that overflow into the stormwater dam. These facilities are not lined since the waste classification of the fine residue did not indicate potential pollution problems.

4.1.3.3. Polluted water treatment facility

No polluted water treatment facility is required, since the waste classification of the fine residue did not indicate any potential pollution problems.

4.1.4. POTABLE WATER PLANT

A filter and chlorination plant will be included at the site of the potable water borehole(s). The plant will comprise an initial sodium hypochlorite dosing system followed by a flocculant and will be designed in accordance with SABS 0241.

4.1.5. PROCESS WATER SUPPLY SYSTEM

During the mine's prefeasibility studies a number of potential water sources were identified and evaluated. The Koppies Dam was identified as the preferred water source for plant makeup water, and borehole water at the site as the preferred source for potable water. Alternative or supplementary water sources were identified but not investigated in more detail, such as ground water from regional ground water sources in the vicinity of the mine.

4.1.5.1. Koppies Dam – make up water for plant

Under the Koppies Government Water Scheme, approximately 1700 ha of water rights are currently allocated for irrigation purposes amongst approximately 80 farmers of Koppies town. Not all water allocations are being actively used at present, and some farmers are struggling to utilise the water rights profitably (many of the water rights accounts are substantially in arrears). It was therefore assumed that a number of the water rights holders could potentially be in the market for selling their water rights. De Beers initiated negotiations with Koppies Dam water rights holders to acquire water rights for the mine. By February 2005 De Beers had acquired options to purchase water rights on 507 ha of water rights. The De Beers offer to purchase is still open and negotiations are continuing.

4.1.5.1.1. Studies required in support of water rights acquisition from Koppies Dam

No impact assessment is required for the trading of existing water rights from Koppies Dam. Metago has received a number of inquiries in this regard, and it is important to point out that an impact assessment would only be required where an application is made for a new water allocation (i.e. if De Beers were to apply to DWAF for an additional water allocation from Koppies Dam). The trading of existing water rights from Koppies Dam affects only who owns such water rights and does not change the existing allocation of water rights from Koppies Dam.

At this point in the project life cycle De Beers are seeking options to purchase water rights rather than outright purchase. Should the necessary approvals for the project be obtained and De Beers decide to take the project into the next phase, De Beers will make a decision on which options to purchase to exercise. The need for a social impact assessment (on the effects of the trading of water rights on farm labourers) would be determined at that stage, and incorporated into the water use license application if required. That may not be necessary if the sellers of water rights are not utilising these rights.

The Department of Water Affairs and Forestry (DWAF) has recently completed a study into water availability in the Koppies Dam catchment. DWAF developed a detailed water balance for the catchment and found that currently the water in the dam (approximately 1700 ha) is not over allocated. (For a discussion on the potential assurance of water supply from the Koppies Dam to Voorspoed Mine refer to Appendix 14.) This does not mean that water users from the dam will never experience interruptions in supply, but rather that the water resource is optimally utilised. There is a trade-off between assurance of supply and water allocation and cost. Converting water from agricultural to industrial use results in a reduction of water allocation per hectare (approximately 62%) and an increase in the cost of water per hectare, but the water is supplied at a higher assurance level. In practice the application of these principles ensure that the overall water demand on Koppies Dam remains the same regardless of whether water is applied for agricultural or industrial use.

4.1.5.2. Borehole water from Voorspoed – potable water

Potable water will be sourced from suitable boreholes on Voorspoed. The boreholes in the vicinity of Voorspoed are indicated on Figure 2-7. The water quality in borehole BH 17 is suitable for human consumption. This borehole would need to be tested to verify that it can deliver the required volume of water. The estimated potable water requirement of the mine is approximately 45 m^3/d.

4.1.6. MINERAL PROCESSING PLANT

The layout of the mineral processing plant is indicated on Figure 4-1.

4.1.7. WORKSHOPS, ADMINISTRATION AND OTHER BUILDINGS

4.1.7.1. Plant workshop

The plant workshop is a cladded building (40 m x 20 m) and includes offices for the workshop manager and space for three boilermakers, three fitters, two electricians, three technicians and nine helpers. It will be equipped with compressed air, fumed extraction for welders, an eyewash and shower. The equipment includes 2 x 5 ton electric hoists, welding machines and drilling machines.

4.1.7.2. Mine workshop

The mine workshop will be a cladded building 40 m x 20 m, including maintenance equipment, a 30 ton overhead crane, potable water, compressed air, welding plugs, three truck maintenance bays and also separate facilities for:

- Large boiler making/welding workshop for bucket repairs.
- One truck wash bay.
- Tyre and vehicle store.

4.1.7.3. Offices and change houses

The main plant and mine offices will cater for permanent administration staff. The main plant office includes a dining room and a training centre. The operating personnel are housed in offices located at the stores or workshops.

A first-aid facility is provided in the plant change room.

A change house for the plant is provided, sized at 322 m^2 for 120 people. The building includes a laundry, ablutions and first-aid.

The mine change house building is initially sized for three years at 300m^2 for 180 people. The building includes a laundry and ablutions. It will be expanded as the operational personnel increase.

4.1.8. HOUSING, RECREATION AND OTHER EMPLOYEE FACILITIES

All housing, recreation and other employee facilities will be provided in the Kroonstad town.

4.1.9. TRANSPORT

The Voorspoed the workforce will commute from the town of Kroonstad. On the basis of the proposed mine plan and numbers for the mine and plant personnel, three forty-seat buses are required for this purpose.

4.1.10. WATER BALANCE

A monthly water balance model for the overall Voorspoed Mine has been developed based on **average** monthly climatic data and operating conditions to determine **average** monthly inflows and outflows of water from the following facilities making up the Voorspoed Mine:

- the Ultra fines disposal facility (UFDF);
- the Resource Tailings Facility (RTF);
- the Plant;
- the Waste Rock Dump (WRD);
- the Open Pit
- associated water storage dams for the abovementioned facilities, Storm Water Control Dam (SWCD) and Raw Water Dam (RWD) and
- make-up water from the Renoster Weir.

4.1.10.1. Water balance design information and assumptions

The design information used for the overall monthly water balance is summarised in Table 4-1 and Table 4-2. Table 4-3 summarises the assumptions applied to, and the average monthly climatic data used in, the water balance model.

TABLE 4-1 INFORMATION USED FOR THE OVERALL WATER BALANCE FOR VOORSPOED MINE

Facility	Information provided
UFDF	• Ultra Fines Footprint area (Phase 2)– 645,306m^2 • Ultra Fines Catchment area (Phase 1 + miscellaneous areas)– 978,614m^2 • Interstitial lock up – 90% of ultra fines water • Seepage – 6.5% of ultra fines water • Slurry water – 80,445m^3/month • Evaporation – 3.5% of ultra fines water
RWD	• Surface area – 18,000m^2 • Capacity – 75,000m^3 • Facility is lined
RTF	• Footprint area (average of phase 1 and phase 4 footprint area) – 551,500m^2 • Interstitial lock up – 100% of resource tailings water • Slurry water – 37,995m^3/month
SWCD	• Surface area – 86,250m^2 • Capacity – 290,000m^3 • Mudrock lined
Open Pit	• Surface area (Average of start-up and LoM) – 441,047,m^2 • Seepage ingress into pit (average over LoM – 15,750m^3
Plant	• Surface area – 350,000m^2 • Total plant water requirement – 150,000m^3/month • Process losses (sewage, potable, dust suppression etc water) - 31,579m^3/month
WRD	• Surface area – 2,030,000m^2
Miscellaneous Catchment Areas	• Surface area – 250,000m^2

TABLE 4-2 ASSUMPTIONS APPLIED TO THE OVERALL WATER BALANCE FOR VOORSPOED MINE

Facility	Assumptions
UFDF	• Pool area – 0% of foot print area, • Wet beach area – 25% of UFDF • Dry beach area – 75% of UFDF • Runoff coefficient for dry beach area o Rainfall < 10mm/month - 0 o Rainfall > 10, < 50mm/month – 0.13 o Rainfall > 50mm/month – 0.4 • Runoff coefficient for wet beach area o Rainfall < 50mm/month – 0.2 o Rainfall > 50mm/month – 0.6 • Maximum return to plant
RTF	• Runoff coefficient for RTF o Rainfall < 10mm/month - 0.05 o Rainfall > 10, < 50mm/month – 0.25 o Rainfall > 50mm/month – 0.6 • Maximum return to plant
Plant	• Runoff coefficient for plant area o Rainfall < 10mm/month - 0.3 o Rainfall > 10mm/month – 0.7

Facility	Assumptions
	• Maximum return to plant
WRD	• Runoff coefficient for WRD o Rainfall < 10mm/month - 0.05 o Rainfall > 10, < 50mm/month – 0.25 o Rainfall > 50mm/month – 0.6 • Discharge downstream
Miscellaneous Catchment Areas	• Runoff coefficient for surface area o Rainfall < 10mm/month - 0.0 o Rainfall > 10, < 50mm/month – 0.13 o Rainfall > 50mm/month – 0.4

TABLE 4-3 CLIMATIC DATA USED IN THE OVERALL WATER BALANCE FOR VOORSPOED MINE

Month	Average Rainfall (mm)[1]	Average Lake Evaporation (mm)[2]
January	95.2	194.4
February	60.5	164.2
March	66.5	149.2
April	44.0	109.0
May	17.5	81.3
June	5.7	60.8
July	4.6	66.2
August	10.8	93.8
September	18.0	131.9
October	61.3	168.2
November	79.6	176.7
December	86.0	194.2
Total	**549.7**	**1589.9**

4.1.10.2. Water balance results

Figure 4-3 shows the monthly inflows and outflows from the various facilities for the average monthly, driest monthly (maximum water demand) and wettest monthly (minimum water demand) conditions respectively.

The expected bulk make up water from the Renoster Weir is expected on average to range between 133,995m^3/month and 29,335m^3/month.

[1] Rainfall data source – Welvaart weather station (No 04013837)

[2] Evaporation data source – Midgley et al (1994) for WR90 Zone 11A Station C7E001 – Koppies Dam

4.1.10.3. Disturbances of water courses

The fine residue storage facility will be located in the headquarters of small stream. The drainage line of the stream is poorly defined, ephemeral, and possibly only exists because of the construction of an earthen wall to dam up water.

4.1.10.4. Storm water

The storm water management facilities for separating clean and dirty water in accordance with GN 704 Regulations are indicated on Figure 4-1.

4.2. CONSTRUCTION PHASE

The main construction activities are outlined below.

- Establishment of the access ramps to the existing open pit.
- Process plant construction, commissioning and production ramp-up.
- Construction of the first paddock for the fines residue storage facility.

Some infrastructure for supply of water and power and for access to the construction sites will be established before construction activities commence.

4.3. OPERATIONAL PHASE

4.3.1. SOIL UTILISATION GUIDE

The depth of topsoil to be stripped and the procedure to be followed are detailed in Table 6-1 and Table 6-2. The location of topsoil stockpiles are indicated in Figure 3-8.

4.3.2. THE PROPOSED MINE SURFACE LAYOUT

The mine surface infrastructure layout as discussed in the rest of Section 4 is detailed in Figure 4-1.

4.3.2.1. Access to the workings

The access ramps to the open pit are indicated on Figure 4-1.

4.3.2.2. All structures that may be affected by blasting vibrations

The closest structures to the mine are the farmsteads and farmworker's houses on the neighbouring properties Belmont 2390 and Welvaart 1011 (refer to (*B1* and *B2* on Figure 2-3). These structures are at least 1,6 km away from the final pit boundary. It is not anticipated that structural damage would result from blasting vibrations at this distance.

4.3.2.3. Anticipated location, extent and depth of surface subsidence

Voorspoed is an open pit mine and there would be no underground mining.

4.3.2.4. All structures and drainage paths that may be affected by surface subsidence.

Not applicable.

4.3.2.5. Pit optimisation and mining plan

The mining plan was developed through determining the ultimate mathematical pit dimensions and mining progression. The optimal pit shell yielded 55,1 million tons of ore, which represents 73% of the mineral resource, at a grade of 20,38 cpht, yielding 11.2 million carats. 189 million tons of waste and un-pay material will have to be moved in order to access this ore resulting in an overall stripping ratio of 1:3,41. The life of mine, at 4 million tpa is 15 years, of which 12 are at full production with the remaining 3 being pre-strip, ramp-up and closure.

Based the final shell, push back analysis was conducted to determine the "best fit" positioning of the intermediate mining shells. This is an iterative process that takes into account minimum mining width, split shell configuration and economics. Once the final and intermediate mining shells were determined, a practical set of mining shells, incorporating ramps and catch berms, were developed. A graphical representation of the shell progression and the final pit shell is given in Figure 3-1 and Figure 3-2.

A series of mine plans was designed for the life of mine based on the information generated from the Whittle optimisation exercise using the calls developed from the bottleneck calculations.

The plans are designed in quarterly face positions for the first 5 years, thereafter annually. Year 1 of operation, 2007, consists purely of waste pre-stripping. This material, 1 million tons will be available for any construction requirements, but it must first be tested to ensure it has the correct qualities to be used for such work. Being mudstones, it may be too friable for any use.

The life of mine extends to the year 2021, which if both ramp-up and closure are include gives a life of 15 years, however, of these, 12 years are at full production of 4.0Mtpa.

The plans have been designed to provide, where possible at least 2 working ore benches while maintaining an average annual sink rate of 3-4 benches per year to improve flexibility in the mining operation.

4.3.3. MINERAL PROCESSING METHOD

The plant process flow is illustrated in Figure 4-2.

The kimberlite ore [Run of Mine (ROM) material] will be directly tipped into a primary crusher system, where it will be crushed to a –200 mm material stream. The crushed ore is then conveyed to the secondary crusher feed screen that screens out the +60 mm material as feed to the secondary crusher. The secondary crusher product combines with the –60 mm screen undersize from where it is conveyed and stockpiled on the primary stockpile.

This material is then extracted from underneath the stockpile by means of vibrating feeders from where it is conveyed to a surge bin and discharged onto a variable speed belt feeder. The conveyor will feed the High Pressure Rolls Crusher (HPRC) via a feed chute. HPRC technology is utilized to maximise the liberation of diamonds and reduce throughput.

The HPRC product will be conveyed to a scrubber. The scrubber discharge will be screened into a +25 mm, -25 +1.5 mm and –1.5 mm fraction. The +25 mm fraction will be conveyed to the primary stockpile feed conveyor. The –25 +1.5 mm fraction will be conveyed to the Dense Media Separation (“DMS”) stockpile and the –1.5 mm fraction pumped to the degrit circuit.

Two combined DMS modules will treat the expected –25 +1.5 mm arising from the HPRC section. The double deck floats screens will cut at 6 mm. The –25 +6 mm material will be re-cycled back to the primary stockpile feed conveyor and the –6 +1.5 mm material will exit the plant as coarse residue and be stored on the resource tailings facility.

The sinks, from the DMS modules, report to the Recovery plant. All recovery tailings are re-cycled back through the process via the HPRC.

A test program was conducted to determine the suitability of filter press technology to optimise the water recovery from the fines residue (the –300 micron fraction). The proposal was to thicken the material before pumping it to three filter presses in parallel. The filter cake produced could then be disposed off by conveyor in combination with the coarse residue to the coarse resource facility. The test work indicated that the fines residue from the Voorspoed kimberlite is not suited for filter press technology.

The following chemicals are used in the plant process:

- FerroSilicon (FeSi) is used in the dense media separation circuit to assist in the separation of coarse (diamond bearing) and fine material. FeSi is inert and a generally benign substance in the quantities and under the conditions used. Most of the FeSi is retained and recycled in the process plant circuit. The fraction that is not recovered is disposed of with the coarse residue on the RTF.

- A flocculent (Magnafloc) is used in the thickener to assist in the settling of solids. The volumetric addition of flocculent at 0.025% w/w is approximately 50 m^3/hour. The settled solids reports to the UFDF. Excess flocculent that is not consumed in settling the solids reports to the thickener overflow stream that is recycled back to the plant process water. The build up of flocculent in the process water is monitored so that only enough flocculent is added to maintain the desired flocculent level in the thickener.

- A coagulant (Calcium Chloride – $CaCl_2$) is used to assist in clarifying the thickener overflow, to prevent excessive carry over of solids into the process water circuit. The process water circuit would be conditioned to contain approximately 300 ppm $CaCl_2$.

4.3.4. PLANT RESIDUE DISPOSAL

The locations of the fine and coarse residue storage facilities are indicated on Figure 4-1. Paste disposal technology will be utilised to optimise water recovery from the fine residue prior to disposal. Containment walls will be built with waste rock to create paddocks into which the paste residue is disposed.

The thickened paste does not flow as easily as conventional fines residue slurry. Combined with the containment walls constructed out of waste rock, this gives the fine residue storage facility a very stable structure.

4.3.5. TRANSPORT

Diamonds will be airlifted from Voorspoed via helicopter.

FIGURE 4-1 MINE SURFACE INFRASTRUCTURE LAYOUT

FIGURE 4-2 PLANT PROCESS FLOW DIAGRAM

FIGURE 4-3 WATER BALANCE DIAGRAM

5. ENVIRONMENTAL IMPACT ASSESSMENT

5.1. STRUCTURE OF THIS CHAPTER AND ASSSESSMENT METHODOLOGY

Issues identified during the EIA process have been discussed in this chapter under the environmental component headings specified in the Aide Memoire for preparation of EMPRs (DME, 1991). The chapter deviates from the structure specified in the Aide Memoire in that it is not divided into sections correlating with the construction, operational, decommissioning and closure phases of the mining project. The reason for this is that many of the identified issues apply to more than one of these phases. Repetition of a particular issue under a number of phases would have made this chapter long and cumbersome to read. Instead, for each issue, the phase in the life of the mining project in which the impacts could occur have been identified. An example of this is given on page 5-2.

5.1.1. ASSESSMENT OF THE SIGNIFICANCE OF IMPACTS

The criteria for determining the severity, spatial scale and duration of potential impacts are given in Table 5-1. The criteria are based on the criteria detailed in *DEAT (2002) Specialist Studies, Integrated Environmental Management Information Series 4, Department of Environmental Affairs and Tourism (DEAT), Pretoria*; *DEAT (2002) Impact Significance, Integrated Environmental Management Information Series 5, Department of Environmental Affairs and Tourism (DEAT)* and the criteria and methodology developed by Theo Hacking[1]. Table 5-1 also provides the definition for determining impact consequence (combining severity, spatial scale and duration) and impact significance (the overall rating of the impact). Impact consequence and significance are determined from Table 5-2 and Table 5-3. The interpretation of the impact significance is given in Table 5-4.

---

[1] Hacking, Theo (1999) An innovative approach to structuring environmental impact assessment reports. Anglo American Corporation-Envirolink. Unpublished.

EXAMPLE SHOWING HOW THIS CHAPTER HAS BEEN STRUCTURED

Environmental component heading

5.2 TOPOGRAPHY

Issue heading

5.2.1 ISSUE: HAZARDOUS EXCAVATIONS

Phase of mining operation

Construction	Operational	Decommissioning	Closure

The issue is applicable to the construction, operational and decommissioning phases of the project.

Bar showing the phase of the operation in which the impacts could occur.

Impacts

Description of the issue and associated impacts.

Discussion

Summary of the assessment of impacts

Assessment of impacts

Impact assessment: Hazardous excavations

Management	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Unmanaged	**H**	**M**	**L**	**M**	**M**	**M**
Managed	**L**	**L**	**L**	**L**	**L**	**L**

TABLE 5-1 CRITERIA FOR ASSESSMENT OF IMPACTS

PART A: DEFINITION AND CRITERIA		
Definition of SIGNIFICANCE		Significance = consequence x probability
Definition of CONSEQUENCE		Consequence is a function of severity, spatial extent and duration
Criteria for ranking of the SEVERITY OR NATURE of environmental impacts	**H-**	Disturbance of pristine areas that have important conservation value. Destruction of rare or endangered species.
		Substantive qualitative environmental / resource deterioration potentially resulting in death, illness or injury.
		Substantive quantitative environmental / resource deterioration frequently exceeding legal, industry or organisational standards.
		Very strong public opposition and action.
	M-	Disturbance of areas that have potential conservation value or are of use as a resource. Complete change in species occurrence or variety.
		Moderate qualitative environmental / resource deterioration potentially resulting in discomfort.
		Moderate quantitative environmental / resource deterioration occasionally exceeding legal, industry or organisational standards.
		Widespread public complaints.
	L-	Disturbance of degraded areas that have little conservation value. Minor change in species occurrence or variety.
		Minor qualitative environmental / resource deterioration possibly resulting in nuisance or minor irritation.
		Minor quantitative environmental / resource deterioration not exceeding legal, industry or organisational standards.
		Sporadic public complaints.
	L+	Rehabilitation / protection of degraded areas that have little conservation value. Minor positive change in species occurrence or variety.
		Minor qualitative environmental / resource improvement.
		Minor quantitative environmental / resource improvement, compliance with legal, industry or organisational standards.
	M+	Rehabilitation / protection of areas that have potential conservation value or are of use as a resource. Complete positive change in species occurrence or variety.
		Measurable qualitative and / or quantitative environmental / resource improvement.
	H+	Rehabilitation / protection of pristine areas that have important conservation value. Ensure preservation of rare or endangered species and habitat.
		Substantial qualitative and / or quantitative environmental / resource improvement.
		Favourable public reaction.
Criteria for ranking the DURATION of impacts	**L**	Quickly reversible. Less than the project life. Short term
	M	Reversible. Life of the project. Medium term
	H	Permanent. Beyond closure. Long term.
Criteria for ranking the SPATIAL SCALE of impacts	**L**	Within the site boundary.
	M	Local area. Beyond the site boundary.
	H	Widespread. Regional / national / international scale. Far beyond site boundary.

TABLE 5-2 DETERMINING IMPACT CONSEQUENCE

PART B: DETERMINING CONSEQUENCE [Severity * Duration * Spatial scale]					
Severity = Low					
Duration	Long term	H			MEDIUM
	Medium Term	M			
	Short term	L	LOW		
			L	M	H
			Spatial scale		
Severity = Medium					
Duration	Long term	H			HIGH
	Medium Term	M		MEDIUM	
	Short term	L	LOW		
			L	M	H
			Spatial scale		
Severity = High					
Duration	Long term	H			HIGH
	Medium Term	M			
	Short term	L	MEDIUM		
			L	M	H
			Spatial scale		

TABLE 5-3 DETERMINING OVERALL IMPACT SIGNIFICANCE

PART C: DETERMINING OVERALL SIGNIFICANCE [Probability * Consequence]					
PROBABILITY (of exposure to impacts)	Definite/ Continuous	**H**	MEDIUM		HIGH
	Possible/ frequent	**M**			
	Unlikely/ seldom	**L**	LOW		
			L	**M**	**H**
			CONSEQUENCE (Part A)		

- ***H = high, M= medium and L= low***

TABLE 5-4 INTERPRETATION OF IMPACT SIGNIFICANCE

INTERPRETATION OF SIGNIFICANCE		
Overall significance	**Nature of impact**	**Decision guideline**
High	Unacceptable impacts	Likely to be a fatal flaw
Medium	Noticeable impacts	Unavoidable consequences, which will need to be accepted if the project is allowed to proceed
Low	Minor impacts	These impacts are not likely to affect the project decision

5.2. ASSESSMENT OF ISSUES

5.2.1. GEOLOGY

5.2.1.1. *Removal of a resource*

Phase of mining operation

Construction	Operational	Decommissioning	Closure
	▒	▒	▒

The issue is applicable to the operational, decommissioning and closure phases of the project.

Approximately 55 million tons of kimberlite or will be removed from the Voorspoed Mine pit during the life of mine. The open pit from which the ore was removed will remain as a void in the geology. The void will fill with water. Approximately 20 million tons of the kimberlite resource will remain in the ore body, and could potentially be exploited in future.

While the geology of the Voorspoed ore body will be permanently changed by mining, the changes in geology will not have significant negative impacts on the health and welfare of people, the well-being of surrounding plant and animal communities and the condition of other natural resources.

Assessment of impacts

No assessment of impacts is given, as the changes in geology will not result in notable negative environmental impacts. The mining of the resource will produce goods and socio-economic benefits to current and future generations.

5.2.2. TOPOGRAPHY

The topography of the site will be altered as outlined in Table 5-5. Only the issues pertaining to hazardous excavations are discussed in this section. Related issues are discussed in the sections as indicated in Table 5-5.

TABLE 5-5 ALTERATION OF TOPOGRAPHY

Infrastructure	Maximum depth / height	Permanent / temporary	Related issues	Section of this chapter
Open pit	400 m	Permanent	Hazardous excavations	5.2.2.1
Waste rock stockpile	60 m	Permanent	Visual impacts	5.2.14
Plant	20 – 25 m	Temporary	Visual impacts	5.2.14
Ultra fines disposal facility	25 m	Permanent	Visual impacts, ground water impacts	5.2.14 5.2.9
Resource tailings facility	60 m	Permanent	Visual impacts	5.2.14

5.2.2.1. Hazardous excavations

Phase of mining operation

Construction	Operational	Decommissioning	Closure
	▒▒▒	▒▒▒	▒▒▒

The issue is applicable to the operational, decommissioning and closure phases of the project.

The open pit can be classified as a hazardous excavation. Barriers such as fencing or berms will be required to ensure that no humans all animals fall into the pit. The decline access to the pit will be sealed in the decommissioning phase.

Trenches for the laying of pipelines could be hazardous. These will be backfilled as soon as possible.

Assessment of impacts

Impact assessment: Hazardous excavations

Management	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Unmanaged	**H**	**M**	**L**	**M**	**M**	**M**
Managed	**L**	**L**	**L**	**L**	**L**	**L**

5.2.3. SOILS

5.2.3.1. Issue: Loss of topsoil resource

Phase of mining operation

Construction	Operational	Decommissioning	Closure
▒	▒	▒	

The issue is applicable to the construction, operational and decommissioning phases of the project.

Impacts

Most of the soils on the site of the mine are arable (Section 2.4) and more than 500 mm deep. It is important that the top 500 mm of the soils is conserved where possible. Topsoil is a resource of high conservation value to current and future generations. It is a gene bank containing seeds of indigenous species. It is usually nutrient rich and has a good texture for plant growth. It is therefore an important medium for the successful rehabilitation of disturbed land. Furthermore, it is essential for the restoration of the land capability of disturbed arable land.

As shown in Table Table 5-6, it is estimated that about 620 ha of land will be disturbed by mining and the development of mine infrastructure. Topsoil will be conserved from all infrastructure sites other than the area around the existing open pit and mine residue storage facilities. The latter sites occupy an area of about 50 ha.

The depth of topsoil to be stripped from infrastructure sites is 250 mm. The total quantity of topsoil to be stripped from the sites of infrastructure is estimated to be 1 425 000 m^3.

TABLE 5-6 MAXIMUM AREAS OF LAND AND SOIL TYPES TO BE DISTURBED BY THE DEVELOPMENT OF MINE INFRASTRUCTURE

Site	Approximate area that will be disturbed	Main soil forms	Soil depth
Waste rock stockpile	203 ha	Westleigh	300 - 500 mm
Resource tailings facility	90 ha	Avalon	500 – 1200 mm
Ultra fines disposal facility	143 ha	Avalon and Sepane	500 – 1200 mm
Storm and return water dams	33 ha	Avalon	500 – 1200 mm
Plant area	38 ha	Avalon	500 – 1200 mm
Open pit	113 ha*		

* Approximately 50 ha of the open pit area have already been disturbed by previous mining activity.

The mine's intentions for stripping of topsoil at the sites of mine infrastructure and its intentions to replace the topsoil when the infrastructure sites are rehabilitated are detailed in Section 6.2.3.1.

Assessment of impacts

Impact assessment: Loss of topsoil resource

Management	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Unmanaged	**H**	**H**	**L**	**H**	**M**	**H**
Managed	**L**	**L**	**L**	**L**	**L**	**L**

5.2.3.2. Issue: Erosion

Phase of mining operation

Construction	Operational	Decommissioning	Closure

The issue is applicable to all phases in the life of the project.

Impacts

All land at the site of the mine is susceptible to erosion when vegetation cover is removed. Natural slope gradients at the mine site are flat and reduce the erosion potential. However, the erosion potential will be increased where land has been transformed, along linear infrastructure and where there are concentrated discharges of water.

Erosion control measures, such as contours and revegetating, should be implemented in all disturbed areas. Erosion controls should be included in the designs of linear infrastructure and water management facilities.

Assessment of impacts

Impact assessment: Erosion

Management	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Unmanaged	**H**	**H**	**M**	**H**	**H**	**H**
Managed	**L**	**L**	**L**	**L**	**L**	**L**

5.2.3.3. Issue: Soil contamination

Phase of mining operation

Construction	Operational	Decommissioning	Closure

▨	▨	▨	

The issue is applicable to the construction, operational and decommissioning phases in the life of the project.

Impacts

Soils could be contaminated by spills of the following materials:

1. Construction materials such as cement and paint at construction sites.
2. Sewage from inadequate sanitary facilities.
3. Fuel and oil from vehicles, workshops and fuelling stations (mainly in the contractors' yards).
4. Process chemicals at the plant site.
5. Polluted water spilled from the process water circuit.
6. Spills from the fines residue disposal pipeline.
7. Run-off from mine residue deposits.
8. Seepage from mine residue deposits.
9. Wastes that are not placed in appropriate collection and disposal facilities.

Through the implementation of the measures outlined in Section 0, the mine will avoid contamination of soils. If incidents of spillage do occur, the mine will implement appropriate remedial measures.

Assessment of impacts

Impact assessment: Erosion

Management	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Unmanaged	**M**	**M**	**L**	**M**	**M**	**M**
Managed	**L**	**L**	**L**	**L**	**L**	**L**

5.2.4. LAND CAPABILITY

5.2.4.1. Issue: Loss of arable land

Phase of mining operation

Construction	Operational	Decommissioning	Closure
▨	▨	▨	▨

The issue is applicable to all phases in the life of the project.

Impacts

About 620 ha of land will be disturbed by mining and the development of mine infrastructure. Most of this land (about 400 ha) is arable.

TABLE 5-7 MAXIMUM AREAS OF LAND WITH AGRICULTURAL POTENTIAL TO BE DISTURBED BY THE DEVELOPMENT OF MINE INFRASTRUCTURE

Site	Approximate area that will be disturbed	Main soil form	Land capability
Waste rock stockpile	203 ha	Westleigh and Sepane	Arable – low and grazing
Resource tailings facility	90 ha	Avalon	Arable - moderate
Ultra fines disposal facility	143 ha	Avalon and Sepane	Arable – moderate and Grazing
Storm and return water dams	33 ha	Avalon	Arable – moderate
Plant area	38 ha	Avalon	Arable - moderate
Open pit	113 ha*	Not surveyed	

* Approximately 50 ha of the pit area have already been disturbed by previous mining activity.

The land at the site of the plant area will be returned to its pre-disturbance potential. The land at the site of the open pit cannot be restored to its pre-disturbance potential and will be classified as dormant mine after mine closure. The surface of the Ultra fines disposal facility, resource tailings facility and waste rock dump will be rehabilitated as far as possible and restored to wilderness land capability.

Restoration of disturbed land to its pre-mining land capability requires careful conservation of soil and erosion control. The mine intends to conserve soil and control erosion as outlined in Section 6.2.3.

Assessment of impacts

Impact assessment: Loss of arable land

Management	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Unmanaged	**H**	**H**	**L**	**H**	**H**	**H**
Managed	**M**	**H**	**L**	**M**	**H**	**M**

5.2.5. LAND USE

5.2.5.1. Issue: Blasting hazards and damage to structures by blasting vibrations

Phase of mining operation

Construction	Operational	Decommissioning	Closure
▒	▒		

The issue is applicable to the construction and operational phases of the project.

Impacts

The mine will blast multiple times a week in the open pits. It will apply the blasting principle that the maximum peak particle velocity will be less than 25 mm/s at a distance of 500 m from a blast in the open pits. The zone within 500 m of the pits can be delineated as the zone affected by blasting.

No structures, other than the ruin of a historical building, that could possibly be affected by blasting are located within 500 m of the open pits.

Fly rock from blasting can be hazardous to humans and animals up to 500 m from a blast. Fly rock rarely occurs where blasts are properly designed.

The air blast associated with blasting can startle humans and animals. This problem can be overcome if the people in the area are warned of the intention to blast and a warning siren is sounded before the blast.

The mine can ensure that impacts associated with blasting are of low significance through implementation of the management measures given in Section 6.2.5.1.

Assessment of impacts

Impact assessment: Blasting hazards and damage to structures by blasting vibrations

Management	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Unmanaged	**H**	**M**	**M**	**M**	**H**	**H**
Managed	**L**	**L**	**L**	**L**	**M**	**L**

5.2.5.2. Issue: Road disturbances and mine traffic

Phase of mining operation

Construction	Operational	Decommissioning	Closure

The issue is applicable to all phases in the life of the project.

Impacts

The traffic impact assessment conducted as part of the EIA (refer to Appendix 13) found that presently all roads near the proposed development accommodate very low traffic volumes. The mine will generate low external traffic since the mining operations are confined to the site. The future traffic demands will be relatively low and the intersections in the area and at the provincial roads could remain unchanged when the mine is fully operational.

The layout of the access road and security control checkpoint to the mine from secondary road S156 should be planned to ensure that ingress traffic into the mine would not block back into road S 156.

The gravel roads in the project area can be difficult to traverse in wet weather. Heavy vehicles can carve out ruts in the road rendering the road treacherous and impassable for light vehicles.

Increased traffic on the access roads to the mine will cause a potential risk to the safety of neighbouring communities, as well as a potential noise and dust nuisance.

Assessment of impacts

Impact assessment: road disturbance and mine traffic

Management	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Unmanaged	**M**	**M**	**L**	**M**	**M**	**M**
Managed	**L**	**L**	**L**	**L**	**L**	**L**

5.2.5.3. Issue: rerouting of secondary road

Phase of mining operation

Construction	Operational	Decommissioning	Closure

The issue is applicable to the construction, operational, decommissioning and closure phases of the project.

Impacts

Access to the mine will be from secondary road S156. Currently a section of road S156 falls within the extent of the final pit boundary and the blasting zone, and would therefore have to be rerouted along the mine's southern boundary, outside of the blasting zone. (Refer to Figure 2-3 and Figure 3-4 for the proposed new road alignment.)

Concern has been raised by members of the Renosterkop farming community that the diverted road will result in an inconvenience due to the increased travel distances between farms. The alignment of the road diversion should be planned to minimise the increased travel distance that farmers may experience. It should be noted that, depending on the point of departure and destination, the road diversion may result in an increase or decrease in travelling distance for road users. It may not be possible to satisfy everyone's expectations in this regard.

Impact assessment: rerouting of secondary road

Management	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Unmanaged	M	H	M	H	H	H
Managed	L	H	M	M	H	M

5.2.5.4. Issue: Failure of mine residue deposits

Phase of mining operation

Construction	Operational	Decommissioning	Closure

The issue is applicable to all phases in the life of the project.

Impacts

The Ultra fines disposal facility could have severe and extensive impacts if there is a structural failure. In the event of a slope failure of the UFDF, the fine residue would flow downstream of the UFDF over the eastern boundary of Voorspoed 401, towards the farmstead and farmworker community living on Welvaart. Human life and buildings that could be affected by a flow failure.

It is highly unlikely that the UFDF will fail. The UFDF has been sited and will be designed, operated, decommissioned and closed in accordance with the requirements of the SABS Code of Practice (SABS 0286) for mine residue deposits and the Mineral and Petroleum Resources Development Act (Act 28 of 2002).

Professional engineers will undertake monitoring of the stability of the mine residue deposits.

Assessment of impacts

Impact assessment: Failure of mine residue deposits

Management	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Unmanaged	**H**	**L**	**H**	**H**	**L**	**M**
Managed	**L**	**L**	**L**	**L**	**L**	**L**

5.2.6. NATURAL VEGETATION

5.2.6.1. Issue: Loss of biodiversity and ecological function

Phase of mining operation

Construction	Operational	Decommissioning	Closure
▒▒▒	▒▒▒	▒▒▒	

The issue is applicable to the construction, operational and decommissioning phases of the project.

Impacts

The mine will impact on vegetation in the project area through direct disturbance at the infrastructure and open pit mining sites as outlined in Table 5-8. The impacts on vegetation of the infrastructure layout options considered in Section 3.2 are illustrated in

Figure 3-5, Figure 3-6 and Figure 3-7. Grazing and previous mining activities have already disturbed the natural vegetation in these areas. Although disturbed, the grassland in this area may still serve as feeding or breeding ground for some fauna species, in addition to providing grazing for cattle. This capacity will be lost.

Areas of vegetation with conservation importance are considered in Table 5-9. Disturbances of these habitats must be avoided due to their sensitive nature. The Voorspoed project team has spent considerable effort to develop an infrastructure site layout that avoids impacting on these areas. Where areas of conservation importance are located close to mine infrastructure sites (the pans on Voorspoed 401), infrastructure development will take place around and / or outside of these areas.

All land disturbed by mining, other than the mine residue disposal sites and return water dam, will be rehabilitated to a stable physical state and its pre-disturbance agricultural potential. The mine residue disposal and return water dam sites will be vegetated to prevent erosion and reduce their visual impact.

Plant habitats close to the mine site that need to be protected from disturbance includes:

- The wetland on Voorspoed 401, northwest of the existing open pit.
- The pans on Voorspoed 401, north of the existing open pit.
- Renosterkop to the southwest of the existing open pit.

These plant habitats described in Table 5-9 could be disturbed as a result of the mining development if:

- The wetland and pans are not avoided in the placement of mine surface infrastructure.
- Natural surface water flow to these areas is impeded.
- Dirty water from mine surface infrastructure areas is not prevented from flowing into these habitats.
- Vegetation is cleared in these habitats (i.e. buffer zones are not maintained).
- Mine staff drive off-road into these habitats.
- Mine staff engage in hunting or harvesting plants in these habitats.
- Erosion is not prevented or controlled where vegetation has been disturbed, especially on the slopes of Renosterkop.
- Waste is disposed of indiscriminately in these habitats.
- Dust generation is not managed properly and dust pollution occurs in these habitats.
- Fencing is not limited to the mine infrastructure boundary so that animal movement is unnecessarily restricted outside mine infrastructure sites.

Impacts on plant habitats in and around the project area will be mitigated through implementation of the management measures listed in 6.2.6.

There is interest in the conservation of Renosterkop from the neighbouring farm community. A nature conservancy could be established on Renosterkop. The koppie also has potential for hiking trails or eco-tourism.

An opportunity exist for the harvesting of medicinal or other rare plant species from the areas where mine infrastructure is to be established. Suitable organisations such as the local botanical society may be approached in this regard.

The mine surface infrastructure layout has been designed to minimise disturbance of the surface water flow to the wetland. The proposed rehabilitation measures would probably increase the flow of water to the wetland. Therefore no ecological flow requirement has been determined for the wetland on Voorspoed 401, since the establishment of the mine should not significantly reduce the flow of water to the wetland.

TABLE 5-8 VEGETATION TO BE DISTURBED BY THE DEVELOPMENT OF MINE INFRASTRUCTURE AND OPEN PIT MINING

Site	Approximate area that will be disturbed	Condition of vegetation at the site	Sensitive vegetation	
			At the site	Near to the site
Final extent of the open pit and open pit haul roads	113 ha	Disturbed by previous mining activity. Woody plant species have established on embankments and mine residue storage facilities. Blue gum trees have been extensively planted around the existing pit and residue storage facilities.	None	None
Waste rock dump on eastern boundary of final open pit	203 ha	The area around the existing mine pit and residue storage facilities have been extensively planted with Blue gum trees. The remainder of this area is made up of grassland, which has been altered by cattle grazing.	None	None
Plant, coarse and fine residue disposal dumps	304 ha	Grassland, with redgrass the dominant species, makes up the majority of the site. Cattle grazing, which is the dominant land use, have altered the grassland. Signs of overgrazing are present.	2 Pans are located in this area. Mine infrastructure is located around these pans, with a minimum buffer of 30m between the mine infrastructure and the delineated pan boundaries.	A wetland (29 ha) is located to the southeast of this area. Mine infrastructure is located outside the main catchment area of the wetland, with a minimum buffer of 50m between the delineated wetland boundary and mine infrastructure.

TABLE 5-9 CONSERVATION IMPORTANCE OF THE PATCHES OF RELATIVELY UNDISTURBED VEGETATION AT OR NEAR THE INFRASTRUCTURE AND OPEN PIT MINING SITES

Vegetation	Conservation importance
Hillslope wetland located on Voorspoed 401 southwest of the plant and mine residue storage facilities	The ecological integrity of the wetland has been compromised through disturbance of the natural water flow feeding the wetland, reducing the amount of water that the wetland receives and the periods that it is inundated. The vegetation in the wetland has also been disturbed through grazing and trampling by livestock, reducing the plant cover and diversity. The conservation importance of the wetland is high not only because of its ecological function (supporting biodiversity), but also because of its hydrological functions (attenuating water flow and acting as a natural filter). In addition, the cumulative impact of the loss of wetland ecosystems throughout the country has made the conservation of the remaining wetland ecosystems a high priority. Due to the high conservation importance of wetland ecosystems, the DTEEA has adopted a policy of zero wetland loss.
Pans located on Voorspoed 401	The ecological integrity of the southern pan has been severely impacted on through sand winning and the planting of blue gum trees in and around the pan. Livestock watering and

Vegetation	**Conservation importance**
	grazing has affected the northern pan, but the pan still supports a diverse plant life. The conservation importance of the pans is high due to their ecological function and the cumulative impacts of the loss of pan ecosystems throughout the country. The DTEEA policy of zero wetland loss is applicable to the pans as well.
Renosterkop	The habitat on Renosterkop is not considered a sensitive area in legal terms (as opposed to the wetland, which is protected under the Water Act). However, given distinct nature of the vegetation relative to the surrounding land, the relatively pristine nature thereof, as well as the value the neighbouring farm community attaches to Renosterkop, the mine should consider Renosterkop to be of high conservation importance.

Assessment of impacts

Impact assessment: Loss of biodiversity and ecological function

Management	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Unmanaged	**H**	**M**	**L**	**H**	**M**	**H**
Managed	**M**	**M**	**L**	**L**	**L**	**M**

5.2.7. Animal Life

5.2.7.1. Issue: Loss of biodiversity and ecological function

Phase of mining operation

Construction	Operational	Decommissioning	Closure
▒	▒	▒	

The issue is applicable to the construction, operational and decommissioning phases of the project.

Impacts

Due to its diverse vegetation and relatively pristine and undisturbed condition, Renosterkop serves as a refuge for a variety of bird and animal species. The wetland is equally important in terms of biodiversity. Although the current status of the wetland is degraded due to cattle grazing, the wetland would provide suitable habitat for many bird and animal species if allowed to rehabilitate. Species that may find the habitats at Voorspoed suitable for nesting or feeding include:

- Amphibian species. Based on geographic distribution patterns the Giant Bullfrog, a threatened species, may be found here. Frogs can survive underground for several years when droughts prevent the development of suitable breeding conditions and it is possible that this species does occur in the wetlands on site.

- Bird species. A total of nineteen Red Data bird species – six listed as Vulnerable, and thirteen as Near Threatened are considered likely to occur on Voorspoed.
- Animal species. Ten Red Data animal species One Endangered, six Near Threatened, and three Data Deficient species were identified as possibly occurring on site.

The fauna described in Section 2.8 could be disturbed as a result of the mining development by:

- Mine staff driving off-road into the habitats of these species (specifically the wetland and grassland on the south-western part of Voorspoed 401 and north-western part of Morgenster 772; and the slopes of Renosterkop on Morgenster 772).
- Mine staff engaging in poaching in the abovementioned habitats.
- Unnecessary vegetation clearing in these habitats (i.e. buffer zones are not maintained).
- Impeding access (for animals) to these habitats (e.g. subdividing the area through fencing).
- Indiscriminately disposing waste in these habitats.
- Impeding surface water flow to these habitats.
- Releasing dirty water generated within the mine surface infrastructure areas into the surrounding environment.
- Killing animals that are perceived to be dangerous, such as snakes.
- Vehicle traffic that could increase road kills.
- Disturbance by noise and vibrations from blasting, vehicle movement and plant operations.
- Increased dust levels in the air.
- Illumination, which will impact on nocturnal animals.

Despite the abovementioned mitigation measures the increase in human and mining activities, with resultant increase in nuisance factors such as noise, dust and vibration, would probably discourage fauna from feeding and breeding in the areas surrounding the mine, and encourage migration to suitable habitat elsewhere.

However, this should be a temporary impact during the life of mine, after closure it is likely that fauna would return to the area again.

<u>Assessment of impacts</u>

Impact assessment: loss of biodiversity and ecological function

Management	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Unmanaged	**H**	**M**	**L**	**M**	**M**	**M**
Managed	**L**	**L**	**L**	**L**	**L**	**L**

5.2.8. SURFACE WATER

5.2.8.1. Issue: Compliance with GN 704 Regulations

<u>Phase of mining operation</u>

Construction	Operational	Decommissioning	Closure

The issue is applicable to the construction, operational, decommissioning and closure phases of the project.

<u>Impacts</u>

The water management facilities for the mine will be designed in accordance with the Government Notice 704 Regulations. These regulations govern the use of water for mining and related activities aimed at the protection of water resources. See the text box on Page 5-22 for detail.

5.2.8.1.1. Alteration of drainage lines

The location of Voorspoed infrastructure relative to watercourses is shown in Figure 1-2 and Figure 2-6.

Figure 3-5, Figure 3-6 and Figure 3-7 highlights clean runoff diversion facilities and dirty water collection facilities on the project site. The following is shown on the figures:

- The Ultra fines disposal facility is partially located on the headwaters of a small watercourse. This situation is not considered to be a stream diversion because the catchment of the drainage line is very small and the drainage line only becomes defined at the site boundary.

- Apart from the exception described above all mine infrastructure is located at least 100 m away from watercourses.

5.2.8.1.2. Separation of clean and dirty water

- Runoff from the areas upstream of the Voorspoed infrastructure sites will be diverted away from the infrastructure sites. The diverted runoff will be fed into the watercourses that it would normally enter.
- The run-off on the western side of the site, from the slopes of Renosterkop, would be unaffected by mine infrastructure development.
- Rain falling on the Voorspoed infrastructure sites will be channelled to dirty water collection facilities – the northern combined stormwater and fine residue return water dam (for the plant and mine residue disposal dumps) and southern storm water dam (for the waste rock dump).
- The waste rock dump is not expected to pollute ground or surface water through acid mine drainage, although there is risk for salinity and TDS to build up in the seepage water from the dump. (refer to Section 5.2.9.3.2) From a design perspective, a facility to collect toe seepage from the waste rock dump and return the toe seepage to the plant would be adequate. The surface runoff water during rainfall events would not be in contact with the waste rock for long enough in order for salinity and TDS levels to build up, and this water could be allowed to overflow from the settling sump downstream to the neighbouring property. De Beers would have to approach DWAF to get approval for an exemption from Regulation 704 for the waste rock dump.

5.2.8.1.3. Capacity of storm water dams

- The dirty water collection facilities on the site will be designed so that they do not spill into any clean water system more than once in 50 years and they have a minimum freeboard of 0.8 metres above full supply level. This means that there will be no discharges of dirty water from the Voorspoed site unless there is an extreme storm event.

Impact assessment: Alteration of drainage patterns

Management	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Unmanaged	**H**	**M**	**M**	**M**	**M**	**M**
Managed	**L**	**M**	**M**	**L**	**L**	**L**

5.2.8.2. Issue: Pollution of surface water

Phase of mining operation

Construction	Operational	Decommissioning	Closure

The issue is applicable to the construction, operational, decommissioning and closure phases of the project.

Impacts

Voorspoed mine has a makeup water requirement of approximately 220 000m^3 and is situated in a semi-arid region. Pit dewatering is not expected to yield a significant amount of water. No excess water will be produced and no water released into the surrounding environment.

Surface water captured and retained in the dirty water management system within the mine site may be polluted through various mining activities. Table 6-6 lists the sources of potential surface water contamination and the management measures proposed to prevent or minimise such pollution.

IMPACT ASSESSMENT: POLLUTION OF SURFACE WATER

Management	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Unmanaged	**H**	**M**	**M**	**M**	**M**	**M**
Managed	**L**	**M**	**M**	**L**	**L**	**L**

EXTRACT FROM THE GOVERNMENT NOTICE 704 REGULATIONS: REGULATIONS ON USE OF WATER FOR MINING AND RELATED ACTIVITIES AIMED AT THE PROTECTION OF WATER RESOURCES

Regulation 1: Definitions, Regulation 2: Information and notification, Regulation 3: Exemptions

Regulation 4: Restrictions on locality *No person in control of a mine or activity may-*

(a) locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year flood-line or within a horizontal distance of 100 metres from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on water-logged ground, or on ground likely to become water-logged, undermined, unstable or cracked;

(b) except in relation to a matter contemplated in regulation 10, carry on any underground or opencast mining, prospecting or any other operation or activity under or within the 1:50 year flood-line or within a horizontal distance of 100 metres from any watercourse or estuary, whichever is the greatest;
(c) place or dispose of any residue or substance which causes or is likely to cause pollution of a water resource, in the workings of any underground or opencast mine excavation, prospecting diggings, pit or any other excavation; or

(d) use any area or locate any sanitary convenience, fuel depots, reservoir or depots for any substance which causes or is likely to cause pollution of a water resource within the 1:50 year flood-line of any watercourse or estuary.

Regulation 5: Restrictions on use of material *No person in control of a mine or activity may use any residue or substance which causes or is likely to cause pollution of a water resource for the construction of any dam or other impoundment or any embankment, road or railway, or for any other purpose which is likely to cause pollution of a water resource.*

Regulation 6: Capacity requirements of clean and dirty water systems *Every person in control of a mine or activity must-*

(a) confine any unpolluted water to a clean water system, away from any dirty area;

(b) design, construct, maintain and operate any clean water system at the mine or activity so that it is not likely to spill into any dirty water system more than once in 50 years;

(c) collect the water arising within any dirty area, including water seeping from mining operations, outcrops or any other activity, into a dirty water system;

(d) design, construct, maintain and operate any dirty water system at the mine or activity so that it is not likely to spill into any clean water system more than once in 50 years; and

(e) design, construct, maintain and operate any dam or Ultra fines disposal facility that forms part of a dirty water system to have a minimum freeboard of 0.8 metres above full supply level, unless otherwise specified in terms of Ch 12 of the Act.

(f) design, construct and maintain all water systems in such a manner as to guarantee the serviceability for flows up to and including those of the maximum flood with an average period of recurrence of once in 50 years.

Regulation 7: Protection of water resources *Every person in control of a mine or activity must take reasonable measures to-*
prevent water containing waste or any substance which causes or is likely to cause pollution of a water resource from entering any water resource, either by natural flow or by seepage, and must retain or collect such substance or water containing waste for use, re-use, evaporation or for purification and disposal in terms of the Act;

(b) design, modify, locate, construct and maintain all water systems, including residue deposits, in any area so as to prevent the pollution of any water resource through the operation or use thereof and to restrict the possibility of damage to the riparian or in-stream habitat through erosion or sedimentation, or the disturbance of vegetation, or the alteration of flow characteristics;

(c) cause effective measures to be taken to minimise the flow of any surface water or floodwater into mine workings, opencast workings, other workings or subterranean caverns, through cracked or fissured formations, subsided ground, sinkholes, outcrop excavations, adits, entrances or any other openings;

(d) design, modify, construct, maintain and use any dam or any residue deposit or stockpile used for the disposal or storage of mineral tailings, slimes, ash or other hydraulic transported substances, so that the water or waste therein, or falling therein, will not result in the failure thereof or impair the stability thereof;
prevent the erosion or leaching of materials from any residue deposit or stockpile from any area and contain material or substances so eroded or leached in such area by providing suitable barrier dams, evaporation dams or any other effective measures to prevent this material or substance from entering and polluting any water resources;

(f) ensure that water used in any process at a mine or activity is recycled as far as practicable, and any facility, sump, pumping installation, catchment dam or other impoundment used for recycling water, is of adequate design and capacity to prevent the spillage, seepage or release of water containing waste at any time;

(g) at all times keep any water system free from any matter or obstruction which may affect the efficiency thereof; (h) cause all domestic waste, including wash-water, which cannot be disposed of in a municipal sewage system, to be disposed of in terms of an authorisation under the Act.

Regulation 8: Security and additional measures *Every person in control of a mine or activity must-*

(a) cause any impoundment containing any poisonous, toxic or injurious substance to be effectively fenced-off so as to restrict access, and must erect warning notice boards at prominent locations so as to warn persons of the hazardous contents;

(b) ensure access control in any area used for the stockpiling or disposal of any residue or substance which causes, has caused or is likely to cause pollution of a water resource so as to protect any measures taken in terms of these regulations;
not allow the area contemplated in paragraph (a) and (b) to be used for any other purpose, if such use causes or is likely to cause pollution of a water resource; and

(d) protect any existing pollution control measures or replace any existing pollution control measures damaged by the removing or reclaiming of materials from any residue deposit or stockpile, and establish additional measures for the prevention of pollution of a water resource which might occur, is occurring or has occurred as a result.

Regulation 9: Temporary or permanent cessation of mine or activity, Regulation 10: Additional regulations relating to winning sand and alluvial minerals from watercourse or estuary, Regulation 11: Additional regulations for rehabilitation of coal residue deposits, Regulation 12: Technical investigation and monitoring, Regulation 13: General, Regulation 14: Offences and penalties, Regulation 15: Repeal of regulations, Regulation 16: Commencement

5.2.8.3. Issue: Reduction in the catchment of dams downstream of the site

Phase of mining operation

Construction	Operational	Decommissioning	Closure

The issue is applicable to the construction, operational, decommissioning and closure phases of the project.

Impacts

The surface water users immediately downstream of Voorspoed are located on the neighbouring properties Welvaart 1011, Cumberland 1228 and Rustig 850, indicated as points *B4i*, *B4ii* and *B4iii* on Figure 2-3. The drainage lines drain into farm dams on the farms Grasvlakte 1887 (via Cumberland 1228), Welvaart 1011 and Rustig 850 that are used as cattle watering points. The dams at points *B4ii* (Grasvlakte 1887) and *B4iii* (Rhenosterkop 347) should not be affected by the mining operations, since no surface infrastructure is planned in the sub catchments feeding these drainage lines.

The dam at point *B4i* (Welvaart 1011) will be affected by reduced surface water runoff, since a mine residue storage facility will be constructed on part of its sub catchment. The total catchment area of the dam at *B4i* is approximately 4,134km^2. The area of the catchment of the dam at *B4i* located on Voorspoed is approximately 2,3km^2. The dam at *B4i* would therefore lose approximately 56% of its current catchment as a result of the construction of the mine residue storage facility. The use of the dam is for stock watering purposes only and therefore no water use has been registered with DWAF by the owner Mr Leonard.

Impact assessment: Reduction in the catchment of dams downstream of the site

Management	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Unmanaged	**M**	**H**	**M**	**H**	**M**	**M**
Managed	**L**	**M**	**M**	**L**	**L**	**L**

5.2.8.4. Consequences on the mine and associated works of floods exceeding the design flood in magnitude

Phase of mining operation

Construction	Operational	Decommissioning	Closure
▒	▒	▒	

The issue is applicable to the construction, operational and decommissioning phases of the project.

Impacts

Voorspoed is situated on a watershed, and given the generally flat topography of the site, there are no clearly defined drainage courses at Voorspoed. During heavy rainfall events surface water would generally flow down gradient as sheet flow and not collect into channels. High volumes of water flowing into the open pit will cause a safety hazard to mineworkers. Water would be diverted around the open pit by storm water berms and channels. No drainage channels and hence flood lines are located near the pit, the closest watercourse is the wetland, located more than 1 km northeast of the final boundary of the open pit.

The southern and eastern drainage lines originating from Voorspoed make up the headwaters of streams and have no significant catchments and drainage channels associated with them. The wetland and the western drainage line downstream of it have a bigger catchment area since the northeastern slopes of Renosterkop drains toward the wetland. During heavy rainfall events the wetland will retain most of the water flowing into it, attenuating the flood intensity and gradually releasing water into the downstream drainage line. Mine infrastructure is located at least 100m buffer away from the wetland and the drainage line below it to ensure that infrastructure is not affected by major storm events.

Assessment of impacts

Impact assessment: Consequences of floods exceeding the design flood

Management	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Unmanaged	**H**	**L**	**M**	**M**	**L**	**L**
Managed	**H**	**L**	**M**	**M**	**L**	**L**

5.2.9. GROUND WATER

5.2.9.1. Potential for groundwater contaminant transport from the fines residue disposal facility

Phase of mining operation

Construction	Operational	Decommissioning	Closure
░	░	░	

The issue is applicable to the construction, operational and decommissioning phases of the project.

Impacts

The groundwater flow model was used to perform an assessment of the potential contaminant transport migration from each of the alternative sites for the Ultra fines disposal facility. The model evaluated the potential for contaminant transport from these sites for an operational period of 10 years.

Note that the potential for the soils to act as a constraining layer was not considered in this simulation. The simulation source from the residue deposit water was assumed to have a total dissolved solids (TDS) value of 1000 mg/L, which is twice the background value of 500 mg/L. The simulations were based on a seepage rate typical of a conventional fines residue disposal facility.

The simulation results for the preferred site layout alternative for the fine residue disposal dump are graphically illustrated in Figure 5-2.

The simulation results indicate that:

- The potential for contaminant migration is between 100-250 m over an operational phase of 10 years, which represents 10-25 m per year.
- The seepage and contaminants from site 3 is partially captured by the mine dewatering while contaminants from sites 1 and 2 migrate towards the west and north-west within the site boundary. Seepage from the proposed residue deposit sites is not likely to impact on the marshy or wetland area.
- No neighbouring boreholes outside the study area are impacted on from the Ultra fines disposal facility site during the life of the mine.

Assessment of impacts

Impact assessment: Potential for groundwater contaminant transport from the fines residue disposal facility

Management	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Unmanaged	**M**	**M**	**M**	**M**	**M**	**M**
Managed	**L**	**M**	**M**	**L**	**L**	**L**

5.2.9.2. Decrease in the availability of groundwater for surrounding groundwater users

Phase of mining operation

Construction	Operational	Decommissioning	Closure

The issue is applicable to the construction, operational and decommissioning phases of the project.

Impacts

The groundwater flow model was used to predict the impact that the dewatering of the open pit might have on surrounding groundwater table and boreholes located on neighbouring properties. The model was used to simulate the potential inflow rates into the pit and the potential radius of influence of pit de-watering. The conceptual groundwater flow during the operational phase is schematically represented in Figure 5-3, and the predicted impacts of pit de-watering in Figure 5-1.

The simulations indicated that:

- The water abstracted from the mine is in the order of 450-1000 m^3/d (5-11 L/s).
- The radius of influence is 1.2-1.5 km. The radius of influence along fault/fracture zones may be larger.
- The pre-operational groundwater level intersects the pit at 1374-1378 mamsl, which is at 26-28 m below surface in the weathered/fractured mudrock. The surface elevation is at 1404 mamsl. In the operational scenario, the groundwater level intersects the pit at 1305-1310 mamsl.
- The yield of borehole BH30 located 1.1 km south of the open pit could be partially affected by mine dewatering. Other existing boreholes on neighbouring properties should not be affected by pit de-watering.

Assessment of impacts

Impact assessment: Decrease in the availability of groundwater for surrounding groundwater users

Management	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Unmanaged	**M**	**M**	**M**	**M**	**M**	**M**
Managed	**L**	**M**	**M**	**L**	**M**	**L**

FIGURE 5-1 OPERATIONAL PHASE PIT DEWATERING

FIGURE 5-2 OPERATIONAL PHASE POTENTIAL CONTAMINANT TRANSPORT MODELING

5.2.9.3. Potential for poor quality leachate from residue deposits

Phase of mining operation

Construction	Operational	Decommissioning	Closure

The issue is applicable to the construction, operational, decommissioning and closure phases of the project.

Background

Acid rock drainage (ARD) is drainage from mine residues that is acidic and may contain elevated levels of dissolved metals. ARD is caused when water comes into contact with the relatively common iron-sulphide minerals such as pyrite (FeS_2) or pyrrhotite (SeF) that has been exposed to weathering and oxidation. The oxidation of sulphide minerals is a natural weathering process, but the potential for this is increased by mining activity, which brings huge volumes of rock to the surface where it is exposed to rapid oxidation. The potential for ARD is related to the chemical composition of the ore and host rock of a particular locality: in a absence of a neutralising agent (e.g. carbonate minerals such as dolomite or calcite) the presence of sulphide minerals in rocks would indicate potential for acid rock drainage.

Apart from sulphide oxidation and neutralisation, natural weathering processes occur which can still cause pollution of seepage and runoff water, e.g. the accumulation of salts in water as it flows over soils and rocks to the sea. Weathered products such as ions of sodium, calcium, magnesium, potassium (cations), chloride, sulphate and bicarbonate (anions) may form salts that accumulate in seepage water as it passes through rocks. A simple indicator of salinity in seepage water is the concentration of total dissolved solids (TDS). Salinity is an important determinant of the usefulness of water for various purposes. Drinking water has a recommended maximum contaminant level for TDS of 450 mg/L for human consumption, while livestock can tolerate levels of up to 10 000 mg/L.

Metals such as aluminium, arsenic, beryllium, bismuth, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, selenium, strontium, tin, titanium and zinc can also accumulate in seepage and runoff water as a result of natural weathering processes. These metals are toxic in high dosages (although most, like iron and chromium, are essential parts of our diets in low dosages).

Impacts

5.2.9.3.1. Fine and coarse residue deposits

Selected samples of the kimberlite and waste rock found at Voorspoed Mine were subjected to laboratory testing and analysis to determine its potential to pollute seepage and runoff water through acid mine drainage, increased salinity and leachate of metals. The report on the test results and analysis are contained in Appendix 12. The main findings and recommendations are discussed below.

Samples of kimberlite waste tested using the South African Acid Rain (SAAR) Leach Test. The results of the South African Acid Rain Leach Test are summarised in Table 5-10.

The following conclusions were drawn from these results:

- Leachate from the kimberlite fine residue deposited on the UFDF is unlikely to result in significant emissions of metals to surrounding water resources. None of the compounds detected in the leachate exceeded the Acceptable Risk Level[1], with the exception of Manganese. It is not uncommon for manganese concentrations to be elevated in the SAAR leach test, since manganese is a very abundant element and easily leaches out at the pH of the SAAR leach test, which is generally more acidic than the moisture contained in the waste rock dump would be. An elevated manganese concentration is not necessarily indicative of a potential pollution problem.

- There is very low to no risk of acid generation from the kimberlite fine residue to be deposited on the UFDF.

- The most important potential impact of the UFDF on surface runoff and seepage water quality will be on the salinity of the surface runoff and possibly the ground water (depending on the geohydrological conditions). Since a paste deposition method is envisaged, and given the fine particle size distribution of the kimberlite fine residue, the impact of seepage from the tailings to ground water or surface water is expected to be negligible. However, the tailings is likely to be subject to capillary rise, which may result in an upward migration of salts towards the

[1] Acceptable Risk Level as defined by DWAF in the Minimum Requirement Document Series, 2nd edition, DWAF, 1998.

surface. The key impact of the UFDF is therefore likely to be on the runoff from the tailings beach. Collection of surface runoff from the tailings surface and re-circulation of the water in the process is expected to adequately mitigate against this impact.

On the basis of the above and general experience with kimberlite residues, no special precautionary measures need be taken to protect water resources and a standard approach to fine residue disposal will be acceptable from a leachability point of view.

5.2.9.3.2. Waste rock dump

The chemical compositions of the rocks that will be deposited on the waste rock dump differ from the composition of the kimberlite discussed in the previous section. Refer to section 2.1.1 for details on the various rock types that make up the country rock surrounding the kimberlite mineral deposit. The project geologist has confirmed that, based on the general mineralogy of these rock types, only the carboniferous shales and mudstones of the Vryheid and Volkstrust formation (refer to Table 2-1) could possibly contain sulphide minerals in significant quantities, and therefore have potential to produce poor quality leachate. Samples of the ECCA group shales have been analysed to ascertain their potential to produce poor quality leachate or acid mine drainage.

The analysis of waste rock samples indicates that:

- There is a very low to no risk of acid generation from the waste rock dump.

- The most important potential impact of the waste rock dumps on surface runoff and seepage water quality will be on salinity. Based on Metago's experience, the contribution to salinity of the runoff and toe seepage from the waste rock dumps will probably be an order of magnitude higher than the natural soils. The concern is not regarding the runoff from the waste rock dump during rainfall – the surface water runoff would not be in contact with the waste rock for long enough for salinity to build up. Dilution (of salts) would also occur during rainfall events. This should result in low salinity and TDS levels in the surface water runoff during rainfall events. Due to infiltration the waste rock dump will act as a sponge, attenuating rainfall and gradually releasing it as toe seepage after a rainfall event. This seepage water would be in contact with the waste rock for longer, increasing the opportunity for salinity and TDS to build up in the seepage water. From a design perspective, a facility to collect toe seepage from the waste rock dump and return the toe seepage to the plant would be considered adequate. Runoff is less likely to result in a significant impact particularly once the waste rock dumps are rehabilitated.

<u>Assessment of impacts</u>

Impact assessment: Hazardous excavations

Management	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Unmanaged	**H**	**H**	**M**	**H**	**M**	**H**
Managed	**L**	**M**	**M**	**L**	**M**	**M**

5.2.9.4. Pit lake water balance

Based on the ground water modelling the inflow into the open pit at the end of the life of mine is expected to be between 450 – 1000m^3 per day. The net evaporative loss for the area is 1040mm/year. The area of the pit near surface is approximately 140 000m^3. The annual net evaporative loss is approximately 145 600 m^3, or approximately 398 m^3 per day. Therefore the pit will reflood after mine closure, as indicated in Figure 5-4. The ingress into the pits will reduce as the pit refloods, ultimately reaching a balance between inflow and evaporation. The lake is likely to become saline. The lake should have little potential to pollute the surrounding area though, since the maximum water level in the lake should be below the level of the shallow regional ground water aquifer, preventing pollution from the pit lake from entering the ground water aquifer. Dissolved metals are unlikely to be a problem from a toxicological point of view, based on the analysis of samples taken from the pit (refer to Section 2.10.3). Monitoring will be necessary to confirm the rate of inflow into the pit and to re-evaluate the pollution potential after closure if required.

TABLE 5-10 SA ACID RAIN LEACH TEST RESULTS

Determinant	Detection limit [ppm]	SA_AR conc [ppm]	Hazard Rating[1]	AR **[ppb]** [1]	EEC	EEC < AR Delist yes/no	Disposal allowed [g/ha/mth] [1]
Aluminium (Al)	0.02	0.1	2	1000	220.0	yes	1515
Antimony (Sb)	0.002	0.01	2	70	22.0	yes	106
Arsenic* (As)	0.005	0.01	2	430	22.0	yes	651
Beryllium (Be)	0.002		ng		0.0	yes	
Bismuth (Bi)	0.2	0.01	ng		22.0	yes	
Boron (B)	0.07	0.01	ng		22.0	yes	
Cadmium* (Cd)	0.003	0.01	1	31	22.0	yes	4.7
Calcium (Ca)	0.3	207	ng		455400.0	yes	
Chromium* (Cr)	0.01	0.05	3	4700	110.0	yes	7121
hex. Chromium* (Cr VI)	0.005		**1**	20	**0.0**	yes	30
Cobalt* (Co)	0.002	0.01	2	6900	22.0	yes	10454
Copper (Cu)	0.002	0.01	2	100	22.0	yes	151
Fluoride (F)	0.1	0.296	3	1000	651.2	yes	1515
Iron (Fe)	0.02	0.1	3	9000	220.0	yes	13636
Lead* (Pb)	0.003	0.01	2	100	22.0	yes	151
Lithium (Li)	0.01	0.01	ng		22.0	yes	
Magnesium (Mg)	0.02	5.83	ng		12826.0	yes	
Manganese* (Mn)	0.002	0.9	2	300	1980.0	no	454
Mercury (Hg)	0.02	0.01	1	22	22.0	no	2.4
Molybdenum (Mo)	0.05	0.01	ng		22.0	yes	
Nickel (Ni)	0.002	0.01	2	1140	22.0	yes	1727
Phosphorus (P)	0.53	0.4	ng		880.0	yes	
Potassium (K)	0.11	77.7	ng		170940.0	yes	
Selenium (Se)	0.02	0.01	2	260	22.0	yes	394
Silver (Ag)	0.002	0.01	3	2000	22.0	yes	3030
Sodium (Na)	0.05	19.7	ng		43340.0	yes	
Strontium (Sr)	0.02	3.25	ng		7150.0	yes	
Titanium (Ti)	0.02	0.01	ng		22.0	yes	
Tin (Sn)	0.004	0.01	ng		22.0	yes	
Vanadium* (V)	0.005	0.01	3	1300	22.0	yes	1970
Zinc (Zn)	0.004	0.23	2	700	506.0	yes	1061
Zirconia (Zr)	0.05	0.01	3	2000	22.0	yes	3030

1 These values are given in the Minimum Requirements Guidelines (DWAF, 1998) except for Al, which has been agreed with DWAF separately

* The limits of detection relate to AAS analysis of TCLP extract (Total Acid Digest results were done using ICP analysis with a higher limit of detection)

bld - below the limit of detection

na - not analysed for

ng - not given in the Minimum Requirements Document

Tons/mth	333333
Approximate density t/m3:	1.4
Volume m3/mth	238,095
Area (Ha)	100
Estimated disposal rate t/ha/month	3,333

Note: where Hazard Rating is 1 the EEC must be compared to 0.1 of the AR

FIGURE 5-3 SCHEMATIC REPRESENTATION OF THE OPERATIONAL PHASE CONCEPTUAL GROUND WATER FLOW

FIGURE 5-4 SCHEMATIC REPRESENTATION OF POST-OPERATIONAL PHASE CONCEPTUAL GROUND WATER FLOW

5.2.10. Air Quality

Potential pollutants arising from the proposed operations at Voorspoed Mine include particulates (fugitive dust) and vehicle tailpipe emissions. Due to the nature of the project, particulates are the main pollutant of concern. Activities at the proposed mine that have the potential to generate fugitive dust are outlined in Table 5-11.

Table 5-11: Activities generating dust during the project

Construction phase	Operational phase	Closure phase
Land clearing	Blasting (only during upset conditions)	Backfill of the open pit
Topsoil removal	Drilling operations	Rehabilitation and stabilisation of areas
Material loading and hauling	Materials handling	
Stockpiling	Wind erosion	
Grading	Crushing and screening	
Bulldozing	Vehicle entrainment along paved and unpaved roads	
Compaction		

Air quality guidelines and standards have been established by various countries to regulate ambient particulate concentrations. A summary of the air quality guidelines available for use in this project are highlighted in Table 5-12. The guidelines used in this study have been chosen taking into account current South African legislation and the impending Air Quality Bill. Where guidelines are available the block is highlighted in grey. Information on the actual guideline values and background on the guidelines is given in

Appendix 10.

Table 5-12: Air quality guidelines available for use in this project

Country/ Organisation	PM10	Dust fallout
South African Department of Environmental Affairs and Tourism (DEAT) – current guidelines		
South African National Standards (SANS 1929) – proposed limits		
United States Environmental Protection Agency (US-EPA) standards		
European Community (EC) standards		
United Kingdom (UK) National Air Quality Objectives		
World Bank (WB)		

Abbreviations: PM10 Particulate matter with a size fraction less than 10µm (microns)

5.2.10.1. Issue: Compliance with guideline values and the potential for human health impacts

<u>Phase of mining operation</u>

Construction	Operational	Decommissioning	Closure

The issue is applicable to all phases in the life of the project.

Air quality impacts were assessed based on compliance with available ambient air quality guidelines (local and international) and the potential for human health impacts. The comparison of predicted pollutant concentrations to ambient air quality guidelines and standards facilitates a preliminary screening of the potential, which exists for human health impacts. The South African DEAT guidelines, the SANS proposed limit values and the European Community (EC) standards (international standards) are used for comparison in this study (Table 5-12).

Given the nature of the operations, only inhalable particulates (PM10) and total suspended particles (TSP) (dust deposition) were assessed. Three scenarios were investigated by Airshed namely the construction phase, operational phase and closure phase. Only the construction and operational phases of the project were modelled. The potential for impacts during the closure phase are dependent on the extent of demolition and rehabilitation efforts during closure and on features which remain namely, the fine- and coarse residue facilities and the waste rock dump. It is believed that the potential for fugitive dust impacts due to the residue facilities will be negligible through comprehensive rehabilitation prior to closure being granted for these facilities.

Both routine (normal/continuous) and upset (abnormal/occasional) conditions were included (Table 5-11). Impacts were assessed at the mine's boundary and at the three sensitive receptor sites namely the farms Welvaart, Labor and Belmont (Section 2.11).

The assumptions and limitations of the air quality study are outlined below.

- Given that only annual tonnages of materials handled were available, it was necessary to assume a constant rate of emissions from such sources during each month. Peaks in materials handling emissions due to intermittent high tonnage handling periods were not accounted for.

- Wind-blown dust was calculated for each hour on the basis of wind speed and atmospheric stabilities occurring during that hour. Peaks in wind-blown emissions were therefore accounted for in the dispersion simulations.
- In the prediction of dust fallout levels, particle size ranges for the specific sources are crucial for the amount of material removed and the distance the material is carried. For most of the sources this information was not available and use was made of generic particle size ranges.
- A limitation of the study is that no baseline-monitored data exists within the vicinity of the mine and the cumulative impact predictions therefore only reflect the contribution from the proposed mining operations.

THE MAIN CONCLUSIONS OF THE AIR QUALITY INVESTIGATION ARE SUMMARISED BELOW. THE METHODOLOGY USED DURING THE AIR QUALITY ASSESSMENT IS DISCUSSED IN DETAIL IN

Appendix 10. It is important to note that all predicted impacts were modelled without mitigation measures.

Dust from the project could have an impact on the ambient air quality, local residents and neighboring communities, employees, the aesthetic environment and possibly fauna and flora.

- ***Inhalable particulates (PM10)***

Construction phase of the mine

Vehicle entrainment of dust from construction sites represents a relatively large source of fugitive dust emissions. Gaseous and particulate emissions from vehicle tailpipes are far lower and therefore of less significance in terms of their impacts. Figure 5-5 and Figure 5-6, respectively, illustrate the maximum daily and annual average predicted PM10 ground level concentrations for the construction phase. Compliance with guideline values is outlined in the textbox below. It was assumed that the construction phase would be approximately two years.

Operational phase of the mine

The main sources of PM10 emissions from the mining and processing operations were identified to be:

materials handling operations, specifically crushing and screening (27% of the total PM10 emissions);

vehicle-entrained dust on all haul roads (24% of the total PM10 emissions); and,

wind blown dust from waste dumps, storage piles and residue disposal sites (22% of the total PM10 emissions).

Figure 5-7 and Figure 5-8, respectively, illustrate the maximum daily and annual average predicted PM10 ground level concentrations for the operational phase of the mine. Compliance with guideline values is outlined in the textbox below. It was assumed that the mining operations and the processing plant would operate 24 hours a day, 7 days a work and blasting would be done once a day.

Compliance with South African and international PM10 guidelines

Pollutant and impact period		**At the mine boundary**	**Maximum impact at Welvaart**	**Maximum impact at Labor**	**Maximum impact at Belmont**
Construction phase					
PM10	Highest daily	All guideline values exceeded	Only EC standards exceeded		✓
	Annual average		✓	✓	✓
Operational phase					
PM10	Highest daily	Only EC standards exceeded due to materials handling operations	✓	✓	✓
	Annual average	✓	✓	✓	✓

Notes: Guidelines used for comparison include SA DEAT current guidelines, SANS proposed limits and EC standards.

✓ Compliant with guidelines/standards used in this study.

- ***Dust deposition (TSP)***

Dustfall impacts are generally confined to a radius of 3 km from the source. This is due to the fact that larger particles, which contribute most to dustfall rates given their mass, are likely to settle out in close proximity to the source (assuming a ground-based source).

Construction phase of the mine

Predicted dust deposition levels resulting from the construction phase of the project are expected to range from slight to very heavy as illustrated in Figure 5-9. Dust deposition levels at the mine's boundary are predicted to be heavy however there is an area within the mine's boundary, a wetland area, where dust deposition levels are predicted to be very heavy. At Welvaart and Labor the dust deposition levels are expected to be moderate and at Belmont the levels are expected to be slight. Compliance with proposed South African standards during the construction phase is outlined in the textbox below.

Operational phase of the mine

The main contributor to dust fallout during the operational phase of the mine is wind blown dust from the waste rock dump, topsoil stockpiles, run of mine (ROM) storage stockpiles and residue disposal facilities. Wind blown dust accounts for 82% of the total TSP emissions.

Dust deposition levels resulting from all operational activities at the mine are predicted to be very heavy within the mine's boundary, near a wetland area and heavy at the mine's boundary (Figure 5-10). At Welvaart, the dust deposition levels are expected to be moderate with a slight dust deposition expected at both Labor and Belmont. Compliance with proposed South African standards during the operational phase of the mine is outlined in the textbox below.

Compliance with Proposed South African Dust Fallout standard

for residential and light commercial areas

Pollutant and impact period		**At the mine boundary**	**Maximum impact at Welvaart**	**Maximum impact at Labor**	**Maximum impact at Belmont**
Construction phase					
TSP	Total daily	Standard exceeded	✓	✓	✓
Operational phase					
TSP	Total daily	Standard exceeded	✓	✓	✓

Notes: ✓ Compliant with standard used in this study.

With the implementation of the dust management plan outlined in 6.2.10, the significance of predicted air quality impacts will be reduced as highlighted in the assessment below. In addition, the mining operations are located downwind of sensitive receptor sites. The highest impacts are predicted on the mine's property and more specifically a wetland area within the mine's boundary. It is important to keep in mind that the predicted impacts are modelled without mitigation measures. It is expected that the predicted impacts will be reduced once management measures are implemented.

<u>Assessment of impacts</u>

Impact assessment: Construction phase – inhalable dust (PM10) impacting on human health and dust fallout (nuisance)

Management	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Unmanaged	**M**	**M**	**M**	**M**	**M**	**M**
Managed	**L**	**L**	**M**	**L**	**L**	**L**

Impact assessment: Operational phase – inhalable dust (PM10) impacting on human health and dust fallout (nuisance)

Management	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Unmanaged	**H**	**H**	**M**	**H**	**M**	**H**
Managed	**L**	**L**	**M**	**L**	**L**	**L**

FIGURE 5-5 CONSTRUCTION PHASE - HIGHEST PM 10 GROUND LEVEL CONCENTRATIONS

FIGURE 5-6 CONSTRUCTION PHASE - ANNUAL AVERAGE PM 10 GROUND LEVEL CONCENTRATIONS

FIGURE 5-7 OPERATIONAL PHASE - HIGHEST DAILY PM 10 GROUND LEVEL CONCENTRATIONS

FIGURE 5-8 ANNUAL AVERAGE PM 10 GROUND LEVEL CONCENTRATIONS

FIGURE 5-9 CONSTRUCTION - TOTAL DAILY DUST DEPOSITION

FIGURE 5-10 OPERATIONAL PHASE - TOTAL DAILY DUST DEPOSITION

5.2.11. NOISE

5.2.11.1. Issue: noise disturbance to neighbouring residents

Phase of mining operation

Construction	Operational	Decommissioning	Closure
▒	▒	▒	

The issue is applicable to the construction, operational and decommissioning phases of the project.

Impacts

The opencast mining operation will utilise diesel-powered earthmoving and mining equipment as well as highly mechanised processes as the plant and conveyor systems. Noise emissions from these sources would lead to an elevation in ambient noise levels in the area. The results of the noise study and noise modelling indicate the following:

- The maximum noise impact will occur at night when meteorological conditions favour the propagation of sound from source to receiver.
- The maximum noise impact will also occur during the construction period and the initial operational phase, since during these stages the mine residue storage facilities and pit walls will not yet provide effective noise screening.
- Due to large distances between the mining activities and neighbouring residences, the resulting total ambient noise levels at the farm labourers houses and farmsteads will be below 45dBA during the night, i.e. within the limits recommended by SANS 10103 for rural residential areas.
- Based on the criteria contained in SANS 10103 the predicted overall and unmitigated noise impact resulting from mining activities is LOW (between 0 – 5 dBA above ambient noise levels).
- The main contribution to the noise impact on the farms Welvaart and Belmont would be caused by hauling and dumping of waste rock.

Assessment of impacts

Impact assessment: Noise disturbance

Management	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Unmanaged	**M**	**M**	**M**	**M**	**L**	**L**
Managed	**L**	**L**	**M**	**L**	**L**	**L**

FIGURE 5-11 CONTOURS OF INCEASED NOISE LEVELS - CONSTRUCTION PHASE

FIGURE 5-12 CONTOURS OF INCREASED NOISE LEVELS - EARLY OPERATIONAL PHASE

FIGURE 5-13 CONTOURS OF INCREASED NOISE LEVELS - LATER OPERATIONAL PHASE

5.2.12. SITES OF ARCHAEOLOGICAL AND CULTURAL INTEREST

5.2.12.1. Issue: Disturbance of archaeological or cultural sites

Phase of mining operation

Construction	Operational	Decommissioning	Closure
▒▒▒	▒▒▒		

The issue is applicable to the construction and operational phases of the project.

Impacts

Heritage resources in the critical area of the proposed new Voorspoed Diamond Mine that will be affected by the development of the new mine are the following:

- Scattered stone tools will be disturbed by the new development.
- The Historical Building (HB01 on Figure 2-3) will be demolished to make way for the expanding open pit.
- The Historical Voorspoed Diamond Mine's open pit and waste rock dumps will be altered and replaced by the new Voorspoed Diamond Mine's expanding open pit and new waste rock dumps and infrastructure.
- Remains from the Relatively Recent Past, such as the face-brick residence and associated outbuildings, the compound used by labourers and the explosives magazine and associated buildings will be destroyed by the new development.

5.2.12.1.1. The scattered stone tools

The scattered stone tools that were observed in the project area have been exposed by agricultural and other activities. These stone tools therefore do not occur in their original archaeological context any longer. The stone tools are also too limited in number to allow for classification (typology) that can be related to the various periods of the Stone Age. Archaeological remains which do not occur in their archaeological context no longer have research value.

5.2.12.1.2. The Historical Building and remains from the Relatively Recent Past

The Historical Building can be considered to be of historical significance due to the following considerations:

- It is older than sixty years and therefore qualifies as a historical structure.
- It has symbolic and cultural significance relating to its original use (as a police station).
- It is unique, i.e. similar structures are scarce and not often repeated at other places.
- It has research value.

5.2.12.1.3. The Historical Voorspoed Diamond Mine

The Historical Voorspoed Diamond Mine qualifies as part of the national estate when one considers the criteria outlined in Section 3(2)(a) and Section 3(3) (a), (b), (c) and (f) listed in the National Heritage Resources Act. These criteria are the following:

- Places, buildings, structures and equipment of cultural significance.
- Its importance in the community, or pattern of South Africa's history.
- Its possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage.
- Its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage.
- Its importance in demonstrating a high degree of creative or technical achievement at a particular period.

The Historical Voorspoed Diamond Mine therefore qualifies as part of South Africa's 'national estate'. This historical phenomenon could be developed and utilized in a heritage education programme, for example as an open-air museum. However, the transformation of the Historical Voorspoed Diamond Mine into a new sustainable diamond mine would surely bring economic and other benefits that will override the more limited economic and social advantages that a museum could provide.

Assessment of impacts

Impact assessment: Disturbance of archaeological and cultural sites

Management	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Unmanaged	**M**	**H**	**L**	**M**	**H**	**M**
Managed	**L**	**L**	**L**	**L**	**L**	**L**

5.2.12.2. Issue: disturbance of graves

Phase of mining operation

Construction	Operational	Decommissioning	Closure
▒	▒		

The issue is applicable to the construction and operational phases of the project.

Impacts

Two graveyards are located within the project area – indicated as graveyard 01 and 02 on Figure 2-3. Both GY1 and GY02 are older than 60 years and therefore qualify as historical cemeteries. Graveyards are protected by various laws, regulations and ordinances.

Assessment of impacts

Impact assessment: disturbance of graves

Management	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Unmanaged	**H**	**L**	**M**	**M**	**L**	**L**
Managed	**H**	**L**	**M**	**M**	**L**	**L**

5.2.13. Sensitive landscapes

The impacts of the mine on sensitive landscapes are not discussed here as they have discussed in other sections as outlined in Table 5-13.

Table 5-13 Sensitive landscapes and impacts on these

Types of sensitive landscapes	Occurrence at Voorspoed	Sections where the impacts are discussed
Nature conservation or ecologically sensitive areas	The wetland and pans are of high conservation importance	5.2.6
Natural resources	Most soils at the mine site have moderate agricultural potential	5.2.3
Sites of outstanding natural beauty, panoramic views	Renosterkop	5.2.6 and 5.2.7
Sites of social significance	Historical building and graves	5.2.12

5.2.14. VISUAL ASPECTS

5.2.14.1. Issue: Negative visual impact

Phase of mining operation

Construction	Operational	Decommissioning	Closure

The issue is applicable to the construction, operational, decommissioning and closure phases of the project.

Impacts

5.2.14.1.1. Landscape impact

The change to the character and quality of the landscape caused by the development will be high due primarily to the scale of the residue storage facilities caused by the mining operation.

5.2.14.1.2. Visibility

Public views in the study area would be experienced from the R721 and nearby farm roads used for the most part, by people living or farming in the area. The farm roads are not frequently traveled. Also, many of the views from the farm roads towards the mine, particularly from the north, would be partially screened due to the topographic lay of the land (see Figure 2-11 and Figure 2-12).

Project components would also be visible from sections of the R721 road but at distances greater than 8,0km. The impact on views from this distance is not severe as is illustrated in the indicative simulation Figure 5-14.

Views from nearby farms, in particular farms Welvaart, Urbanus and Blydskap (Egoli) will be the most affected. This is illustrated in the indicative simulations of Views 4 and 11 in Figure 5-14. Views from the houses associated with these farms, towards the mine will mostly be screened by trees, walls and other vegetation growing in the immediate vicinity of the buildings. Also, the orientation of the houses on farm Welvaart is to the east and for Urbanus it is to the south, i.e. away from the mine. Nevertheless, the residue storage facilities will be highly visible as one approaches these houses or moves around in their gardens.

A visual divide is created by a ridgeline that starts at the top of Renosterkop and runs to the west and southeast of the hill as is illustrated in Figure 2-14. It creates a 'visual shadow' to the south and southwest of the hill thus blocking views to the proposed mine.

The most sensitive viewing area is to the immediate east and north east of the site.

5.2.14.1.3. Visual intrusion

Visual intrusion is directly related to *landscape impact* and the nature of intrusion of a project component on the visual quality of the environment and its compatibility/discord with the landscape and surrounding land use.

To illustrate the effect the mine will have on the study area, the visual study generated indicative simulations (artistic renditions) of the mine infrastructure. These are illustrated in Figure 5-14. It is apparent from these images that the Voorspoed mine would be highly visible/intrusive from east of the site and that the farms Welvaart, Urbanus and Blydskap will be the most impacted due to their relative position to the mine.

The intrusive nature of the mine features would also be apparent from local farm roads within in a 5.0km radius, mostly east of the site.

Lights at night would initially be a cause for concern, as they would be highly visible in a relatively dark rural landscape and would attract attention. However, as the mine dumps grow in height, and due to their location east of the plant, they would ultimately block views to the plant from the sensitive viewing areas to the east of the site.

The visual assessment concluded that the proposed mine should be rated as *highly* intrusive for the following reasons. Its physical presence would:

- Cause a notable change in landscape characteristics over an extensive area ranging to very intensive change over a more limited area.
- Contrast with the patterns or elements that define the structure of the landscape.
- Be partially compatible with land use (previous mining activity and farming is partially compatible with mining), settlement or enclosure patterns of the general area.
- Be unable to be 'absorbed' into the landscape.

The result is:

- A notable change in landscape characteristics over an extensive area and an intensive change over a localized area resulting in major changes in key views and a contribution to negative visual impact.

5.2.14.1.4. Overall visual impact

Based on the considerations summarised above and professional opinion, the visual impact assessment predicts that the overall visual impact would be *moderate* i.e. visual and aesthetic processes have been notably altered - an impact which is real and which is sufficiently important to require management. A *moderate* impact could influence the decision about the project if left unmanaged. A *moderate* rating is given, (and not a *high* rating which intimates an impact, which should influence the decision about whether or not to proceed with the project), primarily because the number of viewers affected is relatively small and because the value of the landscape, scenic beauty alone, does not have potential as a major tourist attraction.

During the construction phase the impact is likely to be slightly higher due to the intense activities of vehicles and other construction equipment and major earthworks associated with building the plant, other infrastructure and preparing the sites for the various residue storage facilities.

At decommissioning the waste rock, coarse residue and fines residue storage facilities will remain and continue to 'exert' an impact on the visual and aesthetic qualities of the area. Their impact could be reduced if highly effective management measures are applied that would result in a minimal contrast with the landscape due to the final form of the dumps being 'natural' and with surfaces rehabilitated with indigenous grasses and tree species.

Assessment of impacts

Impact assessment: Negative visual impact

Management	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Unmanaged	**H**	**H**	**M**	**H**	**H**	**H**
Managed	**L**	**H**	**M**	**M**	**M**	**M**

FIGURE 5-14 INDICATIVE SIMULATIONS – VISUAL IMPACT

5.2.15. Regional socio-economic structure

5.2.15.1. Issue: positive socio-economic impacts - economic benefits from the mine development

Phase of mining operation

Construction	Operational	Decommissioning	Closure
▒	▒	▒	

The issue is applicable to the construction, operational and decommissioning phases of the project.

Impacts

The main positive impacts are summarised below:

- Contribute toward revitalising the mining sector in the Free State Province.
- Provision of employment to a large number of people during the construction and operational phases of the mine, and to a lesser extent during the decommissioning phases. The numbers of jobs created are significant to the local and regional economy.
- A large capital investment and substantial offshore revenue generation.
- A large amount of money paid out locally in the form of the company payroll, stimulating growth in the local economy (the Prefeasibility estimate indicated the salaried income of mine employees to be approximately R530 million over the life of mine).
- Significant amounts of money paid to government in the form of taxes (the Prefeasibility estimate indicated that taxes in excess of R1 000 million will be paid over the life of mine).
- Economic multiplier effects linked to the creation in support of service sector jobs, the procurement of large quantities of consumables annually, and the outsourcing of service provision to local service providers.

While mining is not a sustainable economic activity, the economic benefits generated during the life of the mine may contribute towards sustainable development in the region by stimulating skills development and the development of alternative forms of income generation.

De Beers and the Murray & Roberts (the EPCM contractor) have developed preferential procurement policies with the intention of maximising procurement opportunities for Historically Disadvantaged South Africans (HDSAs). While no clear stipulations regarding the degree of sourcing of local goods and services can be made at present, local suppliers of goods and services to the mine and HDSAs can be expected to benefit from the proposed mine development. It should be noted that the possibility for disappointment of local companies wishing to procure to the mine exists, if these companies are considered by the mine to be technically or financially uncompetitive.

Assessment of impacts

Impact assessment: economic benefits from the mine development

Management	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Unmanaged	**M+**	**M**	**H**	**H**	**M**	**H+**
Managed	**H+**	**H**	**H**	**H**	**H**	**H+**

5.2.15.2. Issue: negative socio-economic impacts - Economic Impact of Mine Closure

Phase of mining operation

Construction	Operational	Decommissioning	Closure

The issue is applicable to the decommissioning and closure phases of the project.

Impacts

Whilst the local and regional economies in particular will receive benefits from the proposed Voorspoed Mine during its life, the economic impact of mine closure will be detrimental to their economic status. It is difficult to determine the exact degree of impact given the current limited knowledge of the mine's actual financial contributions to the local and regional economies (in terms of actual workforce levels, wage bills and state taxes etc.). However, it is suffice to indicate that the loss of the mine's income stream is likely to have a significant negative impact.

Impact assessment: Economic Impact of Mine Closure

Management	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Unmanaged	H	H	M	H	H	H
Managed	M	M	M	M	H	M

5.2.15.3. Issue: negative socio-economic impacts – impact on farmworker employment

Phase of mining operation

Construction	Operational	Decommissioning	Closure
▒	▒		

The issue is applicable to the construction and operational phase of the project.

Impacts

Concern exists amongst neighbouring landowners that skilled employees will transfer their employment to the nearby mine, since it will be able to offer higher wages. The loss of machine operators is a particular worry for farmers as these employees are considered vital to the functioning of the farm, whilst perceived to be difficult to replace.

Farm workers with the relevant skills cannot be prevented from seeking employment at the mine, since it is their constitutional right to do so. Voorspoed Mine also cannot discriminate against the employment of farm workers (to prevent impacting on farm labour) since this would contravene the labour laws of the country.

However, the recruitment on the mine will be competitive and dependent on several factors, including health and mine-related experience. As such it is not a given that all farm worker applicants will be successful. In turn, given the prevalence of farming in the region, it is unlikely that farmers will experience shortages in farm-related skills, including machine-operators, to replace any losses that may occur.

The purchase of existing water rights at the Koppies Dam could also result in a net loss in farm worker employment in this area, as farmers in this region reduce farming operations and hence employment needs, due to decreased water inputs.

At the time of the final version of this EMP was compiled, De Beers had acquired options to purchase 525 hectares of water rights from Koppies Dam. The majority of the water rights under option were not being used at present (i.e. the owners are either not farming or not practicing irrigation farming anymore). A smaller percentage of the water rights were made up of surplus rights of farmers still practicing irrigation farming. None of the farmers who hold water rights currently under option indicated that they would have to retrench farmworkers as a result of selling water rights.

Impact assessment: impact on farmworker employment

Management	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Unmanaged	L	M	M	L	L	L
Managed	L	L	M	L	L	L

5.2.15.4. Issue: Loss of grazing land

Phase of mining operation

Construction	Operational	Decommissioning	Closure

The issue is applicable to the construction phase of the project.

Impacts

The farms comprising Voorspoed Mine are currently being leased to a neighbouring farmer, who is utilising it for livestock grazing. While it is recognised that the land is owned by De Beers, the loss of the land could have a negative impact on the farmer's wider farming enterprise through a forced reduction in herd size. The farmer has also made investments with regard to water supply on the farms, which will be negated if the mine is developed.

5.2.15.5. Issue: influx of mineworkers and jobseekers

Phase of mining operation

Construction	Operational	Decommissioning	Closure

The issue is applicable to the construction phase of the project.

Impacts

The local area of the mine has very limited capacity in terms of housing, basic services, law enforcement and welfare facilities. The housing of labour on site and the potential interactions of these labourers with surrounding communities may result in:

- Disruption of local communities due to different lifestyles and values of immigrant labourers.
- Prostitution and the risk of spreading HIV/AIDS.

- An influx of jobseekers and the establishment of informal settlements around the developing mine.
- Increased social problems such as crime and stock theft.
- Increased immigration to Kroonstad from the surrounding the region as individuals seek employment at the new mining development (the recruitment office will be situated in Kroonstad).

Impact assessment: influx of mineworkers and jobseekers

Management	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Unmanaged	**H**	**M**	**M**	**M**	**H**	**M**
Managed	**L**	**M**	**M**	**L**	**L**	**L**

5.2.15.6. Issue: management of jobseekers' expectations

Phase of mining operation

Construction	Operational	Decommissioning	Closure

The issue is applicable to the construction phase of the project.

Impacts

With the limited number of jobs available at the mine and the high levels of unemployment in the region, it is likely that a significant number of potential jobseekers from the region and the local Voorspoed area are likely to be disappointed in their pursuit of employment on the mine. Therefore the recruitment process and community perceptions of this process must be managed carefully.

Impact assessment: management of jobseeker's expectations

Management	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Unmanaged	**M-**	**M**	**H**	**H**	**M**	**H**
Managed	**L-**	**M**	**H**	**M**	**L**	**L**

5.2.15.7. Issue: management of stakeholders' expectations

Phase of mining operation

Construction	Operational	Decommissioning	Closure

The issue is applicable to the construction phase of the project.

Impacts

Stakeholders in the area have developed high expectations regarding the development they believe De Beers will bring about in the area through their social investment programme. There is also a strong perception among farm workers in the project area that they should receive direct benefits from the mine if they are to tolerate the bulk of the negative impacts associated with it. If the pace or extent of De Beers social investment programme does not meet expectations, it is likely that conflict will arise between residents of the project area and De Beers.

Impact assessment: management of jobseeker's expectations

Management	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Unmanaged	**M-**	**M**	**M**	**M**	**M**	**M**
Managed	**L-**	**M**	**M**	**M**	**L**	**L**

5.2.15.8. Issue: impact on rural lifestyles

Phase of mining operation

Construction	Operational	Decommissioning	Closure

The issue is applicable to the construction, operational, decommissioning and closure phases of the project.

Impacts

Farmers in the vicinity of Voorspoed have expressed concern about the potential impacts the mining development might have on the quality of rural life as currently experienced. The physical presence of the mine will alter the landscape character, and nuisance impacts resulting from mining activities and interaction with mineworkers may negatively impact on the lifestyles of local residents.

Impact assessment: negative impacts on rural lifestyles

Management	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Unmanaged	**M-**	**H**	**M**	**H**	**M**	**H**
Managed	**L-**	**H**	**M**	**M**	**M**	**M**

5.2.15.9. Issue: Increase in crime levels

Phase of mining operation

Construction	Operational	Decommissioning	Closure
▒	▒	▒	

The issue is applicable to the construction, operational and decommissioning phases of the project.

Impacts

The perception exists among some neighbouring residents that the area in the vicinity of the mine may experience an increase in crime levels due to the presence of contractor employees. Concern was also expressed by IAPs that immigration to Kroonstad (of jobseekers hoping to find employment at the mine) might have the knock on effect of increasing crime levels in Kroonstad (since presumably there will be many more jobseekers than potential jobs).

It is debatable if and to what extent the mine should be considered responsible for an increase in crime if the perpetrators of such crime are not mine employees.

Impact assessment: increase in crime levels

Management	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Unmanaged	**M**	**H**	**H**	**H**	**M**	**H**
Managed	**L**	**H**	**H**	**M**	**M**	**M**

5.2.16. INTERESTED AND AFFECTED PARTIES

The issues raised by interested and affected parties during the scoping process are detailed in Table 5-14, with references to the sections where these issues are addressed.

TABLE 5-14 ISSUES RAISED BY IAPS

Issues	Questions or Comments	Sub issue	Reference
Biophysical components			
Fauna	What will impacts of mining activities, specifically blasting, be on the wildlife and bird life using Renosterkop as habitat? What are the potential impacts of dust generated by the mine on vegetation and grazing animals? Could the mine assist in local nature conservation efforts for example of through fencing off Renosterkop?	Fauna	5.2.6.1 5.2.7.1 6.2.6.1 6.2.7.1
		Dust	5.2.10.1

Issues	Questions or Comments	Sub issue	Reference
Biophysical components			
	fencing off Renosterkop?	Conservation	5.2.6 5.2.7
Flora	How can the pristine environment on Renosterkop be protected? There has been a very conscious attempt by the Renosterkop farming community to do various things to improve nature conservation in the area. There is a serious concern that the mining activities will negatively impact on these attempts.	Conservation	5.2.6 5.2.7
Groundwater	Concern was expressed by IAPs regarding the potential impacts of pit de-watering and seepage from the residue disposal dumps on the groundwater quantity and quality on neighbouring properties. What chemicals will be used in the plant process that could potentially seep into groundwater from the mine residue storage facilities? Could pit dewatering cut off groundwater flow to neighbouring properties? What is the connection between the groundwater aquifers found on the mine and neighbouring farms? Will farmers receive compensation (provision of alternative water) if their boreholes were affected by mining activities, and for how long? What will the effect of the mine's sewage plant be on groundwater quality? What will be done with the treated sewage effluent? How will the mine's solid waste be disposed of?	Groundwater quality Groundwater quantity Chemicals in mine residue Sewage plant	5.2.9.1 5.2.9.3 5.2.9.2 5.3.1 5.2.9.3 4.1.3.1
Surface water	What will the impacts of mine infrastructure on surface hydrology be? How will the development affect dams down-stream of the mine site? What preventative measures will be in place to contain and clean up spillages of chemicals used within the plant or mine? Regarding the proposed source of makeup water for the plant (Koppies Dam) concern was expressed that there is not enough water in the dam to provide for the mine's needs, and that the dam is currently over allocated / utilised. Were filter press technology being considered for mine residue disposal due to its water saving potential? Mr Gunter (Gelukkopje 194) utilises water from the Heuningspruit River for irrigation agriculture. The confluence of the Heuningspruit and Renoster Rivers is just upstream of the De Beers dam. Mr Gunter expressed concern that water abstraction from the De Beers Dam will cause the water level in the river to drop, making it difficult or impossible to abstract water from the Heuningspruit.	Surface hydrology Neighbouring dams Surface water management Koppies dam as water source Filter press technology Water abstraction from weir on Renoster River	2.9.1 5.2.8.1.1 5.2.8.1 3.2.4 4.1.5 3.2.6 3.2.2 Pending
Ecological systems	What will the impact of the mining development be on the wetland located on Voorspoed 401?	Wetland	5.2.6.1 5.2.7.1
Topography	How will the mine residue storage facilities alter the local topography?	Visual impact	5.2.14 6.2.14
Air quality	What will the impacts of mining on air quality be?	Air quality impact	5.2.10 6.2.10
Socio-economic components			
Noise	What standards are used for noise assessment in a rural area as opposed to an urban area? What level of noise impacts will be generated by the mine's trucks?	Noise impact	5.2.11.1 6.2.11.1

Issues	Questions or Comments	Sub issue	Reference
Biophysical components			
	Will the neighbouring farms be included in the noise impact assessment? How intense will the noise generated by blasting be?		
Visual impacts	What will the impacts of the mine's lights at night be?	Visual impact	5.2.14 6.2.14
Traffic	What will be the preferred access route to the mine? Will the route be tarred or upgraded? Will an airstrip, helipad or both be used? Is the mine going to use its own transport to transport workers to and from the mine? The diversion of the road around the pit will have a negative effect on the neighbouring farmers. Are there alternatives?	Mine access route Road diversion Helipad Transport	6.2.5.2 6.2.5.3 1.6.4 4.1.9
Safety	How will the communities living along road S156 be affected by the increase in traffic to the mine?	Traffic	5.2.5.2 6.2.5.2
Property value	Concern was expressed by neighbouring farmers that the mining development could negatively impact on the property values of their farms. There is also the concern that certain neighbouring farms will become unviable as an economic unit. Many improvements have been done on the farm Voorspoed over the years that the Leonard family has rented this land. Will they be compensated for this?	Property values	6.2.16
"Sense of place"	What will the impact of the development on the rural character of the landscape be?	Visual impact Impact on rural lifestyles	5.2.14.1 5.2.15.8
Cultural sites	What facilities will be established at the mine site? Will recreational facilities be established at the mine site? Will a hospital or clinic be established at the mine?	Employee housing and recreational facilities	4.1.8
Historical sites	How will the graves on the site be dealt with?	Graveyards	6.2.12.2
Possible effects on human health	Will there be a health risk to surrounding communities as a result of poor air quality?	Air quality health risk	5.2.10 6.2.10.1
Employment	Where will the mineworkers come from? How many people will be employed? Will employment opportunities be available to local people and to women? Will the mine invest in training and capacity building of local people? What percentage of employees will be at management level? Where will the recruitment office for the mine be located? How will IAPs be informed of the job application procedure through the recruitment office? Will people with no mining experience be able to work on the mine? Farmers expressed concern that they will lose workers with machine and equipment experience to the mine. Concern was expressed that some farm workers in Koppies may lose their jobs if farmers sell their water rights to De Beers.	Employment and recruitment	6.2.15.3 6.2.15.6
Housing	Where will the mineworkers be housed? How will housing be obtained? What can be done to prevent illegal informal settlements developing on neighbouring farms? What can be done to prevent mineworkers from living in or renting rooms from neighbouring farmworker communities? Will the mine provide	Employee housing Informal settlement	4.1.8 6.2.15.5

Issues	Questions or Comments	Sub issue	Reference
Biophysical components			
	recreational facilities for its employees? Will the establishment of the mine require any villages or communities to be relocated?	Relocation	NA
Local economic development	Will De Beers add value by cutting diamonds or export raw diamonds? Will the IDP platform as set up by local municipalities be incorporated in the planning of the mine? How can the mine benefit local businesses? Can the mine contribute to local upliftment programs for issues such as nutrition and housing?	Sale of diamonds Local Economic Development	3.1.1 5.2.15.1 6.2.15.1
Crime	Could the mine lead to an increase in crime i.e. diamonds smuggling? Will the mine join the farm neighbourhood watch? Could the establishment of the mine lead to an increase in theft?	Crime	5.2.15.9 6.2.15.9
BEE	How will the mine identify equity partners and how will Kroonstad benefit from this? Will the mine support the development of SMEs, e.g. through a programme to train local youth in the art of diamond cutting and jewellery making?	Local Economic Development	5.2.15.1 6.2.15.1
Other significant environmental issues			
HIV / AIDS	Concern was expressed regarding the potential interactions between the mineworkers and local farmworker communities, specifically with regard to the risk of the spread of HIV infection.	HIV	5.2.15.5 6.2.15.5
Mine closure	What happens after the mine has reached its maximum potential and closure is imminent?	Socio-economic impacts of closure	5.2.15.2 6.2.15.2
EMP	Will the mine still continue to operate if it is found noncompliant with the EMP?	EMP compliance	8.2
Blasting	What will the effect of blasting be on land features and surface infrastructure surrounding the mine?	Blasting	5.2.5.1 6.2.5.1
Procedural issues	How will the information and findings of the specialist studies be disseminated once all the studies have been completed? How can the specialists collect accurate and adequate data during such short interval time to study the area? How independent are the specialists and what recourse does the public have with regard to the process?	Specialist investigations Data collection EIA independence and EIA review process	Vol. 2 of the Voorspoed EMP 2.17.2

5.2.17. CUMULATIVE IMPACTS

Potential impacts of the Voorspoed mine that could contribute to the cumulative impacts on a regional scale are considered further in Table 5-15. Since the are no major sources of pollution or emissions, such as mines or industries, located in the vicinity of Voorspoed, cumulative impacts are not significant for most of the mine's potential impacts.

TABLE 5-15 REVIEW OF POTENTIAL CUMULATIVE IMPACTS OF VOORSPOED MINE

Issue	Comment	Cumulative impact
Socio-economic benefits of the project	The Voorspoed project will add to the positive socio-economic impacts of mines in the region. Voorspoed is the only proposed diamond mine in the Kroonstad region.	Positive *(Contribution can be enhanced through a local economic development programme)*
Negative social impacts	Population influx and informal settlement could become a problem in the vicinity of the mine.	Negative impact. No significant cumulative impacts identified. *(Contribution by Voorspoed mine can be mitigated)*
Visual impacts	The physical presence of the mining operations and associated infrastructure will compromise the scenic attributes and aesthetic value of the area.	Negative impact. No significant cumulative impacts identified *(Contribution by Voorspoed mine post closure can be minimised by effective rehabilitation of the mine residue storage facilities)*
Loss of biodiversity and/or ecological function	The Voorspoed project has been planned so that there is minimum impact on biodiversity and ecological function in the project area. Infrastructure has been sited on land that has been disturbed by cultivation and forestry. De Beers has committed to avoiding disturbance of surrounding plant and animal habitats during the life of the mine. Crop cultivation and grazing have had an impact on biodiversity. Renosterkop is one of very few relatively pristine habitats remaining in the area. However, the wetland and pans could support an increased biodiversity if the mine rehabilitates these habitats.	Negative cumulative impact on loss of biodiversity and ecological function. *(The contribution by Voorspoed mine will be negligible, if sensitive habitats are avoided, as is planned.)*
Loss of arable l and decreased agricultural production	Most of the land at Voorspoed is arable. To avoid disturbance of plant and animal habitats of conservation importance, Voorspoed is choosing to site infrastructure on land disturbed by agriculture and mining. Furthermore, most of the water allocations in the Dwars River catchment have been acquired for mining and are, therefore, no longer available for irrigation farming.	Negative impact. No significant cumulative impacts. *(About 400 ha of arable land and 100 ha of grazing land will be permanently lost at the site of the Voorspoed mine residue storage facilities.)*
Lowering of water levels	The Voorspoed Mine will lower groundwater levels in the vicinity of the Voorspoed ore body when it is operational. The effect will be localised and only one borehole may potentially be affected. The groundwater levels will recover when mining stops.	Negative impact. No significant cumulative impacts. The impact of the Voorspoed mine on groundwater levels will be localised and temporary.

Issue	Comment	Cumulative impact
Deterioration in water quality	The Voorspoed Mine has been planned so that it will dirty water from the mine will not be released into the surrounding environment. The groundwater pollution plume from the fine residue storage facility may migrate beyond the border of the mine site over the operational life of the mine. The use of paste thickening technology for disposal of the fine residue will however significantly reduce the seepage into groundwater from the fine residue storage facility.	Negative impact – can be mitigated. No significant cumulative impacts. *(The contribution by Voorspoed mine is expected to be insignificant.)*
Deterioration in air quality	No major sources of dust pollution were identified in the area.	Negative impact – can be mitigated. No significant cumulative impacts.

5.3. RESIDUAL IMPACTS AFTER CLOSURE

5.3.1. THE POTENTIAL FOR ACID MINE DRAINAGE OR POOR QUALITY LEACHATES EMANATING FROM THE MINE OR RESIDUE DEPOSITS

Refer to Section 5.2.9.3.

5.3.2. THE LONG-TERM IMPACTS ON GROUND WATER

5.3.2.1. Ultra fines disposal facility (UFDF)

The conventional construction of the UFDF allows efficient drainage of the water from the slurry by applying an average rate of rise of 1.25m/year for the residue. The drainage of water promotes consolidation and as the height of the UFDF increases the amount of seepage water through the ground will decrease as the residue consolidates and creates a zone with low permeability above the ground surface. Any seepage water after closure of the facility is likely to be recovered by the underdrains and very little seepage is expected into the ground water, below the UFDF.

The top and side slope surfaces of the UFDF will be covered with topsoil and vegetated at closure. The vegetation will minimise the amount of rainwater infiltrating the UFDF.

5.3.2.2. Resource tailings facility (RTF)

The coarse residue deposited on the CDRF contains only 12.1% water by dry residue mass. A large amount of this water is expected to evaporate or be retained by the residue. At closure the side slopes and top surface will be covered in topsoil and vegetated to prevent infiltration of rainwater. The amount of seepage from the RTF after closure is therefore expected to be insignificant.

5.3.2.3. Waste Rock Dump

No significant impact on the ground water is expected from the waste rock dump after closure. The dump will be rehabilitated by placing topsoil and vegetate the top and side slope surfaces. The vegetation will minimise the infiltration of rainwater into the waste rock dump.

5.3.3. THE LONG-TERM STABILITY OF REHABILITATED GROUND AND RESIDUE DEPOSITS

The following measures will be taken to ensure the long-term stability of the UFDF, RTF and Waste rock dump:

- The outer slopes of the UFDF, RTF and waste rock dump walls will be graded to 1:3 slopes (1 vertical: 3 horizontal).

- The top and side slope surfaces of the UFDF, RTF and waste rock dump will be covered with topsoil and vegetated to prevent erosion and infiltration of rainwater. An allowance has been made to monitor the rehabilitated areas for 3 years to ensure the long-term stability of the residue disposal facilities.

5.3.4. CONSIDER THE USE TO WHICH THE LAND WILL BE PUT WHEN CONSIDERING LONG-TERM STABILITY

The Ultra fines disposal facility (UFDF), the resource tailings facility (RTF), the plant and the return water dam / storm water dam will be positioned mainly on moderately arable land (a small part of the RTF is positioned on grassland) as shown in Figure 2-5 and Figure 3-8. The rehabilitated disposal facilities and the open pit will be fenced off after closure and revert to wilderness land use. The plant area will be rehabilitated to its original land use and the storm water dam / return water dam are left intact for possible farming purposes.

6. ENVIRONMENTAL MANAGEMENT PROGRAMME

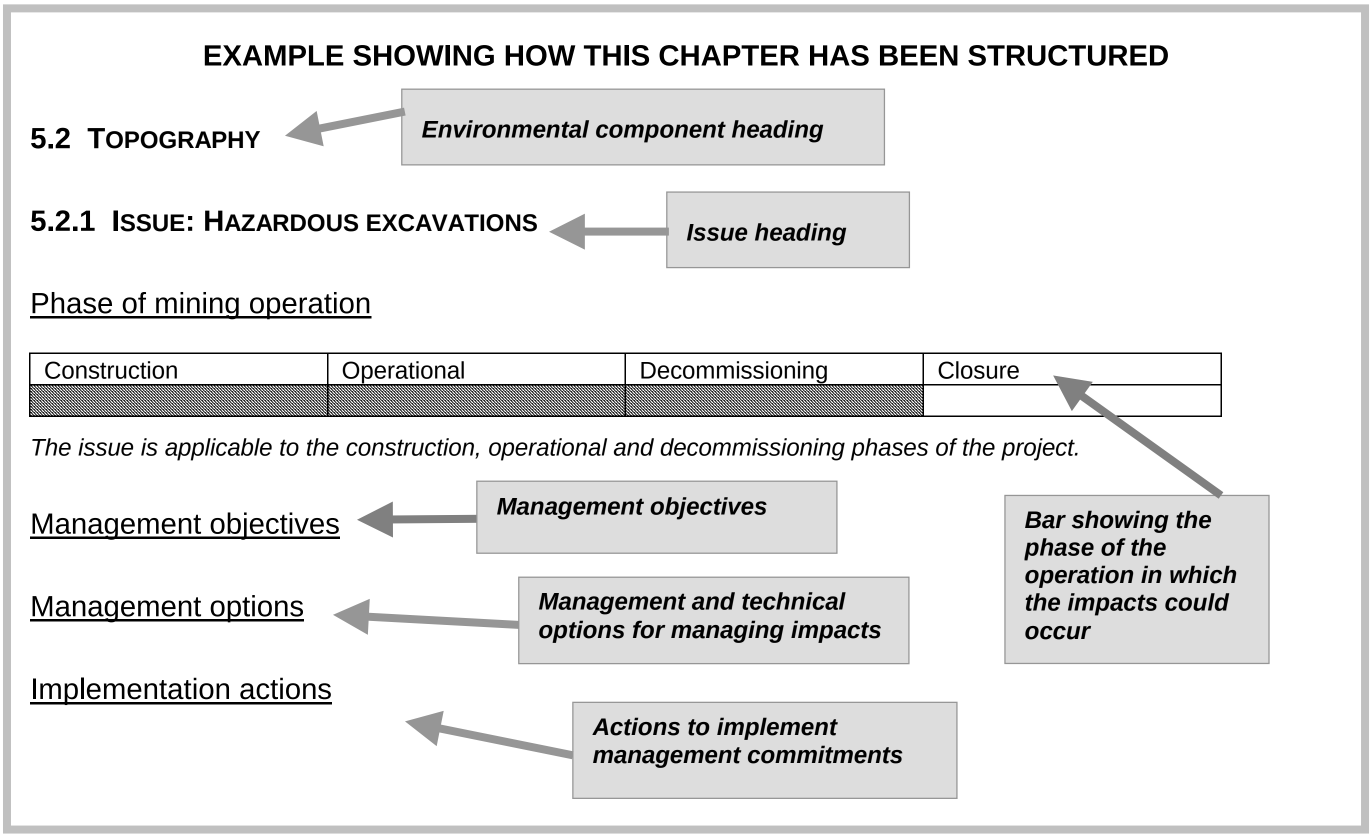
- ***Issues covered in this chapter***

All of the issues discussed in Chapter 5 are covered in this chapter.

6.1. STRUCTURE OF THIS CHAPTER

The various issues have been discussed under the environmental component headings specified in the Aide Memoire for preparation of EMPRs (DME, 1991). This chapter deviates from the structure specified in the Aide Memoire in that it is not divided into sections correlating with the construction, operational, decommissioning and closure phases of the mining operation. The reason for this is that many of the identified issues apply to one or more of these phases. Repetition of a particular issue under a number of phases would have made this chapter long and cumbersome to read. For each issue, the phase in which the impacts occur have been identified.

The chapter deviates from the structure specified in the Aide Memoire in that it is not divided into sections correlating with the construction, operational, decommissioning and closure phases of the mining project. The reasons for this are that the phases overlap and many of the identified issues apply to more than one phase. Repetition of a particular issue under a number of phases would have made this chapter long and cumbersome to read. Instead, for each issue, the phase in the life of the mining project in which the impacts could occur have been identified. An example of this is given in the text box below.



- ***Definition of management commitments***

Management measures that the mine intends to implement are defined in terms of:

- Objectives for the management of impacts and mine closure.
- Technical and management options for managing the impacts.
- Actions required to implement the above measures.

- ***Legal status of the EMP***

Environmental approval has to be obtained from the DME in terms of the Minerals and Petroleum Resources Development Act (MPRDA). The EMP has to be approved by the DME, in consultation with other regulatory authorities with an interest in the environment. When approved, the EMP becomes legally binding.

- ***Updating of the EMP and auditing of compliance with the EMP***

Voorspoed Mine intends to regularly review, refine and update the EMP and to audit compliance with the EMP in terms of the MPRDA.

Compliance with the EMP has to be audited. Specifically, the regulation requires that monitoring of the EMP is undertaken on an ongoing basis and performance assessments (audits) are undertaken regularly. The continued appropriateness and adequacy of the EMP needs to be evaluated during the audits.

Reports on the findings of the audits must be submitted to the DME, other government departments involved in the approval of the EMP and other IAPs on written request.

6.2. MANAGEMENT OF SIGNIFICANT IMPACTS

6.2.1. GEOLOGY

6.2.1.1. Removal of a resource

Phase of mining operation

Construction	Operational	Decommissioning	Closure
	▒	▒	▒

The issue is applicable to the operational, decommissioning and closure phases of the project.

While geology of the Voorspoed ore body will be permanently changed by mining, the changes in geology will not have significant negative impacts hence no management measures are specified.

6.2.2. TOPOGRAPHY

Issues associated with land transformation are listed below. Management measures pertinent to these issues are discussed in the sections identified in brackets.

- Hazardous excavations (Section 6.2.2.1)
- Altered drainage patterns (Section 6.2.8)
- Visual impacts (Section 6.2.14)

6.2.2.1. Hazardous excavations

Phase of mining operation

Construction	Operational	Decommissioning	Closure
	▒	▒	▒

The issue is applicable to the operational, decommissioning and closure phases of the project.

Management objectives

To ensure that humans and large animals do not fall into excavations.

Management and technical options

- Barriers – such as fencing or berms – will be used to ensure that no humans or animals fall into the open pit.
- Other excavations, such as pipeline excavations, will be backfilled and landscaped as soon as possible.
- When the mine is decommissioned, the access ramps will be fenced off to ensure that no humans or animals fall into the open pit.

Implementation actions

Action	Responsible party	Scheduling	Cost provision
Ensure that barriers are included in the detailed design for the project	The Project Manager: De Beers Voorspoed Mine	Voorspoed detailed design phase	None
Ensure that excavations are backfilled and landscaped as soon as possible	Designated person responsible for environment	Voorspoed construction phase	Resources for responsible person: environment – construction phase
Ensure that excavations are backfilled and landscaped as soon as possible	Environmental coordinator	Voorspoed operational phase	Salary for full time environmental coordinator
Ensure that the pit and access rams are fenced off during decommissioning	Environmental coordinator	Voorspoed decommissioning phase	Included in closure costing

6.2.3. SOILS.

6.2.3.1. Issue: Loss of topsoil resource

Phase of mining operation

Construction	Operational	Decommissioning	Closure
▒	▒	▒	

The issue is applicable to the construction, operational and decommissioning phases of the project.

Management objectives

To conserve soil resources disturbed by the development of the mine and to ensure that the pre-mining land capability can be restored.

Management and technical options

Voorspoed will strip topsoil at the sites of mine infrastructure and replace the topsoil when the infrastructure is decommissioned as outlined in Table 6-1. The soil conservation procedure that will be observed by the mine is outlined in Table 6-2.

Fill and construction material will be sourced from the existing open pit. If material is required from a borrow pit a licensed commercial supplier will be used.

TABLE 6-1 TOPSOIL TO BE STRIPPED AND USED IN REHABILITATION

Site	Approximate area that will be disturbed	Main soil forms	Soil depth	Depth of topsoil to be stripped	Depth of topsoil to be replaced
Waste rock stockpile	203 ha	Westleigh and Sepane	300 - 500 mm	300 mm	300 mm
Resource tailings facility	90 ha	Avalon	500 – 1200 mm	500 mm	300 mm
Ultra fines disposal facility	143 ha	Avalon and Sepane	500 – 1200 mm	500 mm	300 mm
Storm and return water dams	33 ha	Avalon	500 – 1200 mm	500 mm	300 mm
Plant area	38 ha	Avalon	500 – 1200 mm	500 mm	500 mm
Open pit	113 ha*		0 mm	0 mm	-

* About 50 ha of this area has already been disturbed by previous mining activity

TABLE 6-2 SOIL CONSERVATION PROCEDURE

Steps	Considerations	Detail
Delineation of areas to be stripped		Stripping will only occur where soils are to be disturbed and when an end-use for the stripped soil has been identified.
Delineation of stockpiling areas	Location and footprint	Suitable stockpiling areas will be identified, preferably in close proximity to the source of the topsoil. The areas will be calculated on the basis of the expected soil volume.
	Storm water controls	Stockpiles will be established within the bounds of storm water management infrastructure.
	Designation of the areas	Soil stockpiles will be clearly identified as such.
Stripping	Invasive vegetation	Invasive plants will be removed before topsoil is stripped.
	Topsoil	The top 300 - 500 mm of soil (‘topsoil’) will be stripped first and put aside, together with any vegetation cover present (only large bushes to be removed prior to stripping).
Stockpiles	Topsoil/ subsoil	Topsoil will be stockpiled separately from any subsoils and rock.
	Erosion control	Rapid growth of vegetation on the stockpiles will be promoted.
	Waste	No waste material will be placed on the soil stockpiles.
	Prevention of compaction	To avoid compaction and consequent damage to the soils, equipment movement on the stockpiles will be limited and the height of the stockpiles will not exceed 5 m.

Steps	**Considerations**	**Detail**
Rehabilitation of disturbed land: restoration of land capability	Replacement of topsoil at other sites	At least 300 mm will be placed on disturbed sites to facilitate rehabilitation of disturbed land. At least 500 mm will be placed on disturbed sites that are to be returned to arable land capability (the plant footprint).
	Fertilisation and seeding	Samples of stripped soils will be analysed to determine the nutrient status. Fertilisers and seeding will be applied if/ as required.
	Erosion control	Erosion control measures will be implemented to ensure that the topsoil is not washed away and erosion gullies do not develop in the arable land.

Implementation actions

Action	Responsible party	Scheduling	Cost provision
Ensure that topsoil is stripped and stockpiled on an ongoing basis in accordance with the EMP management options	Designated person responsible for environment	Voorspoed construction phase	Included in operational closure cost
	Environmental coordinator	Voorspoed operational phase	Salary for full time environmental coordinator
Ensure that topsoil is used for rehabilitation on an ongoing basis in accordance with the EMP management options	Environmental coordinator	Voorspoed operational phase	Salary for full time environmental coordinator

6.2.3.2. Issue: Erosion

Phase of mining operation

Construction	Operational	Decommissioning	Closure

The issue is applicable to all phases in the life of the project.

Management objectives

To prevent erosion.

Management and technical options

Vegetation establishment in disturbed areas will be undertaken as soon as is practical, considering the regional rainfall and growing season (water availability being a constraint).

Where disturbed areas cannot be re-vegetated during the life of the mine appropriate measures will be taken to control erosion. These may include: contours, berms, runoff diversion canals, energy dissipaters, and application of straw mulches or soil binders to exposed soils.

The mine intends to observe the requirements of the Department of Agriculture in the design of effective erosion control measures on bare soils. These requirements are as follows:

- Erosion control measures, such as contours, are required in all areas where slope gradients exceed 2% (1:50);
- Engineered erosion control measures, such as berms and lifts, are required where slope gradients exceed 7% (1:15).

The mine will ensure that erosion controls are included in the designs of linear infrastructure and points of water discharge. Linear infrastructure will be inspected regularly during the rainy season to check that the associated water management infrastructure is effective in controlling erosion.

Energy dissipaters will be constructed at points where there are concentrated discharges of water to the environment (such as culverts and outflows of water from diversion berms or canals).

Implementation actions

Action	Responsible party	Scheduling	Cost provision
Ensure that vegetation establishment is undertaken in disturbed areas as soon as practical	Designated person responsible for environment	Voorspoed construction phase	Included in operational closure cost
	Environmental coordinator	Voorspoed operational phase	Salary for full time environmental coordinator
Where vegetation establishment cannot be undertaken during the life of mine in disturbed areas, ensure that appropriate erosion control measures are implemented	Designated person responsible for environment	Voorspoed construction phase	Included in operational cost
	Environmental coordinator	Voorspoed operational phase	Salary for full time environmental coordinator
Regularly monitor the effectiveness of erosion control measures and / or vegetation establishment in disturbed areas	Environmental coordinator	Voorspoed operational phase	Salary for full time environmental coordinator
	Environmental coordinator	Voorspoed decommissioning phase	Salary for full time environmental coordinator

6.2.3.3. Issue: Soil contamination

Phase of mining operation

Construction	Operational	Decommissioning	Closure
▒▒▒	▒▒▒	▒▒▒	

The issue is applicable to the construction, operational and decommissioning phases in the life of the project.

Management objectives

To prevent contamination of soils.

Management and technical options

Adequate sanitary facilities will be provided at construction sites and areas away from the mine ablution blocks.

Storage areas and vehicle maintenance areas will be surfaced and will have appropriate runoff containment measures, such as bunds and canals, in place.

All chemical, fuel and lubricant storage areas will be underlain by impermeable substrates and will have appropriate runoff containment measures, such as bunds and canals, in place.

Drums containing chemicals will be stored upright in a secure, bunded area with an impermeable surface.

Vehicles will be regularly serviced according to a pre-planned maintenance programme.

Pipelines will be monitored continuously to limit spillage.

An incident reporting system will be developed, including procedures and training, for dealing with incidents.

Major spillage incidents will be reported to the DME, DWAF, DTEEA and the DA (reporting of incidents is required in terms of several Acts – Chapter 8). Appropriate remedial measures will be implemented in consultation with these regulatory authorities.

If spills do occur and soils become contaminated, the appropriate remedial measures will be identified in consultation with an appropriately qualified specialist. On site bio remediation or chemical treatment will be used where appropriate. If necessary, the polluted soils will be classified as wastes and will be discarded at an appropriate permitted waste site. After removal of the contaminated soils, the affected areas will be landscaped and rehabilitated.

Runoff from mine site will be collected and evaporated or discharged to the process water circuit (Section 6.2.8).

Seepage from the Ultra fines disposal facility will be controlled as outlined in Section 6.2.9.

The mine will implement the good waste management practices outlined in Table 6-3.

TABLE 6-3 WASTE MANAGEMENT STRATEGY

Items to be considered		Waste management principles
General	**Specific**	
Procedures	General	A waste management procedure will be developed. This will cover the storage, handling and transportation of waste.
	Classification	Wastes will be broadly classified in terms of the DWAF Minimum Requirements for Waste Disposal (DWAF, 1998).
	Waste minimization and recycling	Opportunities to minimize waste production will be identified and taken where possible. Where possible, waste will be recycled.
Waste disposal facilities	Collection points	Waste collection points will be established on site. Care will be taken to ensure that there will be sufficient collection points with adequate capacity and that these are serviced frequently.
	On site waste disposal facilities	No waste disposal facilities will be developed on site.
	Off site waste disposal facilities	Waste will be disposed of at appropriate permitted waste disposal facilities.
Waste transport	Contractor	An approved subcontractor, working to local authority standards, will undertake the waste transport.
Disposal of different types of waste	Hazardous wastes	Disposal at a permitted hazardous waste disposal facility.
	Non-hazardous waste	Disposal at a permitted non-hazardous waste disposal facility.
	Any soil polluted by a spill of chemicals	If remediation of the soil *in situ* is not possible, the soils will be classified as a waste in terms of the Minimum Requirements and will be disposed of at an appropriate permitted waste facility.
	Building rubble	Care will be taken to ensure that building rubble does not become polluted or mixed with any other waste. The building rubble will be used to backfill excavations.
	Scrap metal	Care will be taken to ensure that scrap metal does not become polluted or mixed with any other waste. The scrap metal will be collected in a designated area for scrap metal (scrap yard). It will be sold to scrap dealers.

Items to be considered		**Waste management principles**
General	**Specific**	
	Oil	Oil will be collected in suitable containers at designated collection points. The collection points will be bunded and underlain by impervious materials to ensure that any spills are contained. An approved subcontractor will remove oil from site.

Implementation actions

Action	Responsible party	Scheduling	Cost provision
Ensure that all chemical, fuel and lubricant storage areas are designed and constructed to contain spillages (refer to SABS 0228).	The Project Manager: De Beers Voorspoed Mine	Voorspoed detailed design phase	Included in the design cost
	Designated person responsible for environment	Voorspoed construction phase	Included in the design cost
Develop a procedure for the handling and storage of hazardous substances	Environmental coordinator	Voorspoed operational phase	Salary for full time environmental coordinator
Include training on the procedure for the handling and storage of hazardous substances in the environmental awareness training programme	Environmental coordinator	Voorspoed operational phase	Salary for full-time environmental coordinator
Ensure that all storage areas, workshops, vehicle maintenance areas and plant equipment are designed to contain spillages and facilitate clean up of spillages	The Project Manager: De Beers Voorspoed Mine	Voorspoed detailed design phase	Included in the design cost
Regularly inspect all storage areas, workshops, vehicle maintenance areas and plant equipment for spillages and take corrective action as required	Designated person responsible for environment	Voorspoed construction phase	Resources for responsible person: environment – construction phase
	Environmental coordinator	Voorspoed operational phase	Salary for full-time environmental coordinator
Develop an incident reporting procedure which defines spillages and describes reporting and clean up	Environmental coordinator	Voorspoed operational phase	Salary for full-time environmental coordinator
Include training on the incident reporting procedure in the environmental awareness training programme	Environmental coordinator	Voorspoed operational phase	Salary for full-time environmental coordinator
Develop a procedure for waste handling, storage and disposal based on the EMP waste management strategy	Environmental coordinator	Voorspoed operational phase	Salary for full-time environmental coordinator
Include training on the procedure for waste handling in the	Environmental coordinator	Voorspoed operational phase	Salary for full-time environmental coordinator

Action	Responsible party	Scheduling	Cost provision
environmental awareness training programme			

6.2.4. LAND CAPABILITY

6.2.4.1. Issue: Loss of arable land

Phase of mining operation

Construction	Operational	Decommissioning	Closure

The issue is applicable to all phases in the life of the project.

Management objectives

To restore disturbed land to its pre-disturbance potential at all sites other than the open pit and mine residue disposal sites, which will be restored to wilderness land capability.

Management and technical options

The mine's intentions for restoration of land capability at the sites of mine infrastructure are outlined in Table 6-4.

TABLE 6-4 AGRICULTURAL POTENTIAL OF SOILS AT SITES OF MINE INFRASTRUCTURE AND THE MINE'S INTENTIONS TO RESTORE AGRICULTURAL POTENTIAL

Site	Approximate area that will be disturbed	Main soil forms	Soil depth	Existing agricultural potential	Agricultural potential to be restored to
Waste rock stockpile	203 ha	Westleigh and Sepane	300 - 500 mm	Arable and grazing	Wilderness
Resource tailings facility	90 ha	Avalon	500 – 1200 mm	Arable	Wilderness
Ultra fines disposal facility	143 ha	Avalon and Sepane	500 – 1200 mm	Arable	Wilderness
Storm and return water dams	33 ha	Avalon	500 – 1200 mm	Arable	Wilderness
Plant area	38 ha	Avalon	500 – 1200 mm	Arable	Arable
Open pit	113 ha*			None (Dormant mine)	None

*Approximately 50 ha of the open pit area have already been disturbed by previous mining activities.

The plant and other buildings will be demolished. Building foundations will be removed to a depth of 0.5m

All other sites, other than the sites of the mine residue disposal facilities, will be landscaped so that the slope gradient is as gentle as possible and minimal erosion control measures are required.

The mine will conserve soil and control erosion as outlined in Sections 6.3.1 and 6.3.2.

A berm and trench will be created around the open pit after closure to prevent surface runoff from flowing into the pit and to prevent people and animals from accidentally falling into the pit.

Implementation actions

Action	Responsible party	Scheduling	Cost provision
Ensure that topsoil is stripped, stockpiled and handled according to the soil conservation procedure.	Designated person responsible for environment	Voorspoed construction phase	Included in operational closure cost
Ensure that rehabilitation is conducted on an ongoing basis in accordance with the soil conservation procedure	Environmental coordinator	Voorspoed operational phase	Salary for full time environmental coordinator
Ensure that rehabilitation is completed in accordance with the soil conservation procedure	Designated person responsible for environment	Voorspoed decommissioning and closure phase	Included in operational closure cost

6.2.5. LAND USE IN THE VICINITY OF THE MINE

6.2.5.1. Issue: Blasting hazards and damage to structures by blasting vibrations

Phase of mining operation

Construction	Operational	Decommissioning	Closure

The issue is applicable to the construction and operational phases of the project.

<u>Management objectives</u>

To prevent injury and to avoid damaging structures.

<u>Management and technical options</u>

The mine will observe the blasting regulations in terms of the Explosives Act 26 of 1956, which require that:

- The danger zone associated with each blast is delineated and people and animals are cleared from this zone before, during and after (30 minutes) after the blast.
- An audible warning is given at least three minutes before the blast is fired.
- Blasts are designed using recognized formulae and by an expert in the field of blasting so that no damage is caused by blasting vibrations.
- All structures and services within 500 m of the blast are marked on a site plan.
- Structures in the immediate vicinity of the blasts are checked in the presence of the owner and a record of the condition of the structures is taken.
- All regulatory authorities with service infrastructure and/or providing services in the area are consulted to determine what safety precautions have to be applied.

The mine will obtain the necessary approvals for blasting and comply with the conditions of these approvals.

The mine will apply the blasting principle that the maximum peak particle velocity will be less than 25 mm/s at a distance of 500 m from a blast in the open pits.

Blasting will be undertaken during daylight hours.

The mine will undertake a thorough crack survey of the potentially affected structures. This will include a photographic record of the structures.

The mine will inform the surrounding communities on Welvaart, Belmont and Urbannus of its blasting programme. A community liaison forum will be established

(Section 6.2.16) and the programme will be made available through the forum as agreed with community representatives.

Implementation actions

Action	Responsible party	Scheduling	Cost provision
Ensure that the mine obtains the necessary approvals for blasting and comply with the conditions of these approvals	Designated person responsible for environment	Voorspoed construction phase	Resources for responsible person: environment – construction phase
Ensure that the mine obtains the necessary approvals for blasting and comply with the conditions of these approvals	Environmental coordinator	Voorspoed operational phase	Salary for full time environmental coordinator
Ensure that the mine informs the surrounding communities of its blasting programme	Environmental coordinator	Voorspoed operational phase	Salary for full time environmental coordinator

6.2.5.2. Issue: Road disturbances and mine traffic

Phase of mining operation

Construction	Operational	Decommissioning	Closure

The issue is applicable to all phases in the life of the project.

Management objectives

To ensure the mine's alteration and usage of road infrastructure is acceptable to roads authorities and other users of the roads.

To ensure the safety of people and livestock.

Management and technical options

Where required, De Beers will upgrade secondary road S169 that will provide access to the mine from the provincial R721 road to an all-weather gravel road. The upgrade will be planned in consultation with the Chief Directorate Roads, Free State Province.

The layout of the access road and security control checkpoint to the mine from secondary road S156 will be designed to ensure that ingress traffic into the mine would not block back into road S 156.

The mine will record and respond, appropriately and without delay, to any complaints about usage of roads by mine vehicles.

The safety of neighbouring residents will be safeguarded through the following measures:

- Construction areas will be fenced and monitored to prevent access by neighbouring residents.
- Construction areas will be appropriately signposted to warn residents against entry and to explain the hazards that entry may pose.
- Drivers of construction vehicles will be made aware of the danger they pose to neighbouring residents. Drivers will be given a strict code of conduct to adhere to when driving through densely settled areas, such as adherence to a speed limit of 30 kph.

<u>Implementation actions</u>

Action	Responsible party	Scheduling	Cost provision
Ensure that secondary road S169 is upgraded to an all-weather gravel road	Designated person responsible for environment	Voorspoed construction phase	Resources for responsible person: environment – construction phase
Ensure that ingress traffic into the mine does not block back into road S 156	Environmental coordinator	Voorspoed operational phase	Salary for full time environmental coordinator
Ensure that the mine responds appropriately and without delay to any complaints about usage of roads by mine vehicles	Environmental coordinator	Voorspoed operational phase	Salary for full time environmental coordinator
Ensure that mine vehicles (including contractors) adhere to code of conduct and speed limit when driving through densely populated areas.	Environmental coordinator	Voorspoed operational phase	Salary for full time environmental coordinator

6.2.5.3. Rerouting of secondary road S156

Phase of mining operation

Construction	Operational	Decommissioning	Closure

The issue is applicable to the construction phase of the project.

Management objectives

To ensure the mine's alteration and usage of road infrastructure is acceptable to roads authorities and other users of the roads.

Management and technical options

The mine will plan re-routing of the secondary road so that the potential detour for the existing users of the road is minimised.

Implementation actions

Action	Responsible party	Scheduling	Cost provision
Plan re-routing of the secondary road so that the potential detour for the existing users of the road is minimised.	The Project Manager: De Beers Voorspoed Mine	Voorspoed detailed design phase	Included in the design cost

6.2.5.4. Issue: Failure of mine residue deposits

Phase of mining operation

Construction	Operational	Decommissioning	Closure

The issue is applicable to all phases in the life of the project.

Management objectives

To prevent failures of mine residue deposits.

Management and technical options

The Ultra fines disposal facility has been sited and planned and will be designed and operated in terms of the SABS Code of Practice (SABS 0286) for mine residue deposits and the requirements of the Mineral and Petroleum Resources Development Act, under the supervision of suitably qualified professional engineers.

Professional engineers will undertake monitoring of the Ultra fines disposal facility at the frequency deemed appropriate by these engineers.

Monitoring of the stability of the Ultra fines disposal facility will continue through the decommissioning phase and until the time when a suitably qualified professional engineer has attested to its long-term stability.

Implementation actions

Action	Responsible party	Scheduling	Cost provision
Ensure that the mine residue deposits are designed in accordance with the SABS code of practice for mine residue deposits and the requirements of the Mineral and Petroleum Resources Development Act	The Project Manager: De Beers Voorspoed Mine	Voorspoed detailed design phase	Included in the design cost
Ensure that the mine residue deposits are operated in accordance with design prescriptions	Environmental coordinator	Voorspoed operational phase	Salary for full time environmental coordinator

6.2.6. NATURAL VEGETATION/PLANT LIFE

6.2.6.1. Issue: Loss of biodiversity and ecological function

Phase of mining operation

Construction	Operational	Decommissioning	Closure
▒▒▒	▒▒▒	▒▒▒	

The issue is applicable to the construction, operational and decommissioning phases of the project.

Management objectives

To minimise the area of disturbance and avoid disturbance of sensitive habitats.

To rehabilitate disturbed land to a stable physical state and prevent proliferation of invasive plants.

Management and technical options

6.2.6.1.1. Minimise the area of disturbance and avoid disturbance of sensitive habitats.

Surface disturbance will be kept to a minimum. Activities will be concentrated in disturbed areas as far as is possible. Human and vehicular activity will be restricted to construction and operational sites.

Mine staff will be made aware the following plant habitats close to the mine site need to be protected from disturbance:

- The wetland on Voorspoed 401, northwest of the existing open pit .
- The pans on Voorspoed 401, north of the existing open pit.
- Renosterkop to the southwest of the existing open pit.

Disturbances at these sites will be prevented through the following measures:

- Buffer zones will be maintained and no vegetation cleared in these habitats. The buffer zones are indicated on Figure 2-3. The buffer zone around the wetland is 100 m. Around the plans the buffer zones are defined by the actual boundary of the band catchments. No mining development will take place between the proposed realigned road S156 and Renosterkop, so no buffer zone is required below Renosterkop.
- Mine staff will not be allowed to drive off-road into these habitats.
- Fencing will be erected around these habitats during the construction phase to ensure the buffer zones are enforced.
- Natural surface water flow to these areas will not be impeded.
- Dirty water from mine surface infrastructure areas will be retained within the mine's storm water control system and prevented from flowing into these habitats.
- Erosion will be prevented or controlled where vegetation has been disturbed, especially on the slopes of the Renosterkop.
- Mine staff will not be allowed to hunt, collect plants or cut firewood in these habitats. Killing of animals that are perceived as dangerous, such as snakes will be discouraged.
- Indiscriminate disposal of waste in these habitats will be prevented.
- The spread of invasive plants into these habitats will be monitored and corrective action taken if required.

- Dust pollution will be monitored and managed as detailed in Section 6.2.10.

<u>Implementation actions</u>

Action	Responsible party	Scheduling	Cost provision
Ensure that sensitive areas are avoided and that buffer zones are created around sensitive areas in the mine design	The Project Manager: De Beers Voorspoed Mine	Voorspoed detailed design phase	Included in the design cost
Ensure that all mining activities avoid sensitive areas and buffer zones around sensitive areas in accordance with the EMP prescriptions	Designated person responsible for environment	Voorspoed construction phase	Resources for responsible person: environment – construction phase
Ensure that all mining activities avoid sensitive areas and buffer zones around sensitive areas in accordance with the EMP prescriptions	Environmental coordinator	Voorspoed operational phase	Salary for full time environmental coordinator

6.2.6.1.2. Rehabilitation of disturbed land to a stable physical state and prevention of proliferation of invasive plants

All land disturbed by mining, other than the Ultra fines disposal facility and return water dam, will be rehabilitated to a stable physical state and its pre-disturbance agricultural potential (Section 6.2.4). The Ultra fines disposal facility and return water dam sites will be vegetated to prevent erosion and reduce their visual impact.

Topsoil will be conserved as outlined in Section 6.3.

Topsoil will be returned to the area from where it was removed where possible. Care will be taken to ensure that topsoil stripped from areas where invasive plants are abundant is not placed elsewhere.

Invasive plants will be removed from land adjacent to mine infrastructure sites.

A weed control programme will be implemented throughout the life of the mine until closure when all areas of the mine have been successfully rehabilitated.

Generally, where vegetation is to be planted, a mixture of commercially available seeds that germinate reliably (high seed viability) will be used. The species to be used will be indigenous (no exotic plant species will be used) and will be selected on the basis of their ability to bind and cover soil (afford erosion protection) and their tolerance of prevailing environmental conditions. Species that can become invasive or a problem in the future cultivation of the rehabilitated land will be avoided. Species that will enhance the arable potential of soils will be used where possible.

Implementation actions

Action	Responsible party	Scheduling	Cost provision
Ensure that rehabilitation takes place in accordance with EMP prescriptions	Environmental coordinator	Voorspoed operational phase	Salary for full time environmental coordinator

6.2.6.1.3. Other measures

The mine will participate in a conservancy if a conservancy is established in the region and it overlaps with the project area. The nature of the mine's participation will be defined if such a conservancy is established and in consultation with other participants in the conservancy.

Implementation actions

Action	Responsible party	Scheduling	Cost provision
Ensure that a community liaison forum for communication with interested and / or affected parties is established	Environmental coordinator	Voorspoed operational phase	Salary for full time environmental coordinator

6.2.7. ANIMAL LIFE.

6.2.7.1. Issue: Loss of biodiversity and ecological function

Phase of mining operation

Construction	Operational	Decommissioning	Closure
▒	▒	▒	

The issue is applicable to the construction, operational and decommissioning phases of the project.

Management objectives

To prevent disturbance of sensitive animal habitats.

To protect watercourses and wetlands and prevent alteration of these habitats directly and indirectly through sedimentation and pollution.

Management and technical options

The measures listed below will be implemented to mitigate impacts on animal populations in and around the mine site:

- Buffer zones will be maintained and no vegetation cleared in these habitats.
- Mine staff will not be allowed to drive off-road into these habitats.
- Fencing will be erected around to use habitats during the construction phase to ensure the buffer zones are enforced.
- Mine staff will not be allowed to hunt, collect plants or cut firewood in these habitats. Killing of animals that are perceived as dangerous, such as snakes will be discouraged.
- Dust pollution will be monitored and managed as detailed in Section 6.2.10.
- Security fencing will be limited to the mine infrastructure boundary so that animal movement is not unnecessarily restricted outside the mine infrastructure sites.

6.2.7.1.1. Rehabilitation of wetlands

The mine will rehabilitate the wetlands through:

Buffer zones will be implemented around the wetlands as indicated on Figure 2-3. A 100 m buffer zone will be maintained around the wetland and drainage line downstream of it. A smaller buffer will be maintained around the pans, based on a site survey of their actual catchments. Berms will be constructed around the pan catchment boundaries to ensure that no dirty water flows into the pans from the surrounding mine surface infrastructure areas.

Restoring the natural surface water flow to the wetland as far as possible. An accurate survey of the site will be done to determine the slope, surface runoff yields and determine adequate mitigation to ensure the maximum surface water flow to the wetlands.

Not allowing overgrazing of the wetland or pans (a limited amount of grazing is beneficial to the grass species).

Filling up human made drainage lines in the wetlands, and removing human made barriers to surface water flow.

Implementation actions

Action	Responsible party	Scheduling	Cost provision
Ensure that sensitive areas are avoided and that buffer zones are created around sensitive areas in the mine design	The Project Manager: De Beers Voorspoed Mine	Voorspoed detailed design phase	Included in the design cost
Ensure that all mining activities avoid sensitive areas and buffer zones around sensitive areas in accordance with the EMP prescriptions	Designated person responsible for environment	Voorspoed construction phase	Resources for responsible person: environment – construction phase
Ensure that all mining activities avoid sensitive areas and buffer zones around sensitive areas in accordance with the EMP prescriptions	Environmental coordinator	Voorspoed operational phase	Salary for full time environmental coordinator
Incorporate the measures required for the rehabilitation of the wetlands in the mine design	The Project Manager: De Beers Voorspoed Mine	Voorspoed detailed design phase	Included in the design cost

6.2.8. SURFACE WATER.

6.2.8.1. Issue: Compliance with Government Notice 704 Regulations

Phase of mining operation

Construction	Operational	Decommissioning	Closure

The issue is applicable to the construction, operational, decommissioning and closure phases of the project.

Management objectives

To ensure compliance with the GN 704 Regulations and conditions of approval of water use license.

To minimise the alteration of drainage patterns in the project area.

Management and technical options

Voorspoed will obtain water use licences and will apply with the conditions of approval of these licences. Voorspoed will apply for the water use licenses identified in Table 6-5.

In compliance with the GN 704 Regulations the mine will divert clean runoff from its mine surface infrastructure and collect dirty runoff from the sites of infrastructure. It will ensure that its storm water collection facilities and dirty water holding facilities are designed for the 1:50 year storm event. This means that there will be no discharges of dirty water from the mine site unless there is an extreme storm event (bigger than the 1:50 year storm).

TABLE 6-5 EXEMPTIONS AND WATER USE LICENSES REQUIRED

Situation	**Exemptions from the GN 704 Regulations that are required**	**Water use licences that are required in terms of Section 21 of the National Water Act**	**Applications to be made by Voorspoed**
The power lines to the plant will be less than 100 m from the wetland for a short distance	None		None
The fines residue disposal facility will be located on a poorly defined drainage line	Regulation 4a	Section 21i[1]	Section 21i water use licence
Some seepage from the fines residue disposal facility may migrate into groundwater outside the mine boundary	Regulation 7a	Section 21g[2]	Section 21g water use licence
Dewatering of the mine workings		Section 21j[3]	Section 21j[3] water use licence

1. Licence for altering the bed, banks, course or characteristics of a watercourse.
2. Licence for disposing of waste or water containing waste in a manner that may detrimentally impact on a water resource.
3. Licence for removing, discharging or disposing of water found underground.

Implementation actions

Action	Responsible party	Scheduling	Cost provision
Ensure that the water management facilities for the mine is designed in accordance with GN 704 Regulations	The Project Manager: De Beers Voorspoed Mine	Voorspoed detailed design phase	Included in the design cost
Ensure that the necessary water licences for the mine are applied for	The Project Manager: De Beers Voorspoed Mine	Voorspoed detailed design phase	Included in the design cost

6.2.8.2. Issue: Pollution of surface water

Phase of mining operation

Construction	Operational	Decommissioning	Closure

The issue is applicable to the construction, operational, decommissioning and closure phases of the project.

Management objectives

To prevent discharges of contaminated water to the environment.

To prevent pollution of water resources in the vicinity of the mine.

Management and technical options

The mine will implement the control measures outlined in Table 6-6 in accordance with the requirements of GN 704 Regulations and the corresponding DWAF M6.1 Operational Guideline. All storm water controls will be designed for the 1:50 year storm event.

There will be no discharges of dirty water from the mine site unless there is an extreme storm event, with a recurrence interval exceeding 1:50 years.

Storm water management infrastructure will be installed before any construction and open pit mining activities commence.

Storage areas and vehicle maintenance areas will be surfaced and will have appropriate runoff containment measures, such as bunds or canals, in place.

The mine will avoid contamination of soils and will implement appropriate remedial measures if incidents of spillage occur (Section 6.2.3.3).

The mine will implement good waste management practices (Table 6-3).

Environmental conditions will be included in construction contracts, thereby making contractors aware of the necessity to prevent accidental spillages by the implementation of good house keeping practices.

Adequate sanitary facilities will be provided at the construction sites until the mine's ablution block and sewage plant is operational.

The water balance for the mine will be refined on an ongoing basis during the life of the mine. Flow meters will be installed in the mine water circuit to enable refinement of the water balance. The water balance will be used to check on an ongoing basis that the capacity of the dirty water holding facilities is adequate, taking the operational distribution and use of water into account.

An annual report on the mine water balance will be submitted to DWAF. This will provide information on the status of the water balance in the wet season and the dry season and under conditions of extreme rainfall.

An emergency response procedure will be developed, defining the reporting of and response to incidents.

<u>Implementation actions</u>

Action	Responsible party	Scheduling	Cost provision
Ensure that water pollution control measures as detailed in Table 6-6 are incorporated into the design of the mine	The Project Manager: De Beers Voorspoed Mine	Voorspoed detailed design phase	Included in the design cost
Ensure the surface water monitoring is conducted in accordance with the protocol defined in the EMP	Designated person responsible for environment	Voorspoed construction phase	Resources for responsible person: environment – construction phase
	Environmental coordinator	Voorspoed operational phase	Salary for full time environmental coordinator
Ensure that water flow measurements are taken in the mine water circuit and that the mine water balance is updated annually	Environmental coordinator	Voorspoed operational phase	Salary for full time environmental coordinator
Ensure that spillages are cleaned up and that appropriate corrective actions are taken to address the cause	Environmental coordinator	Voorspoed operational phase	Salary for full time environmental coordinator
Report all major spillages and any discharges of dirty water into the surrounding environment to DWAF and take corrective action to address the cause	Environmental coordinator	Voorspoed operational phase	Salary for full time environmental coordinator

TABLE 6-6 POTENTIAL SOURCES OF WATER POLLUTION AT VOORSPOED AND PLANNED POLLUTION PREVENTION MEASURES

Sources		**Planned pollution control measures**					
Contamination mechanisms	**Areas**	**Emissions**	**Process water and effluent**	**Spills and failures**	**Seepage**	**Rain and runoff**	**Waste management**
Disturbance of land Dust Erosion Contamination of runoff Spills of materials Poor waste management	All construction sites	Dust suppression by chemical or watering means Minimise the area of disturbance Rehabilitate disturbed land as soon as possible	Water used for dust suppression will evaporate	Erosion control Good housekeeping and immediate clean up of spills	*Not applicable*	Establishment of stormwater management infrastructure prior to construction Minimise the area of disturbance Rehabilitate as soon as possible	Collection of waste and disposal as outlined in Section 6.2.3.3
Plant area Dust Emissions Erosion Spills of materials Seepage from wet areas Contamination of runoff Poor waste management	Material storage areas	*Not applicable*	*Not applicable*	Cement lined floor	Cement lined floor	Within plant stormwater management infrastructure	Collection of waste and disposal as outlined in Section 6.2.3.3
	Conveyors	Dust extractors at crushers, tipping and transfer points	*Not applicable*	Collection and processing of spilled materials	Collection and processing of spilled materials		
	Ore stockpile areas	Dust suppression by means of watering		Collection and processing of spilled materials	Ground water monitoring		
	Product crushing, screening & processing	Dust extractors at crushers, tipping and transfer points	Closed process water circuits – no effluent discharges	Collection and processing of spilled materials Areas underneath processing equipment cement lined and bunded	Product is inert Areas underneath processing equipment cement lined and bunded		

Sources		**Planned pollution control measures**					
Contamination mechanisms	**Areas**	**Emissions**	**Process water and effluent**	**Spills and failures**	**Seepage**	**Rain and runoff**	**Waste management**
Transportation to and from site Dust Spills of materials Poor waste management	Trucks	Water or chemical dust suppression on transport routes Vehicles to observe speed limits Vehicles engines properly maintained & regularly inspected Tarpaulins/ sails covering for trucks carrying light/ dispersible raw materials Trucks will not be overloaded	See wash bays below	Tarpaulins/ sails covering trucks carrying light/ dispersible raw materials Trucks will not be overloaded (checked on weighbridges at the plant) Equipment & procedures in place for spills handling & cleanup	*Not applicable*	Tarpaulins/ sails covering trucks carrying raw materials that will absorb water	Collection of waste and disposal as outlined in Section 6.2.3.3
Services Spills of materials Contamination of runoff Poor waste management	Fuelling station	*Not significant*	Wash down water to be collected in sumps and treated in an oil separator	Bunds with adequate capacity to take a full spill Cleaning up of spills Equipment & procedures in place for spills handling & cleanup	Cement-lined floors	Within plant stormwater management infrastructure	
	Workshops	*Not significant*					
	Wash bays	*Not significant*					
	Stores	*Not significant*	No significant water use				
Domestic and industrial waste collection	Waste collection	Not significant	No significant water use	Picking up of spilled material	Contained in bins/ containers	In containers within the plant stormwater management infrastructure	
Domestic and industrial waste storage and disposal	Storage/ removal bays	Not significant	No significant water use	Bunded Picking up of spilled material	Cement floor	In containers within the plant stormwater management infrastructure	

Sources		**Planned pollution control measures**					
Contamination mechanisms	**Areas**	**Emissions**	**Process water and effluent**	**Spills and failures**	**Seepage**	**Rain and runoff**	**Waste management**
Plant residue disposal Dust Erosion Spills of materials Seepage from wet areas Contamination of runoff Poor waste management	Slimes delivery pipelines	Closed	Water in fines residue will be collected by the drainage systems and will report to pollution control dams The polluted water will be used in the plant	Continuous monitoring Prompt clean up of spilled material and disposal on the slimes dam	Collection of spilled materials		
	Slimes dam	Rehabilitation		Continuous monitoring	To be designed and managed so that the risk of failure is negligible	Toe paddocks around perimeter to collect and evaporate runoff from the slopes Clean runoff diversions upgradient of sites Underdrains collect seepage	
Water management facilities	Sewage plant	*Not applicable*	Effluent to be used in the plant process water circuit	Sized so that it has surplus capacity	*Not applicable*	*Not applicable*	Collection of waste and disposal as outlined in Section 6.2.3.3
	Clean stormwater diversions	*Not applicable*	*Not applicable*	To be sized in accordance with Regulation 6 of the GN 704 Regulations	*Not applicable*	Will prevent runoff from the areas above the plant and plant residue disposal facilities from becoming contaminated	
	Dirty stormwater collection drains	*Not applicable*	Will not carry process water	To be sized in accordance with Regulation 6 of the GN 704 Regulations	*Not applicable*	Will channel contaminated runoff to the northern storm water control dam	

Sources		Planned pollution control measures					
Contamination mechanisms	**Areas**	**Emissions**	**Process water and effluent**	**Spills and failures**	**Seepage**	**Rain and runoff**	**Waste management**
	Combined storm water control and return water dam	*Not applicable*	Polluted water from these dams will be used in the plant process water circuit	To be sized in accordance with Regulation 6 of the GN 704 Regulations	*Not applicable*	Collects drainage water from the mine residue disposal facilities	

<u>Monitoring</u>

The mine will monitor water quality as outlined below. Should any contamination be detected at the compliance monitoring points, the mine will immediately notify the Regional Director of DWAF. It will then identify the source of contamination, identify measures for the prevention of this contamination (in the short term and the long term) and then implement these measures.

SURFACE WATER QUALITY MONITORING WILL BE UNDERTAKEN ON A QUARTERLY BASIS AT THE MONITORING POINTS INDICATED IN

Figure 6-1.

Surface water monitoring points will also include points important to the operation (on-site) these are:

- Return water dam.
- Sewage treatment plant effluent.

SURFACE WATER MONITORING POINTS ARE INDICATED ON

Figure 6-1. The parameters to be monitored are listed in Table 6-7.

TABLE 6-7 PARAMETERS FOR SURFACE WATER QUALITY MONITORING

Constituents	Surface water	Sewage treatment plant (out).
pH	X	X
Suspended Solids (SS)	X	X
Alkalinity (Alk)	X	X
Conductivity (EC)	X	X
Calcium (Ca)	X	X
Chloride (Cl)	X	X
Magnesium (Mg)	X	X
Potassium (K)		X
Sodium (Na)	X	X
Sulphate (SO_4)	X	X
Total nitrogen (N)	X	X
Phosphate (PO_4)		X
Dissolved oxygen		X
Chemical Oxygen Demand (COD)	X	X
Iron (Fe)	X	
Manganese (Mn)	X	

Constituents	**Surface water**	**Sewage treatment plant (out).**
Chromium (Cr)	X	
Vanadium (V)	X	
Fluoride (F)	X	

The monitoring data will be documented, interpreted and reports on trends in the data will be submitted to DWAF on an annual basis. The parameters for analyses should be reviewed in consultation with DWAF after one year so that the protocol can be optimised based on the trends in the data.

The annual monitoring reports will also contain the following information:

- Updates to and the status of the mine water balance.
- Groundwater monitoring results (Section 6.2.9).

6.2.8.3. Issue: Reduction in the catchment of dams downstream of the site

Phase of mining operation

Construction	Operational	Decommissioning	Closure

The issue is applicable to the construction, operational, decommissioning and closure phases of the project.

Management objectives

To ensure that the mine's use of water does not impact on the availability of water to lawful water users.

Lawful water users defined in the National Water Act as:

- *People using water in terms of Schedule 1 of the Act (low impact activities such as domestic water use).*
- *Generally authorised users – people using water in terms of Section 39 of the Act and within the terms and conditions of the General Authorisations (Government Gazette 20256, 8 October 1999).*
- *Registered existing lawful water users – users who undertook lawful water use during 1 October 1996 to September 1998 and have registered this use in terms of the National Water Act.*
- *Licensed users – people granted a water-use licence in terms of the National Water Act.*

Management and technical options

The mine will compensate lawful water users if mining activities result in a significant decrease in water availability to such users.

6.2.8.4. The water balance described in 4.1.10

The strategy for managing the water balance is as follows:

The plant process is optimised for water recovery – a minimal amount of water is sent out to the fines residue disposal facility, most of the water is recovered and recycled to the plant.

Recycled water is used first before makeup water is brought in from the Koppies Dam.

The sources of dirty water to recycle are:

- The return water dam (The fines residue decant and seepage, dirty stormwater from the resource tailings facility, and dirty stormwater from the plant report to the return water dam).
- The open pit.
- Waste settling sump.

<u>Implementation actions</u>

Action	Responsible party	Scheduling	Cost provision
Ensure that the water balance of the mine is operated in accordance with the strategy detailed in the EMP	Environmental coordinator	Voorspoed operational phase	Salary for full time environmental coordinator

6.2.8.5. Storm water

The strategy for managing stormwater is based on Regulation GN 704 and entails the following:

- Clean and dirty stormwater is to be kept separate.
- Channels and stormwater facilities are to be sized to retain the 1:50 year storm event.
- Stormwater trenches / berms will not be lined.
- Channels will be situated upstream and downstream of the various facilities. The upstream channels will deflect clean water away from the facilities, and

the downstream channels will collect dirty stormwater and channel it to the return water dam or stormwater dam.

Implementation actions

Action	Responsible party	Scheduling	Cost provision
Ensure that the storm water is managed in accordance with the strategy detailed in the EMP	Environmental coordinator	Voorspoed operational phase	Salary for full time environmental coordinator

6.2.8.6. Surface rehabilitation

6.2.8.6.1. Mine residue storage facilities

The side slopes and surface of the dumps will be rehabilitated (revegetated) so that rainwater will be shed of the facilities and into the dirty water collection system.

6.2.8.6.2. Plant

The plant area, including stormwater trenches, will be rehabilitated to its pre-mining state. Runoff would be allowed to follow its natural course.

6.2.9. GROUND WATER.

6.2.9.1. Potential for groundwater contaminant transport from the fines residue disposal facility

Phase of mining operation

Construction	Operational	Decommissioning	Closure
▒	▒	▒	

The issue is applicable to the construction, operational and decommissioning phases of the project.

Management objectives

To ensure that the ground water quality of surrounding ground water users are not adversely affected.

Management and technical options

6.2.9.1.1. Measures to reduce the potential for contamination of groundwater

Water will be recovered from the fine residue as efficiently as possible before deposition of the residue on the Ultra fines disposal facility. The fine residue will effectively be deposited as a paste, significantly reducing the amount of seepage to groundwater.

The return water dam will be lined to prevent any seepage.

Monitoring of groundwater qualities will take place and water quality predictions will be updated. Contaminant plumes outside of the mine site will be intercepted by scavenger wells, should contamination be unacceptable.

Contaminated mine water will be pumped directly to the plant for be used in the ore processing process. Oil traps will remove oil and suspended solids will be settled out. By using dirty water in the plant, less clean water is used or contaminated by holding ponds.

6.2.9.1.2. Monitoring of groundwater

The monitoring programme will assess the potential impacts and variation on the water quality during the operational phase. The monitoring data should be used to identify potential impacts on neighbouring groundwater users before it occurs. Mitigation measures can then be implemented in time.

Five additional monitoring boreholes recommended for the groundwater monitoring programme (Table 6-8).

10 monitoring locations are proposed. The monitoring programme will comply with the following specifications:

- The frequency should be done according to Table 6-8. The sampling locations are shown on Map 4.
- The samples should be analysed at a SANAS accredited laboratory for macro and micro chemical constituents listed in Table 2-10 and Table 2-11. The parameters for analyses should be reviewed after one year so that the protocol can be optimised based on the trends in the data.
- The sampling of groundwater should be done with a purging pump. All samples should be filtered and preserved on site.

- The water levels and quality data should be digitally archived for future reference.
- Six monthly monitoring reports should be compiled with trend analyses to determine seasonal variations in water quality.
- The monitoring boreholes should be sited based on the existing geophysical information. Geological borehole profiles and hydrological information should be collected during drilling.
- The new monitoring boreholes should be developed for long-term use and suitably equipped.

TABLE 6-8 PROPOSED NEW MONITORING BOREHOLES AND MONITORING SCHEDULE FOR NEW AND EXISTING SITES

No	Latitude	Longitude	Position	Purpose	Water levels	Flow rate	Macro-chem	Micro-Chem
Mon BH 1				Monitoring of the fines residue disposal facility impact on groundwater quality	Monthly	NA	Quarterly	Bi-annual
Mon BH 2					Monthly	NA	Quarterly	Bi-annual
Mon BH 3					Monthly	NA	Quarterly	Bi-annual
Mon BH 4	27.195678	-27.406171	500 m south west of the existing pit	Monitoring of the pit operations and dewatering on groundwater levels and quality	Monthly	NA	Quarterly	Bi-annual
Mon BH 5	27.202738	-27.395225	500 m north east of the existing pit		Monthly	NA	Quarterly	Bi-annual
Pit	27.400639	-27.197139		Water quality of dewatering	Monthly	Weekly	Monthly	Quarterly
VD-BH1	27.390840	-27.197080		Dewatering to the north	Monthly	NA	Quarterly	Bi-annual
VD-BH2	27.381020	-27.195710		UFDF seepage to the east	Monthly	NA	Quarterly	Bi-annual
VD-BH3	27.391490	-27.209070		Dewatering to the east	Monthly	NA	Quarterly	Bi-annual
VD-BH4	27.395440	-27.214100		Dewatering to the north-east	Monthly	NA	Quarterly	Bi-annual

Implementation actions

Action	Responsible party	Scheduling	Cost provision
Monitor ground water quality in accordance with the protocol for ground water monitoring detailed in the EMP and take appropriate remedial action if required	Environmental coordinator	Voorspoed operational phase	Salary for full time environmental coordinator
Report the results of the water monitoring programme to the regulatory authorities on an annual basis and optimise the water monitoring protocol based on trends in the data	Environmental coordinator	Voorspoed operational phase	Salary for full time environmental coordinator

6.2.9.2. Decrease in the availability of groundwater for surrounding groundwater users

Phase of mining operation

Construction	Operational	Decommissioning	Closure

The issue is applicable to the construction, operational and decommissioning phases of the project.

Management objectives

To ensure that the ground water quantity of surrounding ground water users are not adversely affected.

Management and technical options

The monitoring programme detailed in Section 6.2.9.1.2 will assess the potential impacts and variation on the water quantity during the operational phase. The monitoring data should be used to identify potential impacts on neighbouring groundwater users before it occurs. Mitigation measures can then be implemented in time.

Implementation actions

Action	Responsible party	Scheduling	Cost provision
Monitor the impact of mine dewatering on groundwater levels of neighbouring properties in accordance with the protocol for ground water monitoring detailed in the EMP and take appropriate remedial action if required	Environmental coordinator	Voorspoed operational phase	Salary for full time environmental coordinator

6.2.9.3. Optimising surface rehabilitation in order to minimise adverse ground water impacts

Management objectives

To optimise surface rehabilitation of mine residue storage facilities in order to minimise adverse groundwater impacts as a result of seepage.

Management and technical options

The side slopes of mine residue storage facilities will be rehabilitated and revegetated as soon as practical and on an ongoing basis. The top surface of the facilities will be rehabilitated and revegetated at decommissioning of the facilities. Rain falling on the surface will be shed off, collected in the dirty water management system and channelled to the dirty water dam. By preventing seepage of rainwater into the mine residue deposits, the potential for seepage into groundwater is reduced.

Implementation actions

Action	Responsible party	Scheduling	Cost provision
Ensure that mine residue storage facilities are rehabilitated and revegetated as soon as practical and on an ongoing basis	Environmental coordinator	Voorspoed operational phase	Included in the operational closure cost

6.2.9.4. Meeting the requirements of legitimate ground water users in the affected zone

Refer to Sections 6.2.9.1 and 0.

6.2.10. AIR QUALITY

6.2.10.1. Issue: Compliance with guideline values and the potential for human health impacts

Phase of mining operation

Construction	Operational	Decommissioning	Closure

The issue is applicable to all phases in the life of the project.

Management objectives

To ensure that Voorspoed Mine remains compliant with air quality legislation.

To limit public exposure to unacceptable health risks.

Management options

The main sources of fugitive dust emissions (PM10 and TSP) from the Voorspoed operations were identified to be:

10. Materials handling operations, specifically crushing and screening.
11. Vehicle entrained dust on all haul roads.
12. Wind blown dust from the mine residue storage facilities and waste rock dump.

A dust management plan has been compiled for the mine. The dust management plan is detailed below. This plan will be implemented by Voorspoed at the start of the project. The plan will be revised by plant personnel on an ongoing basis.

- ***Proposed dust management measures***

The following general dust management measures will be implemented during the life of the mine:

13. Removal of vegetation cover will be kept to a minimum.
14. Open areas will be kept to a minimum.

15. Does suppression through chemical or water methods will be utilised on all mine roads when required.
16. Stockpiles will be sheltered, where possible, to prevent wind blown erosion.
17. Strict speed limits will be implemented.
18. Delivery trucks transporting light/ wind- dispersible materials will be covered.
19. Project-related areas will be revegetated as soon as is practically possible to reduce the amount of open areas exposed to wind erosion.

Materials handling operations

Materials handling operations including primary crushing and screening, tipping of material and conveyor transfer points are the main contributing sources to fugitive dust emissions at Voorspoed Mine. The main source resulting in these high impacts was identified as the primary, secondary and tertiary crushers and screens, contributing more than 70%. Mitigation measures to be incorporated in the design specifications of the processing plant include chemical suppressants and/or water sprays on the primary crusher and dry dust extraction units with wet scrubbers on the secondary and tertiary crushers and screens. Water sprays can have up to 50% control efficiency and hoods with scrubbers up to 75%. If in addition, the scrubbers and screens are enclosed, up to 100% control efficiency can be achieved. With these control measures in place, the impacts would reduce to negligible levels. The mine will ensure that the control equipment is maintained and inspected on a regular basis to ensure that the expected control efficiencies are met.

Vehicle entrained dust from paved and unpaved road surfaces

A chemical dust suppression vehicle and / or water truck will be operational at the mine. Where possible, the mine will upgrade roads to all-weather gravel roads to minimize the amount of fine dust generated.

Wind erosion from the waste dump, storage piles and the mine residue storage facilities.

With no controls on the slopes and on the surfaces of these dumps and impoundments, high impacts would be experienced at and beyond the mine's boundary. The walls of the waste dumps, topsoil piles, coarse residue dam and fines residue dam will be vegetated/covered up to 1 m from the top of the working surface as soon as practical during the mining operations. The vegetation cover will be such to ensure at least 80% control efficiency for the walls. This will be an on-going process. As an alternative option, the mine may use waste rock to form the side slopes of the coarse and fine residue dams. This would result in the surface of these impoundments to be below the top of the sidewalls during operations that may result in a reduction in wind entrainment from these surfaces. However, the waste rock dump was predicted to be the main source of wind blown dust, based on generic particle size data. It is therefore very important to rehabilitate and revegetate the side slopes of the fine residue storage facility as soon as practical.

- ***Performance indicators/ Monitoring***

Key performance indicators against which progress may be assessed form the basis for all effective environmental management practices. Performance indicators may be source based or receptor based. Source- and receptor-based performance indicators to be employed by the mine are listed below.

<u>Source based performance indicators</u>

- There will be no visible dust plume outside the primary crusher during crushing operations. In addition the dustfall in the immediate vicinity of various sources will be less than 1 200 $mg/m^2/day$.
- For unpaved haul roads associated with the open pit mining dustfall in the immediate vicinity of the mining perimeter will be less than 1 200 $mg/m^2/day$.
- For the waste dump and Ultra fines disposal facility, vegetation will cover 80% of the entire slope up until 1 m from the crest, and dustfall immediately downwind will be <1 200 $mg/m^2/day$.
- From all activities (construction, operational and closure) associated with the mine, dustfall in close proximity to sensitive receptors (that is, Welvaart, Labor and Belmont) will not exceed 600 $mg/m^2/day$.

The mine will implement a dust monitoring network as outlined below to ensure that the above-mentioned dust deposition limits are adhered to.

<u>Receptor based performance indicators</u>

A dust fallout network will be implemented at the mine before operations commence. This network will provide the mine management team with information on the existing background fugitive dust levels and will give the management team an indication of what the increase in fugitive dust levels are once mining operations commence. This will help bring the mining operations in line with the impending Air Quality Bill. In addition, the dust fallout network would facilitate the following:

20. Compliance monitoring.
21. Validate dispersion model results.
22. Input for health risk assessment.
23. Assist in source apportionment.
24. Temporal trend analysis.
25. Spatial trend analysis.
26. Source quantification.
27. Tracking progress made by control measures.

A dust fallout network comprising of four single dust fallout buckets and three twin directional dust fallout buckets will be installed at the mine. The location of the dust fallout buckets will be based on the maximum zone of impact as predicted during the air quality study. These include single dust fallout buckets at the following locations:

28. Downwind (west) of the waste rock dump and south of the open pit.
29. At the processing plant near the primary crusher.
30. Adjacent to the haul road from the open pit (before it splits to the waste rock dump and processing plant).
31. Immediately downwind (southwest) of the fines residue disposal site.

Twin directional or four directional dust fallout buckets will be placed at the following locations:

32. At the mine boundary between Welvaart, Labor and the Secondary road as it enters the mine property.
33. Between the waste rock dumps and Belmont on the mine periphery.
34. One located at the southwestern periphery of the mine property.

The location of the dust monitoring buckets are illustrated in Figure 6-4.

- ***Record keeping, environmental reporting and community liaison***

Site inspections and progress reporting will be undertaken at regular intervals (at least quarterly) during operations with environmental audits being undertaken annually. Results from the site inspections and off site monitoring efforts will be used to determine progress against source- and receptor based performance indicators. Progress will be reported to regulatory authorities and will be available on request to interested and affected parties.

Corrective action or the implementation of contingency measures will be proposed to the community liaison forum in the event that progress towards targets is indicated by the quarterly/annual reviews to be unsatisfactory.

The mine will record and respond, appropriately and without delay, to any complaints about increased dust levels as a result of the mine and mining and processing operation.

- ***Financial Provision (Budget)***

Capital and annual maintenance costs associated with dust control measures and dust monitoring plans will be included in the financial provision for the mine. Provision will be made for capital and running costs associated with dust control contingency measures and for security measures.

- ***Review of dust monitoring programme***

The monitoring programme should be reviewed in consultation with regulatory authorities annually so that the monitoring protocol can be optimised based on the trends in the data.

<u>Implementation actions</u>

Action	Responsible party	Scheduling	Cost provision
Ensure that the dust management measures detailed in the EMP are included in the design of mine	The Project Manager: De Beers Voorspoed Mine (The JV)	Voorspoed detailed design phase	Included in the design cost
Ensure that dust monitoring is conducted in accordance with the dust monitoring programme detailed in the EMP	Designated person responsible for environment	Voorspoed construction phase	Resources for responsible person: environment – construction phase
	Environmental coordinator	Voorspoed operational phase	Salary for full time environmental coordinator
Report the results of the dust monitoring programme to the regulatory authorities on an annual basis and optimise the dust monitoring protocol based on trends in the data	Environmental coordinator	Voorspoed operational phase	Salary for full time environmental coordinator

6.2.11. NOISE

6.2.11.1. Issue: noise disturbance to neighbouring residents

Phase of mining operation

Construction	Operational	Decommissioning	Closure
▒	▒	▒	

The issue is applicable to the construction, operational and decommissioning phases of the project.

Management objectives

To prevent public exposure to disturbing noise. (According to the Free State Noise Regulations noise is defined as disturbing if it causes the ambient noise to increase by 7 dB or more. The acceptable limit for an increase in the ambient noise is considered to be 5 dB.)

Management and technical options

The mine residue storage facilities opposite the nearest residential properties on Welvaart and Belmont should be constructed as soon as possible to a height which will provide effective screening against the noise emissions.

Dumping operations on top of the waste rock dumps should be restricted to day times only, or alternatively, be carried out behind and below the crest of the dump after dark.

All the diesel powered earthmoving and mining equipment must be of high quality and regularly maintained.

Any obvious increase in the noisiness of any equipment must result in that equipment being scheduled for a maintenance check.

A good maintenance management scheme will be implemented to ensure that vehicles and plant and equipment are properly maintained thus reducing the occurrence of excessive emissions - for example, from faulty exhausts and vibrating surfaces.

A bus system for transporting mine staff to and from work will be established to reduce vehicular traffic.

Implementation actions

Action	Responsible party	Scheduling	Cost provision
Ensure that the noise mitigation measures detailed in the EMP are included in the design of mine	The Project Manager: De Beers Voorspoed Mine (The JV)	Voorspoed detailed design phase	Included in the design cost
Respond without delay to any complaints regarding noise disturbance from neighbouring residents.	Environmental coordinator	Voorspoed operational phase	Salary for full time environmental coordinator

6.2.12. SITES OF ARCHAEOLOGICAL AND CULTURAL INTEREST

6.2.12.1. Issue: Disturbance of archaeological or cultural sites

Phase of mining operation

Construction	Operational	Decommissioning	Closure
▒▒▒	▒▒▒		

The issue is applicable to the construction and operational phases of the project.

Management objectives

To avoid disturbing sites of archaeological and cultural interest.

Where disturbance of sites of archaeological and cultural interest, is unavoidable, the objective is to ensure that adequate measures are taken to conserve the information held within the sites. This must be done in accordance with legal requirements.

Management and technical options

6.2.12.1.1. The historical building

The historical building will be subjected to an investigation before it is demolished by mining activities. Phase II (mitigation) reports are incorporated in SAHRA's data banks (registers) and are required by the National Heritage Resources Act (Sec 38(3)(f)(g)). This work has to be done by a historical architect.

6.2.12.1.2. The Historical Voorspoed Diamond Mine

The history of the Historical Voorspoed Diamond Mine will be conserved in a display that is maintained in a museum in the Free State.

<u>Implementation actions</u>

Action	Responsible party	Scheduling	Cost provision
Commission an investigation to record archaeological information from the historical building before it is demolished	The Project Manager: De Beers Voorspoed Mine	Voorspoed detailed design phase	Included in the design cost
Obtain permission for demolishing the historical building upon completion of the investigation	The Project Manager: De Beers Voorspoed Mine	Voorspoed detailed design phase	Included in the design cost
Collate information on the history of the mine for use in a museum display	The Project Manager: De Beers Voorspoed Mine	Voorspoed detailed design phase	Included in the design cost

6.2.12.2. Issue: disturbance of graves

<u>Phase of mining operation</u>

Construction	Operational	Decommissioning	Closure
▒	▒		

The issue is applicable to the construction and operational phases of the project.

<u>Management objectives</u>

To avoid disturbing the burial sites.

Where disturbance of burial sites is unavoidable, the objective is to move graves according to the requirements of SAHRA.

<u>Management and technical options</u>

Two graveyards have been identified in the project area (refer to Figure 2-3 for their location). These sites will be included on the mine surface infrastructure plan to ensure that the Voorspoed project team and the mine staff and contractors are aware of their locations.

Disturbance of the sites will be avoided if possible. No infrastructure is planned in the vicinity of the graves. However, in the interests of mine security and to ensure easy access to the gravesites by relatives, the relocation of the gravesites may be appropriate. The mine will discuss the possible relocation of the gravesites with the identified relatives and agree with them on an appropriate course of action.

If a decision were reached to relocate the graves, permits will be obtained for the relocation of graves by SAHRA in terms of Section 36 of the National Heritage Resources Act (25 of 1999).

Implementation actions

Action	Responsible party	Scheduling	Cost provision
Avoid the vicinity of graveyards in the location of mine surface infrastructure	The Project Manager: De Beers Voorspoed Mine	Voorspoed detailed design phase	Included in the design cost
Discuss the possible relocation of the graves with relatives	Designated person responsible for environment	Voorspoed construction phase	Resources for responsible person: environment – construction phase
If a decision were reached to relocate the graves apply for the necessary permits	Designated person responsible for environment	Voorspoed construction phase	Resources for responsible person: environment – construction phase

6.2.13. SENSITIVE LANDSCAPES

The impacts of the mine on sensitive landscapes are not discussed here as they have discussed in other sections as outlined in Table 6-9.

TABLE 6-9 SENSITIVE LANDSCAPES AND MEASURES FOR THE MANAGEMENT OF IMPACTS ON THESE

Types of sensitive landscapes	Occurrence at Voorspoed	Sections where the impacts are discussed
Nature conservation or ecologically sensitive areas	The wetland and pans are of high conservation importance	6.2.6.1 and 6.2.7.1
Natural resources	Most soils at the mine site have moderate agricultural potential	6.2.3
Sites of outstanding natural beauty, panoramic views	Renosterkop	6.2.6.1 and 6.2.7.1
Sites of social significance	Historical building and graves	6.2.12

6.2.14. VISUAL ASPECTS

6.2.14.1. Issue: Negative visual impact

Phase of mining operation

Construction	Operational	Decommissioning	Closure

The issue is applicable to the construction, operational, decommissioning and closure phases of the project.

Management objectives

As far as possible, visual mitigation measures should be planned to fit into the existing landscape character or to enhance it.

As far as possible, visual mitigation should aim to blend the proposed development into the surroundings and generally reduce its visibility.

Management and technical options

6.2.14.1.1. Site development

Existing vegetation, especially along the periphery of the site, shall be retained as far as possible to act as visual screens. The minimum amount of vegetation and topsoil should be removed from all mine surface infrastructure areas.

6.2.14.1.2. Earthworks and final form of mine residue storage facilities

As far as possible the geometric shapes of residue storage facilities will be softened by creating a more flowing, natural footprint (refer to Figure 6-2). This may not be achievable for the fine and coarse residue storage facilities, where deposition is by means of pipe and conveyor systems. The side slopes of the fine and coarse residue storage facilities could be landscaped through hauling and dumping waste rock, but this option would have to be evaluated based on cost considerations during the life of the mine.

Harsh, steeply engineered side slopes on the mine residue storage facilities will be avoided. All mine residue storage facility side slopes will be sloped at a 1:3 gradient or less.

The side slopes of all mine residue storage facilities will be revegetated with indigenous grass on an ongoing basis throughout the life of the mine. The top surface of all mine residue storage facilities will be revegetated at mine closure.

From the point of view of mitigating visual impact, a continuous slope would be preferred over a stepped slope in the final profile of the residue disposal dumps, because it would appear more natural. However, in practice continuous slopes (even of low gradient) present significant problems in terms of erosion and consequent pollution of surface water from mine residue storage facilities. The mine will design the residue disposal dumps with a series of lifts and berms as illustrated for the waste rock dump in Figure 6-3. The surface and side slopes of the mine residue storage facilities will be revegetated with indigenous grass interspersed with trees.

6.2.14.1.3. Colour

Buildings will be painted with natural browns and dark greens that complement the colours of the natural surroundings. White and black will not be used.

Where possible the external surfaces of buildings will be textured to create interplay of light and shade. Shiny or bare metal will be avoided.

6.2.14.1.4. Landscaping

All plants, grass and trees used in rehabilitation and landscaping should be ecologically suited to the project area.

Tree screens will be planted along the eastern border of the site to reduce the scale of the dumps from the nearby farmsteads.

6.2.14.1.5. Lighting

Lighting will be designed to provide precisely directed illumination and to reduce light spillage beyond the immediate surrounds of the plant and mine buildings.

The use of high pole top security lighting along the site boundary will be avoided. Where possible only lights that are activated on entry to the site perimeter will by used.

Implementation actions

Action	Responsible party	Scheduling	Cost provision
Ensure that the visual impact mitigation measures detailed in the EMP are incorporated into the mine design	The Project Manager: De Beers Voorspoed Mine	Voorspoed detailed design phase	Included in the design cost

6.2.15. REGIONAL SOCIO-ECONOMIC STRUCTURE

6.2.15.1. Positive socio-economic impacts

Phase of mining operation

Construction	Operational	Decommissioning	Closure
▒	▒	▒	

The issue is applicable to the construction, operational and decommissioning phases of the project.

Management objectives

To maximise the potential socio-economic benefits of the mining development.

Management and technical options

In order to maximise the potential benefits to the local and the regional economy, local labour, service providers and good suppliers will be utilised wherever possible throughout the various phases of the life of the mine.

The mine will also identify and provide assistance wherever possible to suitable HDSA companies and small or medium sized enterprises (SMMEs) that currently, or in future, could provide local procurement to the mine.

The mine will contribute to development in the region through its local economic development programme which was developed as part of the Social and Labour Plan.

Implementation actions

Action	Responsible party	Scheduling	Cost provision
Ensure that, wherever possible, local labour, local service providers and goods suppliers are utilised by the mine	Designated person responsible for environment	Voorspoed construction phase	Resources for responsible person: environment – construction phase

Action	Responsible party	Scheduling	Cost provision
Identify and provide assistance wherever possible to suitable HDSA owned companies and SMMEs that could provide local procurement to the mine.	Designated person responsible for environment	Voorspoed construction phase	Resources for responsible person: environment – construction phase
Implement the mine's Local Economic Development Programme in consultation and cooperation with other stakeholders.	Designated person responsible for sustainable development / corporate social responsibility	Voorspoed operational phase	

6.2.15.2. Issue: negative socio-economic impacts - Economic Impact of Mine Closure

<u>Phase of mining operation</u>

Construction	Operational	Decommissioning	Closure
		▒	▒

The issue is applicable to the decommissioning and closure phases of the project.

<u>Management objectives</u>

To mitigate the impacts of mine closure on the regional economy.

<u>Management and technical options</u>

The mine will investigate mechanisms to mitigate the social and economic impact of mine closure on individuals and on the regional economy, such as training mine employees in non-mining related skills.

Mechanisms to mitigate the impact of closure will be developed and updated on annually throughout life of mine.

<u>Implementation actions</u>

Action	Responsible party	Scheduling	Cost provision
Ensure that the mechanisms are developed to mitigate the social and economic impact of mine closure	The Project Manager: De Beers Voorspoed Mine	Voorspoed detailed design phase	Included in the design cost

6.2.15.3. Issue: negative socio-economic impacts – impact on farmworker employment

Phase of mining operation

Construction	Operational	Decommissioning	Closure

The issue is applicable to the construction and operational phase of the project.

Management objectives

To ensure that the establishment of the mine creates fair employment opportunities and to minimise disruption to those currently employed.

Management and technical options

The mine will establish a transparent recruitment process, informing applicants up front of the skills required and the recruitment procedure to be followed.

Should the mine exercise its options to purchase water rights from Koppies Dam, the potential impact on farmworker employment in Koppies will be evaluated. If farmworker employment will be negatively affected through the purchase of water rights, a socio-economic impact assessment will be conducted and appropriate mitigatory measures implemented.

Implementation actions

Action	Responsible party	Scheduling	Cost provision
Ensure that the mine implements a fair and transparent recruitment procedure	The Project Manager: De Beers Voorspoed Mine	Voorspoed detailed design phase	Included in the design cost
Ensure that the potential socio-economic impacts of the purchase of water rights is assessed and mitigatory steps taken if necessary	The Project Manager: De Beers Voorspoed Mine	Voorspoed detailed design phase	Included in the design cost

6.2.15.4. Issue: Loss of grazing land

Phase of mining operation

Construction	Operational	Decommissioning	Closure

The issue is applicable to the construction and operational phase of the project.

Management objectives

To minimise the impacts of loss of grazing land.

Management and technical options

Investments made within the Voorspoed project area by the neighbouring farmer will be considered and managed within the context of the finalisation of the lease agreement between De Beers and the parties concerned.

6.2.15.5. Issue: influx of mineworkers and jobseekers

Phase of mining operation

Construction	Operational	Decommissioning	Closure
▒	▒	▒	

The issue is applicable to the construction, operational and decommissioning phases of the project.

Management objectives

To prevent deterioration in the socio-economic conditions of the neighbouring communities to Voorspoed mine as a result of jobseekers migrating to the vicinity of mine.

Management and technical options

Kroonstad will be the primary area for accommodation during the construction and operation of the mine. No single sex hostels will be developed for the mine.

The mine will support efforts of the local authority to manage unsustainable settlements.

With regards to the management of squatters, mine management and neighbouring landowners who identify persons residing illegally on their land should follow a specific procedure in order to ensure the successful and timeous mitigation of this problem. An outline of such a procedure is given in Annexure B of Appendix 2. The outline can be used as a basis for discussion in the community liaison forum to be established by mine, to develop a joint approach by the mine and its neighbours to the potential problem of informal settlement around the mine.

At mine closure a significant amount of mineworkers will be without work. The mine should mitigate some of the negative socio-economic consequences of closure through for example training mine employees in none mine related skills, or assisting with the development of self-sustaining employment ventures in the region.

<u>Implementation actions</u>

Action	Responsible party	Scheduling	Cost provision
Ensure that the potential migration of jobseekers and informal settlement around the mine is monitored and that appropriate remedial action is taken if required	Designated person responsible for environment	Voorspoed construction phase	Resources for responsible person: environment – construction phase
	Environmental coordinator	Voorspoed operational phase	Salary for full time environmental coordinator
Ensure that employee accommodation is provided in Kroonstad for the construction and operational phases of the mine.	The Project Manager: De Beers Voorspoed Mine	Voorspoed detailed design phase	Included in the design cost

6.2.15.6. Issue: management of jobseekers' expectations

<u>Phase of mining operation</u>

Construction	Operational	Decommissioning	Closure

The issue is applicable to the construction phase of the project.

<u>Management objectives</u>

To ensure that the recruitment process is fair and transparent.

<u>Management and technical options</u>

A recruitment office will be established in Kroonstad to manage the recruitment process in a fair and transparent manner.

All registered IAPs will be notified of the establishment of the recruitment office and the establishment of the office will be advertised.

Local community members should be informed about the recruitment process, since the employment of local labour (where possible) is vital to the economic growth of the region.

Advertising of jobs will clearly indicate the specific skills required, the general minimum recruitment requirements, and the length of contract.

The local Department of Labour will be consulted on the recruitment process followed.

No ad hoc recruitment will be allowed on-site by either the mine or its contractors.

Local labour will be utilised very possible, provided that the required skills are available.

The recruitment process will take cognisance of the need for the involvement of women in the mining sector.

De Beers employment equity policy will be taken into account in the recruitment process.

Implementation actions

Action	Responsible party	Scheduling	Cost provision
Ensure that the mine implements a fair and transparent recruitment procedure according to the management options listed above.	The Project Manager: De Beers Voorspoed Mine	Voorspoed detailed design phase	Included in the design cost

6.2.15.7. Issue: management of stakeholders' expectations

Phase of mining operation

Construction	Operational	Decommissioning	Closure

The issue is applicable to the construction phase of the project.

Management objectives

To ensure the effective communication of the Local Economic Development plan to all identified stakeholders.

Management and technical options

De Beers will clarify its local economic development plan and corporate social investment plan with stakeholders. Stakeholders will be given the opportunity to provide input into the implementation of these plans.

Those who are to benefit from the corporate social investment plan will be given the opportunity to decide what form of investment best suit their needs.

When finalised De Beers will communicate the local economic development plan and corporate social investment plan to stakeholders.

<u>Implementation actions</u>

Action	Responsible party	Scheduling	Cost provision
Ensure effective consultation and communication of the local economic development and corporate social investment plans to stakeholders.	The Project Manager: De Beers Voorspoed Mine	Voorspoed detailed design phase	Included in the design cost

6.2.15.8. Issue: impact on rural lifestyles

<u>Phase of mining operation</u>

Construction	Operational	Decommissioning	Closure

The issue is applicable to the construction, operational, decommissioning and closure phases of the project.

<u>Management objectives</u>

To minimise the impact of the establishment of the mine on rural lifestyles

<u>Management and technical options</u>

Housing, recreational and social services for mineworker employees will be provided in Kroonstad.

De Beers will investigate partnerships with employees, the Moqhaka municipality and other stakeholders to facilitate the availability of housing and appropriate accommodation within Kroonstad and the surrounding areas.

No mine employees will be allowed to live in or rent accommodation on farms neighbouring on Voorspoed Mine or in the neighbouring farmworker communities.

<u>Implementation actions</u>

Action	Responsible party	Scheduling	Cost provision
Develop a housing strategy for Voorspoed mine employees	The Project Manager: De Beers Voorspoed Mine	Voorspoed detailed design phase	Included in the design cost

6.2.15.9. Issue: Increase in crime levels

Phase of mining operation

Construction	Operational	Decommissioning	Closure
▒▒▒	▒▒▒	▒▒▒	

The issue is applicable to the construction, operational and decommissioning phases of the project.

Management objectives

To contribute towards the safety and security of neighbouring communities.

Management and technical options

The mine will participate in community-policing initiatives.

Implementation actions

Action	Responsible party	Scheduling	Cost provision
Discuss the opportunities for the mine participating in community policing initiatives with the community liaison forum participants	Environmental coordinator	Voorspoed operational phase	Salary for full time environmental coordinator

6.2.16. INTERESTED AND AFFECTED PARTIES

The issues raised by IAP are listed in Table 5-14, along with references to where these issues are assessed in this document and the proposed mitigation measures.

The mine will establish a community liaison forum for information sharing with IAPs.

The mine's public involvement database (Section Appendix 18) will updated on a regular basis.

The mine will continue communicating with IAPs to inform them about new developments at the mine site and progress in the implementation of the EMP.

The mine will strive to develop a relationship of trust and credibility with IAPs.

The mine will ensure that all information shared with IAPs is fully and accurately documented.

Implementation actions

Action	Responsible party	Scheduling	Cost provision
Ensure that a community liaison forum is established	Environmental coordinator	Voorspoed operational phase	Salary for full time environmental coordinator

6.2.17. SUBMISSION OF INFORMATION

The mine will conduct annual performance assessments on its EMP implementation and report the results to the DME. The performance assessments will include the results of the dust monitoring programme.

The results of ground and surface water monitoring will be submitted to DWAF on an annual basis.

The results of dust monitoring will be submitted to DTEEA on an annual basis.

Implementation actions

Action	Responsible party	Scheduling	Cost provision
Ensure that performance assessments and monitoring results are reported to the relevant regulatory authorities annually	Environmental coordinator	Voorspoed operational phase	Salary for full time environmental coordinator

6.2.18. MAINTENANCE

6.2.18.1. Rehabilitated land

Provision has been made in the estimated costs of rehabilitation for the maintenance of rehabilitated land until such time as it is self-sustaining. Provisions include for re-seeding and fertilisation of problem areas, weed and alien vegetation control, management and testing as required.

6.2.18.2. Water pollution control structures

A safety inspection of the storm water dam will carried out at closure to ensure the long term stability of the dam and that it is not expected to cause problems after closure of the mine.

6.2.18.3. Rehabilitated residue deposits

Provision has been made in the estimate of closure costs for the maintenance of the vegetation works on the side slopes and top surfaces of the residue disposal facilities for a period of 4 years.

6.2.19. ENVIRONMENTAL MANAGEMENT

6.2.19.1. Appointments

During the detailed the design phase of the project the Murray & Roberts / Minproc Joint Venture Project Manager, or a member of the design team designated for this responsibility, will ensure that the EMP implementation measures relevant to the design stage of the project are implemented.

During the construction phase of the project a member of the construction management team will be designated as the responsible person for the EMP, and that person will ensure that the EMP implementation measures relevant to the construction stage of the project are implemented.

During the operational and closure phases of the project of mine will appoint a suitably qualified environmental coordinator, who will ensure that the EMP implementation measures relevant to the construction stage of the project are implemented. The mine will ensure that the environmental coordinator has the necessary resources and authority for this responsibility.

6.2.19.2. Financial provision for EMP implementation

A summary of the financial provision required for implementation of the EMP is provided in table Table 6-10. The provision has been included in the regulatory cost provision submitted as part of the Voorspoed Mining Work Programme.

During the design phase of the project no specific financial provision is required, but the designation of a responsible person for EMP implementation is essential to ensure that the mine is designed in accordance with the EMP requirements.

During the construction and operational phases of the project, the biggest resource requirement for EMP implementation is provision for the employment of a full-time environmental coordinator, with adequate training and experience to assume responsibility for overseeing the implementation of and adherence to the EMP.

Alternatively, lesser skilled personnel may be employed for environmental management, and the cost provision used for outsourcing tasks that are above their competency level.

The other big financial resource requirement for EMP implementation is monitoring: water and dust monitoring and EMP compliance assessments.

TABLE 6-10 EMP IMPLEMENTATION COST

Type	Responsible person	Resources	Initial cost	Annual cost	Total cost
Design of mine in accordance with EMP management measures	The Project Manager: De Beers Voorspoed Mine	Voorspoed Mine detailed design team	-	-	-
Construction of mine in accordance with EMP management measures	Designated person responsible for environment – Voorspoed construction phase	Voorspoed Mine implementation and construction team	-	-	-
Operation of mine in accordance with EMP management measures	Environmental coordinator	Salary of permanent environmental coordinator	-	R300 000	R4 200 000
Ongoing mine rehabilitation	Environmental coordinator	Salary of permanent environmental coordinator	-	-	-
		Cost of ongoing rehabilitation provided for in operational cost.	-	-	-
Water monitoring programme	Environmental coordinator	Drilling of monitoring boreholes	R160 000	-	R160 000
		Laboratory testing and analysis of ground and surface water samples, reporting results	R200 000	R100 000	R1 600 000
Dust monitoring programme	Environmental coordinator	Dust monitoring equipment	R100 000		R100 000
		Dust sampling, equipment maintenance and data analysis	-	R70 000	R1 080 000
EMP compliance auditing and reporting	Environmental coordinator	De Beers CHQ Resource or Environmental consultant	-	R45 000	R630 000
Environmental awareness and training programme	Environmental coordinator	Voorspoed Mine Training Department	-	-	-

Type	Responsible person	Resources	Initial cost	Annual cost	Total cost
Totals			R460 000	R515 000	R7 770 500

6.2.19.3. Framework for an environmental awareness and training programme

6.2.19.3.1. Introduction

The Mineral and Petroleum Resources Development Act Regulations require that all mines develop an environmental awareness and training programme. The framework for the Voorspoed environmental awareness and training programme presented here details how the mine will identify training needs to ensure that all personnel whose work may have a significant impact on the environment will receive appropriate training. The framework will be used to develop an environmental awareness training programme and environmental induction material and courses. The framework may be adopted to suit the needs of the mine.[1]

6.2.19.3.2. Identification of training needs

The mine will conduct a training needs analysis to determine the roles different categories of employees play in the implementation and maintenance of the mine's EMP and related environmental management procedures. The training needs analysis will define, for each category of employee:

- Responsibilities in terms of the EMP.
- The required level of knowledge of the EMP.
- The specific training courses required to attain this knowledge.
- The scheduling and interval for attending refresher courses.

Employees will be grouped into the following categories to determine their appropriate level of knowledge required of the EMP:

- Senior management.

---

[1] The proposed Voorspoed Mine would be a new mine – currently no environmental procedures are in place. This EMP contains only a framework for such a procedure, that can be adopted when the responsible parties are appointed.

- Middle management.
- Supervisors.
- Operators.
- Visitors and contractors.

6.2.19.3.3. EMP induction for all employees including contractors

All mine employees, including contractors, will undergo EMP induction. The content of the EMP induction courses will be developed by the Environmental Coordinator in consultation with the mine's Training Department. The environmental induction courses will address:

- Environmental issues defined in the EMP.
- Management and mitigation measures defined in the EMP.
- Environmental management procedures and related operational procedures.
- Environmental incident reporting.

6.2.19.3.4. General environmental awareness training

The Environmental Coordinator, in consultation with the mine's Training Department, will identify opportunities for on-the-job environmental training through appropriate forums, such as toolbox talks, and the need for ad hoc environmental training sessions in response to environmental incidents. The mine may designate certain staff members as EMP Representatives to assist the Environmental Coordinator in communicating environmental knowledge to the rest of the workforce through the identified forums.

6.2.19.3.5. Provision for job specific environmental awareness training

The Environmental Coordinator, in consultation with the mine's Training Department, will consider the need for developing job specific EMP training courses for those employees most directly involved with significant environmental issues identified in the EMP. Job specific EMP training courses may include courses on:

- Waste minimisation and waste management.
- Fuel, oil and chemical spill reporting and clean up.
- Storage and handling of chemicals.
- Rehabilitation and revegetation.

6.2.19.3.6. Training records

Records will be kept off all EMP training courses attended by employees.

6.2.19.3.7. Review of EMP awareness training programme

Mine management will conduct a review of the adequacy of the environmental awareness training programme on an annual basis. The content of EMP induction courses and other components of the environmental awareness training programme will be updated based on the findings of the review.

6.2.19.4. Framework for an environmental emergency and remediation procedure

6.2.19.4.1. Introduction

The Mineral and Petroleum Resources Development Act Regulations require that all mines develop an environmental emergency and remediation procedure. The framework for the Voorspoed environmental emergency and remediation procedure presented here details how the mine will identify environmental emergencies and develop appropriate response and remediation measures. The framework may be adopted to suit the needs of the mine.[2]

6.2.19.4.2. Identification of potential environmental emergencies

The mine will conduct an analysis to identify the different types of environmental emergencies that may occur at the mine and to assess the potential environmental impacts associated with each emergency. Examples of environmental emergencies include:

- Bulk spills of hazardous chemicals or hydrocarbons.
- Fires.
- Failure of the UFDF.
- Bulk spills of process water or fines.

[2] The proposed Voorspoed Mine would be a new mine – currently no environmental procedures are in place. This EMP contains only a framework for such a procedure, that can be adopted when the responsible parties are appointed.

6.2.19.4.3. Drafting of emergency preparedness and response plans

For all each potential environmental emergency an emergency preparedness and response plan will be developed. This plan will identify:

- Responsibilities.
- Communication structures for notification and reporting of the emergency.
- The potential environmental, health and safety risks associated with the emergency and how to respond to these.
- Equipment required for handling the emergency.
- Measures required for ensuring human safety.
- Measures for the containment and clean-up of the environmental emergency.
- Measures required to remediate potential environmental impacts.
- Procedure for identifying and taking corrective action.

Where necessary such response plans may refer to other mine procedures.

6.2.19.4.4. General training on environmental emergencies

All employees will receive appropriate training on the identification and reporting of environmental emergencies.

Members of the environmental emergency response team(s) will receive appropriate training on how to respond to such emergencies.

6.2.19.4.5. Environmental emergency reporting

Records will be kept off environmental emergencies. Any environmental emergency will be reported to the regional office of the DME.

6.2.19.4.6. Review of environmental emergency and remediation procedure

Mine management will conduct a review of the adequacy of the environmental emergency and remediation procedure on an annual basis.

6.3. DECOMMISSIONING PHASE AND CLOSURE

6.3.1. CLOSURE OBJECTIVES

The scope of the rehabilitation and closure plan for any project can generally be defined in terms of a proposed post closure land use which in turn lead to the definition of the rehabilitation and closure objectives and the standards against which rehabilitation and closure success are to be measured.

6.3.1.1. Post-Closure Land Use

The objective for the post closure land use is to rehabilitate the land to a stable condition, if possible, to its pre-mining land use. Where it is impossible to restore land to its pre-mining land use, the objective is to rehabilitate the land to a stable condition (where erosion and accompanying pollution is under control).

6.3.1.2. Rehabilitation and Closure Objectives

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

- Restore as much as possible of the project area to a condition consistent with the pre-determined post closure land use objectives.
- Ensure that the area is left in a condition which poses an acceptable level of risk to public health and safety.
- Reduce as far as is practicably possible the need for post closure intervention, either in the form of monitoring or ongoing remedial works.

6.3.1.3. Rehabilitation and Closure Standards

The standards against which the success of rehabilitation and closure of the mine will be determined have yet to be formulated in detail but should, as a minimum, comply with:

- The requirements of South African Law.
- De Beer's Environmental Policy.

Should a situation arise which is not covered by these guidelines, guidance will be sought from applicable World Bank Standards.

6.3.1.4. Life of Mine Closure Obligations and Premature Closure

Closure is a life of mine process, which typically culminates in tenement relinquishment. It includes rehabilitation, decommissioning and aftercare (post closure) requirements. In many cases the activities associated with the requirements can be incorporated into the operation of the mine and its related infrastructure. Active management of the company's rehabilitation and closure obligations should result in a reduction in the costs associated with fulfilment of those obligations. These reductions should come about by, for example:

- The elimination of double handling of materials.
- The use of operational staff in the rehabilitation processes which, in addition to the associated savings in staff costs, creates a greater awareness amongst staff of the longer-term consequences of their day-to-day activities.
- Reduction of the duration and scope of post mining involvement in the rehabilitation process.

In order to maximise the financial benefits associated with integrating rehabilitation and closure activities into the mining and associated operations it is necessary to identify areas where rehabilitation and closure can commence. This process has the added advantage of identifying situations that should not have arisen and facilitating the elimination of unnecessary environmental disturbances.

It is expected that active management of the current liability would result in reductions in the unit rates associated with rehabilitation activities, greater awareness of the costs of environmental remediation and hence the need to avoid environmental impacts, and the reduction of the life of mine closure liability. If the current liabilities are left unmanaged however, it should be expected that there will be limited awareness of the costs of remediation which will result in the accumulation of an ever increasing life of mine, or total, liability.

6.3.1.4.1. Premature closure

The premature closure costing has been based on the maximum closure cost that can occur at any point in time between 0 and 13 years life of mine. If closure occurs prior to year 13, the closure costs for the waste rock dump are generally the same as the intention is to disturb the total footprint area from start-up of the mine. The premature closure costs of the resource tailings facility tend to be lower if the facility, at any point in time, does not completely cover the designed footprint and a smaller area has been disturbed. Premature closure of the fine residue storage facility, however, results in higher closure costs since its containment walls are constructed from start and placing of topsoil and establishment of vegetation are required on the inner slopes of the walls in addition to the outer slopes and top surface of the disposal facility.

6.3.1.4.2. Closure cost provision

The closure cost provision calculated on basis of the approach described above is summarised in Text Box 1 on page 6-69. The detailed calculations are given in Text Box 2 on page 6-72. The unit rates and calculations for determining unit rates are given in Text Box 3 on page 6-73.

6.3.2. INFRASTRUCTURE AREAS

Infrastructure not required to support the post closure land use will be dismantled and sold for re-use or disposed of to an appropriate landfill facility. The foundations of such infrastructure will be removed and the surface rehabilitated.

6.3.3. MINE RESIDUE DEPOSITS

6.3.3.1. Disposal facilities

The mine residue deposits associated with the project include:

- The Waste Rock Dump.
- Open Pit.
- Resource tailings facility (RTF).
- Ultra fines disposal facility (UFDF).
- A return water facility as well as a storm water control dam located on the north side of the mine property.

The slurry delivery pipelines to the UFDF from the plant, the return water pipeline from the return water dam to the plant and the potable water pipelines from the boreholes to the plant will all be dismantled and sold for scrap at closure. Provision has been made in the closure cost estimate to rehabilitate the ground surface below the pipeline routes.

The buried makeup water pipeline from the Koppies Dam to the plant will be left in the ground at closure.

The solution and storm water trenches around the disposal facilities will be cleaned out of debris at closure.

The return water dam and storm water dam are left intact after a dam safety inspection for possible use for farm irrigation or cattle watering.

6.3.3.2. Ongoing seepage, control of rainwater

The facilities associated with the mine and processing operations have been designed such that, where applicable, they will be permanently isolated from the surface water environment. Where necessary storm water control dams will be left intact to ensure that contaminated water is not released to the environment. No significant costs are expected to be accrued in this regard at closure as it is expected that such facilities would be constructed and operated during the mining / treatment operations. Disturbed areas will be rehabilitated through the placement of a layer of soil / growth medium and the establishment of vegetation to prevent erosion.

6.3.3.3. Long-term stability

Long-term stability of the residue disposal facilities and the waste rock dump have been addressed during their design. The assumptions upon which the designs are based will be periodically reviewed during the development of the facilities and again at closure to ensure their stability in the long term.

6.3.3.4. Final rehabilitation in respect of erosion and dust control

Provision has been made in the estimate of closure costs for the replacement of soil / growth medium to all disturbed areas and the subsequent establishment and maintenance of vegetation. Paddocking of the top surface of the UFDF in addition to the establishment of vegetation has been provided to ensure maximum dust and erosion control of the fine residue product.

6.3.4. REHABILITATION OF DANGEROUS EXCAVATIONS

It is anticipated that the open pit will be left open for possible continued mining in the future. Provision for an access control berm and a fence with access gate around the pit at closure has been made in the estimate of the closure costs.

6.3.5. FINAL REHABILITATION OF OPENCAST MINE HAUL RAMPS AND ROADS

The rehabilitation of the open pit mining operations will include removal of access ramps and roads and the establishment of vegetation on the surface. Provision has been made in the closure cost estimate to rehabilitate 3 km of roads at closure. The access roads to the RTF, UFDF and the return water dam / storm water dam will be left intact for maintenance purposes.

6.3.6. MAINTENANCE

Provision has been made in the estimate of closure costs for the maintenance of vegetation works for a period of 3 years. It is not anticipated that maintenance of civil works would be required, provided that the re-vegetation of disturbed and rehabilitated areas is successful. It is expected that a percentage of the value of the civil works would be retained pending final approval of the works, as is standard practice in the civil engineering industry.

6.4. PROPOSED TIMETABLE, DURATION AND SEQUENCE

Refer to Section 1.6.6.

6.5. FINANCIAL PROVISION

6.5.1.1. General

The estimate of closure costs associated with the proposed mine has been developed in conjunction with the design of the various facilities. Schedules of the works required to carry out the rehabilitation and closure of the various facilities have been compiled. The quantities of works required and the cost of carrying out such works have been used to calculate the aggregate costs required for rehabilitation and closure. The following allowances have then been added to the aggregate costs:

- Contingencies at 10% of the value of the measured works to allow for variations in quantities and rates and also for unmeasured works;
- Contractors preliminary and general costs at 20% of the value of the measured works on the assumption (as called for in the guidelines) that the works may have to be carried out by a third party contractor;
- A project management and design fee at 7% of the expected expenditure to allow for the management of the closure process if necessary.

The closure costs have been based on the assumption that the proposed post closure land use would be to allow grazing on undisturbed areas and that the purpose of reshaping, covering and vegetating the final landforms is to ensure their stability and specifically to prevent the generation of dust. The final landforms are also required to blend into the surrounding topography.

A summary of the closure and rehabilitation obligations calculated for Voorspoed Mine is presented in Text Box 1 on page 6-69.

TEXT BOX 1 SUMMARY OF CLOSURE AND REHABILITATION OBLIGATIONS

6.5.1.2. Processing Plant and related Structures

Allowance has been made for the stripping of topsoil over the entire plant area during the plant construction phase. It is assumed that at closure the salvage value of steel structures and equipment will offset the costs of dismantling and removal. An allowance is included in the closure costing for the demolition and disposal of concrete structures and foundations. It is assumed that the entire plant footprint will be covered with a layer of soil and re-vegetated at closure.

6.5.1.3. Open Pit

Allowance has been made for the stripping and stockpiling of soils from the area into which the open pit will expand and for the construction of an access control berm and fence around the pit. It is assumed that the pit will be left as it is at the end of the life of mine and that the pit slopes will be geotechnically stable.

6.5.1.4. Overburden and Spoils

It is planned to build the waste rock / overburden dump in 12 m high lifts which will be dozed down to 1 in 3 slopes at closure. There will be a 35 m wide step-in after each lift. Provision has been made in the closure cost estimate for the stripping of topsoil as an operating cost and for a portion of the re-shaping, topsoil replacement and re-vegetation to be carried out during the development of the dump. The balance of the rehabilitation will be carried out at closure.

6.5.1.5. Processing Waste Deposits

The development of the ultra fines and coarse resource facilities will be phased through the life of mine. Provision has therefore been made for the stripping and stockpiling of soil, reshaping of slopes where required, replacement of soil, and the re-establishment of vegetation to the facilities as both an operating and a closure cost. The split between operating and closure costs is based on the plans for the development of the facilities.

6.5.1.6. Roads, Surface Water Management and Make-up Water Facilities

Provision has been made for reducing the widths of the roads within the mine area and for the re-establishment of vegetation to the areas affected. It is intended to leave roads into the mine property open in order to support the post closure land use and also to assist in post closure monitoring and aftercare. Provisions have also been made for final inspections of the stormwater control dam and the Renoster Weir and the sealing of water supply boreholes.

6.5.1.7. Provision

It is anticipated that the mine will accrue the funds required for closure by means of annual contributions to an approved Trust Fund. The quantum of funds required for closure and aftercare will be re-assessed annually as called for in the regulations. The shortfall between the estimated closure cost and the accrued funds in the Trust Fund at any point in time may be supplemented by a bank guarantee.

6.5.1.8. Social and Labour Plan

The provision required for the implementation of the social and labour plan has been determined separately to the calculation of these closure costs and has been incorporated into the overall financial model for the project.

TEXT BOX 2: SCHEDULES 1 – 5 DETAIL OF CLOSURE AND REHABILITATION OBLIGATIONS

TEXT BOX 3 UNIT RATES AND CALCULATION OF UNIT RATES

6.6. KNOWLEDGE GAPS

6.6.1. MINE INFRASTRUCTURE LAYOUT AND MINE PROCESS DESIGN

The site infrastructure layout and mine design presented in this report has been developed at a feasibility level of accuracy. During the design stage of the project the need for changes to the layout may become apparent, for example the exact location of storm water berms, trenches and dams.

The maps included in this report indicate detail at a conceptual design level.

6.6.2. SURFACE WATER QUALITY

Analysis of the surface water quality in water bodies downstream of Voorspoed, as required for Section 2.9.2 was not possible. Due to recent drought conditions the dams did not have water at the time of report compilation. The downstream water bodies are indicated on Figure 2-3. Sample and analysis of the water quality in these water bodies will be conducted as part of the mine's surface water monitoring programme.

6.6.3. REDUCTION IN SURFACE WATER RUNOFF

Calculations of sub catchments for drainage lines, dams, wetlands and mine residue deposits were based on 1:10 000 orthophotos of the area, with simulated 1m contours generated from the 5m contours on the orthophotos. The accuracy of the impact predictions and mitigation measures contained in this report would have to be reviewed when detailed survey maps of the project area (1 m) become available during the design phase.

6.6.4. WASTE CLASSIFICATION OF WASTE ROCK

Analysis of waste rock samples to determine their chemical characteristics and potential to produce poor quality leachate or acid mine drainage was outstanding at the time of compilation of the draft report. This analysis has been completed and the report on the analysis is included as Appendix 12. A summary of the main findings of the report is presented in Section 5.2.9.3.

FIGURE 6-1 WATER MONITORING POINTS

FIGURE 6-2 VISUAL MITIGATION (PLAN)

FIGURE 6-3 VISUAL MITIGATION (WASTE ROCK DUMP PROFILE)

FIGURE 6-4 DUST MONITORING POINTS

7. CONCLUSION

The intention of this EIA conclusion is to assist decision makers with their decisions on environmental approval of the project.

The impacts of the project have been arranged in groups in Table 7.1.1 to discern impacts that should influence the decision whether or not to proceed with the project.

Most of the impacts of the mine can be reduced to acceptable levels through proper management and mitigation. The management measures are not difficult to implement and are known to be reliable. A few impacts require careful monitoring to check that the management measures are effective and to ensure that additional remedial measures are implemented without delay if required. The most important positive and negative impacts of the mine are highlighted below.

TABLE 7-1 GROUPING OF ISSUES TO FACILITATE IDENTIFICATION OF ISSUES IMPORTANT TO THE PROJECT APPROVAL DECISION

Issue group	Issue	Significance of the identified impacts	
		If not managed	Managed
Issue Group 1: Most important positive and negative impacts – these are the impacts that need to be taken into account when taking the decision on the environmental acceptability of the development.	Socio-economic benefits of the project	M+	H+
	Negative visual impacts	H	H
	Loss of arable land	H	M
	Loss of biodiversity and/or ecological function	H	M
	Rerouting of secondary road	H	M
Issue Group 2: Negative impacts requiring careful monitoring to ensure that the management measures are effective – careful monitoring is required to ensure that additional remedial measures are implemented without delay if required.	Deterioration of water quality as a result of seepage and decanting (Including the issue: potential for poor quality leachate)	M	L
	Deterioration of water quality as a result of discharges	H	L
	Lowering of groundwater levels through mine dewatering	M	L
	Disturbing noise	H	M
	Reduction in the catchment of dams downstream of the mine	M	L
	Negative socio-economic impacts	H	M

Issue group	Issue	Significance of the identified impacts	
		If not managed	Managed
Issue Group 3: Impacts that can be managed readily – these are impacts that can be reduced to acceptable levels through management and the management measures are not difficult to implement and known to be reliable.	Compliance with the GN 704 Regulations	M	L
	Hazardous excavations	M	L
	Loss of a soil resource	H	M
	Erosion	H	L
	Contamination of soils	M	L
	Blasting hazards and damage to structures by blasting vibrations	H	L
	Road disturbances and mine traffic	M	L
	Failure of mine residue deposits	M	L
	Dust and other emissions	H	L
	Disturbance of sites of archaeological, historic or cultural interest	M	L
	Disturbance of graves	H	L

The Voorspoed project is located in an environment that is sensitive in many respects. It is in quiet rural terrain with an aesthetically pleasing and relatively undisturbed Koppie with high plant and animal diversity adjacent to it. A wetland and pans of conservation importance are located on the mine site. Most of the areas on which the mine infrastructure will be located have been disturbed by agriculture and past mining activity. Consequently, avoiding the sensitive areas and favouring the disturbed areas for the siting of infrastructure results in the location of the infrastructure on arable land.

The mine has been planned and infrastructure has been sited so as to avoid sensitive plant and animal habitats and wetlands, and to minimise disturbance of valuable cultivated land. Management measures will be implemented to prevent degradation of nearby sensitive habitats and wetlands throughout the life of the mine.

The mining operation will detract from the scenic and aesthetic quality of the area, and the coarse and fine residue storage facilities and waste rock dump will remain permanent features in the landscape at closure. Careful rehabilitation of disturbed land and the mine residue dumps will help to mitigate this impact.

The Voorspoed project will have significant positive socio-economic impacts on the local, regional and national economies for the reasons given below.

- Provision of employment to a large number of people.
- A large capital investment and substantial offshore revenue generation.
- A large amount of money paid out locally in the form of the company payroll.

- Significant payments to the government in the form of local, regional and national taxes and levies.
- Creation and support of service-sector jobs, the procurement of large quantities of consumables annually and the outsourcing of service provision to local service providers.

The positive impacts of the project will be enhanced further by means of a local economic development programme to be established in the project area by De Beers.

8. STATUTORY REQUIREMENTS

8.1. LIST OF PERMISSIONS ALREADY GRANTED UNDER OTHER STATUTES

A prospecting permit has been obtained in terms of the Minerals Act. The permit has since lapsed.

8.2. LIST OF PERMISSIONS TO BE OBTAINED

Several environmental permissions (approvals, licences, authorisations and permits) will have to be obtained. These are listed below.

- A mining right has to be obtained from the Department of Minerals and Energy (DME) under the Mineral and Petroleum Resources Development Act (28 of 2002). The authorisation requires evidence of the ability to mine optimally and safely. It also requires evidence of financial ability to rehabilitate the surface.
- Approval of the Voorspoed EMP from the DME in terms of Section 39 of the Mineral and Petroleum Resources Development Act. The EMP has to be approved by the DME, in consultation with other regulatory authorities with an interest in the environment. When approved, the EMP becomes legally binding.
- Environmental authorisation needs to be sought for Voorspoed Mine in terms of section 21 and 22 of the Environment Conservation Act (Act 73 of 1989) from the Free State Department of Tourism, Environmental and Economic Affairs, for the following listed activities: change of land use (for mining as well as the servitude for water pipeline and power line from Renoster River to mine); construction on or near a wetland; explosives magazine; refuelling bay and diesel tanks; diversion of a secondary road; helipad; water abstraction from the Renoster River.
- All identified archaeological sites must be registered with the South African Heritage Resources Agency (SAHRA). A permit in terms of Section 35 of the National Heritage Resources Act (25 of 1999) is required for disturbance of archaeological sites. This will be obtained from SAHRA (or the provincial heritage agency when it is established).

- Permits in terms of Section 36 of the National Heritage Resources Act are required for disturbance of grave sites. These should be obtained from SAHRA (or the provincial heritage agency when it is established).
- Water-use licences from DWAF in terms of Section 22 of the National Water Act (36 of 1998). This (these) must cover all the water uses at the mine. A water use licence application will be submitted to DWAF with the related supporting documentation.

TABLE 8-1 SUMMARY OF MAIN ACTS PERTINENT TO VOORSPOED

Acts and the main environmental provisions	Relevance to Voorspoed
Constitution of the Republic of South Africa Act (108 of 1996)	
New South African law, including environmental law, is strongly influenced by the Constitution, which promotes specific moral, social and political values. The provisions of the Constitution are the over-arching legal principles against which all legislation must be measured. Chapter Two of the Constitution contains the Bill of Rights, which is the cornerstone of the new South African democracy. The Bill of Rights is binding on South African law and courts, all government departments and organisations and all South Africans, not only in terms of rights, privileges and benefits that it gives, but also in terms of duty and responsibility to implement and protect Constitutional rights and values. Sections 7, 8 and 24 of the Bill of Rights give constitutional force to sustainable development. They oblige government to pass reasonable legislation to protect the environment, prevent pollution and ecological degradation, and secure sustainable development. Section 32 provides that everyone has the right of access to any information held by the state or another person that is required for the exercise or protection of any rights. Section 33 entitles everyone to administrative action that is lawful, reasonable and procedurally fair. If one's rights have been adversely affected by administrative action one may request that written reasons for the decision be given.	**Respect for the responsibility of regulatory authorities to the public** Regulatory authorities need to be well positioned to justify any decision they take with respect to environmental management at Voorspoed. Any IAP is a potential litigant.
National Environmental Management Act (107 of 1998) (NEMA)	
Co-operative governance and public involvement NEMA provides the framework for integrating good environmental management into all development activities and to promote co-operative environmental governance with regard to decision-making by State organs. National government departments and provinces have to produce and update environmental management and implementation plans in terms of this Act. This is intended to promote co-ordination of environmental functions. The Act requires that the environment be protected as people's common heritage. It promotes public participation and requires that the interests, needs and values of all IAPs be taken into account in decisions. It also promotes social, economic and environmental considerations in all decisions.	**Co-operative governance** NEMA requires co-ordination and co-operation between regulatory authorities with an interest in the environment. NEMA discourages duplication of environmental authorisation/ approval processes by different regulatory authorities. **Public involvement** NEMA encourages public involvement.
Authorisations required in terms of NEMA Section 24 of the Act does make provision for the formulation of new EIA requirements for identified activities. No regulations or notices will made in terms of this section of the Act until the Minister of Environmental Affairs and Tourism is satisfied that the existing EIA regulations made in terms of the Environment Conservation Act are redundant.	None at present.
Control of emergency incidents Section 30 of NEMA deals with emergency incidents – excluding water pollution incidents and including major emissions, fires or explosions leading to serious danger to the public or pollution of the environment. Emergency incidents should be attended to as follows: the incident and any risks posed by the toxicity of the release should be reported; all reasonable measures to minimise and contain the effects must be taken; measures identified by regulatory authorities should be implemented as specified.	**Notification of any incident causing pollution** Voorspoed needs to notify DTEEA/ DEAT of any incident with potential to lead to an emergency incident.
Principles Principles are set out in NEMA with the intention of achieving sustainable development. Reduce resource use, waste generation and pollution. Promote energy efficiency, promote use of renewable energy resources and environmentally	Voorspoed needs to observe the principles.

Acts and the main environmental provisions	Relevance to Voorspoed
friendly alternative energy resources.	
Environment Conservation Act (73 of 1989)	
Waste disposal Section 20 of the Environment Conservation Act requires a permit be obtained from DWAF to establish, provide or operate any waste disposal site, unless an exemption is granted by DWAF. The definition of waste specifically excludes mine residues (overburden, waste rock, tailings and slag), effluent, building rubble used for filling/ levelling, radioactive substances, and power station ash (Government Notice 1986 of 24 August 1990). Section 20 also requires that waste be disposed of at a permitted waste disposal facility. A series of guidelines to assist applicants for waste site permits ("Minimum Requirements Waste Management Series") have been published by DWAF.	**Waste other than mine residues** Voorspoed must dispose of waste at permitted facilities. Voorspoed needs a permit to develop any waste disposal facilities if it decides to. **Mine residues** This requirement does not apply to mine residues
Environmental authorisation for new developments Environmental authorisation has to be obtained for specific types of new developments (called "identified activities") in terms of Sections 21 and 22 of the Environment Conservation Act and the corresponding Regulations 1182 and 1183. Regulation 1182 lists activities for which an EIA is required. Items in this list that could be pertinent to Voorspoed are as follows: Item 1c – the construction and upgrading of transportation routes/ structures/ facilities for manufacturing, storage and/or handling any substance which is dangerous/ hazardous and/or controlled by national legislation; Items 2a & b – change in land use from residential to industrial/ commercial use or from light industrial to heavy industrial use. Item 8 – waste disposal in terms of Section 20 of the Environment Conservation Act; Item 9 – scheduled processes in terms of the Atmospheric Pollution Prevention Act. At present mines are generally not expected to obtain environmental authorisation in terms of the environmental Conservation Act. Instead, they obtain environmental approval in terms of the Minerals Act. Domestic and industrial waste disposal facilities are obvious exceptions to this. New precedents are set on a regular basis. Mines should ensure that they consult authorities on the application of this requirement when undertaking new developments.	**New developments at Voorspoed:** environmental authorisations/ exemptions For any new development at the Voorspoed site, Voorspoed should consult DTEEA during the early stages of planning of the development to determine whether it is necessary to obtain authorisation for the development. All consultations should be documented and the necessary application forms should be completed.
Mine Health and Safety Act	
Safe and health working environment (design, construction, commissioning, operation, decommissioning and closure of mines). This Act requires that safety and health hazards to which an employee may be exposed are identified and the corresponding risks are assessed. Employees must be informed of these hazards and risks. The risks must be eliminated where possible. Risks that cannot be eliminated must be controlled and minimised. Where it is not possible to reduce risks to acceptable levels, employees must be provided with personal protective equipment (PPE) and a programme of monitoring the risk to which the employee is exposed must be implemented. People who design, manufacture, repair, import or supply goods to mines and/or erect or installs structure at mines must ensure that these are without risk to safety and health when used properly.	The whole act needs to be observed. This Act applies mainly to the occupational environment.
Mining right and EMP approval in terms of the Mineral and Petroleum Resources Development Act (28 of 2002)	
Mining rights application A mining right has to be obtained from the Department of Minerals and Energy (DME) under the Mineral and Petroleum Resources Development Act (28 of 2002). The authorisation requires evidence of the ability to mine optimally and safely. It also requires evidence of financial ability to rehabilitate the surface.	**Mining authorisation** in addition to the EMP, the mining rights application must include a Social and Labour Plan, Mining Works Programme and supporting information pertaining to De Beers' capabilities and track record of diamond mining.
Environmental authorisation/ approval of the EMP Complementary to the requirement for mining authorisation, is a requirement to submit an EMP to the Director: Mineral Development for approval. Failure to comply with the EMP can result in suspension of the mining authorisation. An EMP for a new mine has to be developed through an EIA process, with public involvement as an integral part of the process. The findings of the EIA and EMP are documented in an EMP report. The DME has to consult other government departments with an interest in the environment before approving an EMP. The EMP approval is complementary to the mining right that has to be obtained under the Mineral and Petroleum Resources Development Act (28 of 2002). Failure to comply with the EMP can result in suspension of the mining right.	**EMP approval** The EMP for the Voorspoed Mine will be completed in November 2004 and it will be submitted to the authorities in December 2004.
Amendment of EMPs Mines are expected to continually update their EMPs. Refinements to the EMP need to be added in the form of amendments to the EMP.	**Amendment of the mine's EMP** Voorspoed needs to keep its EMP up to date.

Acts and the main environmental provisions	Relevance to Voorspoed
Auditing of compliance with the EMP Compliance with the EMP has to be audited under the Mineral and Petroleum Resources Development Act (28 of 2002). Specifically, the regulation requires that monitoring of the EMP is undertaken on an ongoing basis and performance assessments (audits) are undertaken every two years, or as specified in the EMP. The continued appropriateness and adequacy of the EMP needs to be evaluated during the audits. Reports on the findings of the audits must be submitted to the DME, other government departments involved in the approval of the EMP and other IAPs on written request.	For any new development at the Voorspoed mine site, Voorspoed should update its EMP. **Future audits** Voorspoed will have to submit audit reports to the DME and other authorities on a regular basis to prove compliance with its EMP.
National Water Act (36 of 1998)	
The reserve, water resource strategies and classification of water resources The National Water Act empowers national government to regulate the use, flow and control of all water in the country. It requires that "the reserve" (the quality and quantity of water required to satisfy basic human needs and protect aquatic ecosystems and other water users requirements in the area) is determined and that water allocations are restricted in favour of the reserve. Currently, water resource strategies are being developed for the whole country and for catchments. These will address provision for the reserve and international obligations. They will delineate water management areas and define both water availability and water requirements in these areas. Catchment strategies and water allocation plans will be developed by catchment management agencies in accordance with the national water strategy. The national and catchment strategies are being developed concurrently. A water-resource-classification system is to be established and resource-quality objectives are to be established for each class of resource.	**Participation in development of water law** Voorspoed will need to keep up to date with the progress in the water law and understand and address the implications for the mine.
Prevention of pollution of water resources Section 19 of the National Water Act states that any person who owns, controls, occupies or uses land is deemed responsible for taking measures to prevent pollution of water resources. If these measures are not taken, the responsible authority may do whatever is necessary to prevent the pollution or remedy its effects and to recover all reasonable costs from the responsible person. Non-compliance with this provision constitutes a criminal offence.	**Responsibility/ liability for pollution** Voorspoed can be deemed responsible/ liable for any pollution on its site/ emanating from its site/ operations.
Pollution incidents Section 20 of the National Water Act deals with pollution of water resources following an emergency incident, such as an accident involving the spilling of a harmful substance that finds/ may find its way into a water resource. The responsible person is required to report the incident as soon as possible to DWAF, the relevant police or fire department, or catchment management agency. Regulation 704 of the Act (outlined below) requires that DWAF is notified of such an incident by the fastest possible means and that the following information is provided: the date and time of the incident; a description of the incident; the source of pollution; the impact/ potential impact on water resources and downstream water users; and remedial action to be taken. Within 14 days, DWAF (Regional Director) must be informed of the remedial measures to be taken to correct and prevent recurrence of the incident.	**Notification of DWAF of any incident causing pollution** Voorspoed needs to notify DWAF of any incident with potential to cause pollution of water resources as soon as is possible.
Water treatment Section 26 of the National Water Act makes provision for making of regulations on water/ waste treatment, including: the outcome/ effect that must be achieved; the design, construction, operation and maintenance of waterworks.	**Take note of progress in the development of the regulations** New regulations could influence effluent and waste disposal practices at Voorspoed.
Water discharges: receiving water quality objectives and effluent standards Specifications for the quality of discharges are likely to be defined in terms of receiving water quality objectives and waste load allocations. DWAF has no official guidelines on how to determine receiving water quality objectives and pollutant loads that can be accepted from specific sources. It needs to establish the reserve, the strategy and the resource quality objectives for river systems in terms of the new National Water Act, before it can give firm guidance on receiving water quality objectives downstream of specific operations.	Take note of trends in the development of discharge controls and guidelines
Water-use licences Water-use licences are required for all water uses in terms of Sections 22 and 40 – 42 of the National Water Act. Exceptions are made for water uses that are: listed in Schedule 1 of the Act (low impact activities such as domestic water use); covered by general authorisations in terms of Section 39 of the Act; or existing lawful uses (water uses permitted in terms of the old Water Act, 54 of 1956). Section 21 of new National Water Act lists the water uses for which licences have to be obtained and thereby gives wide definition to the term "water use". The list includes: water abstraction; water storage; stream diversion; stream flow reduction activities; effluent discharge; waste disposal which could impact on water resources;	**Water-use licence** Voorspoed will apply for water use licences in accordance with the Water Act

Acts and the main environmental provisions	Relevance to Voorspoed
watercourse alteration; underground water removal and discharge; and use of water for recreational purposes. It also includes controlled activities (including irrigation of land or recharging of aquifers with waste water) identified in Section 38 or declared in terms of Section 39 of the Act. DWAF may require any study or assessments to precede the issuing of a water use licence.	
Waste disposal Section 21 of the National Water Act does identify "disposing of waste in a manner which may detrimentally impact on a water resource" as a water use that requires licensing in terms of Sections 40 – 42 of the Act. Mine residues are exempt from the waste permitting requirements in terms of the Environment Conservation Act. DWAF does require licensing of mine residues in terms of Section 21(g) of the National Water Act.	**Water use licences for the residue disposal facilities** Voorspoed will need to apply for a water use licence for the fine residue storage facility in terms of Section 21(g) of the Act.
GN Regulation 704: regulations pertaining specifically to mining (Replaces Regulation 287 of the old Water Act. Exemption may be granted from specific requirements of the regulation. The person in control of the operation must provide the manager with the means to comply with the regulation.) DWAF must be notified of proposals to mine, proposals to close mines and amendments to EMPs. DWAF must be notified of emergency incidents involving a water resource. No infrastructure may be established within a 1:100 year floodline of any watercourse or on ground likely to become waterlogged, unstable or cracked.* No mining under or within a 1:50 year floodline or a 100 m of a watercourse (which ever is greatest will be allowed).* No residue or substance likely to cause pollution may be placed in workings or any other excavation. No substance or facility likely to cause pollution may be located within a 1:50 year floodline. No material likely to cause pollution may be used to construct infrastructure. Clean-water-diversion and dirty-water-collection facilities for the 1:50 year storm event must be constructed. Prevent polluted water from entering any water resource (re-use, purify or evaporate). Prevent the flow of surface water into workings. Ensure water-holding facilities and residue deposits are stable. Ensure that there are no uncontrolled discharges from water systems. Domestic waste and wash water must be discharged to authorised facilities. Impoundments containing toxic or injurious substances must be fenced off and warning signs must be erected in prominent locations. Provide adequate security for protection measures. Pollution control measures must be compliant with the regulation in the event of temporary or permanent cessation of mining activity. Remedial measures for any damage to watercourses and the riparian zone must be implemented for temporary or permanent cessation of mining activity. Winning of sand and alluvial minerals from watercourses is not permitted unless precautions are taken to ensure that the watercourse is stable, erosion and sedimentation do not occur, the flow characteristics of the watercourse are not altered. Water must be treated to an acceptable standard before return to the watercourse. Infrastructure must be located outside of the floodline as outlined above. Coal residue deposits must be rehabilitated concurrently with mining and must be compacted to prevent spontaneous combustion and minimise infiltration of water. DWAF may request a technical investigation of water management infrastructure and systems on mines by a competent person. Any dams for impounding wastewater, tailings or slurry must have minimum freeboard of 0.8 m above the full-supply level. Plans, specifications and designs must be approved by a professional engineer and submitted to DWAF. **	**Exemptions required** Voorspoed requires exemptions for the items marked with a * **Approvals required** Voorspoed must get detailed designs for dirty water holding dams and tailings dams approved by DWAF (see **). Water use licences supersede exemptions. In all cases where Voorspoed requires exemptions it also requires water use licences. Consequently, Voorspoed will not apply specifically for exemptions independently of the water use licences.
National Veld and Forest Fire Act (101 of 1998)	
Fire protection associations among land owners are to be established for predicting, preventing, managing and extinguishing fires. A fire danger rating system is to be established. Landowners have to prepare and maintain firebreaks wide enough and long enough to prevent veldfires from spreading on to surrounding land. Owners are also required to acquire equipment and protective clothing and to have access to personnel. Any person between 16 and 60 can be called on to fight fires. For the purposes of fire fighting, people may enter any land and break or enter any premises.	Firebreaks Voorspoed must ensure that adequate firebreaks are established around the mine.
Disaster Management Bill (Published in January 2000)	

Acts and the main environmental provisions	Relevance to Voorspoed
Provides for establishment of an integrated, coordinated approach to disaster management by national, provincial and local government. Provides for establishment of a disaster management policy for preventing or reducing the risk of disasters, mitigating the severity of disasters, emergency preparedness ad a rapid and effective response to disasters and post-disaster recovery. Provides for establishment of a national disaster management centre and provincial and municipal disaster management offices.	Take note of developments
Air Pollution Prevention Act (45 of 1965) This Act deals with control of noxious or offensive gases, smoke, dust and motor vehicle emissions. Responsibility for regulatory control is divided between the Chief Air Pollution Control officer (CAPCO) in the Directorate of Air Pollution within DEAT and local authority inspectors. The local authorities are responsible for smoke, dust and vehicle emissions.	
Air pollution registration certificates The Atmospheric Pollution Prevention Act schedules approximately 70 processes producing emissions (Schedule II). Operators of scheduled processes have to get permits (air pollution registration certificates) to operate (Part II, Section 9). These define the air-pollution-control technology to be used and standards (emissions limits and ambient air quality guidelines) to be achieved. The Chief Air Pollution Control officer (CAPCO) decides on the permit conditions based on the best practicable means (BPM) principle. There are no formal guidelines on factors to be considered in determining what constitutes BPM.	**Air pollution registration certificates** Voorspoed will not be operating any scheduled process, therefore it does not require an air pollution registration certificate
Emissions: receiving air quality objectives and emission standards Criticisms of air pollution control in South Africa include: the BPM approach coupled with emission limits does not address compromises between public health protection, costs to industry or local conditions or circumstances; the permitting of individual operations fails to recognise the regional significance of total pollution loading. The White Paper on Integrated Pollution and Waste Management promotes the setting of standards for ambient air quality followed by the setting of source control limits that correspond with the relevant local ambient air quality objectives. At present, the CAPCO uses interim ambient air quality objectives that a crudely derived from occupational exposure limits – specifically, the American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit values. The ambient air quality objectives are derived from the occupational exposure limits by multiplying these by a safety factor – 1/50 (for non-carcinogenic substances) and 1/100 (for carcinogenic substances). In addition to these limits, the CAPCO has set maximum allowable limits for the more common pollutants which are: sulphur dioxide, ozone, nitrous oxides, suspended solids, smoke and dust fall out.	**Take note of trends in the development of discharge controls and guidelines** Voorspoed needs to follow trends in the development standards for air pollution control.
Smoke control The Act leaves initiative to control smoke almost entirely to local authorities. Controls provided for are outlined below. Permission to install and operate fuel-burning appliances has to be obtained from the CAPCO or the local authority (Part III, Section 15 and 16). Local authorities may serve abatement notices on any party if the product of combustion emanating from the premises occupied by the party is a nuisance or health hazard to occupiers of surrounding properties (Part III, Section 17). A local authority can make smoke regulations specifically designed for the area under its jurisdiction (Part III, Section 18). A local authority can declare a smoke-control zone and prohibit emissions, which exceed a specified colour or density Part III, Section 20. Provision is made for local authorities to implement smoke control measures and recover the costs from the parties who fail to comply with local smoke control regulations (Part III, Section 18). This provision is however seldom invoked.	Take note of this
Dust control Dust control measures apply to areas declared as dust control areas under the Atmospheric Pollution Prevention Act (Part IV, Section 17). These require anybody causing nuisance to occupiers of adjacent land to take prescribed steps or (where no steps are prescribed) adopt best practicable means for preventing the nuisance.	Take note of this
National Heritage Resources Act (25 of 1999)	
Archaeology, palaeontology and meteorites Objects, which have been declared to be Heritage Objects, may include archaeological & palaeontological objects. These must be listed in a Register maintained by the South African Heritage Resources Agency (SAHRA) and must be protected by the owner.	**Archaeology, palaeontology and meteorites** Where disturbance of sites of archaeological and cultural interest. is unavoidable, adequate measures

Acts and the main environmental provisions	Relevance to Voorspoed
Section 34 provides that no person may alter or demolish any structure, which is older than 60 years except under the authority of a permit issued by the provincial heritage authority. Thus unlike the National Monuments Act a declaration as a national monument does not need to take place first. Section 35 provides for the protection of archaeological and palaeontological sites and material and meteorites. These are all regarded as the property of the State under the responsibility of SAHRA. Any one discovering such objects in the course of development is required to immediately report the find to the responsible heritage authority. A permit is required to destroy, damage, excavate, alter, deface or otherwise disturb any such site or meteorite.	must be taken to preserve the information held within the sites. This will involve excavation, systematic surface collection and analysis and curation of the material and documentation in a museum as stipulated by the SAHRA.
Burial ground and graves Section 36 deals with burial grounds and graves. Graves are broadly defined to include any place of interment. SAHRA shall identify graves of victims of conflict and any other graves, which it deems to be of cultural significance. A permit is required to destroy, alter, remove etc such graves. The section goes on in (b) to require a permit also to destroy, remove etc any grave or burial ground which is situated outside a formal cemetery administered by a local authority and which is older than 60 years. A permit will only be granted if SAHRA is satisfied that the applicant has made satisfactory arrangements for the exhumation and re-interment of the contents and reached agreement with the affected communities regarding the future of such grave or burial ground. **Old structures** Section 38 that any person who intends undertaking a development that will change the character of a site (which would include constructing a road, mining etc) shall at the earliest stages of initiating such a development, notify SAHRA and furnish it with details regarding the location, nature and extent of the proposed development. SAHRA may, if it has reason to believe that a heritage resource will be affected by the development require the submission of an impact assessment report. SAHRA, will decide whether the development may proceed. **These provisions do not apply if an EIA covering heritage resources is required under other legislation e.g. the Minerals Act as long as the consenting authority ensures that the evaluation fulfils the requirements of SAHRA** and that SAHRA's comments and recommendations are taken into account prior to the granting of the consent.	**Burial ground and graves** Voorspoed needs to obtain a permit to relocate any graves. Voorspoed must then make satisfactory arrangements for the exhumation and re-interment of the contents of such graves. Voorspoed must contact and consult communities and individuals who have a traditional interest in such graves or burial grounds and reach agreements with such communities and individual regarding the future of such grave or burial ground. Voorspoed must notify SAHRA and furnish it with details regarding the location, nature and extent of the proposed development.

9. AMENDMENTS TO EMPR

This part is intended to accommodate amendments to the document so that it remains dynamic and complete.

10. REFERENCES AND SUPPORTING DOCUMENTATION

REFERENCES

Concession Creek Consulting (October 2004) Socio-Economic Impact Assessment. Johannesburg.

DEAT (1992). Integrated Environmental Management (IEM) Guideline Series. Documents 1 To 6: The IEM Procedure; Scoping; Report Requirements; Review; Checklist of Environmental Characteristics; and Glossary of Terms. Department of Environmental Affairs and Tourism (DEAT), Pretoria.

DEAT (April 1998). Environmental Impact Management: Guideline Document, EIA Regulations, and Implementation of Sections 21, 22 and 26 of The Environment Conservation Act. Department of Environmental Affairs and Tourism (DEAT), Pretoria.

DPR Projects (Pty) Ltd (October 2003) Socio-Economic Impact Study for the Proposed Diamond Mine at Voorspoed in the Free State – Baseline Report. Johannesburg.

Gallagher, M. (De Beers) (2004) VOORSPOED DIAMOND MINE OPEN PIT MINE PLANS – Feasibility study base case report.

Harvey, F. & Venter, J. (Steffen, Robertson and Kirsten) (2004) Geotechnical Evaluation and Slope Design for the 200m Pit Feasibility Study, Voorspoed Mine, prepared for De Beers Consolidated Mines.

Jacobs EO, Boshomane MAW and Paterson DG (September 2004) Soil Survey for Voorspoed Diamond Mine near Kroonstad, Report No GW/A/2004/65. Pretoria.

Jooste T.F. (2004) Traffic Impact Assessment. Pretoria.

Liebenberg-Enslin H, Watson R. and Venter C (2004) Air Quality Impact Assessment Study for the proposed Voorspoed Diamond Mine near Kroonstad. Johannesburg.

Lockwood G and Ginsberg I (2004) An Ecological Assessment of the Farms Voorspoed 401, Voorspoed 2480, Geldenhuys 1477 and Morgenster 772. Johannesburg.

Low, B & Rebelo, T. (1996) Vegetation of South Africa, Lesotho and Swaziland. DEAT. Pretoria.

Malherbe FR (September 2004) Noise Study for the Voorspoed Diamond Mine. Pretoria

Metago Environmental Engineers (Pty) Ltd (August 2004) Report on the Scoping Stage of an Environmental Impact Assessment to produce an Environmental Management Programme for Voorspoed Diamond Mine. Johannesburg.

Midgley DC, WV Pitman and BJ Middleton (1994) Surface Water Resources of South Africa, Volume II Drainage Region C Vaal, WRC Report No 298/2.1/94.

Newtown Landscape Architects (September 2004) Voorspoed Diamond Mine Visual Assessment. Johannesburg.

Pistorius J. (September 2004) A Heritage Impact Assessment (HIA) study for an EMP for the Voorspoed Diamond Mine near Kroonstad in the Free State Province of South Africa. Pretoria.

Schulze (1965) Climate of South Africa. Part 8 General Survey.

Smithers & Schulze (2000) Design rainfall depths at selected stations in South Africa.

Strategic Environmental Focus (Pty) Ltd (2004) Endorheic Pan Assessment of the Farm Voorspoed 401, Free State. Pretoria.

Strategic Environmental Focus (Pty) Ltd (2004) Wetland Assessment of the farm Voorspoed 401, Free State. Pretoria.

Vivier JJP (October 2004) Geohydrological specialist investigation at the De Beers Voorspoed Mine. Pretoria.

APPENDIX 1 VOORSPOED MINE SOCIO-ECONOMIC IMPACT ASSESSMENT BASELINE REPORT – DPR PROJECTS

APPENDIX 2 VOORSPOED MINE SOCIO-ECONOMIC IMPACT ASSESSMENT REPORT - CONCESSION CREEK CONSULTING

APPENDIX 3 NOISE STUDY FOR THE VOORSPOED DIAMOND MINE - FRANCOIS MALHERBE ACCOUSTIC CONSULTANTS

APPENDIX 4 SOIL SURVEY FOR VOORSPOED DIAMOND MINE - INSTITUTE FOR SOIL, CLIMATE AND WATER

APPENDIX 5 ECOLOGICAL ASSESSMENT OF VOORSPOED MINE - DELTA ENVIRONMENTAL CONSULTANTS

APPENDIX 6 WETLAND ASSESSMENT OF THE FARM VOORSPOED - STRATEGIC ENVIRONMENTAL FOCUS

APPENDIX 7 ENDORHEIC PAN ASSESSMENT OF THE FARM VOORSPOED - STRATEGIC ENVIRONMENTAL FOCUS

APPENDIX 8 HERITAGE IMPACT ASSESSMENT OF VOORSPOED - DR JULIUS PISTORIUS

APPENDIX 9 VISUAL IMPACT ASSESSMENT FOR VOORSPOED - NEWTOWN LANDSCAPE ARCHITECTS

APPENDIX 10 AIR QUALITY IMPACT ASSESSMENT – AIRSHED PLANNING PROFESSIONALS

APPENDIX 11 GROUNDWATER IMPACT ASSESSMENT - SOUTHERN AFRICA GEOCONSULTANTS

APPENDIX 12 AN ASSESSMENT OF THE POLLUTION POTENTIAL FROM MINE WASTE RESIDUES FOR VOORSPOED DIAMOND MINE

APPENDIX 13 TRAFFIC IMPACT ASSESSMENT FOR VOORSPOED MINE

APPENDIX 14 SYSTEM ANALYSIS OF THE RENOSTER RIVER FOR VOORSPOED MINE ASSURANCE OF SUPPLY

APPENDIX 15 REPORT ON THE SCOPING STAGE OF AN ENVIRONMENTAL IMPACT ASSESSMENT TO PRODUCE AN ENVIRONMENTAL MANAGEMENT PROGRAMME FOR THE PROPOSED VOORSPOED MINE

APPENDIX 16 MINUTES OF AUTHORITIES MEETING TO PRESENT DRAFT EMP

APPENDIX 17 MINUTES OF PUBLIC MEETING TO PRESENT DRAFT EMP

APPENDIX 18 LIST OF REGISTERED IAPS FOR THE VOORSPOED EIA

11. CONFIDENTIAL MATERIAL

Should the proponent wish to keep certain business (including technical innovations and/or processes) or financial information confidential and to exclude this from the EMPR document, reference to this should be made in this part.

APPENDIX C

Voorspoed Mine Final Closure Plan, Redco and Uvuna Sustainability, 2019

VOORSPOED MINE

CLOSURE PLAN 2019

Project no: DB 037

August 2019

Client:	De Beers – Voorspoed Mine	
Project number	DB 037	
Project reference	4100711987	
Contact Person:	Mr. H. Kgasago Mine Closure Champion Voorspoed Mine *Office:* +27 (56) 216 8605 Mobile: +27 (72) 093 0126 *Email: Hans.Kgasago@debeersgroup.com*	
Contract:	FINAL CLOSURE PLAN	
Service Providers:	Rehabilitation Design & Construction Services (Pty) Ltd t/a Redco 3 Fabriek Street Parys 9585 PO Box 19214 Noordbrug 2522 Office: +27 56 811 5335 Fax: +27 86 768 3221 Email: dp@redcoservices.co.za VAT no: 4370210595	Uvuna Sustainability (Pty) Ltd. 9 Beatrice Avenue Northcliff 2195 Mobile: +27 83 448 4425 Mobile: +27 83 707 7774 Email: ralton@uvuna.com teresa@uvuna.com VAT no: 4400273746
Project Team & Specialists:	DP van der Merwe (Pr.Eng.) Antoinette Scheepers	Ralton Maree (M.Sc) Teresa Steele-Schober (M. EM)
REVISION: Date Issued:	Final Report to client August 2019	

EXECUTIVE SUMMARY

Voorspoed Mine is an open pit diamond mine, owned by De Beers Consolidated Mines (DBCM). The mine is located within the Fezile Dabi District of the Free State Province of the Republic of South Africa, approximately 30km north of Kroonstad and 50km south of Vredefort. The mine is located within the Ngwathe Local Municipality.

Following the EMPr amendment where closure criteria are addressed at a high level, Voorspoed Mine initiated the mine closure planning process in 2011. Table 2. Closure plan development history for Voorspoed Mine.presents the closure plan development history for the mine.

Table i. Closure plan development history for Voorspoed Mine.

Mine Closure Plan (MCP) Status	Date of Mine Closure Plan development	Independent Practitioner
Preliminary MCP	January 2011	Shangoni
Improved Preliminary MCP	August 2014	Redco / E-TEK
Final MCP 2017	December 2017	Redco / Uvuna Sustainability
Final MCP 2019[1]	June 2019	Redco / Uvuna Sustainability

This closure plan has been written to give effect to the various legal and corporate requirements that govern the process and requirements for the closure of Voorspoed Mine. Closure conditions and commitments are influenced by legislation, EMP commitments and license conditions.

The closure vision for Voorspoed Mine is:
To close the mine in line with the relevant legal requirements and do this in such a way that the mining area can be utilised in a sustainable manner after closure has been achieved.

The end land use for Voorspoed Mine is to reinstate most of the rehabilitated footprint area back to agricultural land. The aim is to achieve a sustainable land use, complies with the closure vision and match the rehabilitated footprint with the surrounding area as reasonably practical.

Arable land within the property will be retained as croplands while it is proposed that the grazing potential over the larger portion of the site should be reinstated. However, controlled grazing is proposed for the more sensitive biodiversity rich areas. Areas such as the open pit and top of the FRD facility will be regarded as restricted areas due to the limited land use. Measures will be put in place to prevent access to these facilities as far as possible. The end land use plan is presented in Figure i. Further detail regarding end land use planning is presented in Section 4.4 of this report.

[1] This Mine Closure Plan

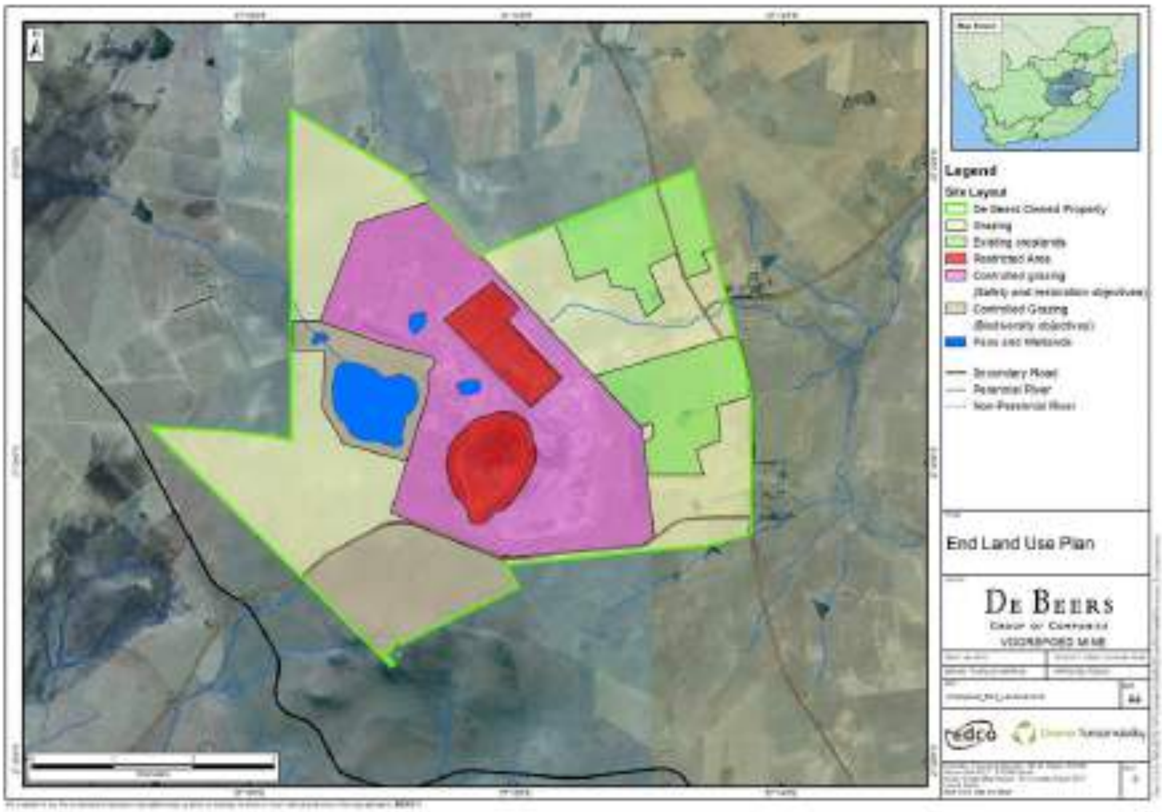


Figure i. Proposed End Land Use Plan for Voorspoed Mine.

Based on a risk assessment process where risks and residual risks were identified, Mine Closure Criteria were developed to address risks. Actions required to implement the Mine Closure Criteria are detailed in the Mine Rehabilitation plan, which also documents the proposed implementation schedule for identified actions (ANNEXURE A). Significant Residual Risks (risks that remain high or significant post the implementation of proposed mitigation measures) are presented in Table ii. Further detail regarding significant residual risks and their mitigation can be sourced in Section 5.4.

Table ii. Residual Risks

RISK AREA	RISK
Open Pit	Human injury or death due to uncontrolled access to the pit (falling into the pit) (Including illegal miners)
Open Pit	Attempted illegal mining of the remaining resource once the site has been decommissioned impacting on human safety, integrity of rehabilitation efforts, increased financial liability, reputational damage and possible inability to obtain a closure certificate.
Fine Residue Deposit	Possibility of outer slope (embankment) failure resulting in environmental and safety threats, due to saturation caused by the concentration of surface water to low areas.
Fine Residue Deposit	Impact to soil, groundwater and / or surface water, due to contaminated seepage/leachate from FRD. Current seepage qualities indicate elevated levels of SO_4, Na, EC, TDS, Nitrates, Ca, Cl and SAR. Trends in Na, SO_4, TDS and EC concentrations in SWM01 (downstream of the FRD) show increasing concentrations over the LOM. Concentrations of Na, Cl, and TDS in the closest borehole (VDBH01) show increasing trends over the LOM. The FRD has been built over a non-perennial stream which will likely be impacted by seepage from this facility and the WRD. Downstream water quality impacts are predicted post-closure.

RISK AREA	RISK
Fine Residue Deposit	If the FRD retains water on the surface post closure, it remains a dam with safety risk, due to: - Having a water holding capacity of > 50 000m3 - Having walls >5m in height.
Coarse Residue Deposit	Impact to soil, groundwater and / or surface water, due to contaminated seepage/leachate from the CRD. Seepage from the CRD indicates elevated concentrations of EC, TDS, Cl, SO_4, Nitrate and Na. There is also evidence of hydrocarbon-influenced seepage. Groundwater qualities in GDH-04 do not yet appear to be impacted however GHD-03 indicates contamination of groundwater - elevated concentrations of Cl, SO4, Na. TDS and EC are above baseline of MBH03 (closest baseline borehole). Pollution from seepage will in part migrate beyond the mine boundary but will not inhibit use of groundwater for human or animal consumption.
Coarse Residue Deposit	The existing rehabilitated slope on the eastern side of the CRD has been profiled to have a single slope (without benches) with a slope length that may not facilitate a stable and sustainable end land use status. The slope currently has inadequate surface water management measures, which may facilitate erosion.
Pre-1912 Tailings Dump	The remaining material within the Pre-1912 tailings dump may contain a diamond grade that is relatively higher than other discard dumps, potentially attracting illegal miners post closure, resulting in potential safety incidents, legal consequences and reputational damage to De Beers.
Waste Rock Dump	Impact to soil, groundwater and / or surface water, due to contaminated seepage/leachate from the WRDs. Seepage from the WRD contains elevated concentrations of EC, TDS, SO_4, Na and Nitrate. SWM05 is the nearest surface water sampling point downstream of the WRD. This point shows increasing concentrations of Na over the LOM. The closest borehole (VDBH04) showed frequent instances of exceeding various DWS drinking water parameters over the LOM.
Infrastructure	Potential hydrocarbon contaminated material at the plant, workshops and oil & fuel handling facilities that: • Potentially pollutes the natural environment. • Needs to be decontaminated; or • Needs to be disposed of legally at a registered waste disposal facility.
Infrastructure	Possibility of not obtaining permission to dispose building rubble (inert demolition waste) on-site (exemption from regulator). If a disposal permit is not granted, a suitable certified offsite disposal facility must be utilised for rubble disposal.
Infrastructure	Off-site infrastructure that has been identified to remain / not be demolished post mine closure will attract (i) ongoing care and maintenance or (ii) demolition costs if the infrastructure cannot be transferred to (and maintained by) 3rd parties. To date, post closure end-land use, ownership and associated maintenance of applicable infrastructure have not been confirmed or agreed to with relevant stakeholders. Specific infrastructure includes: • External access roads. • Electrical transmission and distribution infrastructure. • The Renoster River weir and/or associated infrastructure.
Infrastructure	The revised closure criteria for the raw water pipeline (above surface infrastructure demolished; sub surface infrastructure remains in situ) may not meet farmers expectations (or perceived commitments made to farmers during the Mine project development phase), where pipeline infrastructure adjacent to farm properties will become the property of farmers post-closure. It remains unclear whether or not farmer expectations are that the pipeline maintains a water provision capability post closure. Applicable water use licencing will need to be addressed dependent on the ultimate outcome.
Bio-Physical - Biodiversity	Surface water runoff to the wetland and pans has (i) decreased due to surface runoff being diverted away from the wetlands / pans (e.g. through stormwater management structures) and (ii) deteriorated in quality, causing a reduction in the ecological integrity / functioning of these systems. These impacts were not contemplated in the original EIA or approved WUL and will need to be rehabilitated before the site is relinquished.
Bio-Physical - Biodiversity	Although there are no areas classified to be 'protected areas', specialist studies identify various areas of high biodiversity value worthy of conservation status, given the distinct nature of the vegetation relative to the surrounding land and the relatively pristine nature thereof. Specific areas to be noted include: • Renosterkop area.

RISK AREA	RISK
	• Pans and wetland. • Undisturbed grassland areas.
Bio-Physical – Surface water	Surface water quality impacts to the non-perennial stream running to the north-east of the mining area.
Bio-Physical – Surface water	Contamination of off-site surface water resources as a result of run-off from MRDs is expected. However, due to incomplete monitoring data there is a lack of understanding of the significance of current and post-closure impacts on offsite surface water receptors as a result of run-off from the MRDs. The C70H catchment has been identified to be located in a River National Freshwater Ecosystem Priority Area (NFEPA) catchment.
Bio-Physical – Surface water	The volume and quality of water that will dewatered post-closure is unknown at present. The quantities and qualities may influence disposal options for this water when the RWD is decommissioned.
Bio-Physical – Soils	The extent of hydrocarbon contamination on site, and the associated quantities of contaminated material to be bio-remediated / disposed is unknown. Soil hydrocarbon and salt contamination will impact negatively on land capability.
Bio-Physical – Land Use and Land Capability	Risk of liabilities reverting back to De Beers should the end land users / tenants (post closure) not adhere to agreements/ contracts or do not implement proper maintenance / management of the property.
Bio-Physical - Topography	The open pit will significantly alter the local topography
Social – Interested and Affected Parties	Inability to obtain approval/ endorsement of land uses and closure plan by communities and/ or authorities
Social – Authorities	Relevant government departments and stakeholders have not been consulted regarding the mine's proposed (most recent) physical, bio-physical and social closure criteria and objectives. Failure to obtain agreement from the regulators on the proposed closure criteria may impact the closure period and final relinquishment of the site. Given the lack of stakeholder consultation regarding proposed closure criteria, assumptions driving the development of closure criteria and associated designs may not be approved or deemed adequate by authorities leading to additional/amended closure criteria that may attract additional cost. This should be considered in the context that selected closure criteria developed as part of the Final Closure Plan deliverables are not aligned to the approved EMP.
Social – Authorities	Various pieces of legislation require Voorspoed to apply for permits, licences and / or environmental authorisation as part of the mine closure process. A detailed understanding of permit requirements will be required to ensure that the decommissioning and closure schedule can be implemented as planned.

The previous itemised closure liability was calculated in 2018 as forerunner to the 2019 Final Closure Plan update. Redco updated the rates and quantities during this study to calculate market related costs for the region, but also to reflect changes in designs and the resultant effects on rates. Rates for dismantling and demolition of infrastructure were obtained from a national demolition contractor that visited the site to assess local conditions. The rates for earthworks were calculated based on site conditions and a combination of local and typical plant hire rates. The quantities for earthworks were calculated on a volume basis (m^3), because this is more in line with the standard method of measurement for civil engineering quantities, tendering and volume balances. The quantities for earthworks were modelled and calculated from a DTM of a lidar survey that was done in September 2018, with subsequent updated surveys of selected areas that changed since the lidar survey. The closure liability sheets should be read in conjunction with the reference drawings in ANNEXURE F. The closure liability sheets are included in ANNEXURE E. The closure liability has decreased slightly since 2018 and is due to the net variance of factors increasing and decreasing the costs. The following changes caused the closure liability to increase:

- The emergency CRD stockpile remained when the operations ceased at the end of 2018 and allowance must be made for the rehabilitation of the dumps and footprint;
- Design changes for the CRD, i.e. reshape the slopes to single 16° slopes instead of benches and 18° intra-bench slopes and an additional coarse basalt cover layer to reduce erosion; this also increased the footprint area that must be covered;
- The same design changes were applied to the eastern side of FRD1B and FRD2, i.e. increased reshaping costs to reshape to 16° and an additional coarse basalt armour layer;
- The cost for the rehabilitation of the plant footprint increased, because of the remaining stockpile dumps at the DMS and crushed ore stockpile areas;
- The backfilling cost of the primary crusher void increased based on more accurate calculations and to allow sufficiently for the consolidation and settlement of the backfilled material, especially inert concrete and building rubble;
- A portion of the Pre-1912 tailings facility remains and must be reshaped and covered with growth medium;
- The cost of the remaining basalt dump increased based on the expected remaining material after suitable graded material was removed for the armouring of the CRD and FRD slopes;
- The cost of rehabilitating certain of the general disturbed areas increased to allow for weed and invader plant control on areas outside the mine disturbed footprint, but on the property of the mine;
- The monitoring cost was increased to allow for a minimum of 10 years and increased pit stability monitoring; and
- Some of the maintenance cost increased, e.g. invader control and follow-up vegetation.

The following liabilities reduced since 2018:

- The cost for the closure of the buildings category reduced, because some infrastructure has already been removed from site;
- The cost for the remainder of the WRD rehabilitation reduced, because some of the works have already been implemented by the mine;
- The cost for the reshaping of the FRD2 outer slopes reduced, because of the change in design and changes to the volume of buttress material that was used for FRD1B;
- The covering and water control on the top of the FRD facility was removed from the liability, because it is not deemed practical to work safely on the top area. It remains uncertain as to when the top area will be dry enough to allow any possible earthworks actions;
- The cost of the rehabilitation of the RWD and SWCD reduced, because it was changed to a partial backfill designs instead of making the facilities free draining;
- The closure liability of the open pit reduced, because the security fence was already delivered on site; and
- Some of the maintenance cost reduced, e.g. cleaning of sediment from benches (benches removed due to design change).

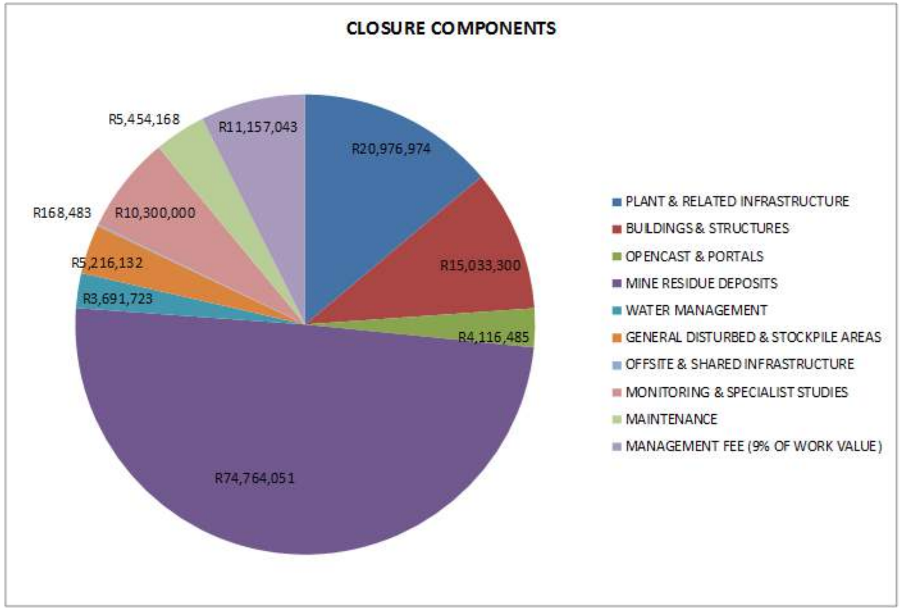
A closure liability estimate was generated with respect to physical and bio-physical aspects, based on the proposed mine closure criteria, required actions and proposed implementation schedule.

A summary of the unscheduled closure liability (2019) and the 10-year closure liability forecast is presented in Figure ii.

SUMMARY

Zone	Area	Unscheduled closure: Decommissioning	Unscheduled closure: Restoration	Unscheduled closure: 2019 Total	10-Year forecast: 2020	10-Year forecast: 2021
A	PLANT & RELATED INFRASTRUCTURE	R 13,925,026.31	R 7,051,948.02	R 20,976,974.33	R 20,976,974.33	R 12,480,031.00
B	BUILDINGS & STRUCTURES	R 11,683,896.68	R 3,349,403.76	R 15,033,300.44	R 15,033,300.44	R 15,033,300.44
C	OPENCAST & PORTALS	R 524,339.27	R 3,592,145.72	R 4,116,484.99	R 3,268,691.12	R -
D	MINE RESIDUE DEPOSITS	R -	R 74,764,050.51	R 74,764,050.51	R 57,882,686.77	R 26,510,166.06
E	WATER MANAGEMENT	R 192,849.00	R 3,498,874.33	R 3,691,723.33	R 3,691,723.33	R 3,691,723.33
F	GENERAL DISTURBED & STOCKPILE AREAS	R -	R 5,216,132.37	R 5,216,132.37	R 5,216,132.37	R 5,216,132.37
G	OFFSITE & SHARED INFRASTRUCTURE	R 165,568.90	R 2,913.75	R 168,482.65	R 168,482.65	R 168,482.65
H	MONITORING & SPECIALIST STUDIES	R -	R 10,300,000.00	R 10,300,000.00	R 8,931,000.00	R 6,023,200.00
J	MAINTENANCE	R -	R 5,454,168.41	R 5,454,168.41	R 5,454,168.41	R 2,080,760.56
I	MANAGEMENT FEE (9% OF WORK VALUE)	R -	R 11,157,043.38	R 11,157,043.38	R 9,561,419.19	R 5,678,985.23
	Sub Total #1	R 26,491,680.16	R 124,386,680.25	R 150,878,360.41	R 130,184,578.62	R 76,882,781.64
	Preliminary & General	R 6,622,920.04	R 25,732,409.22	R 32,355,329.26	R 27,923,039.86	R 16,295,149.10
	Contingencies	R 1,324,584.01	R 5,661,481.84	R 6,986,065.85	R 6,031,157.97	R 3,560,189.82
	Total (excl VAT; incl P&G's and contingencies)	R 34,439,184.21	R 155,780,571.31	R 190,219,755.52	R 164,138,776.45	R 96,738,120.56
	15%	R 5,165,877.63	R 23,367,085.70	R 28,532,963.33	R 24,620,816.47	R 14,510,718.08
	Total (incl VAT)	R 39,605,061.84	R 179,147,657.01	R 218,752,718.85	R 188,759,592.92	R 111,248,838.64

Zone	Area	2022	2023	2024	2025	2026	2027	2028	2029
A	PLANT & RELATED INFRASTRUCTURE	R -	R -	R -	R -	R -	R -	R -	R -
B	BUILDINGS & STRUCTURES	R -	R -	R -	R -	R -	R -	R -	R -
C	OPENCAST & PORTALS	R -	R -	R -	R -	R -	R -	R -	R -
D	MINE RESIDUE DEPOSITS	R 1,764,317.54	R -	R -	R -	R -	R -	R -	R -
E	WATER MANAGEMENT	R -	R -	R -	R -	R -	R -	R -	R -
F	GENERAL DISTURBED & STOCKPILE AREAS	R -	R -	R -	R -	R -	R -	R -	R -
G	OFFSITE & SHARED INFRASTRUCTURE	R 168,482.65	R -	R -	R -	R -	R -	R -	R -
H	MONITORING & SPECIALIST STUDIES	R 3,983,000.00	R 3,414,000.00	R 2,845,000.00	R 2,276,000.00	R 1,707,000.00	R 1,138,000.00	R 569,000.00	R -
J	MAINTENANCE	R 1,413,951.05	R 1,018,537.60	R 29,413.00	R 29,413.00	R 29,413.00	R 29,413.00	R 29,413.00	R 29,413.00
I	MANAGEMENT FEE (9% OF WORK VALUE)	R 173,952.02	R -	R -	R -	R -	R -	R -	R -
	Sub Total #1	R 7,503,703.25	R 4,432,537.60	R 2,874,413.00	R 2,305,413.00	R 1,736,413.00	R 1,167,413.00	R 598,413.00	R 29,413.00
	Preliminary & General	R 836,687.81	R 254,634.40	R 7,353.25	R 7,353.25	R 7,353.25	R 7,353.25	R 7,353.25	R 7,353.25
	Contingencies	R 366,487.56	R 221,626.88	R 143,720.65	R 115,270.65	R 86,820.65	R 58,370.65	R 29,920.65	R 1,470.65
	Total (excl VAT; incl P&G's and contingencies)	R 8,706,878.63	R 4,908,798.88	R 3,025,486.90	R 2,428,036.90	R 1,830,586.90	R 1,233,136.90	R 635,686.90	R 38,236.90
	15%	R 1,306,031.79	R 736,319.83	R 453,823.04	R 364,205.54	R 274,588.04	R 184,970.54	R 95,353.04	R 5,735.54
	Total (incl VAT)	R 10,012,910.42	R 5,645,118.71	R 3,479,309.94	R 2,792,242.44	R 2,105,174.94	R 1,418,107.44	R 731,039.94	R 43,972.44



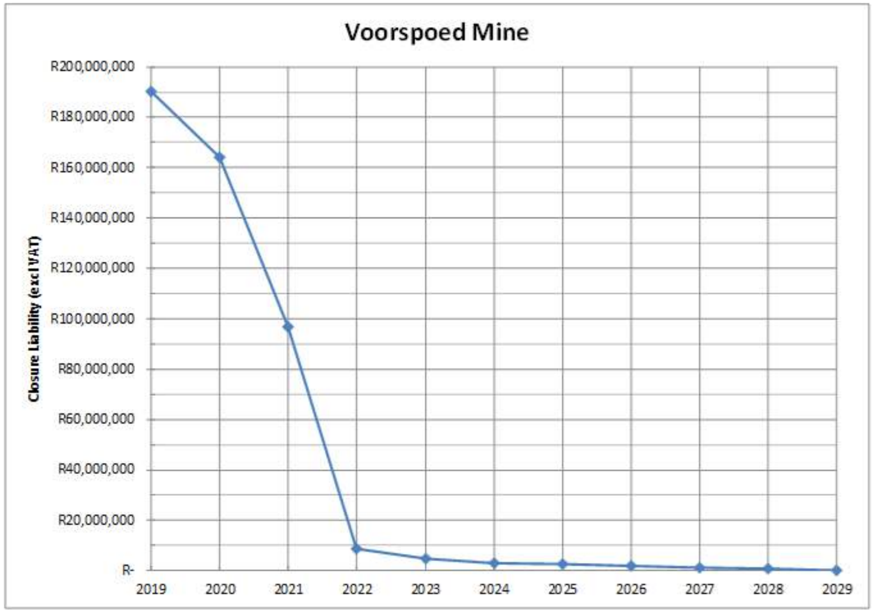


Figure ii. Summary of Voorspoed Mine Closure Liability with respect to physical and bio-physical aspects

In line with the commitments included in the Social and Labour Plan, Voorspoed Mine has, and will provide financially for the following programmes:

- Human Resources Development (HRD) Programme;
- Mine Community Development Programme; and
- Process to manage downscaling and retrenchment.

Although socio-economic baselines and impacts are addressed by this closure plan, costs associated with the implementation of proposed mitigation measures are excluded from the liability estimate presented in Figure ii. Social Closure costs are calculated and provisioned separately by Voorspoed Mine.

During the compilation of this final mine closure plan, a number of gaps were identified. These gaps arise as a result of an absence of:

- Specialist studies that would provide clarity on the nature and / or extent of an identified risk or inherent uncertainties in specialist studies undertaken to date;
- Adequate consultation with relevant authorities and / or stakeholders thus placing uncertainty on the acceptability of the proposed closure and success criteria; and / or
- Proven results that demonstrate the effectiveness of planned success criteria.

Table iv details these gaps and the aspect of the closure plan to which they relate.

Table iv. Closure gaps and associated action plans.

Closure Plan Element	Identified Gap	Recommended Actions
Mine surface area structures	The presence and extent of hydrocarbon contaminated soil near the plant, workshops and oil and fuel handling facilities is unknown.	Develop a formalised bio-remediation site and activity protocol to adequately deal with hydrocarbon-contaminated material volumes. A Waste License may be required in terms of the NEM: Waste Act for the proposed bioremediation site. This needs to be confirmed.
	The acceptability to the relevant authorities of disposing of building rubble (inert demolition waste) on-site is not known e.g. into the pit.	A plan for authority and relevant stakeholder engagement must be developed and implemented. This should be addressed as part of the updated (2019), ongoing SEP process.
Mineral Residue Facilities (WRD, CRD and FRD)	A groundwater pollution plume has developed as a result of seepage from the various MRDs. The rate of movement and potential impact to surface water systems and offsite groundwater users has been modelled but the actual changes in quality	Implement post-closure groundwater quality monitoring programme. Based on the risk, it is not anticipated that any additional

Closure Plan Element	Identified Gap	Recommended Actions
	and resultant impacts can only be tracked through regular monitoring of groundwater qualities.	mitigation to address water quality will be required.
Coarse Residue Deposit	The nature and extent of impacts to soil as a result of seepage from the CRD is unknown.	A soil sampling programme needs to be undertaken to determine if and to what extent soils have been contaminated.
Fine Residue Deposit	The duration that the RWD will need to remain post closure to capture and retain decant from the FRD is unknown. The anticipated quality of water in the dam post-closure is unknown therefore the final management plan to handle this water once the facility is decommissioned is uncertain.	A water and salt balance for post-closure scenario needs to be developed. The duration that the RWD must be retained in order to mitigate any water quality impacts needs to be determined. Management measures to dispose of water contained in the RWD at the time of decommissioning need to be determined.
Off-site surface infrastructure	To date, the post closure end-land use, ownership and associated maintenance of applicable infrastructure has not been confirmed or agreed with relevant stakeholders. Specific infrastructure includes: • External access roads. • Electrical transmission and distribution infrastructure. • The Renoster River weir.	A plan for authority and relevant stakeholder engagement must be developed and implemented. This will be addressed as part of the updated (2019), ongoing SEP process.
	The revised closure criteria for the raw water pipeline (above surface infrastructure demolished; sub surface infrastructure remains in situ) may not meet farmers' expectations (or perceived commitments made to farmers during the Mine project development phase). The commitment was that pipeline infrastructure adjacent to farm properties will become the property of the farmer post-closure. It remains unclear whether or not the farmers' expectations are that the pipeline maintains a water provision capability post closure. Applicable water use licencing will need to be addressed dependent on the ultimate outcome.	A plan for authority and relevant stakeholder engagement must be developed and implemented. This will be addressed as part of the updated (2019), ongoing SEP process.
Open pit	Failure of the pit sidewalls is expected. The extent of the back-break zone has been estimated but may not be completely accurate.	Implement a post-closure pit stability monitoring programme.
	Based on experience at other closed diamond mines, unauthorised access to the open pit is likely despite every effort to remove the possibility or incentive for people to access the mine illegally. Ongoing monitoring and maintenance of access	A fencing, enviroberm and trench maintenance programme will need to be developed and implemented.

Closure Plan Element	Identified Gap	Recommended Actions
	control structures will be required to minimise the likelihood of human injury or death.	
Authority Engagement regarding Closure Criteria	Applicable authorities (who will need to authorise the mine closure plan) have not been consulted on the proposed mine closure and success criteria.	A plan for authority and relevant stakeholder engagement must be developed and implemented. This will be addressed as part of the updated (2019), ongoing SEP process.
Surface water	The FRD has been built over a non-perennial stream. Seepage from the FRD and WRD are modelled to impact the water quality in this stream post-closure. The actual impact can only be determined through the implementation of a post-closure ground and surface water monitoring programme. Authorities and potentially affected stakeholders have not been engaged on this issue.	Implement a post-closure ground and surface water monitoring programme. A plan for authority and relevant stakeholder engagement must be developed and implemented. This will be addressed as part of the updated (2019), ongoing SEP process. This will be addressed as part of the updated (2019), ongoing SEP process.
	Contamination of off-site surface water resources as a result of run-off from MRDs is expected. However, due to incomplete monitoring data there is a lack of understanding of the significance of current and post-closure impacts on offsite surface water receptors	Regular and consistent surface water monitoring at offsite sensitive receptors needs to be undertaken during the remaining LOM and post-closure. Potential impacts and the planned management measures (if required) need to be communicated to stakeholders. This will be addressed as part of the updated (2019), ongoing SEP process.

Table of Contents

List of Figures

List of Tables

DEFINITIONS AND ACRONYMS

DEFINITIONS

Rehabilitation: The process of returning the environment in a given area to some degree of its former state, after some process has resulted in its damage;

Remediation: The process of removing pollutants or contaminants from the environment;

Residual environmental impact: The environmental impact remaining after physical closure and before a closure certificate has been issued;

Sensitive Area: A sensitive area or environment can be described as an area or environment where a unique ecosystem, habitat for plant and animal life, wetlands or conservation activity exists or where there is a high potential for eco-tourism;

Sustainable: Capable of being sustained; using a resource so that the resource is not depleted or permanently damaged (Source: http://www.merriam-webster.com/ dictionary/);

Sustainability: A state in which the demands placed on the environment can be met without compromising the environment and reducing its capacity to allow all people to live well now and in the future;

Sustainable environmental rehabilitation: The process to rehabilitate disturbed areas by the implementation of the necessary rehabilitation designs, plans and practises to an end state and land capability which will ensure the requirements of a sustainable environment is satisfied.

ACRONYMS

Acronym	Description	Units
AA MCT	Anglo American Mine Closure Toolbox	
AEW	Anglo Environment Way	
AIDS	Acquired Immunodeficiency Syndrome	
ARL	Acceptable Risk Level	
BoQ	Bill of Quantities	
CRD	Coarse Residue Deposit	
DBCM	De Beers Consolidated Mines	
DESTEA	Department of Economic, Small Business Development, Tourism and Environmental Affairs	
DMR	Department of Mineral Resources	
EIA	Environmental Impact Assessment	
EMP	Environmental Management Programme	
EMPr	Environmental Management Programme Report	
FRD	Fine Residue Deposit	
GNR	Government Notice Regulation	
HIV	Human Immunodeficiency Virus	

I&AP	Interested and Affected Parties	
LoM	Life of Mine	
mamsl	Metres above mean sea level	m
MAP	Mean Annual Precipitation	
mbgl	Metres below ground level	m
MCP	Mine Closure Plan	
MHSA	Mine Health and Safety Act (Act 29 of 1996)	
MPRDA	Minerals and Petroleum Resources Development Act (Act 28 of 2002)	
MSDS	Material Safety Data Sheet	
NEMA	National Environmental Management Act (Act 107 of 1998)	
NEMBA	National Environmental Management: Biodiversity Act (Act 10 of 2004)	
NEMPA	National Environmental Management: Protected Areas Act (Act 57 of 2003)	
NEMWA	National Environmental Management: Waste Act (Act 59 of 2008)	
NFEPA	National Freshwater Ecosystem Priority Areas	
NNP	Net Neutralisation Potential	
NWA	National Water Act (Act 36 of 1998)	
ODIMWA	Occupational Diseases in Mines and Works Act (Act 78 of 1973)	
PCD	Pollution Control Dam	
PM_{10}	Particulate Matter less than ten microns	
$PM_{2.5}$	Particulate Matter less than 2.5 microns	
RWD	Return Water Dam	
SAAR	South African Acid Rain (test)	
SANBI	South African National Biodiversity Institute	
SEAT	Anglo American Socio-Economic Assessment Toolbox	
SLP	Social & Labour Plan	
SOW	Scope of Work	
SWCD	Storm Water Control Dam	
SWMP	Storm Water Management Plan	
TDS	Total Dissolved Solids	
VAT	Value Added Tax	
WMA	Water Management Areas	
WRD	Waste Rock Dump	
ZOR	Zone of Relaxation	

1 INTRODUCTION

1.1 Background

Voorspoed Mine is an open pit diamond mine, owned by De Beers Consolidated Mines (DBCM). The mine is located within the Fezile Dabi District of the Free State Province of the Republic of South Africa, approximately 30km north of Kroonstad and 50km south of Vredefort (Figure 1). The mine is located within the Ngwathe Local Municipality.

De Beers acquired the Voorspoed Mine from the Voorspoed Diamond Mining Company in 1912. After several sampling programmes were undertaken by De Beers, the Voorspoed Mine was established between 2006 and 2008. Operation at the mine commenced in 2008. The mining activities for Voorspoed Mine are licenced until October 2023. Operations at the mine were ceased in December 2018. The mine is currently in the closure phase.

During the operational phase, waste rock and kimberlite ore was blasted, loaded and hauled from the pit using conventional truck and excavation methods. A Waste Rock Dump (WRD) has been created along the pit boundary to receive waste rock that is removed from the pit in order to access the kimberlite ore.

During operations, ore was stockpiled adjacent to the primary crusher from where it was fed into the treatment plant for treatment. In the treatment plant, ore was crushed, scrubbed and screened with the objective of recovering diamonds. Crushed ore was fed into a Dense Medium Separation plant, where diamond-bearing gravel (with a high specific gravity) is separated from lighter, non-diamond-bearing ore. Two residue streams are created by the treatment plant. The crushed non-diamond-bearing ore was disposed of on the Coarse Residue Deposit (CRD), and fine material emanating from the crushing and scrubbing process was pumped to, and disposed of on the Fine Residue Deposit (FRD) facility. The remnants of a tailings dump pre-dating 1912 (with a relatively higher grade) is situated to the east of the open pit.

The Mining Right comprises the whole of the Farm Voorspoed 2480 under Deed of Transfer T10075/1974 (Figure 2). The Mining Lease Area comprises the following farms:

- Remaining Extent of Voorspoed 401;
- Remaining Extent of Morgenster 772; and
- Remaining Extent of Geldenhuys 1477.

Relevant detail regarding the mine site is summarised in Table 1.

Table 1. Voorspoed Mine site detail.

Item	Description
Province	Free State
Magisterial District	Fezile Dabi District Municipality
Local Authority	Ngwathe Local Municipality
Farms comprising Voorspoed Mine	Voorspoed 2480 (consolidation of subdivision 1 of the Farm Voorspoed 402, Subdivision 1 of the Farm Geldenhuys 1477, Subdivision 1 of the Farm Geldenhuys 1477, Subdivision 2 of the Farm Morgenster 772)
Farms in the project area neighbouring on Voorspoed Mine	Belmont 2390, Welvaart 1011 Renosterhoek 1291 Wolvenkraal 396 Satisfied 1234 Welgelegen 793 Denbigh 1229 Cumberland 1228 Siding 1568
Quaternary Catchment	C70H

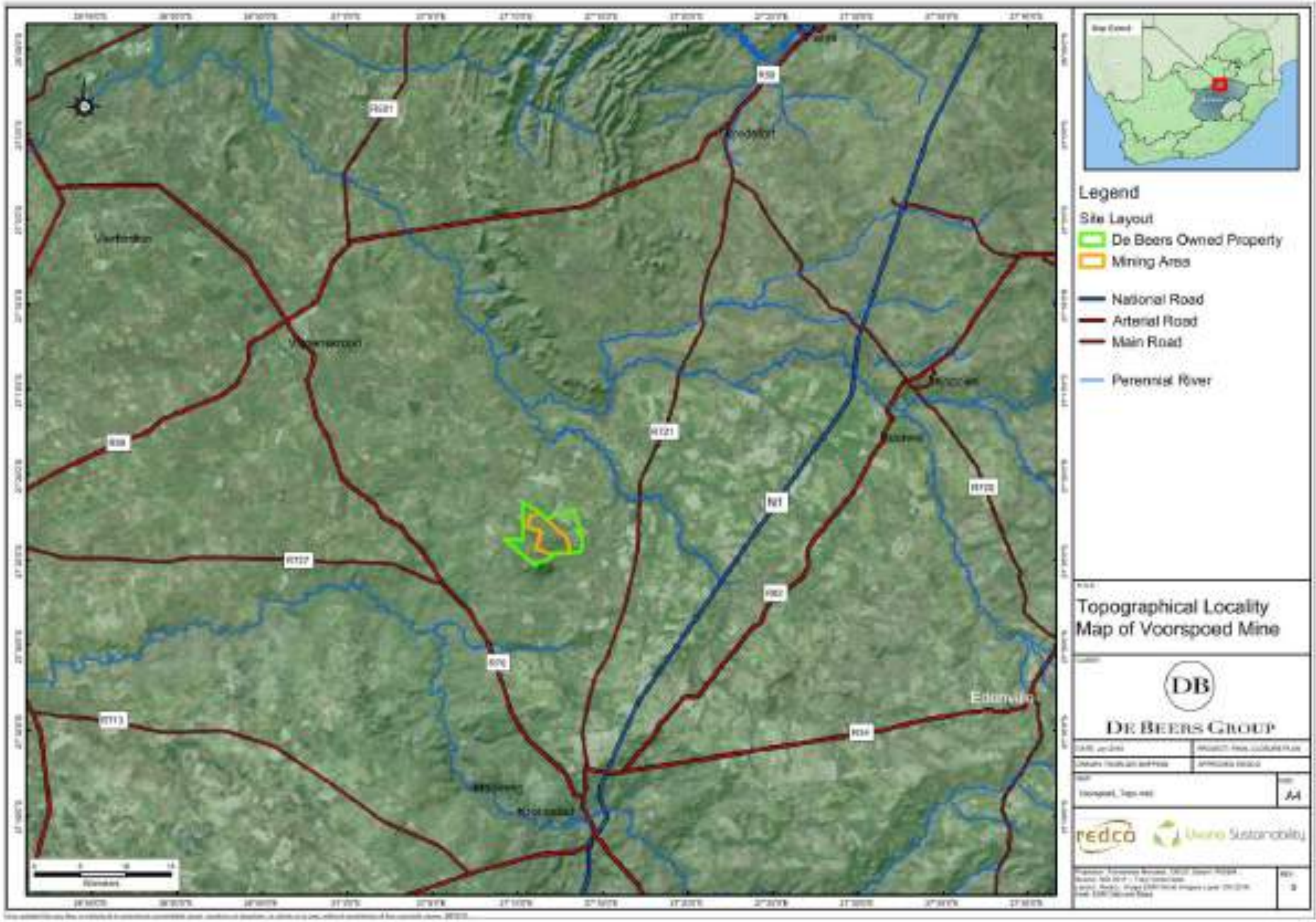


Figure 1. Locality of Voorspoed Mine.

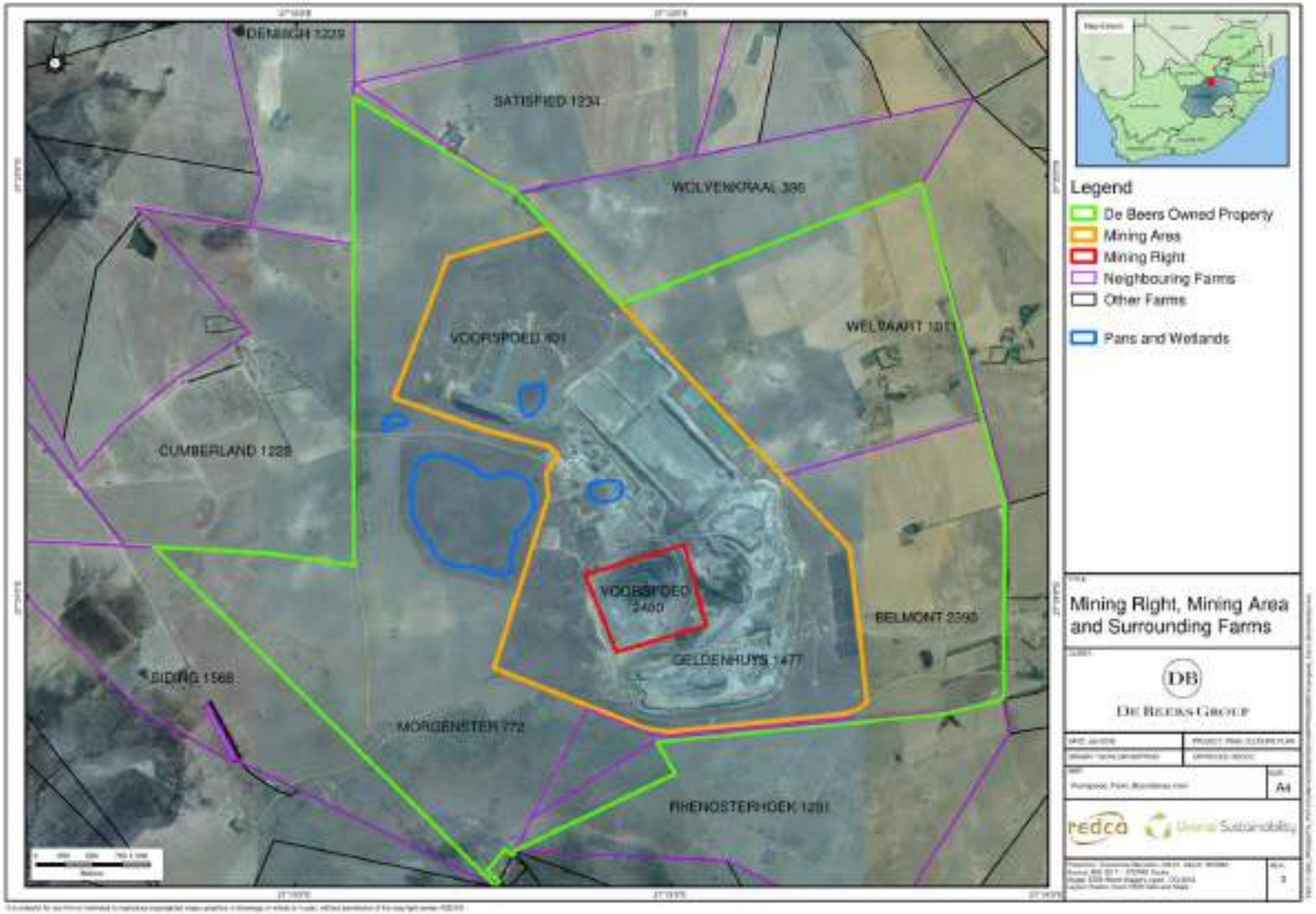


Figure 2. Voorspoed Mining Right, Mining Area and Surrounding farms.

1.2 Closure Planning and Approach

Following the EMPr amendment where closure criteria are addressed at a high level, Voorspoed Mine initiated the mine closure planning process in 2011. Table 2. Closure plan development history for Voorspoed Mine.presents the closure plan development history for the mine.

Table 2. Closure plan development history for Voorspoed Mine.

Mine Closure Plan (MCP) Status	Date of Mine Closure Plan development	Independent Practitioner
Preliminary MCP	January 2011	Shangoni
Improved Preliminary MCP	August 2014	Redco / E-TEK
Final MCP 2017	December 2017	Redco / Uvuna Sustainability
Final MCP 2019[2]	June 2019	Redco / Uvuna Sustainability

This Closure Plan and its supporting documents present an update of the existing MCPs as presented in Table 2.

1.2.1 Scope of Work

1.2.1.1 Geographical Scope of Work

The geographical scope of work that was addressed during the compilation of this plan included:

- Voorspoed Mining Area and associated infrastructure / activities; and
- Off-site infrastructure supporting the Voorspoed Mine operations.

1.2.1.2 Technical Scope of Work

The technical scope of work that was addressed during the compilation of this plan included the following aspects:

- Physical Aspects
  - Mine area infrastructure;
  - Off-site infrastructure;
  - Mineral residue sites; and
  - Open pit.

- Bio-Physical Aspects
  - Biodiversity;
  - Surface water;
  - Groundwater;

[2] This Mine Closure Plan

  - Geochemistry;
  - Air Quality;
  - Soils;
  - Land use and land capability; and
  - Topography / visual.

- Socio-economic Aspects
  - Employees and their dependants;
  - Affected Parties;
  - Interested Parties; and
  - Authorities.

The closure planning approach was applied to all items[3] within the scope of work presented in Section 1.2.1.

1.2.2 Closure Plan Development

The development of the Voorspoed Closure Plan was guided by:

- Statutory requirements (legislation of the Republic of South Africa);
- Internal corporate requirements with regard to mine closure (Anglo American Mine Closure Performance Standard and associated Mine Closure Toolbox); and
- Good practice (Good practice experience of Redco and Uvuna specialists).

Figure 3 presents a high-level summary of the approach that was followed to deliver the Voorspoed Mine Closure Plan. The Mine Closure Planning approach included the following process steps:

- Determination of the scope
  - The scope includes all geographical and technical components of the scope as presented in 1.2.1.

- Information review
  - Site visits to Voorspoed Mine were conducted;
  - Discussions, interviews and meetings with relevant De Beers personnel and their representatives;
  - A comprehensive literature review including:
    - Existing Mine Closure Plans and associated documents;
    - Specialist studies;
    - Mine plans; and
    - Rehabilitation plans.

[3] Although socio-economic baselines and impacts are addressed by this closure plan, costs associated with social closure aspects are calculated and provisioned by Voorspoed Mine, as per the Social and Labour Plan (SLP) commitments and other social requirements as identified by Voorspoed Mine and relevant specialist studies (e.g. ERM 2019).

- Identification and determination of information as input into the process including:
    - Regulatory, internal corporate and good practice requirements;
    - Outputs from the baseline review and specialist study assessments;
    - Outputs from existing gap analysis information; and
    - Outputs from available stakeholder engagement and socio-economic information sources.

- Setting of Mine Closure Vision, Objectives and End Land Use objectives.

- Risk Assessment including:
    - Development of iterative closure criteria in order to address gaps and risks that have been identified.

- Development of site-specific rehabilitation and Mine Closure criteria.

- Development of designs and plans for mine-specific closure including:
    - Closure management maintenance and aftercare;
    - Closure liability cost estimates;
    - Closure programme and associated cash flow; and
    - Concurrent / progressive rehabilitation during the remaining operational period.

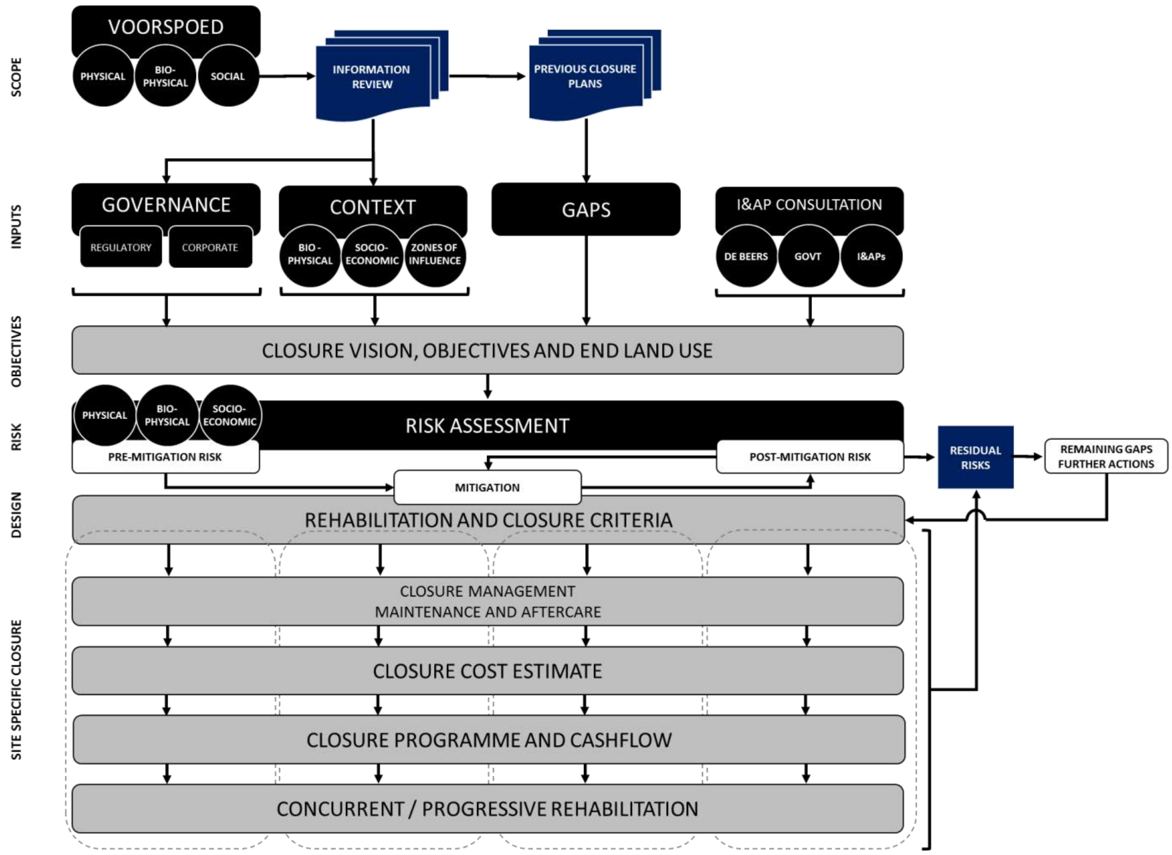


Figure 3. Voorspoed Mine Closure Planning approach.

Voorspoed Mine has adopted the Anglo American plc Mine Closure Toolbox (AA MCT) approach and its requirements for closure planning. The aim of the Mine Closure Planning Toolbox is to expand the focus of mine closure planning from financial provisioning for rehabilitation and physical closure to planning for sustainability beyond mine closure and leaving a positive legacy. The Mine Closure Toolbox consists of the following three Tools:

- Tool 1: Strategic planning for mine closure:
  Through this Tool basic expectations are identified, baselines of social, environmental and economic knowledge are gathered and a specific post-closure vision is identified through focused engagement, acknowledging that this is likely to change over the life of the mine.

- Tool 2: Rapid assessment of the status of a mine's existing closure plan:
  This Tool identifies knowledge gaps in the mine's existing closure plan and defines what level of detail the closure plan should contain relative to the remaining time to closure.

- Tool 3: Filling the gaps in the closure plan:
  Through this Tool the approach, technology and resources required to close the gaps are determined and scheduled.

The Tools follow a logical sequence as shown in Figure 4. A key element of this approach is that the post-closure vision is defined upfront to ensure that the mine is designed and operated in a manner that is geared towards closure. For existing operations the post-closure vision can be retrospectively generated using this Toolbox, however, depending on the remaining life of an operation, post-closure opportunities might be limited compared to that of a new operation (Anglo American, 2013).

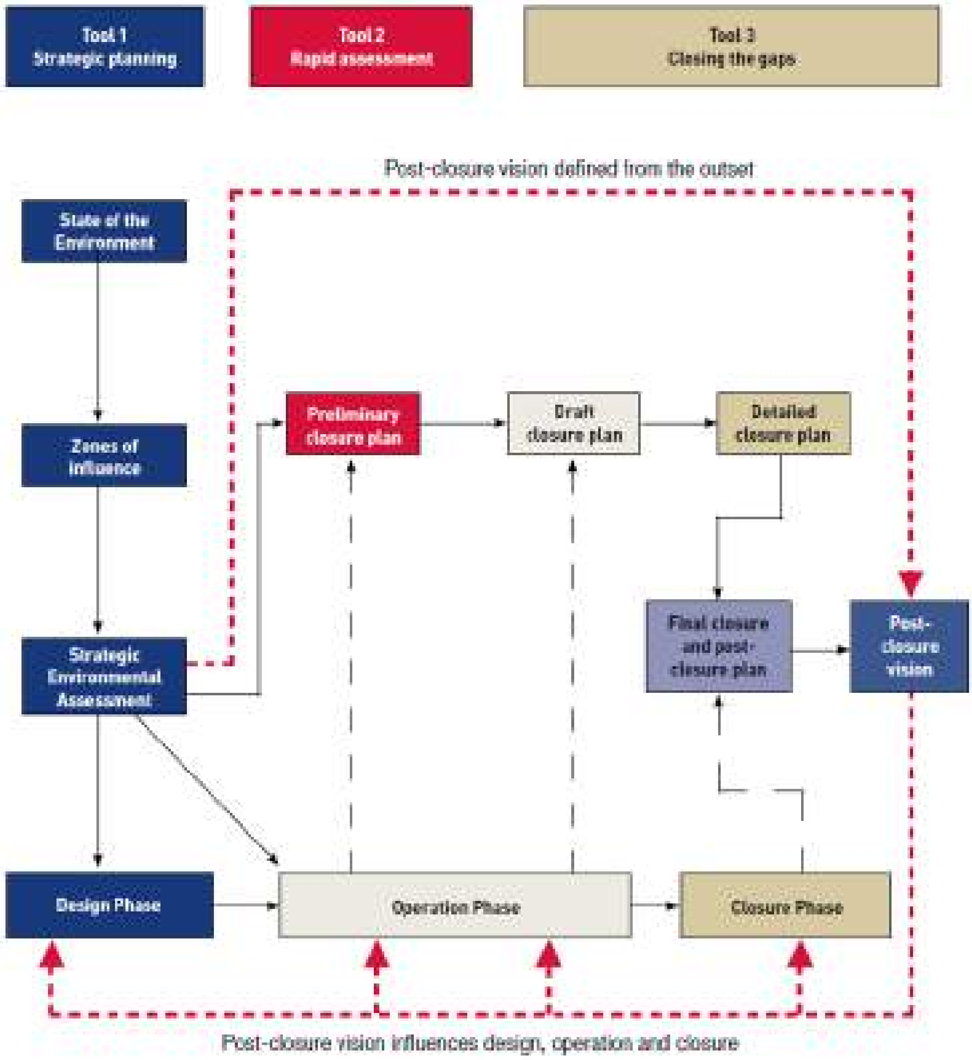


Figure 4. Approach to achieve mine closure that delivers a positive legacy (from Anglo American, 2013).

1.3 Mine Closure Plan Inputs, Assumptions and Limitations

The following inputs, assumptions and/or limitations are applicable to this closure plan, its development and its deliverables:

- Although mine closure was scheduled for 2020, the final mine model resulted in the economic resources being depleted in the 4th Quarter of 2018. The projected mine life until 2020 was thus not achieved. The economics and mine life of Voorspoed mine was significantly impacted by the weak and geo-technically complex country rock, as well as unexpected changes in geology.
- This report has been prepared for the particular purpose outlined in the Scope of Work and the use of this report, in whole or in part, is not intended for any other context or purpose.
- Stakeholder Engagement and I&AP consultation has been conducted by Voorspoed Mine as part of the Mine’s ongoing stakeholder Engagement Programme. Extensive stakeholder consultation was conducted during the development of the Social Impact Assessment (SIA).

Additional stakeholder engagement and/or consultation processes will be conducted after the development of this Final Closure Plan.

- Proposed closure criteria are to be approved by relevant authorities.
- Existing specialist study reports were provided by Voorspoed Mine, as referenced in this report. No additional specialist studies, sampling or monitoring activities were commissioned or conducted during the development of this closure plan.
- It is recognised that the passage of time may affect the information and assessments provided in this report. Redco and Uvuna's opinions, interpretation and deliverables are therefore based upon the information that was provided by Voorspoed Mine and which existed at the time of compiling this report.
- Although socio-economic baselines and impacts are addressed by this closure plan, costs associated with social closure aspects are calculated and provisioned by Voorspoed Mine, as per the Social and Labour Plan (SLP) commitments and other social requirements as identified by Voorspoed Mine and relevant specialist studies (e.g. ERM 2019).

2 GOVERNANCE

This closure plan has been written to give effect to the various legal and corporate requirements that govern the process and requirements for the closure of Voorspoed Mine. Closure conditions and commitments are influenced by legislation, EMP commitments and license conditions.

2.1 Legal / Regulatory requirements

The overarching framework governing South Africa is the Constitution of the Republic of South Africa (Act 108 of 1996). Various rights are entrenched in the Constitution, including the right to an environment that is not harmful to the health or well-being of the population – otherwise called the environmental right.

The mining industry is regulated by mining, environmental, human health and safety legislation. The interaction between various Acts of parliament that deal with the environment is varied and complex, as is the range of environmental issues that are regulated. This discussion is limited to those aspects considered most directly related to this closure plan and its associated cost assessment and is by no means a complete summary of all applicable environmental legislation nor is it a compliance register. An overview of applicable legislation is presented in Table 3.

Table 3: Summary of applicable legislation

Act / Regulation	Purpose
Mineral and Petroleum Resources Development Act 28 of 2002 (MPRDA) and Mineral and Petroleum Resources Development Regulations (GNR 527 of 23 April 2004) (MPRDR)	The MPRDA is the central Act governing mining in South Africa. The Act requires an operation to obtain a mining right and to have an approved environmental management programme (EMPr) in place prior to undertaking any mining-related activities. Where activities intended to be undertaken are not provisioned for in an existing EMPr, an amendment application must be submitted to the Department of Mineral Resources (DMR) and approved prior to the commencement of such activities. The MPRDA, together with the MPRDR, sets out the provisions relevant to closure obligations.

Act / Regulation	Purpose
	The provisions dealing with EMPrs under the MPRDA were transferred to the NEMA with effect from 2 December 2014 further aligning the EMPr and environmental authorisation processes as referred to below. In addition, provisions associated with mine closure obligations are now dealt with in terms of the Financial Provisioning Regulations, 2015 (GNR 1147 of 20 November 2015) (new Regulations) which set out certain transitional arrangements in respect of financial provision made under the MPRDA. The MPRDA is the main source of rehabilitation obligations. It requires rights holders to 'as far as reasonably practicable' rehabilitate the land affected by the operation 'to its natural or predetermined state, or to a land use which conforms to the generally accepted principle of sustainable development' (Section 38 (1) (d) of MPRDA, 2002). Mining-related activities invariably also trigger a range of environmental provisions contained in legislation including (but not necessarily limited to) the National Environmental Management Act, 107 of 1998 (NEMA), the National Water Act, 36 of 1998 (NWA) and the National Environmental Management: Waste Act, Act 59 of 2008 (NEMWA). The closure planning process of mines in South Africa is predominantly regulated by Section 43 of the MPRDA and more specifically by Government Notice Regulation 527, published in April 2004. Section 43 (1) provides an outline of the process which should be followed by regulatory bodies to grant closure certificates. Section 43(1) states that the holder of a mining right remains responsible for any environmental liability, pollution or ecological degradation, and the management thereof, until the Minister has issued a closure certificate. Furthermore, section 43(5) of the MPRDA stipulates that no closure certificate may be issued unless the Chief Inspector and the Department of Water and Sanitation have confirmed in writing that the provisions pertaining to health and safety and management of potential pollution to water resources have been addressed.
National Environmental Management Act 107 of 1998 (NEMA).	The NEMA is the overarching environmental legislation governing the undertaking of listed activities, environmental authorisations, EMPRs, and the duty of care in respect of prevention and remediation of pollution.
The National Environmental Management: Biodiversity Act (Act 10 of 2004)	NEMBA provides for the management and conservation of South Africa's biodiversity; the protection of species and ecosystems that warrant protection; the sustainable use of indigenous biological resources; the fair and equitable sharing of benefits arising from bioprospecting involving indigenous biological resources; the establishment and functions of a South African National Biodiversity Institute, and matter connected therewith. In the context of planning for mine closure, cognizance must be taken of the presence of ecosystems within the broader mine boundaries that have been designated as protected.
The National Environmental Management: Protected Areas Act (Act 57 of 2003)	The NEMPA provides for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes; for the establishment of a national register of all national, provincial and local protected areas; for the management of those areas in accordance with national norms and standards; for intergovernmental co-operation and public consultation in matters concerning protected areas; and for matters in connection therewith.
Environmental Impact Assessment (EIA) Regulations (GNR 982 of 4 December 2014) and Listing Notices 1, 2 and 3 GNR 983 – 985 of 4 December 2015)	The EIA Regulations set out the procedure in respect of applications for environmental authorisation that require either a basic assessment or a scoping and environmental impact reporting process to be followed. With effect from 8 December 2014 activities requiring, inter alia, a mining right, license or closure certificate furthermore require an environmental authorisation.
Financial Provisioning Regulations, 2015 (GNR 1147 of 20 November 2015) (Financial Provisioning Regulations) To be repealed	The Financial Provisioning Regulations under the NEMA came into effect on 20 November 2015. These Regulations set out details with respect to 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 environmental impacts that may become known in the future."

Act / Regulation	Purpose
	On 10 November 2017, the Minister of Environmental Affairs gave notice of her intention to make (new) regulations pertaining to the financial provision for prospecting, exploration, mining or production operations under section 44(aE), (aF), (aG), (aH) read with sections 24(5)(b)(ix), 24(5)(d), 24N, 24P and 24R of the National Environmental Management Act, 1998 (Act No.107 of 1998). The proposed new financial provisioning regulations were published for comment on in GN 1228. Once finalized and approved, these new regulations will replace GN1147 which will be repealed.
National Water Act 36 of 1998 (NWA)	This Act provides for the protection of water resources and the control of entitlements to water use. It sets out certain water uses that require licensing prior to the undertaking thereof (subject to specific exceptions) and makes provision for the duty of care in respect of the prevention and remediation of pollution of water resources.
Regulations on Use of Water for Mining and Related Activities aimed at the Protection of Water Resources (GNR 704 of 4 June 1999) (Regulations on Use of Water for Mining)	The Regulations on Use of Water for Mining sets out certain legal obligations with regard to the management of water resources. The following regulations are of specific relevance: • Regulation 4 sets out restrictions on locality of infrastructure including, inter alia, residue deposits and dams; • Regulation 5 places a restriction on the use of residue or other substances which may cause water pollution for construction of, inter alia, dams or roads; • Regulation 6 provides for the capacity requirements of clean and dirty water systems; and • Regulation 3 allows for exemption to be granted in respect of having to comply with the aforesaid provisions.
National Environmental Management: Waste Act 59 of 2008 (NEMWA)	The purpose of the NEMWA is to provide reasonable measures for the prevention of pollution and ecological degradation and to provide for the licensing and control of waste management activities, and matters incidental thereto. The Act relies on the cradle-to-grave principle in respect of waste management. As such, waste generators are required to ensure that waste is segregated, transported and disposed of in accordance with the requirements of the Act. With effect from 2 May 2014, Chapter 4: Part 8 of the NEMWA, dealing with contaminated land, came into effect. As such, when it is anticipated that land has been significantly contaminated (note: this also includes historical contamination that occurred prior to the coming into effect of these provisions) notification to the Department of Environmental Affairs (DEA) is required and site investigations need to be carried out. In addition, if land is found to be contaminated, this must be disclosed to a buyer during property transfer. With effect from 2 September 2014 residue stockpiles and residue deposits, previously managed under the MPRDA, are no longer excluded from the ambit of the NEMWA and are now governed as hazardous waste.
List of Waste Management Activities that have or are likely to have a Detrimental Effect on the Environment (GNR 921 of 29 November 2013) (List of Waste Management Activities)	In terms of the NEMWA, no person may commence, undertake or conduct a waste management activity except in accordance with, inter alia, a waste management license (WML) issued in respect of that activity (if a license is required). The activities requiring licensing are set out in the List of Waste Management Activities which came into effect on 29 November 2013 (replacing the old List of Waste Management Activities (GN 718 of 3 July 2009)). Certain of the important changes in the new List of Waste Management Activities include: • Storage of general and hazardous waste no longer requires a WML (see below); and • Remediation of contaminated land is, with effect from 2 May 2014, dealt with under the NEMWA and also does not require licensing.
National Norms and Standards for the Storage of Waste (GNR 926 of 29 November 2013) (Norms and Standards for Storage of Waste)	As stated above, a new List of Waste Management Activities came into effect on 29 November 2013, which makes provision for three categories of waste management activities: • Category A: Activities requiring a basic assessment process to be conducted (including, inter alia, recycling, disposal or treatment of general waste or hazardous waste, or the establishment or reclamation of residue deposits or stockpiles requiring a prospecting right);

Act / Regulation	Purpose
	• Category B: Activities requiring a scoping and environmental impact reporting process to be conducted (including, inter alia, recycling, treatment or disposal of larger quantities of hazardous waste, or the establishment or reclamation of residue deposits or stockpiles requiring a mining right); and • Category C: Activities requiring compliance with certain Norms and Standards (including, inter alia, the storage of general and hazardous waste). The activities related to storage of general and hazardous waste at facilities of specified capacities which previously required a WML are now included in Category C with the effect being that the undertaking of these activities must be in accordance with the Norms and Standards for Storage of Waste. The Norms and Standards set out requirements for, inter alia, the registration of new waste storage facilities; location, construction and design; management of the facilities; training of personnel; preparation of an emergency preparedness plan; investigations; auditing; and reporting.
National Norms and Standards for the Remediation of Contaminated Land and Soil Quality in the Republic of South Africa (GNR 331 of 2 May 2014) (Norms and Standards for the Remediation of Contaminated Land)	The Norms and Standards for the Remediation of Contaminated Land came into effect on 2 May 2014 in conjunction with the contaminated land provisions referred to under the NEMWA above. The purpose of the Norms and Standards for the Remediation of Contaminated Land is to: • Provide a uniform national approach to determine the "contamination" status of an investigation area; • Limit uncertainties about the most appropriate criteria and method to apply in the assessment of "contaminated" land; and • Provide minimum standards for assessing necessary environmental protection measures for remediation activities.
Mine Health and Safety Act 29 of 1996 (MHSA)	The MHSA is the key piece of legislation governing health and safety at South African mines. The Act is designed to promote mine health and safety by setting minimum standards and guidelines for the following key issues: • Identifying hazards and risks; • Providing for employee participation in matters relating to health and safety; • Providing for effective monitoring of health and safety conditions; • Providing for enforcement of health and safety standards; • Promoting a culture of health and safety at mines; • Promoting training in health and safety; and • Promoting co-operations and consultation on health and safety between the state, • Employer and employee.
Occupational Diseases in Mines and Works Act 78 of 1973 (ODIMWA)	The ODIMWA sets out the framework for the payment of compensation in respect of certain diseases contracted by persons employed in mines and works, and matters incidental thereto.
Communal Property Associations (Act of 1996), the Protection of Informal Land Rights (Act of 1996) and the Restitution of Land Rights (Act of 1994)	South African legislation does not specifically address relocation and resettlement. However, the Bill of Rights in the Constitution protects human rights, property rights, and housing rights. Relocation and resettlement should adhere to the Constitution, and also other relevant legislation and policy. The most relevant of these is the Extension of Security of Tenure Act (Act 62 of 1997) which facilitates long-term tenure of land and regulates conditions of residence and conditions upon which residence may be terminated. The Act is intended for the security of tenure of particularly agricultural/farm workers. Section 13 addresses compensation that must be paid by the owner to the evicted occupier. The compensation paid must take into account the cost of replacing structures and improvements and the value of crops if they are not allowed to be removed from the land.

The DMR has published the following principles to govern mine closure in the South African context:

- 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 pre-determined 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.

Figure 5 demonstrates how legislative requirements with respect to the content of closure plans (MPRDA and NEMA) have been considered and addressed. Requirements associated with each body of legislation have been mapped to the content of this closure plan, through the use of numbers, uppercase and lower case letters. Figure 5 also presents the relevant chapter numbers where legal requirements with respect to mine closure report content are addressed within this report.

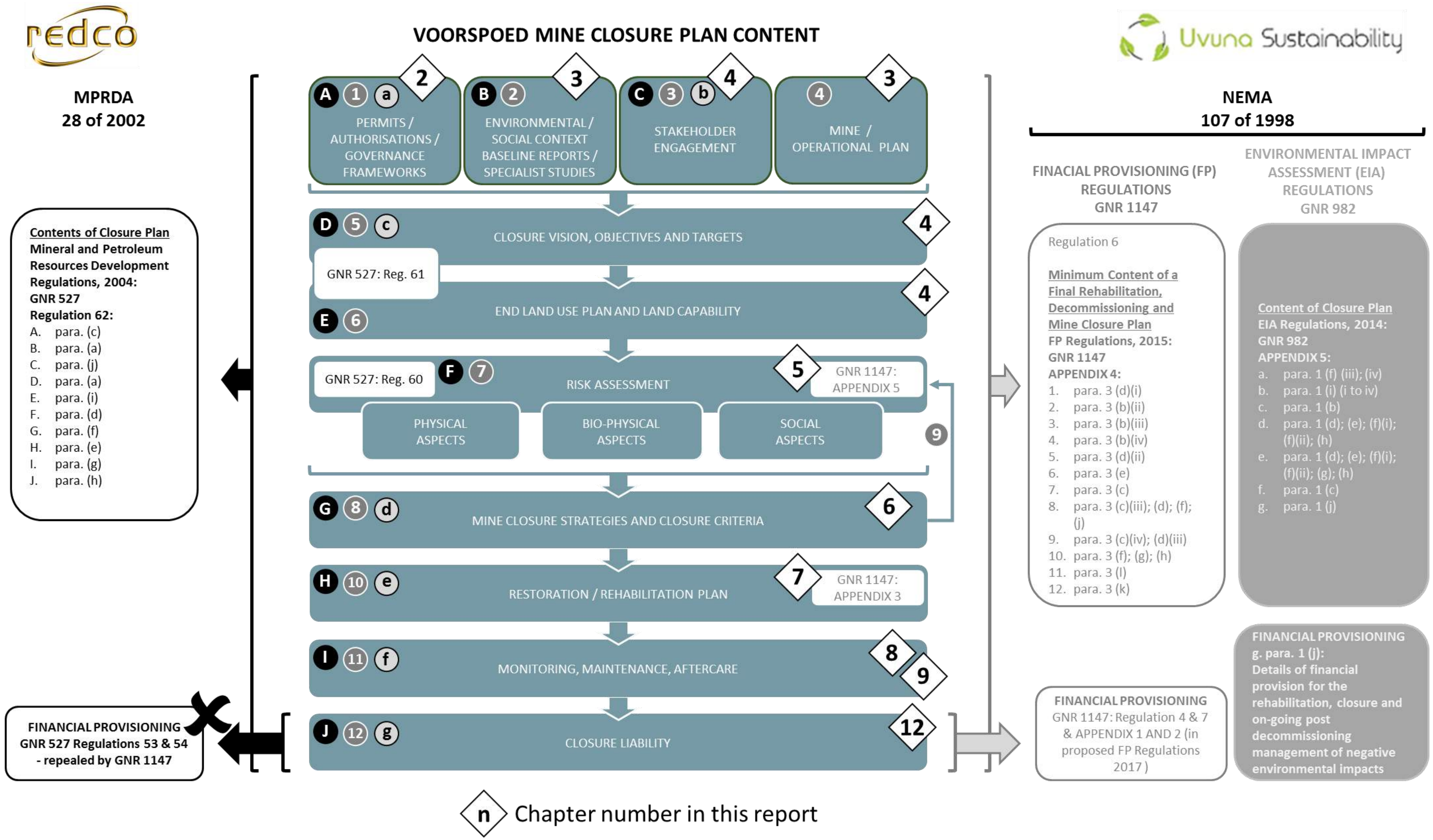


Figure 5. Legislative requirements addressed in the Voorspoed Closure Plan.

2.2 Corporate requirements

Voorspoed Mine is owned by De Beers Consolidated Mines, and is, therefore, part of the Anglo American group. The policies, standards and procedures that the mine must comply with are set at the Anglo American group level and these are adapted by the De Beers Group of Companies for application within the business unit.

2.2.1 Anglo American Policies

Anglo American's conduct is guided by its Good Citizenship Business Principles which encompass business integrity, safety and sustainable development, employment and labour rights, community development and human rights.

The Group published its FutureSmart Mining programme in 2018. This is the company's blueprint for the future of the company and is an innovation-led approach to sustainable mining. The Sustainability Strategy rests on three Global Sustainability Pillars:

- Trusted Corporate Leader;
- Thriving Communities;
- Healthy Environment.

Each site is required to develop a tailored 5-year plan that aligns with the pillars and delivers on the sustainability goals set by Group. The stretch goals form this strategy are presented in Figure 6.

OUR GLOBAL SUSTAINABILITY PILLARS	GLOBAL STRETCH GOALS		
TRUSTED CORPORATE LEADER	**Accountability** Our vision is to transform the relationship between mines and communities, and wider society	**Ethical value chains** Our vision is to be a part of a value chain that supports and reinforces positive human rights and sustainability outcomes	**Policy advocacy** Our vision is to take a lead on issues that affect our business in a way that is collaborative and aimed at society's wider goals
THRIVING COMMUNITIES	**Education** Our vision is for all children in host communities to have access to excellent education and training	**Health and well-being** Our vision is for the SDG targets for health to be achieved in all our host communities	**Livelihoods** Our vision is shared, sustainable prosperity in our host communities
HEALTHY ENVIRONMENT	**Biodiversity** Our vision is to deliver net positive impact (NPI) across Anglo American through implementing the mitigation hierarchy and investment in biodiversity stewardship	**Climate change** Our vision is to operate carbon neutral mines	**Water** Our vision is to operate waterless mines in water scarce catchments

Figure 6: Anglo American Sustainability Strategy Global Stretch Goals (from Anglo American, 2018).

These pillars are underpinned by Critical Foundations which form the common and minimum requirements for each operation and the business as a whole. These include:

- Leadership and culture;
- Zero harm;
- Human rights;
- Inclusion and diversity;

- Group standards and procedures; and
- Compliance with legal requirements.

2.2.1.1 Standards and procedures

Anglo American is in the process of revising its various standards and procedures. An overview of the existing standards and procedures that are of relevance to mine closure is provided in this section.

Anglo American environmental performance standards

Each environmental performance standard addresses the requirements for managing a specific environmental component at various stages of the mining lifecycle – from exploration phase through to closure. The closure and post-closure requirements of the various performance standards require the operation to understand the risks (including residual risks) that are present during the decommissioning, closure and post-closure phases and to ensure that suitable controls and / or financial provisioning is in place to address the identified risks.

Environmental performance standards that require mine closure actions include:

- Performance Standard 1 – Social and Environmental Impact Assessment
- Performance Standard 2 – Water
- Performance Standard 3 – Air Quality
- Performance Standard 4 – Mineral Residue
- Performance Standard 5 – Non-mineral Waste
- Performance Standard 6 – Hazardous Substances
- Performance Standard 7 – Biodiversity
- Performance Standard 8 – Rehabilitation

The Anglo American Mine Closure Standard

In addition, a specific performance standard that governs Mine Closure has been developed. The purpose of this standard is to ensure that all Anglo American projects and managed operations pro-actively plan for closure to manage risks and opportunities, so that at closure a positive legacy is left behind, which contributes to sustainable development (Anglo American, 2018).

The mine closure standard requires that consideration of closure should be integrated into decision making at planning and operational levels, rather than being left until the last few years of production. The standard applies throughout the mine life cycle from the commencement of operations to relinquishment, and includes operations under care and maintenance.

The Mine Closure Toolbox (MCT) contains more detailed guidance on how to meet the minimum requirements outlined in the mine closure standard. The standard should be applied in conjunction with local legislation or applicable national standards of specific countries, regions and/or districts.

Anglo American's Mine Closure Toolbox (AA MCT)

Anglo American's Mine Closure Toolbox supports the implementation of the Mine Closure Performance Standard. It was developed in an effort to ensure that operations leave a positive environmental, social and economic legacy. The tool is designed for use in conjunction with the Socio-Economic Assessment Tool (SEAT) and other tools developed to support sustainable development planning, risk assessment and project evaluation.

The toolbox facilitates an iterative and detailed approach to mine closure, ensuring that the full spectrum of opportunities, risks and liabilities is identified. It further ensures that closure plans are fully accounted and provided for, both in the case of LoM closure as well as premature closure. Three separate tools make up the closure toolbox, namely strategic planning, gap analysis and the identification of required actions to address the identified gaps. The physical, biophysical and socio-economic components of mine closure should be addressed in an integrated manner to ensure confidence in the closure plan (Anglo American, 2013).

2.2.1.2 De Beers Policies and Principles

The De Beers operations are governed by the organisation's three guiding principles. These are:

- Sustainable development through partnership – a commitment to operating in accordance with national legislation and towards the goal of sustainable development.
- Diamond dreams and development – working to address the poverty and socio-economic deprivation that affects many of the communities where the company operates.
- Accountability and living up to diamonds – ethical conduct is governed by the De Beers' Best Practice Principles assurance programme.

These guiding principles are further underpinned by an additional 42 principles that encompass the discipline areas of society, confidence, people and environment.

A series of Policies support the various Principles. An overarching commitment in these policies is that the company will take responsibility for the short and long-term economic, social and environmental implications of decisions across the diamond pipeline. Some notable commitments in these policies that relate to mine closure include:

- Environmental Policy:
    - Aiming to have no net loss of significant biodiversity through responsible planning and stewardship of biodiversity, from exploration through to the closure of operations and making a contribution to biodiversity conservation in the regions within which we operate.
    - Ensuring that comprehensive environmental planning, implementation and costing for exploration, project, operational and closure phases is undertaken and that the financial provision for present and expected future environmental liabilities and obligations is included in life of mine plans.

  - Engaging and co-operating openly with governments, local communities, employees and other interested parties to improve understanding, promote constructive interaction and seek solutions to common environmental and social issues.
- Social Policy:
  - Delivering a lasting positive socio-economic benefit to host countries and communities through leveraging core business for development impact and engaging in additional corporate social investment activities.
  - Utilising a formal management approach to investigate, respond and, where appropriate, provide redress to social incidents and stakeholder grievances.
  - Ensuring that comprehensive social performance planning, costing and implementation for exploration, project, operational and closure phases is undertaken.

2.3 Closure Conditions and Commitments

In addition to the legal requirements in respect of mine closure, Voorspoed Mine is obliged to comply with the commitments and conditions contained in the authorisations which have been issued to the mine. The following considerations are relevant to existing closure conditions and commitments:

- Existing closure criteria are approved in the:
  - Environmental Management Programme Report (EMPR) for Voorspoed Diamond Mine (Metago, 2005a);
  - Amended Environmental Management Programme Report to Include New Areas (Shangoni, 2010);
  - Water Use Licence in terms of Chapter 40 of the National Water Act (2011); and
  - Voorspoed Mine Social and Labour Plan (2017-2021), Version 03.
- Various conditions documented in the EMPRs above are out of date and no longer relevant, practical or pragmatic.
- As a consequence of the above, this Mine Closure Plan (and previous versions of the MCP) deviate from closure criteria and associated commitments made in the EMPRs.
- Deviations to Closure criteria as contemplated above are based on:
  - Improved understanding with regard to closure risks, requirements and solutions.
  - Development of practical closure criteria that adequately address risk.
  - Learning from past experience and trials.
  - Updated information and specialist studies, informing revised risk assessments.
  - Development of appropriate, reasonable and pragmatic technical and economic solutions.
- Following the development of this Mine Closure Plan, the EMP commitments need to be aligned with updated closure plan and associated criteria.
- Post the development of this report, updated closure criteria and deviations will be discussed with stakeholders and authorities (via a Stakeholder Engagement Plan (SEP)) to obtain an agreed Final Closure Plan towards authority approval of the Plan. Commitments as documented in this report and the Voorspoed Mine Social and Labour Plan (SLP) will form the basis of the SEP.

Commitments and obligations (relevant to Mine Closure) as documented in the existing authorisations are presented below. Where relevant, proposed mine closure criteria (presented in Section 6 of this report) deviations from the commitments listed below are highlighted in Table 4.

2.3.1 Environmental Management Programme Report (EMPR)

Environmental Management Programme Report for Voorspoed Diamond Mine (Metago, 2005a) and Amended Environmental Management Programme Report to Include New Areas (Shangoni, 2010)

The conditions described here have been excerpted from the EMPr but placed into mine closure categories for easier reference. Nomenclature referring to selected infrastructure in the existing authorisations differs to the nomenclature used currently (e.g. RTF is currently referred to as CRD; UFTF is currently referred to as FRD). Therefore, the EMPr nomenclature has been altered in the summary below to reflect the current designations.

Open Pit

- Barriers such as fencing or berms will be required to ensure that no humans all animals fall into the pit.
- When the mine is decommissioned, the access ramps will be fenced off to ensure that no humans or animals fall into the open pit.
- Pit dewatering is not expected to yield a significant amount of water. No excess water will be produced, and no water released into the surrounding environment.
- The pit will re-flood after mine closure. The ingress into the pit will reduce as the pit re-floods, ultimately reaching a balance between inflow and evaporation.
- The pit lake is likely to become saline. The lake should have little potential to pollute the surrounding area though, since the maximum water level in the lake should be below the level of the shallow regional ground water aquifer, preventing pollution from the pit lake from entering the ground water aquifer.
- A berm and trench will be created around the open pit after closure to prevent surface runoff from flowing into the pit and to prevent people and animals from accidentally falling into the pit.
- Monitoring will be necessary to confirm the rate of inflow into the pit and to re-evaluate the pollution potential after closure if required.

Soils

- Erosion control measures, such as contours and revegetating, should be implemented in all disturbed areas.
- Erosion controls should be included in the designs of linear infrastructure and water management facilities.
- Topsoil will be returned to the area from where it was removed where possible.
- Invasive plants will be removed from land adjacent to mine infrastructure sites.

- A weed control programme will be implemented throughout the life of the mine until closure when all areas of the mine have been successfully rehabilitated.

Land use

- About 620 ha of land will be disturbed by mining and the development of mine infrastructure.
- Agricultural potential of soils at sites of mine infrastructure and the mine's intentions to restore agricultural potential. It was proposed that all areas are to be restored to Wilderness potential, with the exception of the plant area that had an objective to be restored to arable land use[4].
- The land at the site of the plant area will be returned to its pre-disturbance potential[5].
- The land at the site of the open pit cannot be restored to its pre-disturbance potential and will be classified as dormant mine after mine closure.
- The surface of the FRD, CRD and WRD will be rehabilitated as far as possible and restored to wilderness land capability[6].
- All land disturbed by mining, other than the mine residue disposal sites and return water dam, will be rehabilitated to a stable physical state and its pre-disturbance agricultural potential.
- The plant area will be rehabilitated to its original land use[7] and the storm water dam / return water dam are left intact for possible farming purposes[8].

Mine residue deposits

- The FRD has been sited and will be designed, operated, decommissioned and closed in accordance with the requirements of the SABS Code of Practice (SABS 0286) for mine residue deposits and the Mineral and Petroleum Resources Development Act (Act 28 of 2002).
- Monitoring of the stability of the FRD will continue through the decommissioning phase and until the time when a suitably qualified professional engineer has attested to its long-term stability.
- The mine residue disposal and return water dam sites will be vegetated[9] to prevent erosion and reduce their visual impact.
- The FRD is partially located on the headwaters of a small watercourse. This situation is not considered to be a stream diversion because the catchment of the drainage line is very small and the drainage line only becomes defined at the site boundary.
- It is believed that the potential for fugitive dust impacts due to the residue facilities will be negligible through comprehensive rehabilitation prior to closure being granted for these facilities.
- At decommissioning the waste rock, coarse residue and fines residue storage facilities will remain and continue to 'exert' an impact on the visual and aesthetic qualities of the area.

[4] End Land Use objectives have been updated as documented in Section 4.4
[5] End Land Use objectives have been updated as documented in Section 4.4
[6] End Land Use objectives have been updated as documented in Section 4.4
[7] End Land Use objectives have been updated as documented in Section 4.4
[8] Mine closure criteria have been updated and altered as documented in Section 6.
[9] Mine closure criteria have been updated and altered as documented in Section 6. The top surface of the FRD will be partially vegetated.

Their impact could be reduced if highly effective management measures are applied that would result in a minimal contrast with the landscape due to the final form of the dumps being 'natural' and with surfaces rehabilitated with indigenous grasses and tree species.

- The top[10] and side slope surfaces of the FRD will be covered with topsoil and vegetated at closure.
- At closure the side slopes and top surface of the CRD will be covered in topsoil and vegetated to prevent infiltration of rainwater[11].
- The WRD will be rehabilitated by placing topsoil and vegetate the top and side slope surfaces.
- The outer slopes of the FRD, CRD and WRD walls will be graded to 1:3 slopes[12] (1 vertical: 3 horizontal).
- The top and side slope surfaces of the FRD, CRD and WRD will be covered with topsoil and vegetated to prevent erosion and infiltration of rainwater[13].
- The rehabilitated disposal facilities and the open pit will be fenced off after closure and revert to wilderness land[14] use.
- Harsh, steeply engineered side slopes on the mine residue storage facilities will be avoided. All mine residue storage facility side slopes will be sloped at a 1:3 gradient or less.

Biodiversity

- Where vegetation is to be planted, a mixture of commercially available seeds that germinate reliably (high seed viability) will be used. The species to be used will be indigenous (no exotic plant species will be used) and will be selected on the basis of their ability to bind and cover soil (afford erosion protection) and their tolerance of prevailing environmental conditions.
- Species that can become invasive or a problem in the future cultivation of the rehabilitated land will be avoided.
- Species that will enhance the arable potential of soils will be used where possible.

Infrastructure

- The plant and other buildings will be demolished. Building foundations will be removed to a depth of 0.5m
- All other sites, other than the sites of the mine residue disposal facilities, will be landscaped so that the slope gradient is as gentle as possible and minimal erosion control measures are required.

Social

[10] Mine closure criteria have been updated and altered as documented in Section 6. The top surface of the FRD will not be covered with topsoil and will be partially vegetated.
[11] Mine closure criteria have been updated and altered as detailed in Section 6. The infiltration of rainwater on all MRDs will not be able to be prevented
[12] Mine closure criteria have been updated and altered as detailed in Section 6. Slopes will be profiled to at least 1:3. Slopes may be profiled to a lower gradient in certain areas.
[13] Mine closure criteria have been updated and altered as detailed in Section 6. The infiltration of rainwater on all MRDs will not be able to be prevented. The top surface of the FRD will not be covered with topsoil and will be partially vegetated.
[14] End Land Use objectives have been updated as documented in Section 4.4

- The mine will investigate mechanisms to mitigate the social and economic impact of mine closure on individuals and on the regional economy, such as training mine employees in non-mining related skills.
- Mechanisms to mitigate the impact of closure will be developed and updated on annually throughout life of mine.

Approval of an amendment to the approved environmental management programme (EMPR) for the extension of the mining area for De Beers Consolidated Mines (Voorspoed Mine) (2010)

- All mine waste (suitable for rehabilitation) must be taken back to the excavation area for backfilling purposes. Rehabilitation of the mining area must be done concurrently with mining activities (whenever and wherever possible)[15].
- Dump structures must not be left on the surface, this includes topsoil stockpiles, overburden stockpiles, waste rock stockpiles, tailings dumps and slimes dams[16].
- All excavations must be backfilled to the natural surface level; if a bulk factor exists it must be accommodated on the total area of disturbance.

2.3.2 Water Use Licence

Water Use Licence in terms of Chapter 40 of the National Water Act (2011)

- The licensee must, at least 180 days prior to the intended closure of any facility, or any portion thereof, notify the Regional Head: Free State of such intention and submit any final amendments to the IWWMP and RSIP as a final Closure Plan, for approval[17].
- The licensee shall make full financial provision for all investigations, designs, construction, operation and maintenance for a water treatment plant should it become a requirement as a long-term water management strategy.

2.3.3 Social and Labour Plan (SLP)

De Beers Consolidated Mines Proprietary Limited, Voorspoed Mine, Social and Labour Plan (2017-2021), Version 03

The Voorspoed Mine SLP is largely based on information derived from the Social Impact Assessment (SIA) conducted in 2016 (ERM, 2017). The SIA identified key social impacts that may be the result of the closure of the Mine. The engagement processes associated with the SIA also identified the issues within the communities and the needs of the stakeholders engaged. Management measures have been identified to address these impacts, issues and needs. (see Sections 3.3 and 6.3). The SLP addresses socio-economic aspects and commitments from 2017 to 2021.

In line with the commitments included in the SLP, Voorspoed Mine will provide financially for the following programmes:

[15] Mine closure criteria have been updated and altered as documented in Section 6. A specialist study regarding options for pit closure has been conducted and concluded that backfilling of the open pit is not feasible. The Open Pit will, therefore, not be backfilled (see Section 4.3).

[16] Mine closure criteria have been updated and altered as documented in Section 6. Dump structures will remain on surface.

[17] The deliverables of this Final Mine Closure Plan and report shall meet the requirements for the RSIP and Final Closure Plan commitments.

- The Human Resources Development (HRD) Programme;
- The Mine Community Development Programme; and
- The process to manage downscaling and retrenchment.

The SLP aims to ensure that through the effective implementation of its HRD Plan, systems for creating employee mobility will be in place. In addition to these plans, where it is clear that job losses cannot be avoided, the skills base of retrenched employees will be further diversified. This will be addressed through specific learnership programmes aimed at providing employees, as far as is practically possible, with alternative skills and experience to enhance their employability outside of the mining sector. This process will ensure that retrenched employees are more marketable and can capitalise on current and emerging employment opportunities that exist within the local labour market. In addition, Voorspoed Mine will implement the necessary mechanisms to ameliorate the social and economic impacts on individuals in the Moqhaka and Ngwathe local communities (DBCM, SLP 2017).

Voorspoed Mine's Skills Development Plan for the remaining Life of Mine focuses on mine closure. The Skills Development Plan will comprise of legal, compliance, competence and portable skills training. The mine closure plan compels a focus on a re-skilling programme aimed at developing employees to acquire a skill which are not only beneficial to the employer but will enable them to meaningfully compete for alternative employment post the mining activities. This Programme is based on the results of an Employee Portable Skills Audit conducted in 2016 as well as internal qualifications assessment (DBCM, SLP 2017).

Voorspoed Mine will manage the downscaling and retrenchment process in conjunction with the relevant employee representative bodies, in accordance with the applicable legislation. The mine has a functional Future Forum which has been established since 2014 which inter alia engage on downscaling and retrenchments (DBCM, SLP 2017). The engagement of the Future Forum is guided by the following principles:

- Promote a culture of self-employment and self-maintenance, aimed at improving access to business and or employment opportunities;
- Promote on-going engagement between Voorspoed Mine, the union(s) and other relevant parties in respect of any problems and or challenges experienced by either of the parties, and in relation to possible alternative job creation projects;
- Jointly and openly engage on matters relating to Life of Mine and mine closure;
- Jointly engage in strategic planning, deployment or other appropriate strategies that affect jobs, and evaluate progress; and
- Mitigate the effects of job losses and a decline in employment through turnaround or redeployment strategies, and to seek alternative solutions to the threats to job security and potential measures to prevent a decline in employment.

Further detail regarding the SLP commitments can be sourced in the Voorspoed Mine, Social and Labour Plan (2017-2021), Version 03.

2.3.4 Closure Plan deviations from authorisations

The major mine closure criteria deviations from the exiting authorisations as presented above are presented in Table 4. All other commitments are generally aligned to, and catered for adequately by the updated closure criteria in this report.

Table 4. Consolidated summary of selected, major deviations between existing authorisations and revised closure criteria.

Closure component	Existing Commitment	Authorisation	Revised Mine Closure Criteria
End Land Use	Land use categories are identified for various components of the mine ranging from an '*arable*' end land use to a '*wilderness*' end land use.	EMPr (2005) EMPr (2010)	End Land Use objectives have been updated as documented in Section 4.4
MRDs	The top and side slope surfaces of the FRD, CRD and WRD will be covered with topsoil and vegetated to prevent erosion and infiltration of rainwater.	EMPr (2005) EMPr (2010)	Mine closure criteria have been updated and altered as detailed in Section 6. The infiltration of rainwater on all MRDs will not be able to be prevented. The top surface of the FRD will not be covered with topsoil and will be partially vegetated.
	Dump structures must not be left on the surface, this includes topsoil stockpiles, overburden stockpiles, waste rock stockpiles, tailings dumps and slimes dams.	Conditions stipulated in the DMR approval of EMPr (2010)	Mine closure criteria have been updated and altered as documented in Section 6. Dump structures will remain on surface.
Open Pit	All mine waste (suitable for rehabilitation) must be taken back to the excavation area for backfilling purposes. All excavations must be backfilled to the natural surface level; if a bulk factor exists it must be accommodated on the total area of disturbance.	Conditions stipulated in the DMR approval of EMPr (2010)	Mine closure criteria have been updated and altered as documented in Section 6. A specialist study regarding options for pit closure has been conducted and concluded that backfilling of the open pit is not feasible. The Open Pit will, therefore, not be backfilled.
Water Storage Facilities	The storm water dam / return water dam are left intact for possible farming purposes	EMPr (2005) EMPr (2010)	Mine closure criteria have been updated and altered as detailed in Section 6. The water storage facilities will not be left intact for farming purposes.

3 CONTEXT

3.1 Physical Context

3.1.1 Pre-Mining Baseline

De Beers acquired the Voorspoed Mine from the Voorspoed Diamond Mining Company in 1912. After several sampling programmes were undertaken by De Beers, the Voorspoed Mine was established between 2006 and 2008. Operation at the mine commenced in 2008.

Prior to the development of the mine in 2006, the area on which the current mine site is located was relatively undeveloped, having been used for agricultural (primarily grazing) purposes.

Within the vicinity of the current open pit area, remnants from mining activities in the early 1900s were present, including a relatively shallow open pit and a tailings dump pre-dating 1912 (with a relatively higher grade), situated to the east of the open pit. Prior to development of the current mine, trees (particularly *Eucalyptus* species) and vegetation had begun to 'colonize' the old spoil dump, the pit and the surrounding areas (Newtown Landscape Architects, 2004).

3.1.2 Current state

The following infrastructure has been developed and/or upgraded on the site since 2006 as presented in Figure 7.

3.1.2.1 Infrastructure

On site Surface Infrastructure

- Access Road;
- Electrical power distribution network and associated infrastructure;
- Mobile (temporary) offices and administrative buildings;
- Stores and freight yard;
- Workshops;
- Laydown areas, service areas and salvage yard;
- Concrete surfaces associated with infrastructure;
- Explosives magazine;
- Main Treatment Plant and associated infrastructure;
- Conveyor belts and associated infrastructure;
- Internal roads, parking areas and walkways;
- Open pit and associated haul road network and supporting infrastructure;
- Security fencing;
- Return Water Dam; and
- Stormwater Control Dam.

Off-site surface Infrastructure

- Access roads maintained by the mine;
- Electrical power distribution network and associated infrastructure suppling Voorspoed Mine only;
- Renoster River weir (not constructed, but upgraded and maintained by mine) and associated water pumping infrastructure; and
- Raw Water pipeline.

3.1.2.2 Mine Residue Deposits

- Waste Rock Dump;
- Coarse Residue Deposit;
- Pre-1912 Tailings Dump; and
- Fine Residue Deposits.

3.1.3 Life of Mine (LOM) Plan

The final mine model resulted in the economic resources being depleted in the 4th Quarter of 2018. The projected mine life until 2020 was thus not achieved. The economics and mine life of Voorspoed mine was significantly impacted by the weak and geo-technically complex country rock, as well as unexpected changes in geology.

In line with the updated life of mine plan, and based on the need for profitable resource extraction and a profitable business case, operations have ceased at Voorspoed Mine. The mine is, therefore, formally within the mine closure phase.

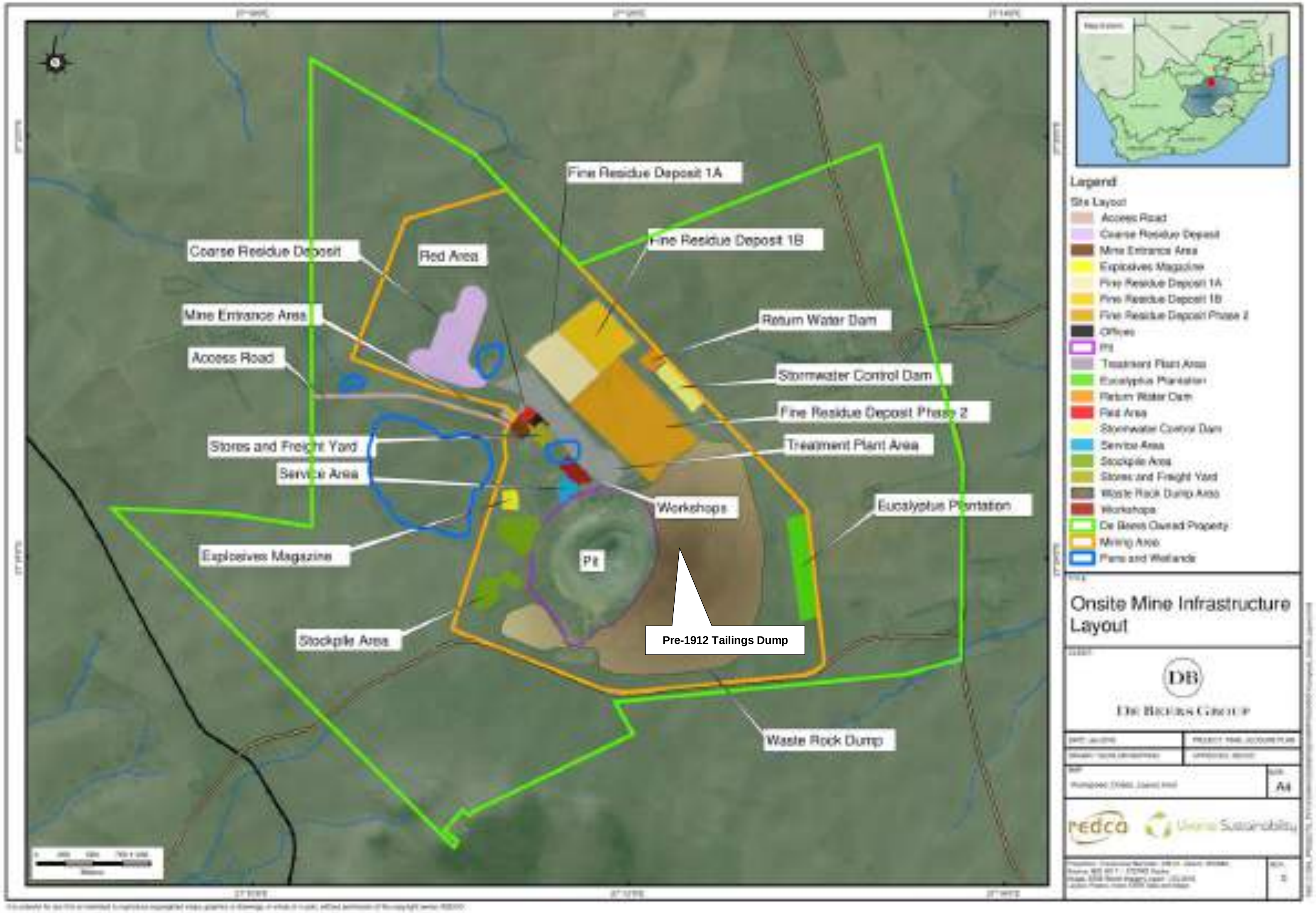


Figure 7. Voorspoed Mine onsite mine infrastructure.

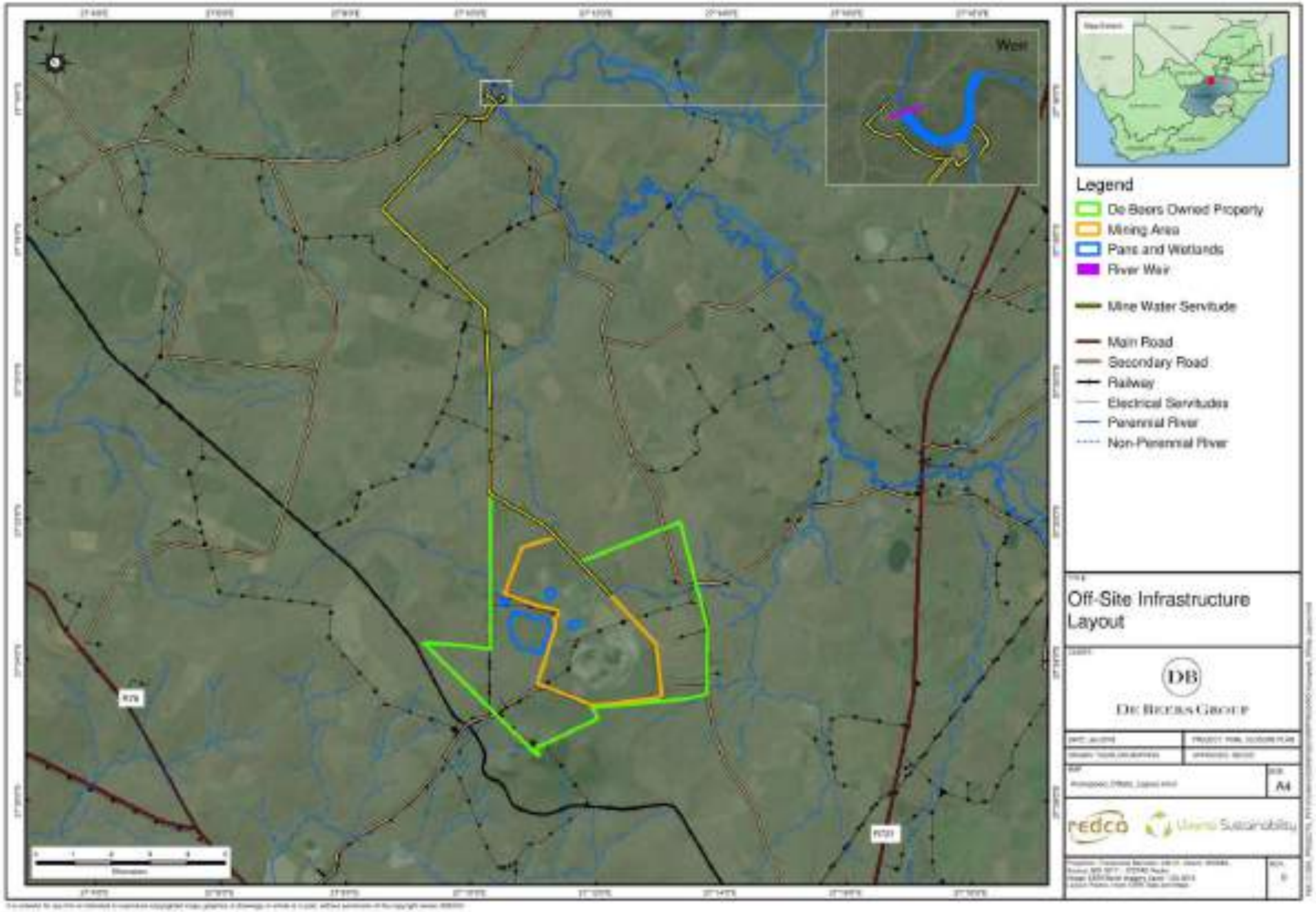


Figure 8. Voorspoed Mine off-site infrastructure.

3.2 Bio-physical Context

3.2.1 Climate

Voorspoed Mine falls within the Highveld Climate Zone. Temperatures in this climatic zone are generally high, with moist wet summers and dry winters. The long-term average annual rainfall is 560 mm, of which approximately 80% falls from October to March. The average evaporation over the same period is 2 085 mm. Temperatures vary from an average monthly maximum and minimum of 29.8°C and 15.8°C for January to 18.7°C and -0.3°C for July respectively. Frost is likely to form over the months of May to September. Generally, winds are light except for short periods during thunderstorms. The area may experience the following extreme weather events:

- Frost is common during the winter period.
- The area typically experiences rainfall in the form of showers and thunderstorms.
- Tornados may occur, but very infrequently.

3.2.1.1 Extreme weather conditions and climate change

The climate at Voorspoed Mine does not pose any severe challenges for rehabilitation activities. However, cognisance of heavy thunderstorms must be taken as heavy downpours raise the risk of extensive erosion across rehabilitated and non-rehabilitated areas. Heavy downpours can also damage proposed storm water management structures (Redco 2014).

Future climate change predictions for southern Africa suggest an increasing trend in temperature. Climate change models predict that temperatures will continue to increase, particularly if there is significant reduction in the global GHG emissions. Although the effect of climate change on precipitation remains uncertain, there may be a significant reduction in the number of rain days, resulting in an increase in the average rainfall intensity and increased flooding risk. It is, therefore, likely that there will be an increase in the variability of rainfall and a resulting increase in the risk of flooding.

In respect of climate change, potential impacts to the area which could influence the rehabilitation programme include:

- Higher temperatures in the form of higher maximum and average temperatures in an area that already experiences very high temperatures;
- Lower annual rainfall in an area that already receives relatively low volumes of precipitation and further increases risks of salinisation of water sources in the region;
- More erratic rainfall patterns with greater frequency of drought, floods and extreme thunderstorms. The storms may further impact soils which are already exposed due to low vegetation cover and experience high levels of over-grazing;
- Changes to vegetation as a result of lower precipitation, increased evaporation, higher water-salinity levels, increased erosion and an increased prevalence of survivalist human-induced exploitation of the natural vegetation base.

It may be required to apply an additional safety factor to the design of the storm water management system to account for the potential increase in rainfall intensity and increased flooding frequency.

3.2.1.2 Potential Post Closure Impacts

The potential climate-related post closure impacts and associated considerations are presented in Table 5.

Table 5. Potential climate-related post-closure impacts.

Issue	Potential Impact/s	Considerations
Progressively higher annual and seasonal temperatures driven by climate change	Drier and harsher conditions resulting in: • Poorer establishment of vegetation post rehabilitation activities • Higher probability of fires driven by dry, hot and windy conditions	Uncertainty regarding the variability and intensity of future temperatures. Appropriate actions include: • Establishment of indigenous, hardy grass, shrubs and tree species. Mixture of annual and perennial grass species to facilitate sustainability. • Retain and maintain fire-breaks. • Development of fire-fighting emergency response and capability during dry seasons.
Increase in intensity of flooding / excessive storm water events	• Potential erosion across rehabilitated and non-rehabilitated areas. • Heavy downpours may damage proposed storm water management structures.	Uncertainty regarding the variability and intensity of future precipitation and associated events. Appropriate actions include: • Appropriate design of the storm water management system to account for the potential increase in rainfall intensity and increased flooding frequency.

3.2.2 Biodiversity

3.2.2.1 Regional Context

The site is located in the Grassland biome, but elements of the savanna vegetation of the Vredefort Dome region further north from the site are also present on Renosterkop to the south of the site. The vegetation types on the flatter plains lies at the intersection of Central Free State Grassland and Vaal-Vet Sandy Grassland. A wetland at the mine site forms part of the Highveld Salt Pans vegetation type which constitutes an azonal vegetation type (Mucina & Rutherford 2006).

3.2.2.2 Pre-Mining Baseline

Flora

According to Mucina & Rutherford (2006) four vegetation types occur at the mine site (Figure 9):

- Vaal-Vet Sandy Grassland Gh10;
- Central Free State Grassland - Gh6;
- Vredefort Dome Granite Grassland - Gh11; and
- Highveld Salt Pans - AZi10.

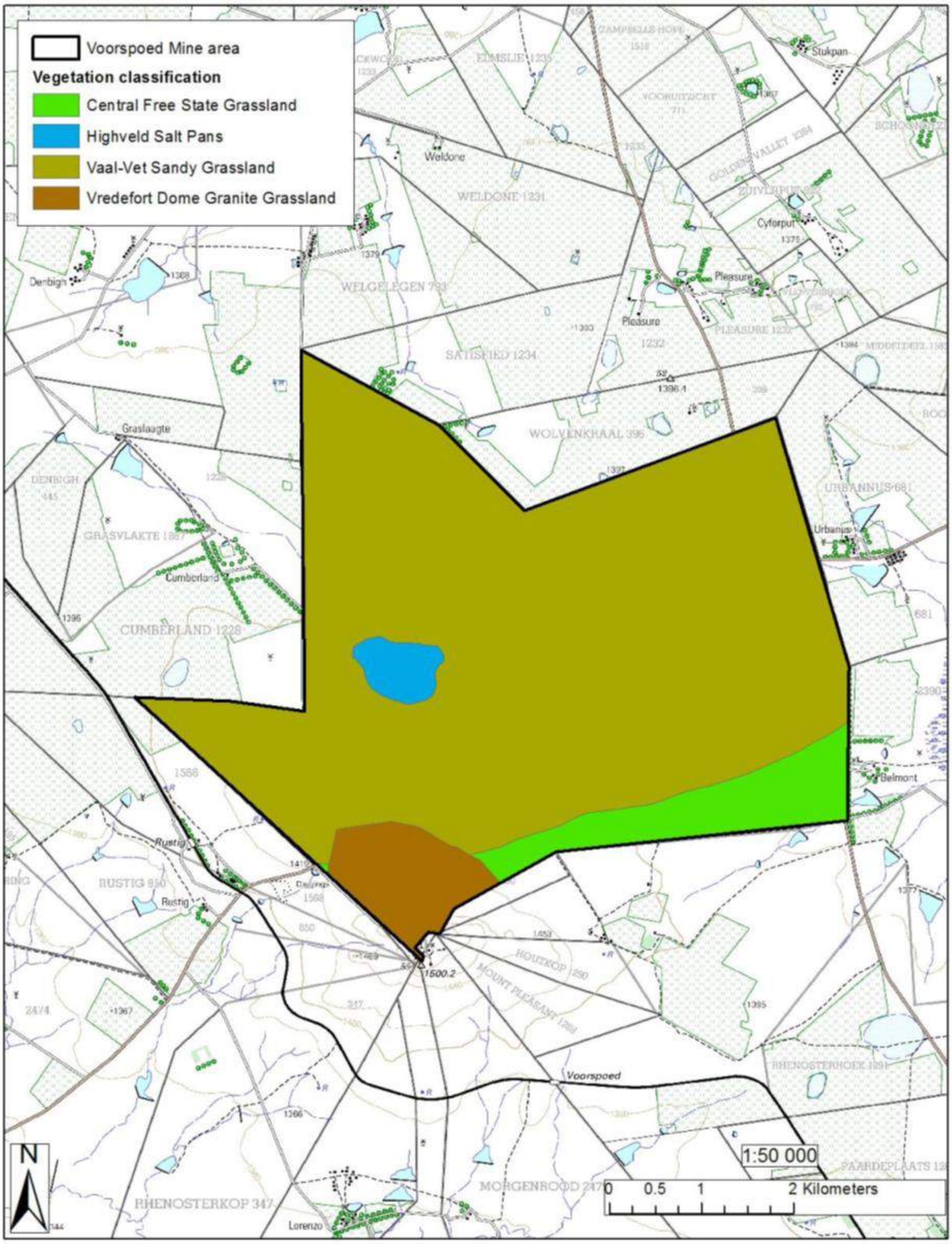


Figure 9. Vegetation classification for Voorspoed Mine and surrounding area (from Bucandi 2013).

Vaal-Vet Sandy Grassland (Gh10)

This vegetation type occurs in the North-West and Free State Provinces and is situated in the summer rainfall region with a mean annual precipitation of ±530mm. The landscape is dominated by plains with some scattered, slightly irregular undulating plains and hills. The relative dominance of the grass species *Themeda triandra* is an important feature of Gh10. Aeolian and colluvial sand overlay sandstone, shale, and mudstone of the Karoo Supergroup (mostly Ecca Group) as well as older Ventersdorp Supergroup Andesite and basement gneiss in the north. Soil forms are mostly Avalon, Westleigh, and Clovelly (Mucina & Rutherford, 2006).

Gh10 is recorded by Mucina & Rutherford (2006) as endangered because approximately 63% has already been transformed due to commercial crop cultivation and grazing pressure from cattle and sheep. Only 0.3% of this vegetation type is currently statutorily conserved in Bloemhof Dam, Schoonspruit, Sandveld, Faan Meintjies, Wolwespruit and Soetdoring Nature Reserves.

The Gh10 Grassland ecosystem is listed as *Endangered* by the National Environmental Management: Biodiversity Act: National list of ecosystems that are threatened and in need of protection, (Gov. Gazette 34809, Gov. Notice 1002, 09 December 2011).

Central Free State Grassland (Gh6)

This vegetation unit is situated in the summer rainfall region with a mean annual precipitation of ±560mm. The landscape is characterised by undulating plains supporting short grassland. Under natural conditions it is dominated by *Themeda triandra*, but is dominated by *Eragrostis curvula* and *E. chloromelas* in disturbed habitats. Dwarf Karoo-shrubs establish in severely degraded clayey bottomlands and overgrazed and trampled low-lying areas are prone to Acacia Karoo encroachment. The geology of this vegetation type is generally dominated by sedimentary mudstones and sandstone of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) as well as those of the Ecca Group (Karoo Supergroup). These rock formations give rise to vertic, melanic and red soils, typically of the Arcadia, Bonheim, Kroonstad, Valsrivier and Rensburg soil forms (Mucina & Rutherford, 2006).

Gh6 is described by Mucina & Rutherford (2006) as vulnerable due to almost 25% being transformed for crop cultivation and building of large dams such as the Koppies and Kroonstad Dams. Small portions of the Central Free State Grassland are conserved in the Willem Pretorius, Rustfontein and Koppies Dam Nature Reserves as well as in some private Nature Reserves.

Vredefort Dome Granite Grassland (Gh11)

Gh11 mainly occurs in the central portion of the Vredefort Dome in the Free State and North-West Provinces around the towns of Parys and Vredefort. It is characterised by slightly undulating plains with short *Themeda triandra* – dominated grassland. Big boulders are conspicuous in the area creating microhabitats for a large diversity of plants and other life forms. The average rainfall, which falls mainly in the summer months, is 594mm per annum. Summers are hot and severe frost occurs in winter. Granite and gneiss underlie this area and include the Inlandsee Gneiss. Various soil types including deep Hutton, moderately deep Avalon and shallow Mispah soil forms occur (Mucina & Rutherford, 2006).

Mucina & Rutherford (2006) describes Gh11 as endangered as almost 50% is already transformed into cultivated lands, urban development and roads and none of this unique vegetation type is currently conserved in statutory conservation areas.

The Gh11 Grassland ecosystem is listed as *Vulnerable* by the National Environmental Management: Biodiversity Act: National list of ecosystems that are threatened and in need of protection, (Gov. Gazette 34809, Gov. Notice 1002, 09 December 2011).

With regard to the Voorspoed site, the Gh11 grassland ecosystem area is restricted to the immediate area surrounding Renosterkop, in the southernmost corner of the mining lease area (Figure 9). According to Mucina and Rutherford (2006), Renosterkop is located on Vredefort Dome Granite Grassland. Satellite imagery suggests that this "koppie" is one of the southernmost outliers of the Vredefort Dome and would therefore be quite unique in its geology and ecology. The area is in a nearly pristine condition with only small impacts that could reduce the natural biodiversity. These include large towers and a few small buildings constructed at the summit, barbed wire fences and a concrete and dirt road approaching the towers. Individual prickly-pear trees (*Opuntia ficus-indica*) are scattered over the area, but this seems to be the only alien vegetation occurring on Renosterkop. Surveys show that Renosterkop hosts a variety of species and contains high biodiversity value, with plant diversity at Renosterkop being exceptionally high and also unique.

The Highveld Salt Pans (AZi10)

The Highveld Salt Pans Vegetation Type (AZi10) occurs over a wide distribution area that stretches from the Eastern Cape, Northern Cape, North-West, Gauteng and Free State Provinces and is characterised by depressions in the plateau landscape containing seasonal (infrequently permanent) water bodies supporting vegetation with a zoned concentric pattern and open grassland to sparse grassy dwarf shrub land on the edges of the pans. Geologically the depressions of AZi10 are usually formed by shales of the Ecca Group giving rise to vertic clayey soils. Pans of AZi10 are inundated and/or saturated only during the wet months, which occurs in the summer months in the north-eastern region and bimodal elsewhere in the distribution area of AZi10. Winters are cold with frequent frost (Mucina & Rutherford, 2006).

About 4% of AZi10 has been transformed as a result of agriculture, building of roads, mining and urbanisation. All these threats are increasing and putting pressure on more areas of this vegetation type. A small portion of this vegetation type is statutorily conserved in the Vaalbos National Park and Bloemhof Dam, Soetdoring, Willem Pretorius, Baberspan and S.A. Lombard Nature Reserves (Mucina & Rutherford, 2006).

Fauna

Various specialist studies have documented the fauna that are likely to appear at the Voorspoed Mine Site. Identified species roam throughout the area which is primarily used for agricultural purposes.

Further detail can be sourced from specialist studies related to the description of biodiversity, as referenced in the bibliography.

It is noteworthy that photographic evidence suggests that Giant Bullfrog exist on the Voorspoed Mine area and it is highly likely that this species utilise the wetland as a breeding site.

Pans and Wetland

Notable surface water features within the mining right area include two (2) endorheic pans (the Northern Pan and Southern Pan) and a wetland (recently re-classified as an endorheic pan by Exigo, 2016b). The pans are 12.3 ha and 7.7 ha in maximum extent with the volume of water in the pans proportional to rainfall as water accumulation within the pans only exits by means of evaporation and infiltration

The wetland and two Endorheic pans at Voorspoed mine are listed and identified as Natural Wetlands (NWCS L4 class) within the National Freshwater Ecosystem Priority Areas project (NFEPA) and form part of a NFEPA wetland cluster (Figure 10). The wetlands at the Voorspoed Mine forms part of the Highveld Salt Pans vegetation type which constitutes an azonal vegetation type (Mucina & Rutherford, 2006).

The pans provide a valuable ecological ecosystem service, supporting a variety of plants and animals, including aquatic invertebrates, amphibians, reptiles, small and large mammals and local bird populations. Wetlands are an important feature in the Renosterspruit and Heuningspruit Catchment.

The ephemeral wetland located to the north west of the open pit is classified as a Hillslope wetland. The area of the wetland is approximately 29 ha in extent. Wetland plant species such as *Junctus* and *Scirpus* have been observed within the wetland after rains. These species area adapted not only to waterlogged conditions, but also to the ephemeral nature of these wetlands, remaining in the soil as seeds, bulbs and rhizome during the dry periods. The ephemeral nature of the wetland is due to the dry climate. Inundation of the wetland is likely after heavy rainfall, which normally occurs any time during November to April.

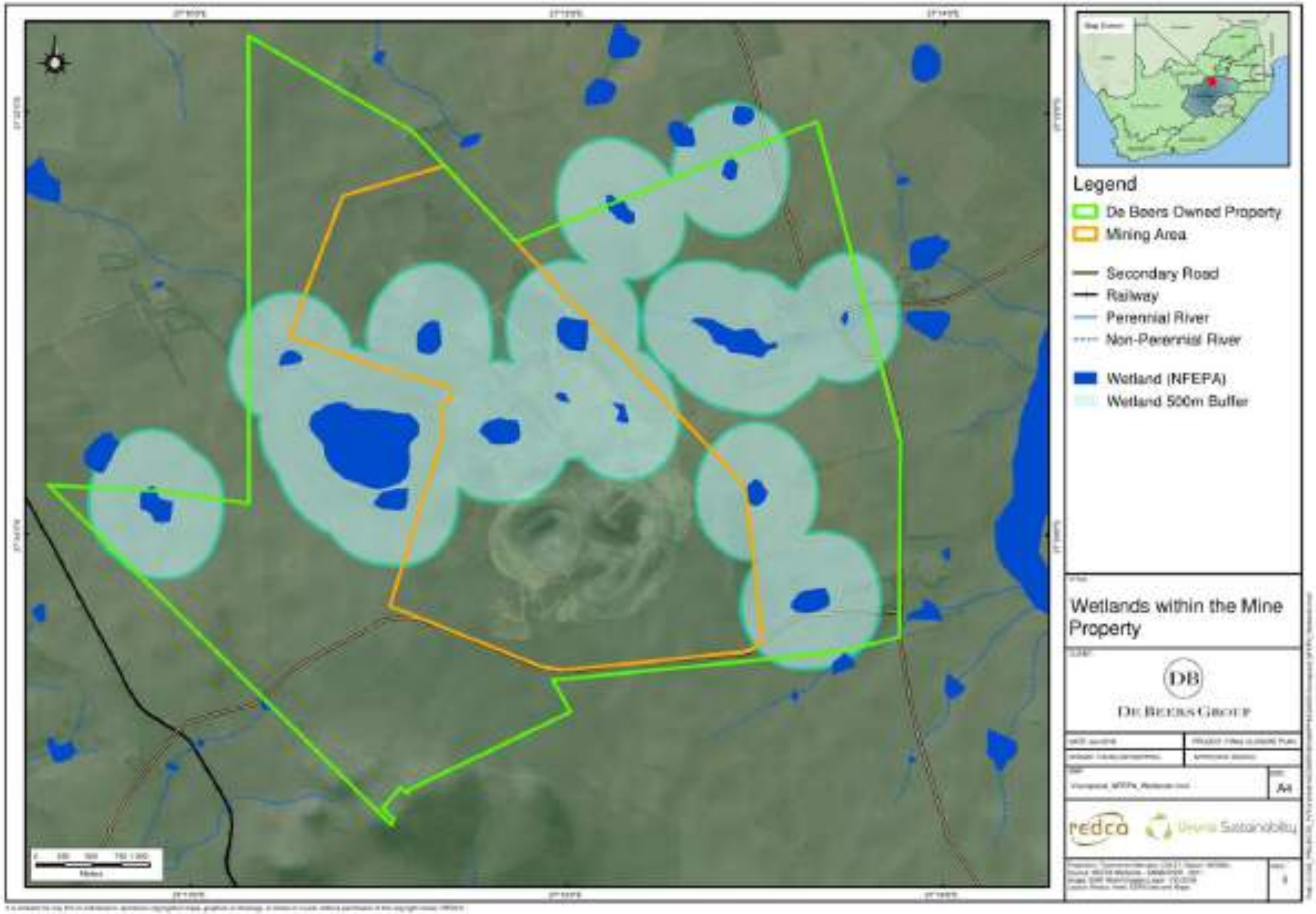


Figure 10. National Freshwater Ecosystems Priority Areas (NFEPAs) wetland cluster at Voorspoed Mine (SANBI, 2007).

3.2.2.3 Current state

Flora

The grassland ecosystems have been negatively impacted by the development of mine infrastructure and the expansion of the mining-related footprint.

The Renosterkop area is located outside of the mining area and, therefore, has not been impacted by mining activities.

Concurrent Rehabilitation

The following rehabilitation works have been implemented on the mine (Figure 11):

- **WRD**: The southern and eastern slopes of Lift 1 have been rehabilitated about 4 years ago. The areas have a good grass cover and an ecological assessment done in 2017 indicated that the area is comparable with the surrounding areas and can support the end land use. The northern portions of the eastern slope were rehabilitated a year later than the southern slopes, but also show a good grass cover. The slope lengths are about 55 – 60 m long. The slopes show good stability at this stage, despite minor erosion gullies that are visible. It was assumed for this assessment that the area will stabilise and no additional corrective actions were proposed or costed;
- **WRD**: The southern and eastern slopes of Lift 2 have been rehabilitated less than a year ago. Vegetation has germinated, but the area is still very sensitive. It was assumed for this assessment that the area will improve and stabilise and no additional corrective actions were proposed or costed;
- **WRD**: The bench between Lift 1 and 2 has edge berm walls, but these are the original temporary berms for water control and safety during construction. The crest walls must be trimmed or enlarged where needed and cross berm walls must be constructed on the bench. This aspect was included in the cost assessment;
- **FRD**: The north-western slope of FRD 1A and 1B was reshaped, covered and seeded. Vegetation has established, but the cover is not yet satisfactory and erosion is visible on the bottom portion of the slope of FRD 1B. The cost to cover this portion and re-seed it was included in the cost assessment;
- **CRD**: The northern portion of the eastern slope of Leg 1 was reshaped in one single slope to 18° and covered with 300mm soil just more than a year ago. Erosion gullies formed in the first rain season and the area was repaired subsequently. Contour berms were constructed on a portion of the area. The rehabilitated works are not according to the original design and the area must be monitored for stability. The cost to reshape the slope to have two benches and covering it again was included in the cost assessment.

Figure 11. Areas where concurrent rehabilitation has been implemented.

Vegetation studies were conducted at the mine to evaluate the vegetation establishment and growth after re-seeding and to determine some of the ecological processes and landscape functioning after rehabilitation (NWU, 2014; Omni eko, 2017). On rehabilitated areas, the rehabilitation method used was a success over a short period of time, due to the high establishment and cover of the grasses. The primary grass production and subsequent grazing capacities of all restored slopes were found to be very high. These were substantially higher than what would be expected of natural veld in this region. The high grass production and excellent veld conditions were also indicative of a dense grass ground cover. A higher plant cover greatly reduces the risk of soil erosion.

A very high re-seeding rate, large amount of compost and fertiliser and the good rains after the re-seeding process could have contributed to this success. The annual species (especially *Eragrostis tef*) was high in abundance contributing to the good stability rate. The litter and rock patches also contribute to the high stability rates. The lower infiltration and nutrient cycling rates should also become higher over time. Although the sites should not be disturbed by fire or grazing at this stage, the grazing capacity is quite high due to the high phytomass production. The grass sward mainly consists of decreaser type of ecological status species.

Pans and Wetland

A 100m buffer has been maintained around the wetland to the west of the active mining area. A smaller buffer, aligned with the catchment size of each of the pans was demarcated during the initial EIA process and was meant to be maintained throughout the LoM (Shangoni, 2010). In addition, the mine was required to construct berms around the boundaries of the pans catchment to prevent dirty water inflows from the surrounding mine surface infrastructure areas.

The buffers around the Northern and Southern pans have not been maintained as required by the EIA. Both pans and the wetland have been impacted by mining activities.

- Northern pan – the CRD has been established on the western side of the pan. Access roads have also been created to the south and east of the pan.
- Southern pan – the eastern half of the pan has been modified and an access road, pedestrian walk-way and areas of the processing plant constructed.
- Wetland – the main access road to the mine has been constructed to the north of the wetland, across the wetland outflow. The mine's security fence and a road was constructed along the eastern boundary.

Alien Invasives

Various Alien invasive species have established on the Voorspoed site in response to disturbance of surface areas (Exigo, 2016a). Table 6 presents the dominant alien invasive species found on site.

Table 6. Dominant alien invasive species found on the Voorspoed site (adapted from Exigo, 2016).

Species	Common Name	Distribution on site
Argemone ochroleuca	Mexican poppy	Throughout site although dominant species on WRD, stockpiles and on edges of haul roads
Chamaesyce inaquillatera	Smooth creeping milkweed	Throughout site
Chenopodium album	White goose foot	Plant area and bare ground outside plant
Cirsium vulgare	Scotch thistle, spear thistle	Throughout site, although in isolated areas of mining areas and outside impacted areas in disturbed areas along roads
Conyza bonariensis	Flax-leaf fleabane	Throughout site – especially disturbed areas with weeds
Datura stramonium	Common thorn apple	Isolated areas of mining area
Eucalyptus camaldulensis	Blue gum	In Mining areas (high priority) and on outskirts (low priority)
Opuntia ficus-indica ***Opuntia stricta***	Prickly pear	Outside impacted areas
Salsola kali	Common saltwort / tumbleweed	Throughout site – inside mining area and outside on open areas
Schinus molle	Pepper tree	Around open pit and haul roads in isolated areas
Sonchus oleraceus	Sowthistle	Throughout site – inside mining area and outside on open areas
Tamarix chinensis	Pink tamarisk	Inside mining area
Tagetes minuta	Southern Cone Marigold / Kakiebos	Throughout site – inside mining area and outside on open areas
Taraxacum officinale	Common dandelion	Throughout site – inside mining area and outside on open areas
Verbena brasiliensis	Brazilian verbena	Throughout site – inside mining area and outside on open areas

The most dominant, and therefore, important species for control inside the processing plant and mining areas include:

- *Salsola kali* - throughout plant areas, WRDs and stockpiles
- *Argemone ochroleuca* - throughout plant areas, WRDs and stockpiles
- *Eucalyptus camaldulensis* - in pan and surrounding mining areas

All other weeds and alien invasive species occur in isolated areas of the project area.

Critical Biodiversity Areas and Ecological Support Areas

Figure 12 presents the extent of Critical Biodiversity Areas (CBA) and Ecological Support Areas (ESA), related to the Voorspoed Mine site, as identified by the 2015 Free State Biodiversity Plan.

According to the Department of Economic, Small Business Development, Tourism and Environmental Affairs (DESTEA), 2015 Free State Terrestrial CBAs:

- CBA are areas that are irreplaceable or the best option for meeting biodiversity targets. There are no or very few other options for meeting biodiversity targets for the features associated with CBA1 areas. CBA2 based on complementarity, efficiency, connectivity and/or avoidance of conflict with other land or resources uses.
- ESA are areas that are currently in either good or fair ecological condition, for which the objective is to retain them in at least fair ecological condition (ESA1) or areas that are currently in severely modified ecological but that nevertheless retain sufficient ecological functioning to fulfil the purpose for which the ESA was selected. The objective is to prevent further deterioration in ecological condition.

3.2.2.4 Anticipated Post Closure Impacts

The anticipated post closure impacts for biodiversity and associated considerations are presented in Table 7.

Table 7. Anticipated biodiversity post-closure impacts.

Issue	Anticipated Impact/s	Considerations
Ability to achieve "no net loss" of significant biodiversity post closure.	Nett Loss in biodiversity resources	Adequate understanding of sensitive biodiversity receptors and areas. Management plans to address biodiversity risks in the context of the End Land Use Plan
Surface water runoff and quality to the wetland and pans post closure.	• Water feed (volume) and quality impacts • To be addressed via rehabilitation plan	-
Establishment of exotic weeds and invaders on exposed and disturbed surfaces.	• Weeds and invader species will establish in the short term during the ecological succession process following restoration activities • To be addressed via the rehabilitation and alien invasive eradication programme	-

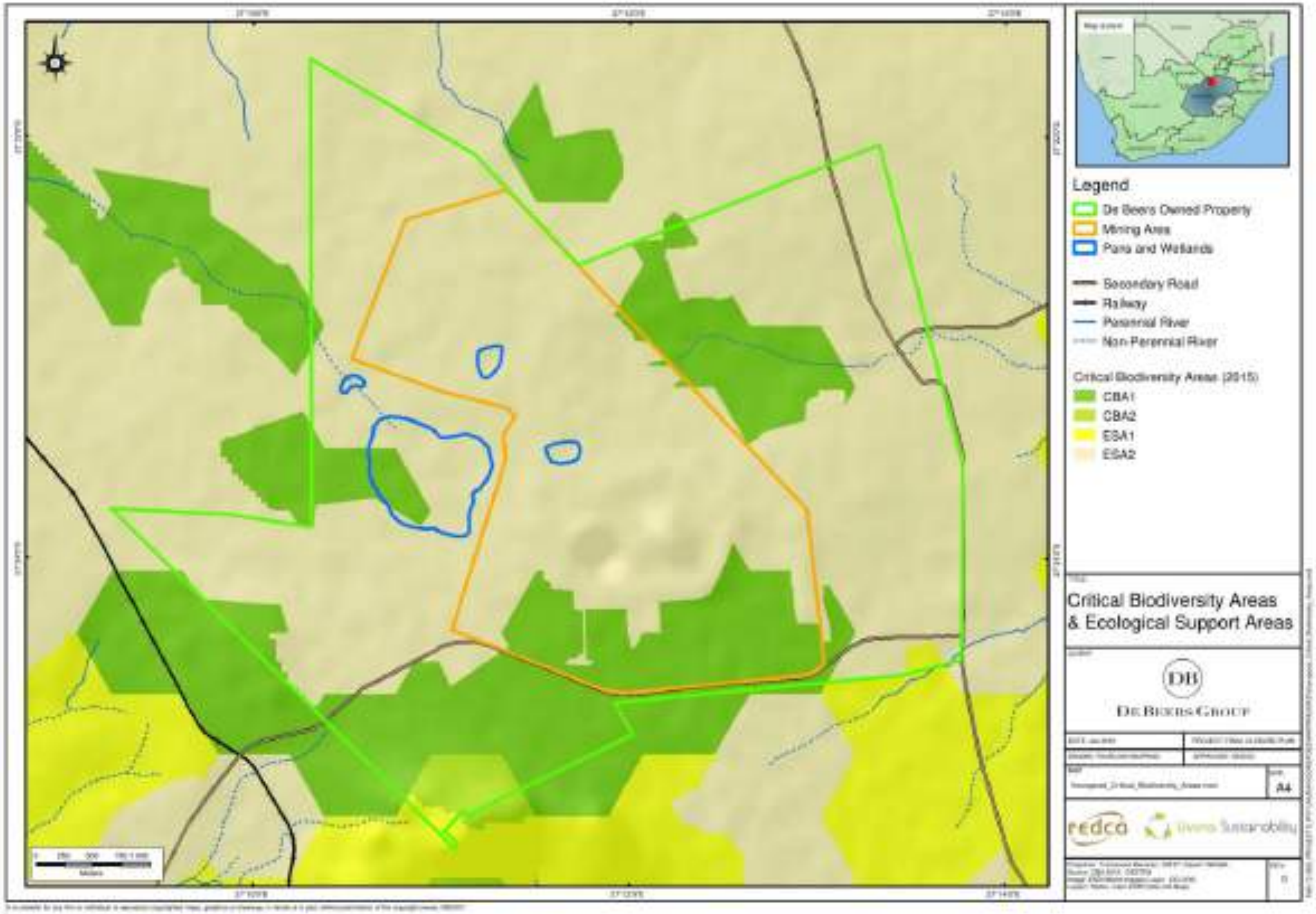


Figure 12. CBA and ESA areas associated with the Voorspoed site (DESTEA, 2015 Free State Terrestrial CBAs [Vector] 2015).

3.2.3 Surface water

3.2.3.1 Regional Context

Surface water resources are well developed in the Free State Province through the construction of several large dams. The water supply is augmented by various transfer schemes that import water from other Water Management Areas (WMA), as well as from the Kingdom of Lesotho. Future water requirements will depend on increased water transfers (Shangoni, 2011).

Groundwater is currently used where surface water supply is inadequate or bulk water supply is not financially feasible. Climate change models predict a reduction in the amount of rainfall, which will exacerbate the impact of limited surface water and groundwater resources (Shangoni, 2011).

Deteriorating water quality is impacting on the quantity of water available for different uses. Key issues of concern include the poor-quality effluent discharged from municipal sewage treatment works due to overloading and/or poor operations and maintenance; polluted storm water run-off; high salinity pollution due to mining activities; and elevated salinity and nutrient pollution from poor farming practises. As a consequence, river health has deteriorated resulting in loss of river functions and services, and sustainability of the river ecosystem. Many wetlands in the Province have also been directly and/or indirectly impacted by a variety of different land uses and from chemical and biological pollutants (Free State DTEEA, 2008).

Figure 13 presents the Quaternary catchments associated with, and surrounding Voorspoed Mine.

3.2.3.2 Pre-Mining Baseline

Catchments and drainage lines

Voorspoed falls into quaternary catchment C70H. Water emanating from the mine drains into farm dams, which eventually drain into the Heuningspruit River, a tributary of the Renoster River which is part of the Vaal River System. The mean annual runoff (MAR) for the quaternary catchment is 7.3 million m^3 over a catchment area of $251km^2$. (Shangoni, 2010).

The mine is situated on a watershed that is surrounded by generally flat topography. There are no clearly defined drainage courses and surface water generally flows as sheet flow following heavy rainfall events. There are five (5) sub-catchments present on the mining area which influence the direction which surface water run-off will flows. These are indicated in Figure 14 (Metago, 2005a).

Three drainage lines are found within the boundary of the mine (Metago, 2005a):

- The western drainage line, downstream of the wetland located on Voorspoed 401, approximately 899m long, draining toward the farm dam on Grasvlakte 1887. The wetland and drainage line from it is ephemeral and will only have flow periodically during and after heavy rainfall events.

- The eastern drainage line downstream of the farm dam on the eastern border of Voorspoed 401, approximately 194m long, makes up the headwaters of a stream and drains towards the farm dam on Welvaart 1011. This drainage line is ephemeral and will only have flow periodically during and after heavy rainfall events. The drainage line is probably the result of the earthen wall of the farm dam and may not have existed as a clearly defined drainage line prior to the construction of the dam.
- The southern drainage line emanating from the northern slopes of Renosterkop on Morgenster 772, approximately 210m long, which make up the headwaters of a stream and drains toward the farm dams on Rhenosterkop 347. This drainage line is ephemeral and will only have flow periodically during and after heavy rainfall events.

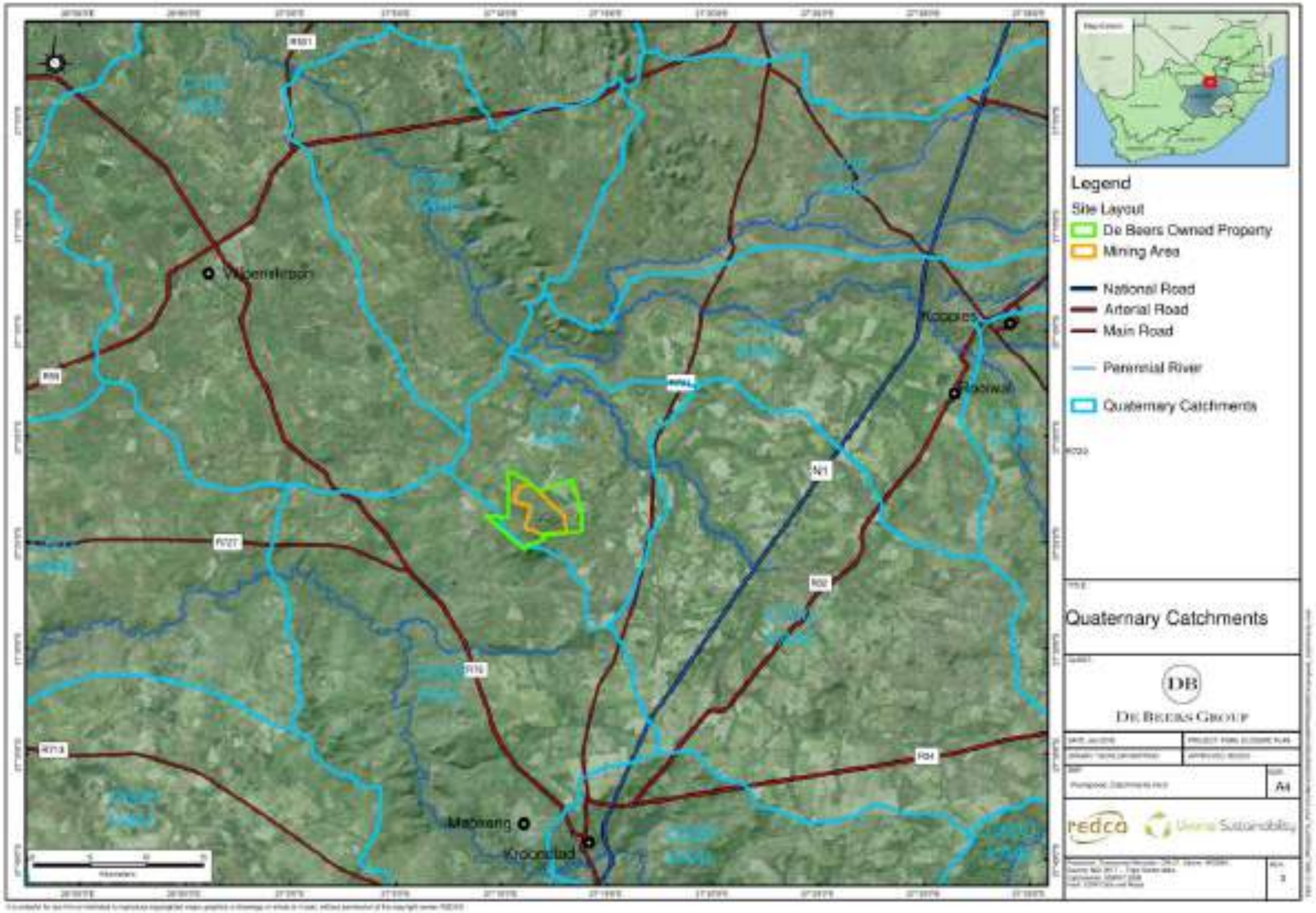


Figure 13. Quaternary catchments associated with, and surrounding Voorspoed Mine.

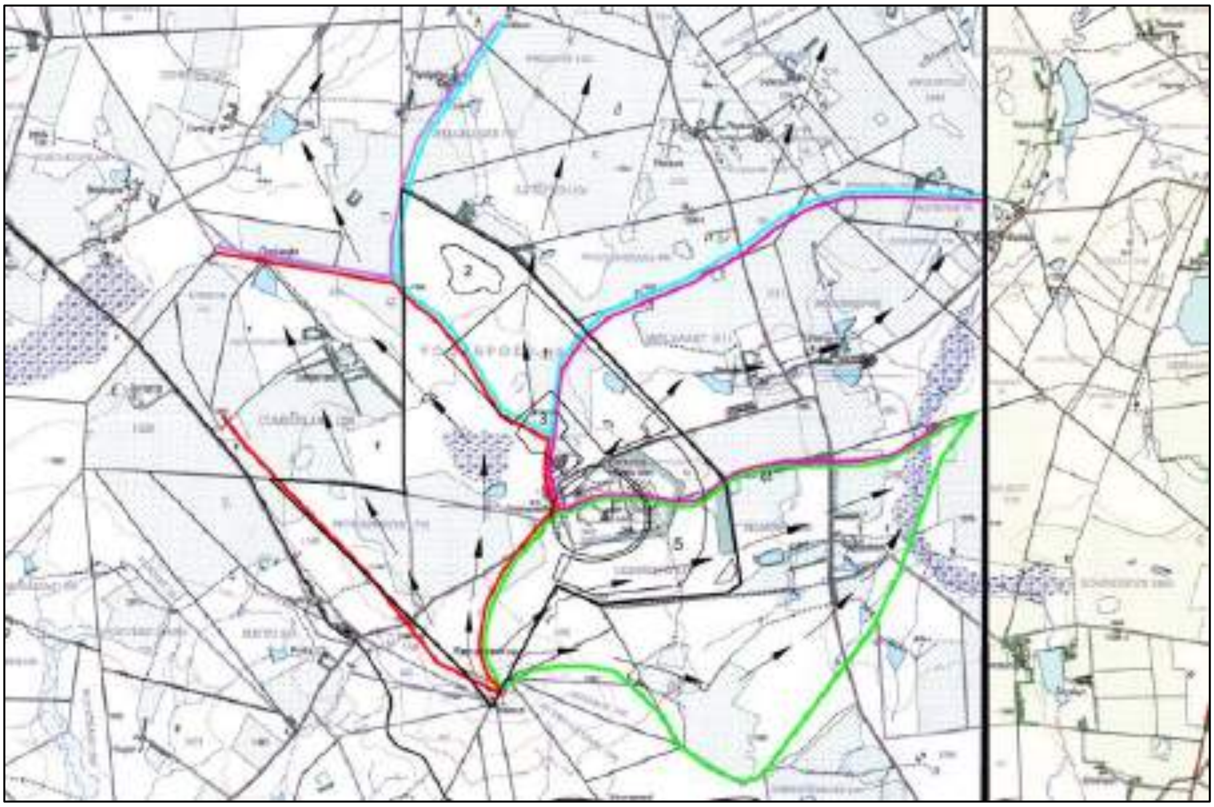


Figure 14. Sub-catchment boundaries (from Metago, 2005a).

Mean annual precipitation and evaporation

Data on mean annual precipitation (MAP) has been obtained from the Welvaart weather station (Jones & Wagener, 2012). The MAP based on daily readings from the Welvaart station (in 2012) was 557mm. Peak rainfall volumes in excess of 800mm per year have been recorded. Highest monthly rainfall is typically recorded in January and the lowest in July.

Rainfall depths that have been used as design inputs for Voorspoed are (Jones & Wagener, 2012) presented in Table 8.

Table 8. Rainfall data used as design inputs for Voorspoed Mine (Jones & Wagener, 2012).

Recurrence	2yr	5yr	10yr	20yr	50yr	100yr
24 hour rainfall (mm)	51.4	68.9	81.4	94.1	111.5	125.4

Evaporation readings were obtained from the Kroonstad Agricultural Station and has been calculated by Jones and Wagener (2012) to amount to 1245mm/a.

Pans and Wetlands

Other notable surface water features within the mining right area include two endorheic pans (the Northern Pan and Southern Pan) and a wetland (recently re-classified as an endorheic pan by Exigo, 2016b) (Figure 15). The pans are 12.3 ha and 7.7 ha in maximum extent with the volume of water in the pans proportional to rainfall as water accumulation within the pans only exits by means of evaporation and infiltration. In terms of their pre-mining baseline condition, both pans were impacted to a greater (southern pan) or lesser (northern pan) extent by land use practices at the time. These impacts included (Strategic Environmental Focus, 2004a):

- Northern Pan - impacted by livestock watering which reduced the amount of water in the pan and resulted in trampling and overgrazing of the surrounding vegetation. The pan was still functioning well (high ecological functioning) and supported a variety of animal life. The pan was considered to be of high conservation importance and ecological sensitivity.
- Southern Pan - Blue gum trees planted around the pan and 'sand-winning' operations (prior to mining) changed the pan from being endorheic to functioning as a drainage line. These impacts reduced the pan's functionality and conservation importance. The pan was however still considered to have high ecological sensitivity.

The wetland, located to the west of the Pit, was classified as a hillslope seepage wetland with an extent of approximately 29 ha. Despite the wetland being considered to have little conservation importance, it still maintained value from the ecological functions it provided. These included habitat and food during the wet season, a water filter and water attenuation during flood events (Strategic Environmental Focus, 2004b).

Downstream water users

Surface water users immediately downstream of Voorspoed included the neighbouring properties Welvaart 1011, Cumberland 1228 and Rusting 850. Water also flows into farm dams on these properties as well as Grasvlakte 1887 (via Cumberland 1228).

Water quality

No surface water quality samples were obtained during the sampling run for the EIA (in 2003 / 2004) as all features were dry (Metago, 2005a). Some baseline water quality data (from 2007) is captured in the mine's water monitoring database (De Beers Voorspoed – From Start Rev 2.xlsx).

Figure 15. Delineation of the pans and wetland (pre-mining)

3.2.3.3 Operational Management

Mine water supply and infrastructure

Make-up water required for the plant is abstracted from the Renoster River via a weir. The weir was constructed prior to mining operations at Voorspoed. This water supply forms part of the Koppies Government Water Scheme. An 18km pipeline runs from the weir to deliver water to the mine. Potable water is supplied from an on-site borehole.

Precipitation falling on top of the Mine Residue Deposits (MRDs) either evaporates or is captured within the mine's dirty water management system and re-used within the plant. This causes an impact on the quantity of water available to the receiving environment. Additionally, natural surface water drainage patterns are impacted upon due to the existence of these MRDs, resulting in contamination of storm water and less clean storm water runoff to the receiving environment (Voorspoed, 2012). The area of Voorspoed where runoff is captured and not released to the catchment (dirty water) is approximately 10.94 km^2. This represents a loss of approximately 318 175m3 MAR, which equates to a reduction of 4.36% of inflows to catchment C70H (Shangoni, 2011).

Various clean and dirty water management facilities have been constructed and utilized during Voorspoed's life of mine. The polluted water facilities were designed to capture run-off from mine residue facilities and dirty infrastructure areas and direct it via trenches to settling ponds which feed the return water dam which in turn overflows to the stormwater control dam (SWCD). Dirty water in the RWD feeds the Process Water Dam which supplies the plant with its main water feed (Jones & Wagener, 2012).

The SWCD was initially sized to cater for stormwater runoff from the plant and FRD areas. During the course of the mine however, the tailings deposition process to the FRD changed from a dry paste deposition to a wet tailings deposition. Penstocks in the FRD were installed in 2012 to drain process water as well as stormwater from the FRD. The penstock was designed to discharge into the existing channel which drained towards the pollution control dams.

The additional inflows due to the wet tailings deposition on the FRD increased the flow volumes into these dams, for which they were not initially designed. The dams were designed so that they would not be likely to spill more than once in 50 years (in accordance with GN704, section 4(d)) (Jones & Wagener, 2012).

Pans and Wetlands

A 100m buffer has been maintained around the wetland to the west of the active mining area. A smaller buffer, aligned with the catchment size of each of the pans was demarcated during the initial EIA process and was meant to be maintained throughout the LoM (Shangoni, 2010).

Both pans and the wetland have been impacted by mining activities (Figure16).

- Northern pan – the CRD has been established on the western side of the pan. Access roads have also been created to the south and east of the pan.
- Southern pan – the eastern half of the pan has been modified and an access road, pedestrian walk-way and areas of the processing plant constructed.
- Wetland – the main access road to the mine has been constructed to the north of the wetland, across the wetland outflow. The mine's security fence and a road was constructed along the eastern boundary.

Monitoring

Surface water locations are monitored on a quarterly basis including mine surface water dams, the sewage treatment plants, the Northern Pan and offsite locations.

Figure 16. Pan and wetland impacts in 2017.

3.2.3.4 Current State

Surface water quality

Water quality monitoring results obtained from the surface water monitoring locations around Voorspoed over the LoM highlight areas that will need to be addressed as part of the mine closure planning process.

Dirty water generated within the mine boundaries is contained within the Return Water and Surface Water Control Dams. Water qualities within these dams have been monitored over the LoM and the following comments are noted (Golder, 2017):

- Return Water Dam: The water was characterised by near-neutral to alkaline pH (7.3-9.0) and variable concentrations of TDS (196-1779 mg/L), calcium (22-102 mg/L), sodium (16-457 mg/L), chloride (9.9-544 mg/L), nitrate (<0.057-60 mg/L) and sulphate (21-452 mg/L).

The Voorspoed Mine water quality monitoring database (De Beers Voorspoed – From Start Rev 2.xlsx) was reviewed. The following trends are noted:

- SWM03 – increasing trends in the concentrations of Na, TDS, SO_4, Cl and EC above baseline levels is noted over the LoM. Whilst the actual concentrations have remained within drinking water limits for these constituents, the increasing trend could reflect impacts from surface runoff originating from the FRD and CRD.

Samples of the seepage generated by the various MRDs were analysed in 2017. The results indicate that concentrations of some parameters exceeded DWS Class 1 drinking water standards. These parameters were (Aquatico, 2017):

- FRD seepage – EC, TDS, SO_4, Nitrate and Na.
- CRD seepage – EC, TDS, SO_4, Nitrate, F and Na.
- WRD seepage – TDS, SO_4 and Nitrate.

Open Pit

The Pit in the operational phase does not constitute a significant surface water feature. Any accumulation of rain water and groundwater in the Pit is pumped out to ensure the safety of mining operations.

Pans and Wetlands

The two pans have been affected by mining infrastructure and activities (Exigo, 2016b):

- Northern pan – located to the east of the Coarse Residue Dump (CRD) has been affected by diversion canals and hauls roads around the facility which have contributed to diverting surface run-off from feeding the pan. The CRD extends to the border of the Northern Pan and recent monitoring has revealed that this has impacted water quality in the pan (Aquatico, 2014).

- Southern pan – located adjacent to the offices and EMV workshop the pan has been affected by the construction of treatment plant components, roads and a concrete walkway (Exigo, 2016b).

3.2.3.5 Anticipated Post Closure Impacts

Golder Associates (2017) completed a geohydrological contaminant transport model to predict the extent, significance and pathway of pollution plumes arising from seepage from the Voorspoed Mine MRDs and Pit. The results are described further in the Groundwater section (Section 3.2.4) however aspects of this study have application to surface water impacts as well.

This study was supplemented by an assessment by Golder Associates (2019) into the risks, impacts and management requirements for pit backfilling versus the establishment of a pit lake. This assessment considered three scenarios. Scenario 1 (establishment of a pit lake) most closely aligns with the proposals of this Mine Closure Plan.

The primary surface water post closure considerations include:

- Within 10 – 15 years post closure the non-perennial stream that runs from underneath the FRD to the north-east of the mine will act as a sink to the solute plume over time. As the stream is non-perennial the salt loads will likely accumulate during dry periods and be flushed downstream following rainfall events. This may result in periodic spikes in surface water quality as a consequence of discharges to the stream (Golder, 2017). Based on the risk, it is not anticipated that additional mitigations other than proposed rehabilitation measures and water quality monitoring will be required.
- Seepage of groundwater into the open pit will accumulate post closure as dewatering of the Pit will no longer be required. A Pit lake will develop over time (Figure 17) and is expected to reach a level of 1313 mamsl after 200 years (Golder, 2019, Scenario 1).The Pit is not expected to decant as the water surface will be approximately 95m below surface at 200 years post closure. The pit will continue to act as a sink for groundwater indefinitely (Golder, 2017).
- Channelling of runoff from surface infrastructure into the Pit could increase the rate at which the Pit re-waters post mining.
- The quality of drainage from the wall rock in the Pit is likely to be similar to that of leachate from the WRD in the long term. Inflows and evaporation will influence the concentrations over the long term. The TDS concentration in the pit at 200 years post closure is estimated to be 598 mg/l (Golder, 2019) which is below the domestic water quality limit of 1000 mg/l.
- Constituents of concern that are likely to remain elevated in the Pit water include TDS, Nitrate, SO_4 and F. Under normal climate conditions it is expected that these concentrations will be limited to the Voorspoed Mine area.
- Sodium concentration stays below the livestock limit for all scenarios considered. For Scenario 1 the Sodium concentration exceeds the domestic water limit at the onset of re-watering but drops below the limit within 2 years.

- Sulphate concentration stays below the livestock limit in all scenarios considered. For Scenario 1, the Sulphate concentration also stays below the domestic water quality limits. The calcium trend is similar to the sulphate trend.
- Selenium exceeds both the livestock and drinking water limits for most of the time. For Scenario 1 the Selenium concentration drops below the domestic water limit but then starts to increase until it is exceeded approximately 100 years after closure.
- Seepage water qualities from the CRD, FRD and WRD were analysed. See the Groundwater section for further detail.
- Water qualities of the RWD water indicate that, on decommissioning, this water will not be suitable for discharge to the environment as it has exceeded drinking water and livestock watering guidelines.

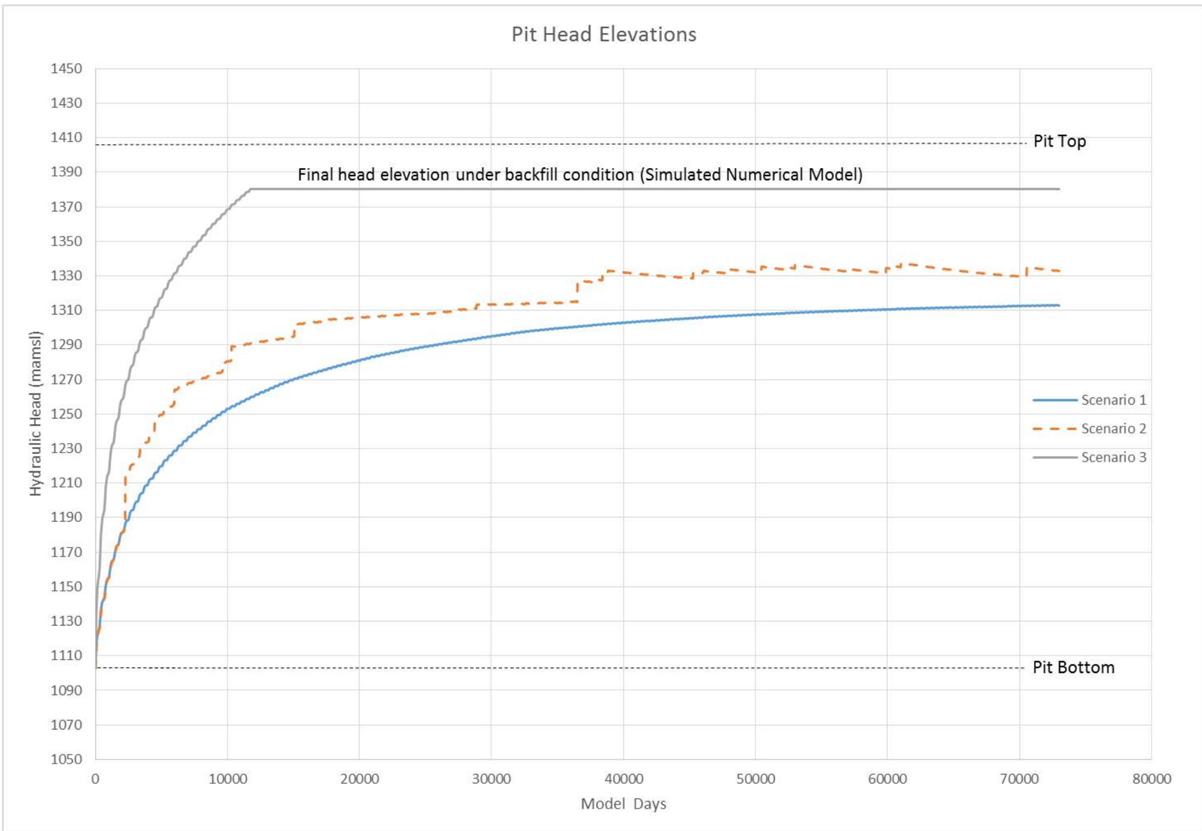


Figure 17: Simulated water head in the pit (Golder, 2019)

The anticipated post closure impacts for surface water and associated considerations are presented in Table 9.

Table 9. Anticipated surface water post-closure impacts.

Issue	Anticipated Impact/s	Considerations
Surface water quality impacts to the non-perennial stream running to the north-east of the mining area.	Periodic spikes in surface water quality (above drinking water qualities) as a consequence of discharges to the stream from the groundwater pollution plume.	Impacts have not been discussed with stakeholders to date. This will be addressed as part of the updated (2019) Stakeholder Engagement Plan (SEP).

Issue	Anticipated Impact/s	Considerations
Contamination of off-site surface water resources as a result of run-off from MRDs is expected. However, due to incomplete monitoring data there is a lack of understanding of the significance of current and post-closure impacts on offsite surface water receptors. The C70H catchment has been identified to be located in a River National Freshwater Ecosystem Priority Area (NFEPA) catchment.	• Surface water qualities in offsite dams may already have been impacted by runoff from the MRDs. • Water monitoring of surface receptors has not been consistent in recent years thus the actual impact is uncertain. • The salt water balance completed by Golder only considered operational phase impacts.	• Modelled surface water impacts to offsite sensitive receptors has not been undertaken thus the extent and significance of anticipated impacts is uncertain. • Impacts have not been discussed with stakeholders. This will be addressed as part of the updated (2019) Stakeholder Engagement Plan (SEP).
Reduced inflow and poor quality of water feeding the Northern and Southern Pans and Wetland, impacting on the ecological functioning of these systems.	• The pans and wetland have become dewatered during the LoM as a result of mining activities. • The quality of water in the Northern Pan has deteriorated as a result of the development of the CRD adjacent to the pan.	• Impacts have not been discussed with stakeholders. This will be addressed as part of the updated (2019) Stakeholder Engagement Plan (SEP).
Reduced flow of clean water in the C70H catchment as a result of containment of dirty mine water within the mine area.	• This represents a loss of approximately 318 175m^3 MAR, which equates to a reduction of 4.36% of inflows to catchment C70H.	-
The volume and quality of water that will be contained in the RWD 10 years post-closure is unknown at present. The quantities and qualities may influence disposal options for this water when the RWD is decommissioned.	• The quality of water in the RWD at the time of decommissioning may not be suitable for discharge to the environment.	• Expected qualities of the water in the RWD need to be monitored.

3.2.4 Groundwater

3.2.4.1 Regional Context

Groundwater in the Free State Province has been, and continues to be used for rural domestic supplies, stock watering and water supply to several towns, where surface water supply is inadequate or bulk water supply is not financially feasible. Groundwater is well utilised for water supply in the Middle Vaal, Lower Vaal and Upper Orange water management areas and is the only water resource available in many areas.

3.2.4.2 Pre-Mining Baseline

Aquifer types

The subsurface hydraulic zones at Voorspoed can be categorised into four zones (SAGC, 2004):

1. A regional shallow aquifer related to the layered sedimentary Karoo rocks dominated by shale and mudrock of the Ecca Group that has a general low permeability. This aquifer zone can be

divided into an upper weathered/fractured zone that extends from surface to 40-60 m depth and a deeper fractured/solid zone.

2. Faults and dolerite dyke intrusions with associated fracturing or fill material may form zones for groundwater movement or barriers impeding groundwater flow.
3. A localised deep aquifer occurs (100 – 400 m) that is defined by faulting and brecciated rocks associated with the kimberlite intrusions in the area. Deep seated faulting, fracturing and weathering associated with intrusion will have a significant effect on the hydraulic character of the aquifer.
4. Regionally occurring localised shallow aquifers associated with surface water drainage courses such as the zone defined by the confluence of the Heuningspruit and Renoster River in the north of the project area.

Groundwater does not directly contribute to the base flow of local streams in the direct vicinity of Voorspoed Mine. These streams and/or drainage lines are non-perennial and are only active during and after rain events.

Groundwater users and levels

A hydrocensus was conducted before mining operations commenced. A total of 32 boreholes were surveyed within a 6km radius of the pit area. Water from these boreholes was used as follows (SAGC, 2004):

- 7 boreholes were used for stock watering only;
- 9 boreholes were used for stock watering as well as domestic water supply;
- 1 borehole was used exclusively for domestic supply (farm Welvaart).

None of the boreholes surveyed were used for irrigation supply.

Average borehole depth ranged from 20m to 200m with domestic and stock watering boreholes drilled up to 50m deep. Regional static water levels ranged from 3m to 30m below ground level. Groundwater usage immediately downstream from Voorspoed Mine is used for stock watering and domestic purposes. Groundwater is the only source of water for farms located away from the Heuningspruit.

Groundwater quality

Fourteen groundwater samples were analysed for water quality during the pre-mining EIA process. These results were compared against the DWS Target Water Quality Range for Domestic Use (TWQR, 1996). The following results were obtained:

- The average electrical conductivity value of groundwater samples was 108 mS/m with a minimum of 75 mS/m and maximum of 294 mS/m (Pit 1). The Electrical Conductance (EC) values from all the samples exceeded the DWAF TWQR of 70 mS/m, with the maximum EC content observed in Pit1. Values from this sample were however below the upper limit for Class II water quality (SABS Standard).

- The pH levels of all the observed samples were within the pH range of 6.9 - 8.6, i.e. neutral pH.
- Elevated fluoride concentrations were detected in samples Pit 1 and Pit HB. These values were below the upper limit for Class II water quality.
- Nitrate concentrations in groundwater samples ranged between 2 and 36 mg/L (VD BH4). Samples from BH12, BH13 and VD BH4 exceeded the SABS standard for Class II water quality (maximum allowable).
- Elevated sodium concentrations were detected in samples Pit 1, Pit HB, BH10, VD BH1, VD BH3 and VD BH4. Except for Pit 1, all samples were below the upper limit for Class II water quality.
- The iron concentration values obtained from all groundwater samples within the Voorspoed Diamond Mine area exceeded the DWAF water quality guideline for domestic water use. Concentrations from Pit 1, VD-BH3 and VD-BH4 also exceeded the limit for Class II water quality.
- Manganese concentrations, which exceeded the Target Water Quality Range, (1996) were observed in samples Pit 1, VD BH1, VD BH3 and VD BH4. Elevated aluminium concentrations were also observed in Pit 1, VD BH3 and VD BH4.

The obtained water qualities were plotted on Piper diagrams to characterize the chemical signatures of the water. Three distinct chemical groups were determined (SAGC, 2004):

- Water samples from Group 1 (BH12, BH13, BH15, BH17and BH30,) have a carbonate-bicarbonate character. No distinct cation group was identified. This group is characteristic of recharged water.
- Water samples from Group 2 (VD-BH1, BH10 and BH8) have a sodium-bicarbonate character and is characteristic of ion-exchanged waters.
- Water samples from Group 3 (VD-BH3, VD BH4, Pit 1 and Pit HB) have a distinct sodium-bicarbonate character, which is indicative of ion exchanged water. Based on the chemical character, the pit and VD-BH3 may be linked by the same fracture system.

3.2.4.3 Operational Management

Mining Infrastructure

Activities at Voorspoed over the life of mine have the potential to impact on both groundwater quality and quantity. A number of waste facilities have been constructed (potential quality impacts) as well as the pit where dewatering has been required (albeit limited dewatering) to continue with safe operations (potential quantity impacts).

Waste facilities include:

- Fines Residue Deposit (FRD)

- Coarse Residue Deposit (CRD)
- Waste Rock Dump (WRD)
- Stormwater Control Dam (SWCD)
- Return Water Dam (RWD)

None of the mine residue facilities (CRD, FRD or WRD) are lined thus enabling seepage of contaminated water into groundwater reserves. The RWD is lined with a 1500 micron HDPE liner. The SWCD is lined with mudrock (Jones & Wagener, 2012). Disposal of residue on the FRD changed from the planned paste deposition to a wet deposition during the LoM. Penstocks were installed (in ± 2013) which would have assisted with capturing and removing water from the FRD.

The pit is dewatered in order to continue with safe mining operations. Predictions by SAGC (2004) based on a maximum pit depth of 100m were that groundwater inflows to the pit could range from 450 m^3/day to 1 000m^3/day.

Monitoring

Groundwater quality and depth of water are monitored on a quarterly basis. Water samples are submitted to a SANAS accredited laboratory for analysis. The location of existing monitoring boreholes is reflected in Figure 18.

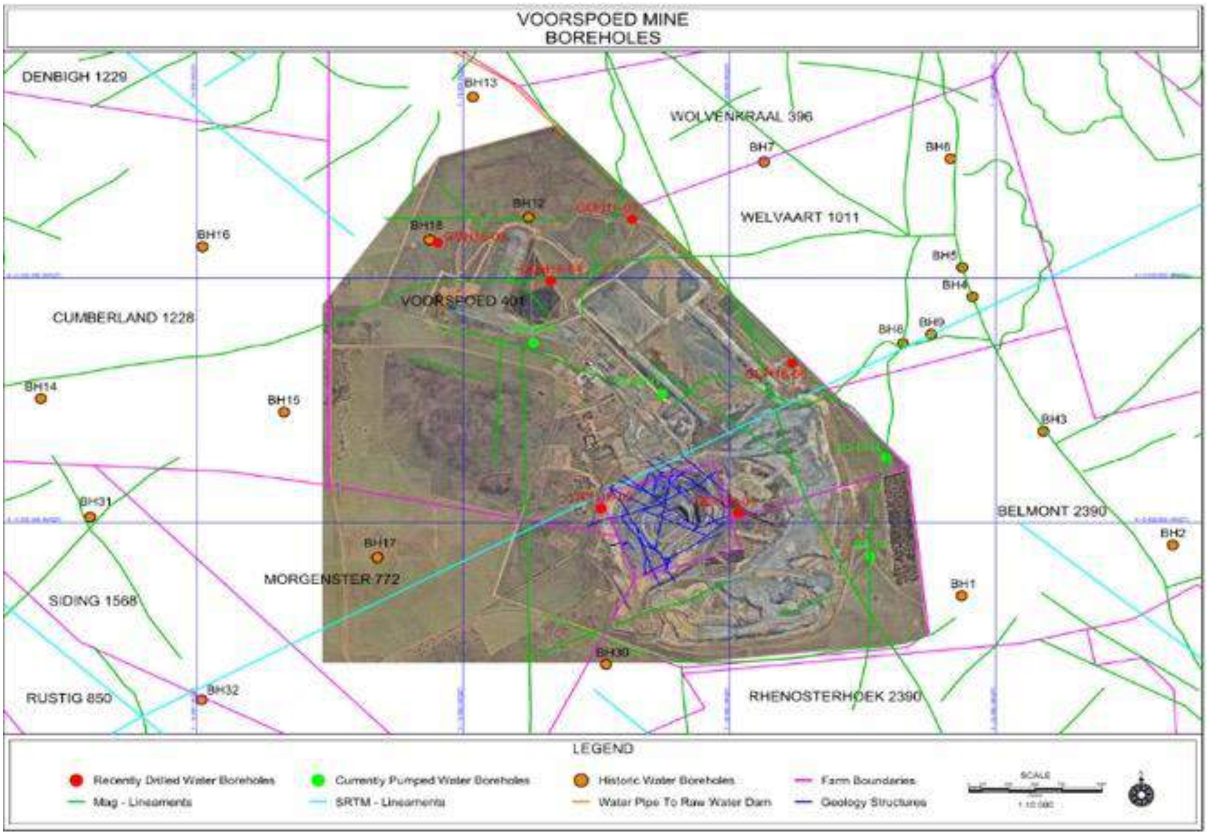


Figure 18. Location of groundwater monitoring holes (Voorspoed, 2017)

Groundwater flow and levels

As a result of pit dewatering activities, the open pit acts as a sink for local groundwater flow. Groundwater in the areas of the MRDs flows away from the pit. Because Voorspoed is situated on relatively flat topography the groundwater flows generally radiate outwards towards the local perennial rivers (Figure 19).

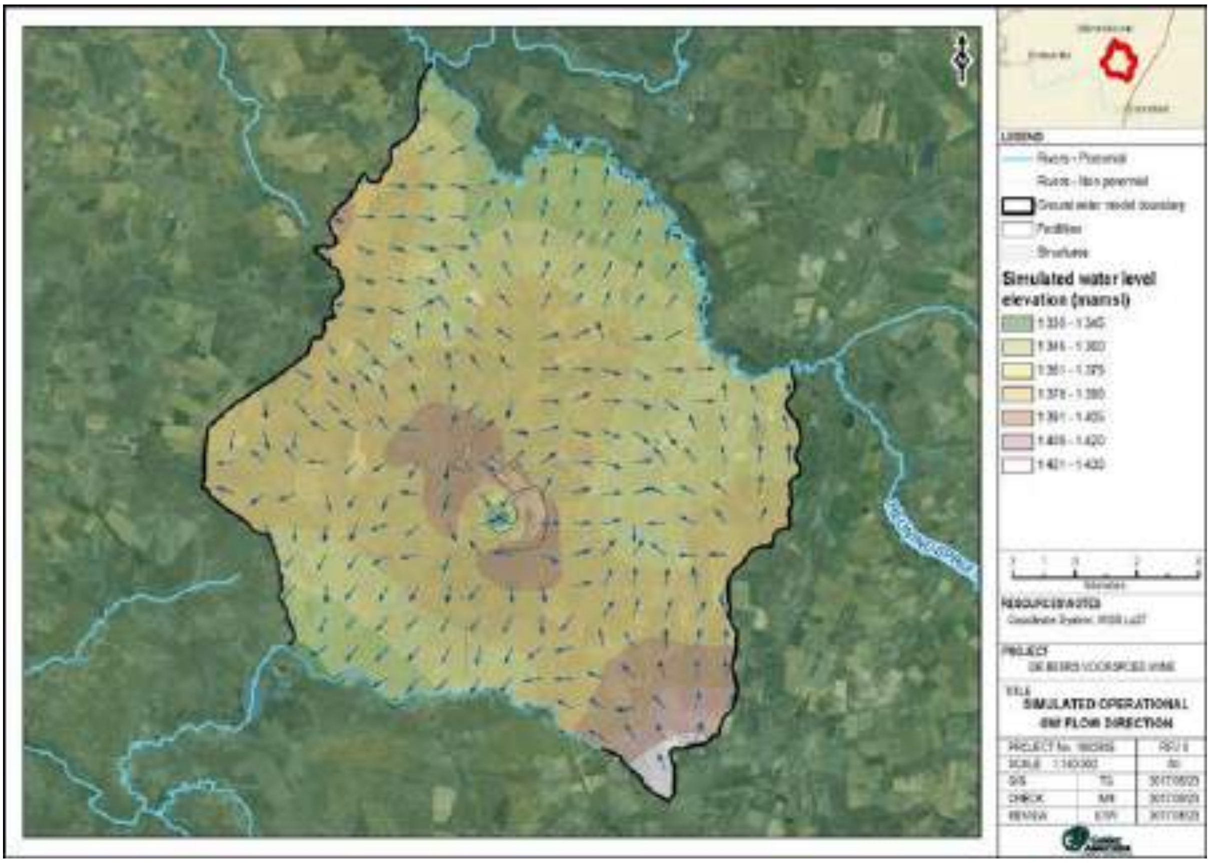


Figure 19. Operational groundwater flow directions (from Golder, 2017)

3.2.4.4 Current State

Groundwater hydrocensus 2017

An updated hydrocensus was conducted by Golder in 2017 in order to determine:

- If additional potential receptors occur within the study area; and
- If water uses have altered since mining operations commenced.

During the survey, 12 boreholes outside of the mining area were surveyed of which eight could be recorded for water level and / or water quality.

Groundwater quality

Water qualities are monitored on a quarterly basis by Aquatico. Their analyses only reference DWS drinking water standards and do not consider changes in water chemistry compared to the pre-mining baseline. Golder (2017) analysed 16 water samples during their hydrocensus campaign (including mine dirty water facilities). The following conclusions regarding the current state of groundwater quality within and beyond the Voorspoed Mine area can be drawn:

- Natural groundwater quality evolves from recently recharged waters characterised by a Ca/Mg-HCO_3 signature to water representative of dynamic flow, characterised by a Na-HCO_3 signature and gradually towards a deep Karoo water quality signature which is characterised by Na-Cl signatures.
- Stagnant groundwater, or groundwater impacted by mining activity is characterised by elevated levels of Cl and SO_4.
- The Pit water sample displayed a Na-SO_4 signature.
- Water samples associated with the CRD and FRD have Na-Cl signatures which likely reflects the background hydrochemical signature of Karoo sedimentary formations.
- The FRD, CRD, RWD and Pit Water also contain elevated concentrations of Nitrate (NO_3 as N).
- Although the Pit Water, FRD, CRD and RWD have high levels of SO_4, the background Na-Cl signature of the Karoo aquifers still dominates the water quality signature in the area.
- Groundwater quality from the mining area has slightly elevated salinity levels (TDS ~750mg/l) compared to the surrounding far field area (TDS <500mg/l).

Borehole MBH-02 is located offsite and a review of the water quality data for this monitoring point over the LoM indicates a steady increase (Figure 20) in salinity (Nitrate). Whilst the current concentrations are within drinking water limits, the increase above baseline concentrations is notable. This is also an important observation as it indicates a potential risk for the surface water system downstream of Voorspoed Mine after closure (see Surface Water, Section **Error! Reference source not found.**) (Golder, 2017).

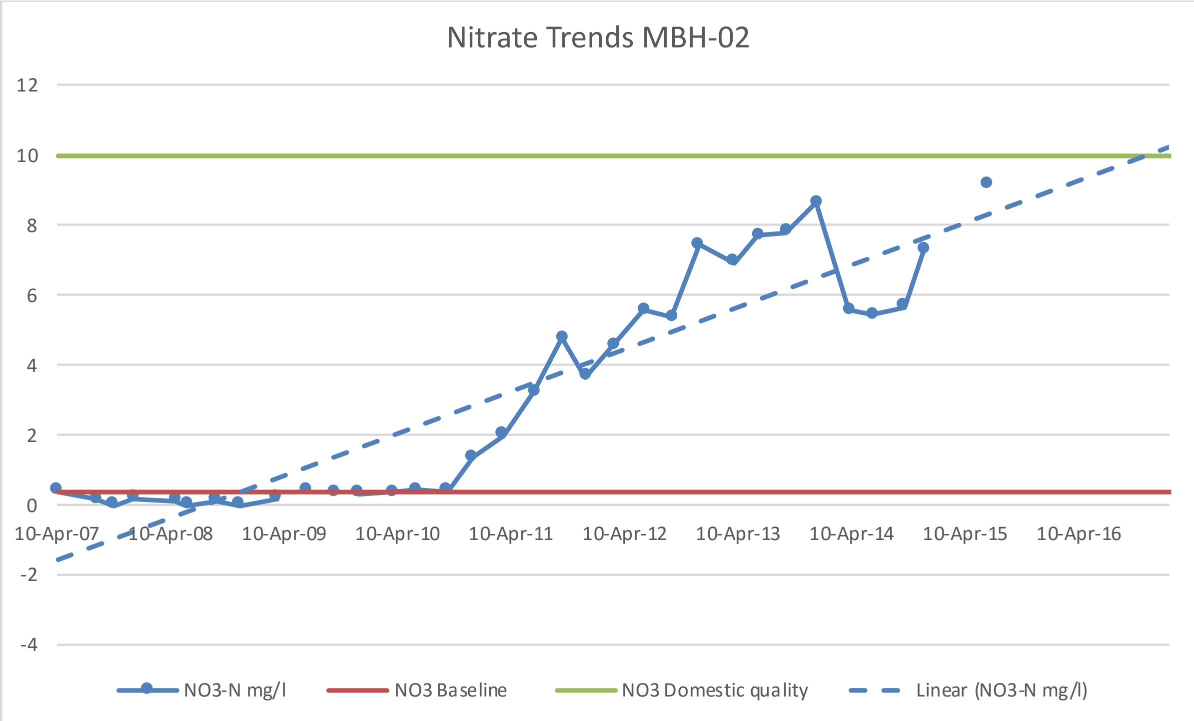


Figure 20. Nitrate trends in borehole MBH-02 (data from Voorspoed Mine)

Borehole VDBH01 is located within the mine area, to the immediate west of the pit. This borehole is also close to the FRD which is another potential contaminant source. Analysis of TDS concentrations in this borehole over the LOM indicate rising trends. The resultant water quality (in terms of TDS) however remains within the Class I DWS water quality range (Golder, 2017).

Groundwater levels

As a result of mining operations and pit dewatering, a local dewatering cone has developed around the pit area (Golder, 2017). The cone does not extend beyond the mine's borders (Figure 21). On the eastern side of the pit, seepage from the WRD has limited the lateral movement of the dewatering cone which extends further to the west of the pit.

Monitoring undertaken by Aquatico confirms that the closest borehole to the pit (VD BH01) has been impacted by the pit dewatering. Following the cessation of pumping from this borehole the water level has recovered to 10m higher than the pre-mining water level of 2004 (Golder, 2019). The closest borehole supplying an external party is LEONARD2, located to the south of the mine. Levels in this borehole have remained stable (Aquatico, 2014).

Golder (2019) further concludes the following with respect to the current status of groundwater levels at Voorspoed:

- VDBH04 is located 400 m from the foot of the coarse waste rock dump. Based on measured water levels and inferences from topography, groundwater is expected to flow from the waste rock dump toward this borehole. The water level trend at this site closely represents the CRD trend.

- MBH01 - MBH05 are located on adjacent properties north and north east of the mine. With the exception of MBH01 and MBH 05, the remaining monitoring boreholes have sporadically been monitored and consequently data interpretation is limited. MBH01 and MBH 05 both closely correlate with the CRD trend.
- MBH10 and MBH 19, showed sharp rise in water level (> 15 m) that were seemingly associated with significant recharge events. These types of fluctuations are common in low permeability aquifers.

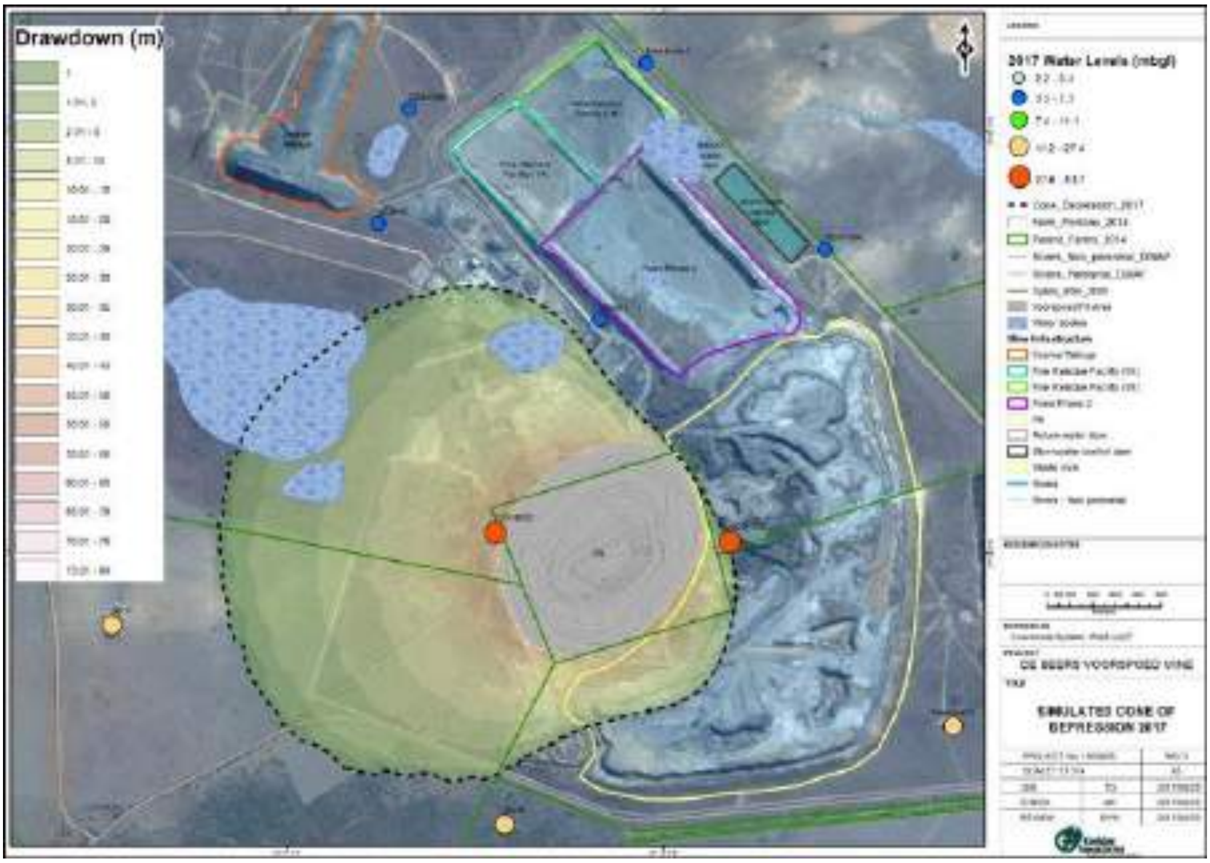


Figure 21. Simulated cone of depression (from Golder, 2017)

3.2.4.5 Anticipated Post Closure Impacts

Groundwater levels

On cessation of mining operations, the need to dewater the pit will discontinue and groundwater levels will begin to recharge and rebound. The country rock has low permeability which will influence the rate of groundwater level recharge and development of the pit lake. Aquifer saturation levels have only been impacted around the pit, and will therefore not be a significant factor for a post closure management measure. This issue is described further in the Surface Water section (**Error! Reference source not found.**) (Golder, 2017).

Groundwater quality

The most likely post-closure groundwater impact will be the further development and migration of the contaminant plumes associated with the CRD, FRD and WRD. Golder (2017) modelled the development and movement of a potential contaminant plume using SO_4 as an indicator as there is no other source of sulphate within close proximity to the mine thus it is a suitable tracer of mine seepage. The following is expected in respect of migration of the contaminant plume (Golder, 2017):

- The Pit will continue to act as a sink during the post operational phase of the LoM and as such some of the seepage from the WRD and FRD will continue to be captured by the Pit;
- Due to the low permeability of the aquifer, the radius of influence of the pit is limited and consequently a component of seepage is expected to migrate downgradient toward the identified receiving boreholes.
- The contamination from WRD appears to be rainfall driven, hence the behaviour of the plume varies seasonally.
- However, the simulated plume for a period of 200 years indicates that the plume generated from the WRD will unlikely exceed the drinking water limits in terms of sulphate on the farms neighbouring the mine.
- The CRD, while having the highest source concentrations, does not appear to impact on nearby boreholes. It follows that either seepage from this site is not entering the groundwater system or that the boreholes installed do not suitably represent the upper fractured aquifer.
- Seepage from the FRD is predicted in part to migrate towards the pit and off site in a north easterly direction toward identified receptors.
- The two receptor boreholes which are likely to be impacted over time, BH30 (15 years post operations) and BH 4 (100 years post operations) are expected to gradually increase in sulphate concentration but are not expected to exceed drinking water limits for sulphate.
- Water qualities on adjacent farms which will be affected by the sulphate plume are unlikely to exceed the SANS 241:2011 drinking water limits for sulphate. Similarly, livestock water quality limits are unlikely to be exceeded.
- Water qualities in the receiving boreholes are only likely to be impacted 10-15 (BH 30) and 100 (BH 4) years post operations. Based on the risk, it is not anticipated that additional mitigations other than proposed rehabilitation measures and water quality monitoring will be required.

The conceptual post closure hydrogeological model described above is presented in Figure 22.

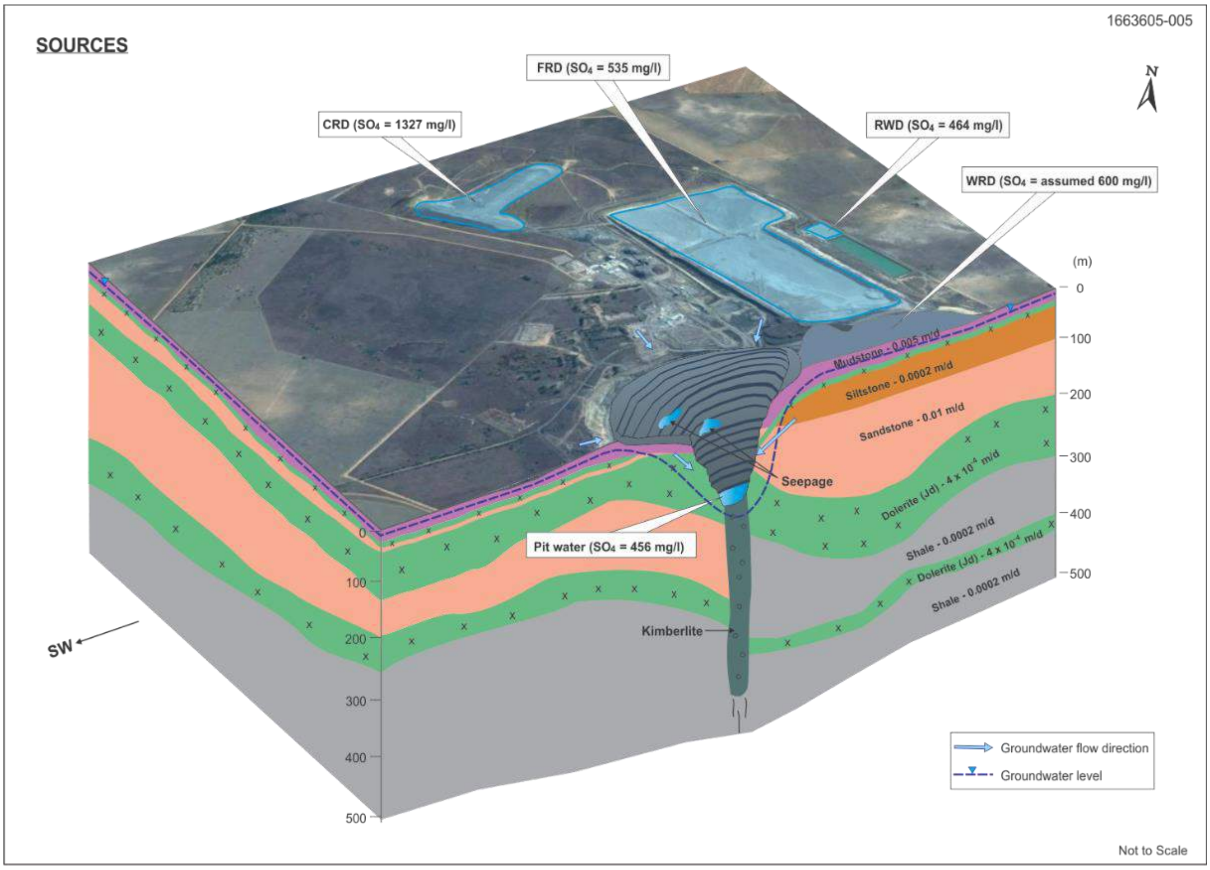


Figure 22: Conceptual 3D block model for post closure (from Golder, 2019)

The anticipated post closure impacts for groundwater and associated considerations are presented in Table 10.

Table 10. Anticipated groundwater post-closure impacts.

Issue	Anticipated Impact/s	Considerations
A pollution plume has been caused by seepage from the various MRDs. This plume will impact water qualities in boreholes within the mine area and on neighbouring properties.	• The Pit remains a local sink for groundwater contamination post operations. • The water qualities in affected boreholes are expected to remain acceptable for human and / or livestock consumption post mining. • Groundwater immediately below the CRD, FRD and WRD is expected to be most significantly impacted by contaminated seepage and will be unusable for domestic and / or livestock consumption.	• The model was based on sulphate concentrations as an indicator of mine-impacted water. It is uncertain to what extent other parameters are likely to be impacted as a result of seepage from the MRDs. • Additional monitoring boreholes are required (including drilling) to track the progression of the pollution plume over time. These have been recommended by Golder (2017) and Voorspoed Mine is in the process of incorporating the additional boreholes into to the mine's monitoring network. Information derived from the new boreholes will be used to update the groundwater model.

Issue	Anticipated Impact/s	Considerations
Dewatering of the mine Pit during the operational phase has been required to ensure the safety and continuity of mining operations.	A cone of depression of the groundwater levels (dewatering cone) has been created as a result of the construction of the Pit and dewatering activities. This cone is restricted to an area of ~1.5km from the pit and does not impact external groundwater users.	None identified.

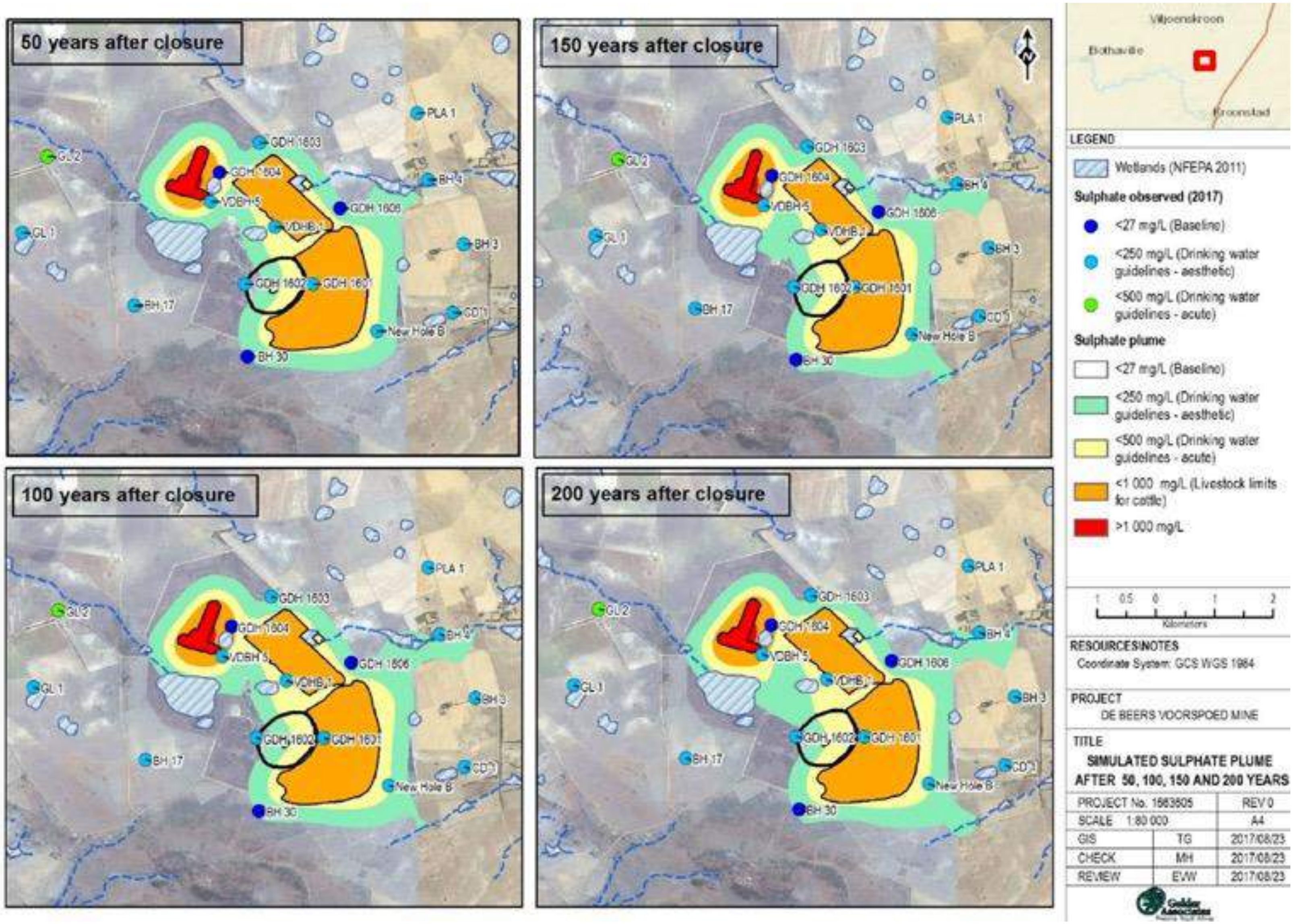


Figure 23. Modelled sulphate plume development 50, 100, 150 and 200 years post operations (from Golder, 2017)

3.2.5 Geochemistry

3.2.5.1 Pre-Mining Baseline

Prior to the commencement of mining activities, the geological units that have been targeted by the mine were largely undisturbed. The mining activities and mineral processing plant give rise to waste streams which could potentially pose risks to the environment as a result of their inherent chemical composition.

In order to determine whether or not the geochemistry of the ore or waste rock is potentially acid generating, acid base accounting tests were undertaken. In addition, samples were subjected to the South African Acid Rain (SAAR) test in order to determine what other potential pollutants may be generated from the waste materials. A total of 19 host rock samples were analysed for potential acid generation and six (6) samples subjected to the SAAR test (Metago, 2005b).

Results of geochemical analyses

Host rock samples were subjected to XRF analysis. Based on the elemental composition of the surrounding rocks, the predominant cations that could be released in any seepage and runoff would be Ca, Mg, K, Si and Na. Metals including Fe, Al, Mn and possibly other metals such as V, Cr and Ti could be present in trace concentrations, or in the event that the rock is acid generating, in potentially harmful concentrations (Metago, 2005b).

The SAAR Leach Test showed relatively low leachability of contaminants from the rock samples. Of the 38 determinants analysed, only 16 (less than 50%) showed analytical results above the method detection limit for one or more of the samples. The determinants detected in the leachate can be grouped as follows:

- Major cations – Calcium, magnesium, sodium and potassium - moderate masses were leached from all samples;
- Silica – was leached from all except one sample but is not expected to remain in solution at significant concentrations under neutral pH conditions;
- Metals – aluminium, iron; zirconium and chrome were detected in some of the tests;
- Earth alkali metals – barium, strontium and manganese were leached from all samples;
- Sulphur compounds – Sulphur and sulphate were leached from all samples in low concentrations; and
- Boron – was leached from three samples in low concentrations.

The SAAR test of the host rock material showed that the toxicological pollution potential from the host rock material, with the possible exception of manganese, is negligible.

Total leachate concentrations suggested that each tonne of waste rock generated is capable of releasing around 2.7kg of salts. This means that salinity loads from the waste rock dump may be significant in the long-term, particularly in an arid climate (Metago, 2005b).

SAAR analyses of both host rock and kimberlite revealed elevated concentrations of manganese above the acceptable risk level (ARL). Metago however concluded that manganese from waste rock was unlikely to mobilise under neutral pH conditions and would only pose a risk if the material was determined to be acid generating.

Net neutralisation potential (NNP) tests were conducted on host rock samples to determine if waste rock would be acid generating. The results revealed that all samples constituted a "very low risk" of ARD generation and that no further testing of the material with respect to the prediction of ARD was required.

The Metago analysis concluded that (Metago, 2005b):

- The most important potential impact of the waste rock dumps and tailings dam on surface runoff and seepage water quality would be on salinity of the surface runoff and possibly the groundwater depending on the geohydrological conditions. From a design perspective, a facility to collect toe seepage from the waste rock dumps and return the toe seepage to the plant would be considered an adequate mitigation measure. Runoff was expected to be less likely to result in a significant impact particularly once the waste rock dumps are rehabilitated;
- The leach test of the kimberlite showed that the pollution potential would be similar to that of the waste rock and that the key issue to be managed would again be salinity. Since a paste deposition method was envisaged and, given the fine particle size distribution of the kimberlite tailings, the impact of seepage from the tailings to groundwater or surface water was expected to be negligible. The tailings were however likely to be subject to capillary rise and hence there could be an upward migration of salts towards the surface. The key impact of the tailings dam was thus expected to be on the runoff from the tailings beach. Collection of surface runoff from the tailings surface and re-circulation/ re-use of the water in the process was expected to adequately mitigate against this impact; and
- The design of the facilities was based on the assumption that there would be very low to no risk of acid generation.

3.2.5.2 Operational Management

Mining Infrastructure

Activities at Voorspoed over the life of mine have the potential to impact on both groundwater and surface water quality. A number of waste facilities have been constructed.

Waste facilities include:

- Fines Residue Deposit (FRD)
- Coarse Residue Deposit (CRD)
- Waste Rock Dump (WRD)
- Stormwater Control Dam (SWCD)
- Return Water Dam (RWD)

None of the mine residue facilities (CRD, FRD or WRD) are lined thus enabling seepage of contaminated water into groundwater reserves. The RWD is lined with a 1500 micron HDPE liner. The SWCD is lined with mudrock (Jones & Wagener, 2012).

Source-Pathway-Receptors

A conceptual geochemical model was developed by Golder (2017). This model identifies the facilities that pose pollution risks (sources), the pathway through which pollution could be transported and the potential receptors of the pollution. This model is summarised in Table 11.

Table 11. Source-pathway-receptor model (from Golder, 2017)

Source	Pathway	Proximate Receptor	Ultimate Receptor
Open pit	Run-off on wall rock, ramps and pit floor to sump area. Seepage through fractures on pit floor.	Non-perennial tributaries of the Heuningspruit and Renosterspruit. Local fractured and weathered aquifer system and contact aquifer system associated with sub-vertical faults/dolerite dykes.	The Vaal River and the regional aquifer.
Waste rock dump	Runoff on WRD slopes. Seepage through waste rock.		
ROM stockpiles	Run-off on stockpile slopes.		
Coarse residue dump	Run-off on CRD slopes. Seepage through the coarse residue.		
Fine residue dump	Run-off on FRD wall slopes. Seepage through fine residue.		

The major receptors are:

- Surface water: Mining takes place on a watershed. Un-named non-perennial tributaries drain the eastern side into the Heuningspruit, and western side into the Renosterspruit. The Heuningspruit drains into the Renosterspruit and ultimately the Vaal River. The monitoring database for the raw water dam at Voorspoed indicates that the water quality of Koppies dam, which is located on the Renoster River, is alkaline with variable TDS (254-781 mg/L), sodium (42-218 mg/L), chloride (38-303 mg/L) and sulphate (29-118 mg/L).
- Groundwater: Groundwater around Voorspoed occurs in the shallow aquifer zone comprising the weathered and fractured, layered Karoo Ecca Group strata, which is classified as a minor to insignificant aquifer. A deep water-bearing zone may exist but contributes to a much lesser degree to the flow regime. Secondary geological structures (viz. sub-vertical faults and dykes) behave as preferential flow paths for groundwater flow (i.e. contact aquifer units). Close to the pit, groundwater flows towards the pit and north of the residue dumps, groundwater flows in a northerly and north easterly direction while south of the mine flow occurs in a south – south westerly flow direction.

Groundwater quality around the mine area monitoring sites is characterised by slightly elevated salinity levels (TDS ~750 mg/L), with elevated [rising] sulphate, sodium and chloride concentrations. Although fluoride has been identified as one of the risk constituents in the waste rock classification study, it is confined to the pit water quality and probably represents a primary, deep water source associated with the remaining Kimberlite orebody (Golder, 2017).

Hydrochemical assessment
Golder (2017) undertook hydrochemical analyses of various water sources at Voorspoed as part of their assessment. Samples included mine water, surface water and groundwater that is sampled within the mine site area. These results are described in the Surface water (Section 3.2.3) and Groundwater (Section 3.2.4) sections of this report.

Updated geochemical assessment
Samples of material from the various mineral residue facilities were taken and analysed in order to inform a determination of the potential acidity and neutralisation potential of these facilities.

Elemental enrichment in the samples was assessed in order to identify elements that could be considered potential constituents of concern (PCOCs). PCOCs could pose a risk to the environment as these elements are present in concentrations greater than crustal concentrations. The PCOCs identified were:

- The waste rock materials from the waste rock and pit walls at Voorspoed are enriched (in decreasing order) in carbon, bismuth, antimony, boron, chromium, arsenic, sulphur, tungsten, lithium, selenium, nickel, magnesium and uranium
- Samples from the coarse residue and fine residue materials at Voorspoed are enriched (in decreasing order) in tellurium, carbon, bismuth, platinum, gold, selenium, arsenic, antimony, lanthanum, chromium, boron, barium and sulphur.
- Selenium, arsenic, antimony, chromium, boron and sulphur are environmentally-significant as they are associated with sulphides, carbonates and mafic silicate minerals, which are fast weathering minerals. These are therefore PCOC for seepages from the waste rock dump and pit water.

Golder also carried out Australian standard leaching procedure (ASLP) and net acid generation (NAG) leach tests on coarse residue, fine residue and waste rock samples, in order to obtain indications of the potential drainage quality and PCOC from the mine residue dumps at Voorspoed. The results were also compared to DWS (2016) water quality planning limits (WQPL) for the management units in the Renosterspruit catchment. The WQPL replaced the resource water quality objectives (RWQO). It should however be noted that WQPL are set only for pH, EC, turbidity and ammonia for catchment C70H, in which the Voorspoed mine is located.

The waste streams were analysed in order to classify the wastes in terms of the Waste Classification and Management Regulations (WCMR) and the Norms and Standards for the Assessment of Waste for Landfill Disposal (GN R.634 to R636, 23 August 2013). The overall geochemical profile of the waste rock materials has no exceedances of LCT0 however the waste rock does not fully meet the definition of a Type 3 waste due to a low risk from leachable concentrations. The waste is however not classified as a Type 4. A Class D barrier or cover could therefore be motivated given the geochemical profile of the waste rock.

Golder notes in a February 2019 report that all mine residue materials have sufficient buffering capacity to neutralise the initial oxidation of sulphides. Excess buffering capacity exists in the wall rock and waste rock dump materials.

The above studies concluded the following (Golder, 2017 and 2019) (Figure 24):

- Voorspoed Pit Water
  - The total dissolved solids and nitrate exceeded the domestic and livestock water quality guidelines;
  - Sodium and selenium exceeded domestic and irrigation water quality guidelines:
  - Electrical conductivity and SAR exceeded irrigation water quality guidelines;
  - Sulphate and fluoride exceeded domestic water use guidelines; and molybdenum exceeded irrigation and livestock guidelines.

- In-pit Wall Rock and Waste Rock Dump
  - Wall rock materials are likely to produce predominantly near-neutral, low-metal drainage on exposure to rainfall.
  - The following constituents that exceeded water quality guidelines (some marginally) in leachate samples are likely to be elevated in pit water and seepage from the waste rock dump
    - pH is likely to exceed DWAF (1996) domestic and irrigation water quality guidelines as well as WQPL for Renosterspruit water management units;
    - Aluminium is likely to exceed domestic, livestock and irrigation water quality guidelines;
    - Iron, manganese and arsenic are likely to exceed domestic and irrigation water quality guidelines;
    - Molybdenum is likely to exceed livestock and irrigation water quality guideline; and
    - Sodium absorption ratio (SAR) is likely to exceed irrigation water quality guidelines.
  - The NAG leachate results indicate that the waste rock materials are likely to generate neutral mine to acid rock drainage with low to high metal concentrations.
  - The total concentration of aluminium, calcium, iron, magnesium, potassium, sodium and silicon exceeds 1% in the waste rock samples. However, the leachable concentrations of these elements do not exceed the threshold for environmental hazard (at 1:20 dilution factor, 1% is 500 mg/L) as are leachable concentrations of all the other analytes. Therefore, the waste rock material from the WRD is [considered to be] non-hazardous to the environment due to low solubility of elements.

- Coarse Residue Dump
  - The coarse residue is not potentially acid generating (Non-PAG), although secondary sulphate precipitates were observed on CRD surfaces and around seepage areas.
  - The coarse residue materials are likely to produce predominantly near-neutral, low-metal drainage upon exposure to rainfall, with pH likely to exceed RWQO for local catchment management unit C70H; aluminium, iron and manganese are likely to exceed the domestic and irrigation water quality guidelines and Sodium Absorption Ratio likely to exceed the irrigation water quality guideline.
  - The material from the CRD is classified as non-hazardous waste.

- Fine Residue Dump
  - The fine residue is not potentially acid generating (Non-PAG).
  - The fine residue materials are likely to produce predominantly near-neutral, low-metal drainage upon exposure to rainfall, with pH likely to exceed RWQO for local catchment management unit C70H; aluminium, iron and manganese are likely to exceed the domestic and irrigation water quality guidelines and Sodium Absorption Ratio likely to exceed the irrigation water quality guideline.
  - The sampled materials from all the FRDs are classified as non-hazardous waste.

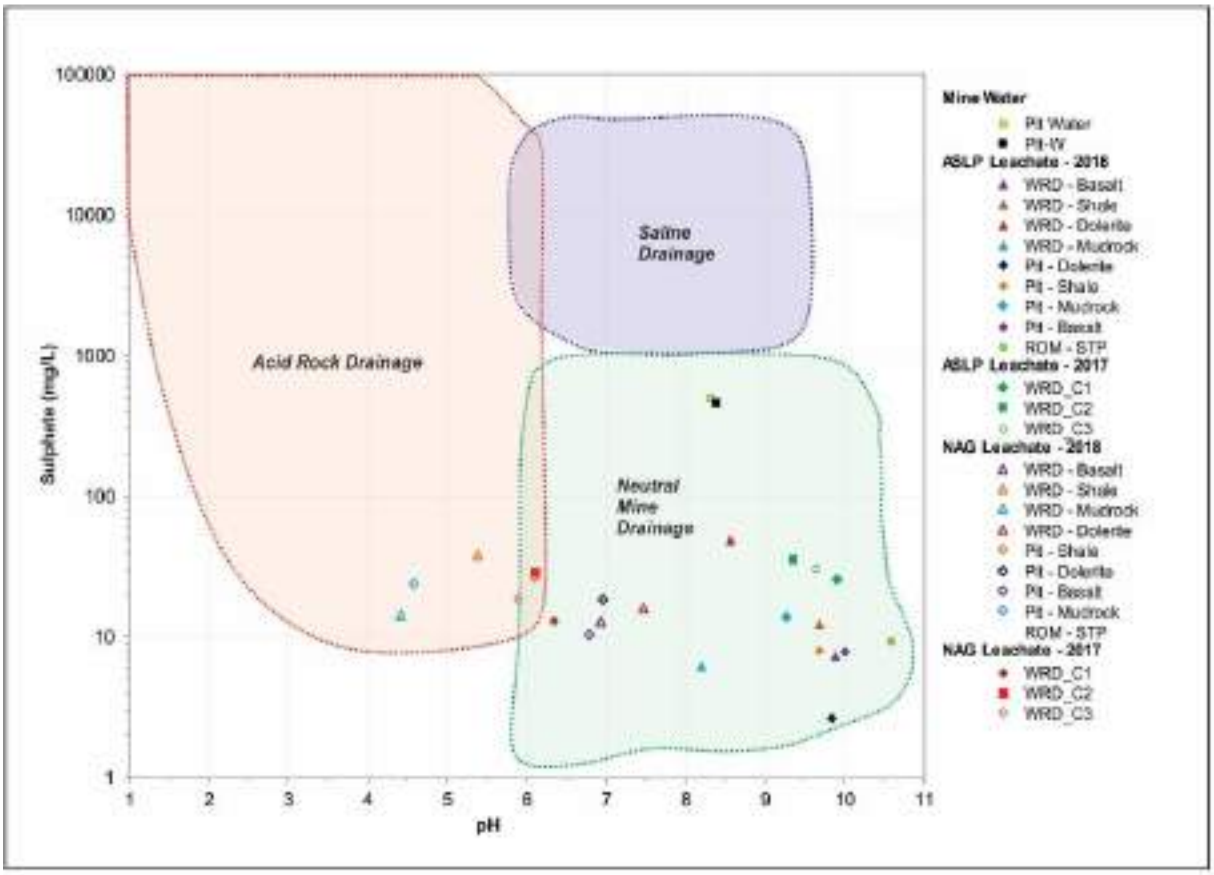


Figure 24: Classification of leachate and pit water samples from Voorspoed (Golder, 2019)

The results of the pit water sample which was collected as part of the groundwater baseline study was compared to the results of a water sample collected from a borehole (BH30) located upgradient of the open pit and which is considered to be representative of the local background water quality. The comparison concluded that (Golder, 2019):

- The baseline and background water also exceeded water quality guidelines for TDS, EC, calcium and sodium (baseline pit water). The ammonia concentration in background groundwater also exceeded the WQPL for Renosterspruit catchments. This shows that the current mining activities at Voorspoed are not the only source of these constituents.
- The baseline pit water exceeded water quality guidelines for chloride, aluminium, iron, magnesium, manganese and potassium, which were below the limits in recent pit water.
- Levels of sulphate, nitrite and nitrate, which exceeded water quality guidelines in recent pit water samples, were below the guidelines in the baseline water sample. This shows influence of mining activities on levels of these constituents in pit water. The nitrate is possibly from blasting residue and sulphate from oxidation of sulphide minerals exposed by mining activities in the pit.
- Molybdenum and selenium levels, which exceeded levels in recent samples, were not determined in the 2004 sample.

3.2.5.3 Anticipated Post Closure Impacts

The issues described in this section have been captured in the Surface water (Section 3.2.3) and Groundwater (Section 3.2.4) sections of this report. They are repeated here for completeness.

Table 12. Anticipated geochemistry post-closure impacts.

Issue	Anticipated Impact/s	Considerations
A pollution plume has been caused by seepage from the various MRDs. This plume will impact water qualities in boreholes within the mine area and on neighbouring properties.	• The Pit remains a local sink for groundwater contamination post operations. • The water qualities in affected boreholes are expected to remain acceptable for human and / or livestock consumption post mining except for selenium. • Groundwater immediately below the CRD, FRD and WRD is expected to be most significantly impacted by contaminated seepage and will be unusable for domestic and / or livestock consumption.	• The Golder model was based on sulphate concentrations as an indicator of mine-impacted water. It is uncertain to what extent other parameters are likely to be impacted as a result of seepage from the MRDs. • Additional monitoring boreholes are required (including drilling) to track the progression of the pollution plume over time. These have been recommended by Golder (2017) and Voorspoed Mine is in the process of incorporating the additional boreholes into to the mine's monitoring network. Information derived from the new boreholes will be used to update the groundwater model.
Surface water quality impacts to the non-perennial stream running to the north-east of the mining area.	Periodic spikes in surface water quality (above drinking water qualities) as a consequence of discharges to the stream from the groundwater pollution plume.	Impacts have not been communicated to stakeholders. This will be addressed as part of the updated (2019) Stakeholder Engagement Plan (SEP).
Contamination of off-site surface water resources as a result of run-off	• Potential impact to water qualities in offsite dams.	• Modelled surface water impacts to offsite sensitive receptors has not

Issue	Anticipated Impact/s	Considerations
from MRDs is expected. However, due to incomplete monitoring data there is a lack of understanding of the significance of current and post-closure impacts on offsite surface water receptors as a result of run-off from the MRDs. The C70H catchment has been identified to be located in a River National Freshwater Ecosystem Priority Area (NFEPA) catchment.	• Water monitoring of surface receptors has not been consistent in recent years thus the actual impact is uncertain. • The salt water balance completed by Golder only considered operational phase impacts.	been undertaken thus the extent and significance of anticipated impacts is uncertain. • Impacts have not been communicated to stakeholders. This will be addressed as part of the updated (2019) Stakeholder Engagement Plan (SEP).

3.2.6 Air Quality

3.2.6.1 Regional Context

Voorspoed Mine is located in a rural, agricultural setting, where the primary risk to air quality is the generation of dust, typically derived from the use of gravel roads and agricultural crop planting activities.

3.2.6.2 Pre-Mining Baseline

Prior to development of the mine, the main activities contributing to dust generation (and associated potential for air pollution) within the region include farming, small residential communities and business trade (Shangoni, 2011).

3.2.6.3 Operational Management

In addition to external sources of dust generation (primarily farming activates), Voorspoed Mine contributes to the regional generation of dust, primarily via its earthmoving and road traffic activities.

Mitigations to minimise the generation of dust during the operation phase include the use of dust allaying chemicals / materials on major haul roads, traffic areas and parking areas and the implementation of dust suppression activities. A fall-out dust monitoring programme has been implemented as part of the mine’s Environmental Management System (EMS) to monitor the extent of fall-out dust.

3.2.6.4 Anticipated Post Closure Impacts

Based on proposed mitigation and rehabilitation measures, and the cessation of mining activities, it is anticipated that the mine facilities and infrastructure areas will not constitute a significant source of dust generation post-closure. Based on proposed rehabilitation criteria, certain areas may, however, may be at risk of continued dust generation. These include the upper surface of the FRD facilities, should they dry out and not be covered with growth media to facilitate the establishment of vegetation.

Various external fugitive dust sources (e.g. agricultural activities, wind erosion of open areas, vehicle generated dust along unpaved roads) will continue as sources of regional dust generation post-closure. Sensitive receptors identified to be located nearest to the mine include the farms of Belmont, Welvaart and Labor.

The anticipated post closure impacts for air quality and associated considerations are presented in Table 13.

Table 13. Anticipated air quality post-closure impacts.

Issue	Anticipated Impact/s	Considerations
Generation of dust from mine facilities and infrastructure areas post closure	Impacts are envisaged to be low given the proposed rehabilitation measures and the cessation of mining activities.	Potential for dust generation off the upper surface of the FRD facilities should they dry out and not be covered with growth media to facilitate the establishment of vegetation.

3.2.7 Soils

3.2.7.1 Regional Context

The parent material of the soils is mainly derived from the underlying Ecca sandstone and shale with dolerite sills. Most of the area consists of moderately deep to deep, brown, apedal to weakly structured sandy loam to sandy clay loam topsoils underlain by brown to yellow-brown, apedal sandy clay loam sub-soils on a mottled soft plinthite layer. Unconsolidated material with signs of wetness may often be found deeper down. The dominant soil forms are Avalon (Av). Small areas have been found were soft plinthite occurs higher in the profile. The soft plinthite horizon is an indication of a fluctuating water table in the sub-soil in parts of the year, rising in summer and falling in winter. Usually, even at the end of the winter, the sub-soil is moist.

Lower positions in the landscape are dominated by soils where plinthic material is found higher up in the profile, which means that water may occur closer to the surface, especially in the wetter parts of the year. The dominant soil form is Westleigh (We). The lowest parts of the landscape, around vleis, dams and streams, are occupied by a dark brown, loam to clay loam topsoil horizon underlain by a brown to black, moderately to strongly structured, blocky clay loam subsoil, usually calcareous. Lighter grey, calcareous, unconsolidated material with signs of wetness often occurs deeper in the profile. The dominant soil form is Sepane (Se).

In isolated areas of the Sepane unit, the soil develops into dark, strongly structured, calcareous swelling clay soils of the Arcadia (turf) soil form with visible cracks and either a crusting or self-mulching (crumbly) soil surface. The texture of these soils is clay, with 45 - 55% clay. These soils are difficult to manage because of the heavy impermeable clay. In the south-west corner, rock and shallow soils occur, surrounded by moderately deep to deep, red and yellow-brown apedal to weakly structured sandy clay loam topsoil underlain by red and yellow-brown apedal sandy clay loam sub-soils. Occasionally a soft plinthite horizon can be found deeper down. The dominant soil forms are Hutton (Hu) and Clovelly (Cv). These soils have a moderately high agricultural potential although they may be shallow in places (Neka, 2017).

3.2.7.2 Pre-Mining Baseline

Prior to the development of the mine, disturbance of soils and associated soil horizons was limited to:

- Agricultural activities, including impacts to soils via grazing pressures and the cultivation of arable croplands; and
- Surface and soil horizon disturbance associated with historical mining (early 1900s) at the Voorspoed site.

3.2.7.3 Operational Management

Soil resources

During the operation phase of the mine, topsoil stripping, stockpiling and concurrent rehabilitation placement activities have occurred. Applicable procedures to manage these processes are in place as part of the mine's EMS. The current topsoil balance demonstrates a surplus in topsoil resources available for rehabilitation purposes.

Soil contamination

Due to the use and management of hydrocarbon-based fuels and lubricants over the life of mine, it is anticipated that that source areas (workshops, salvage yard) will have soils contaminated with hydrocarbons.

Salt contamination from MRDs is anticipated around the footprints of the MRD facilities.

3.2.7.4 Current state

Soil resources

The Voorspoed farm, which has largely been disturbed by mining, is dominated by moderately deep soils of the Avalon (Av) form, which comprise brown, apedal to weakly structured sandy loam to sandy clay loam topsoils underlain by brown to yellow-brown, apedal sandy clay loam sub-soils over a grey-brown, mottled, soft plinthite layer. The south-western and south-eastern sections of the farm contain Westleigh (We) soils that characteristically have soft plinthite occurring directly under the topsoil. Soils in and around vleis, dams and streams, typically have dark brown, loam to clay loam topsoil underlain by grey-brown, mottled sandy clay to clay subsoil with signs of wetness. The dominant soil form in these areas is Katspruit (Ka/W map unit). The dominant soil form adjacent to wetland areas on Voorspoed farm are Sepane (Se) soils that have a dark brown, loam to clay loam topsoil horizon underlain by a brown to black, moderately to strongly structured, blocky clay loam subsoil, usually calcareous. Lighter grey, calcareous, unconsolidated material with signs of wetness often occurs deeper in the profile.

The farm Morgenster contains a variety of soil forms, but is dominated by deep to moderately deep red apedal Hutton (Hu) soils and yellow-brown Avalon (Av) soils, along with smaller patches of structured Sterkspruit (Ss) soils, and with gleyed structured Sepane (Se) soils described above. In the south west corner of the farm, rock and shallow soils of the Mispah (Ms) form occur, surrounded by moderately deep to deep soils with a red and yellow-brown apedal to weakly structured sandy clay loam topsoil, underlain by red and yellow-brown apedal sandy clay loam subsoils. The dominant soil forms are Hutton (Hu) and Clovelly (Cv). These soils have a moderately high agricultural potential although they may be shallow in places. Westleigh (We) soils dominate along the northern boundary of the farm adjacent to the large wetland comprises Westleigh soils, with the characteristics described above.

On Welvaart farm the northern area comprises predominantly Avalon (Av) soils that are moderately deep to deep, comprising brown, apedal to weakly structured sandy loam to sandy clay loam topsoils underlain by brown to yellow-brown, apedal sandy clay loam sub-soils over a grey-brown, mottled, soft plinthite layer. In some areas a soft plinthite layer occurs directly under the topsoil to classify these soils as Westleigh (We) soils. The low lying drainage line running west to east through Welvaart comprises wetland soils, with the dominant soil form being Katspruit (Ka), with a small patch of Kroonstad (Kd) soils. The Sepane (Se) soil form is common on the lower slopes along the drainage line and adjacent to the wetland, and is typified by having a dark brown, loam to clay loam topsoil horizon underlain by a brown to black, moderately to strongly structured, blocky clay loam subsoil, which is usually calcareous. Along the eastern boundary of Welvaart is an area of brown, loam to clay loam topsoil horizon underlain by a yellow- brown to brown, weakly structured, clay loam subsoil, where the dominant soil form is Tukulu (Tu), with the Oakleaf (Oa) soil form being subdominant. Close to the middle of the farm is a patch of Sterkspruit (Ss) soils characterised by having a dark reddish-brown, apedal, sandy clay loam topsoil underlain by a strongly structured horizon with dark brown clay cutans.

On the farm Belmont, lying just south of Welvaart, the northern areas are dominated Westleigh (We) soils that characteristically have plinthic material lying directly under the topsoil. Most of the central part of the farm consists of Avalon (Av) soils. In the south-east, the farm also has a small area of Sterkspruit (Se) soils with the same characteristics described for the same soil form on Welvaart. The remainder of the farm is occupied by the Sepane (Se) soil form.

Soil chemistry

Soils were analysed for a range of parameters as described earlier. Clear textural differences were evident between the apedal soils (Hutton, Avalon, and Clovelly) and more structured soils (Sepane, Valsrivier, Sterkspruit). Topsoil textures are generally in the sandy loam to sandy clay loam range (10-20% clay), and the soils are not strongly leached, with subsoil values of between 20 and 30 when the sum of cations is divided by the clay percentage. Values over 15 are considered eutrophic (lightly leached), as confirmed by the presence of calcium in the subsoil, which has not been leached out as would be the case in a higher rainfall environment (Neka, 2017).

The phosphorus (P) levels in the soils are variable, generally reflecting cultivation practices, where topsoils on cultivated land have higher levels of P. The organic carbon levels also often reflect the effects of cultivation, with values generally below 1%, and often significantly so. Apedal soils are neutral to acidic, while clay soils are often slightly alkaline. The soils did not have any major cation imbalances that would affect agricultural potential of the soils (Neka 2017).

3.2.7.5 Anticipated Post Closure Impacts

The anticipated post closure impacts for soils and associated considerations are presented in Table 14.

Table 14. Anticipated soils post-closure impacts.

Issue	Anticipated Impact/s	Considerations
Extent of soil contamination with hydrocarbons at workshops	Soil contamination	Extent of hydrocarbon contamination and associated volumes to be treated or disposed

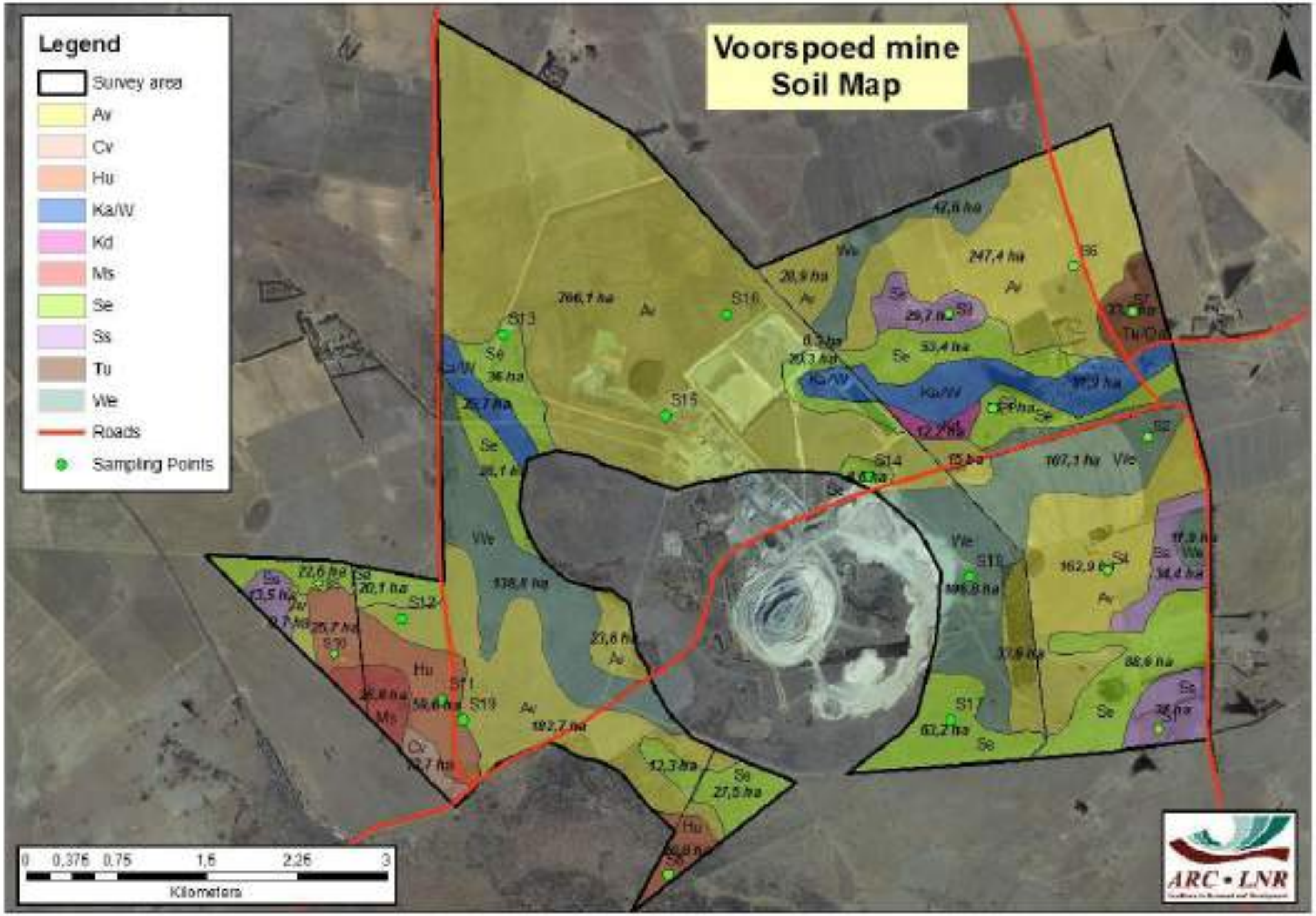


Figure 25. Voorspoed Mine soil map (from Neka, 2017).

Table 15. Description of soil units at Voorspoed Mine (from Neka, 2017).

MAP UNIT	DOMINANT SOIL FORM/ FAMILY	SUBDOMINANT SOIL FORM/ FAMILY	EFFECTIVE DEPTH (mm)	DESCRIPTION OF MAPPING UNIT	LAND CAPABILITY	AREA (ha)
Av	Av3100/3200	We2000, Pn3100	500 - 1000+	Brown to yellow-brown, apedal to weakly structured, sandy loam to sandy clay loam topsoil on yellow-brown, apedal to weakly structured, sandy clay loam subsoil on grey, mottled soft plinthite, often grading into a wet, clay layer.	Arable, moderate	1 466.2
We	We2000/1000	Av3100/3200, Pn3100	300 - 500	Dark brown to brown, apedal to weakly structured, sandy loam to sandy clay loam topsoil horizon on grey, weakly structured, sandy clay loam to clay loam, mottled soft plinthite subsoil.	Arable, low	415.0
Se	Se2220/2210	Va2122/2121, Ar1100	250 - 400	Dark brown, sandy loam to sandy clay loam, weakly structured topsoil horizon, on dark brown, moderately to strongly structured blocky clay loam subsoil, usually calcareous. Lighter grey, mottled clay material with signs of wetness is often found deeper in the profile.	Grazing	411.0
Hu	Hu3100	Bv3100, Cv3100	600 - 1200+	Reddish-brown to red, apedal to weakly structured, sandy loam to sandy clay loam topsoil on red, apedal to weakly structured, sandy clay loam subsoil, on weathering rock or (occasionally) soft plinthite.	Arable, moderate	109.1
Cv	Cv3100	Oa2120, Tu2110, Hu3100	600 - 1200+	Brown, apedal to weakly structured, sandy loam to sandy clay loam topsoil on brown to yellow-brown, apedal to weakly structured, sandy clay loam subsoil on weathering rock.	Arable, moderate	13.7
Ka/W	Ka1000	Kd1000	300-750	Dark brown greyish-brown, weakly structured, sandy clay loam topsoil on grey to grey-brown, gleyed sandy clay to clay subsoil. Surface water may occur.	Wetland	123.0
Kd	Kd1000	Ka1000	300-750	Dark brown to greyish-brown, weakly structured, sandy clay loam topsoil on grey, apedal, sandy loam to sandy clay loam subsoil on gleyed, structured, sandy clay to clay subsoil.	Grazing	12.2
Ss	Ss1200	Se2210	300-650	Dark brown to reddish-brown, weakly structured, sandy loam to sandy clay loam topsoil abruptly overlying brown, strongly structured, sandy clay to clay subsoil with dark brown clay cutans.	Grazing	115.4
Tu/Oa	Tu1110	Oa1110	600-950	Brown, weakly structured, sandy loam to clay loam topsoil horizon on yellow-brown to brown, weakly structured, sandy clay loam to clay loam subsoil, usually calcareous. Lighter grey, calcareous, unconsolidated material with signs of wetness often occurs deeper in the profile	Arable, low	33.3
Ms	Ms2100	R	0 - 250	Brown, apedal loamy topsoil directly overlying hard rock. Rock outcrops also occur in this unit.	Grazing	34.0
					Total	2 732.9

3.2.8 Land Use and Land Capability

3.2.8.1 Regional Context

Voorspoed Mine is located within the Free State Province which is predominantly known for its agricultural sector. Agriculture accounts for more than 90% of the land use in the Free State, followed by 7% used for settlements, 1.6% set aside for formal conservation, while 0.5% is used for mining activities (Redco 2014).

3.2.8.2 Pre-Mining Baseline

Voorspoed was briefly mined from 1906 to 1912. De Beers acquired Voorspoed Mine in 1912 from the Voorspoed Diamond Mining Company. Since 1912 the land use at Voorspoed has been agriculture, including the cultivation of dryland crops and the use of large portions of the Voorspoed Mine site for livestock grazing purposes. According to the Amended EMPr and associated specialist studies, there are several landscapes / environments that are regarded as sensitive and ecological important at Voorspoed Mine. These landscapes / environments are summarised in Table 16.

Table 16. Sensitive landscapes / environments at Voorspoed Mine (adapted from Shangoni, 2011)

Type of sensitive Landscape	Occurrence at Voorspoed Mine	Sensitivity	Location
Ecologically sensitive Areas (Biodiversity)	Wetland	High conservation importance.	Outside of the mining area
	Northern and Southern Pans	High conservation importance.	Within the mining Area
Natural Resources	Av, Hu and Cv unit soils	Good agricultural potential, moderate for arable.	Within and outside of the mining area
Sites of outstanding natural beauty, panoramic views	Renosterkop	Prominent natural feature, focal point of most views in the area.	Outside of the mining area

3.2.8.3 Operational Management

During the development and operational phase of the mine, large portions of the site have been altered to a mining land use. This includes the development of the open pit and associated infrastructure to support he extraction of diamonds. Associated infrastructure includes the development of existing infrastructure and mineral residue deposits as documented in Section 3.1.

De Beers-owned properties that are located outside the Mining Area and that are not impacted directly by mining activities are leased to neighbouring farmers who use the land for grazing and crop cultivation purposes. Access to certain ecologically sensitive areas is restricted by the mine, based on the requirements of the mine’s Environmental Management System (EMS).

3.2.9 Topography

3.2.9.1 Regional Context

The topography of the area is flat to slightly undulating, sloping gently to the north. There is a small koppie (known as Renosterkop) to the south-east of the mine, rising approximately 100 m above the surrounding land. The character of the area can be described as generally flat to rolling rural land comprising cultivated lands and grass veld used for grazing. Groups of large blue gum trees are scattered across the area, and are most often associated with property boundaries, farmsteads, and roads.

3.2.9.2 Pre-Mining Baseline

The area is characterised by generally flat to rolling rural land comprising cultivated lands and grassveld (composed of Redgrass and Lovegrass) used for grazing. The area is dotted with groups of large blue gum trees, most often associated with farmsteads, roads or property boundaries.

A small hill, Renosterkop, is located to the southwest of the mine site. It protrudes approximately 100m above the surrounding landscape. Its vegetation is in a 'pristine' state and provides habitat for a variety of animals and birds. It is a prominent natural feature, which is the focal point of most views in the area.

The remnants of the old Voorspoed mining operation, a waste dump and plantations of blue gum trees, were also evident within the mine site. It is evident that trees (a combination of indigenous and exotic) and other plant material have begun to 'colonize' the old spoil dump, the pit and its surrounding areas.

3.2.9.3 Operational Management

The key mining and associated activities that have resulted in topographical and/or visual impacts during the life of the operation include:

- Development (and deepening) of the open pit
- Development of Mineral Residue Deposits including:
    - Waste Rock Dump
    - Coarse Residue Deposit
    - Fine Residue Deposits
- Development of infrastructure associated with the mine.

Concurrent rehabilitation activities have commenced on site where sections of the MRDs have been profiled, ameliorated and seeded. In many areas, vegetation has successfully been established on profiled MRD surfaces, significantly reducing the aesthetic impact of the deposits.

3.2.9.4 Current State

Impacts as a result of the altering of the topography of the area is mostly aesthetic in nature. The development of large mineral residue deposits negatively impact the aesthetic character of an area.

Although vast sections of the MRDs currently present a negative aesthetic impact, vegetation has successfully been established on profiled various MRD surfaces as part of the mine's concurrent rehabilitation plan, significantly reducing the aesthetic impact of the deposits.

The open pit remains as void, impacting on the topography of the immediate mine site.

3.2.9.5 Anticipated Post Closure Impacts

Post closure, portions of the MRDs that have not been rehabilitated by concurrent rehabilitation activities will remain an impact on the visual and aesthetic qualities of the area. These impacts will, however, be mitigated through effective implementation of the mine's rehabilitation plan.

3.3 Socio-economic Context

3.3.1 Pre-Mining Baseline

3.3.1.1 Social Baseline

Voorspoed Mine is located in the Fezile Dabi District Municipality (FDDM), situated within the northern portion of the Free State. FDDM is the second smallest District Municipality in the province covering 16.4% of the provincial area. The area of jurisdiction of FDDM covers four local municipalities, namely Metsimaholo (FS 204), Moqhaka (FS201), Ngwathe (FS203) and Mafube (FS 205) (Shangoni, 2010). Voorspoed is located within Ngwathe Local Municipality (NLM).

NLM was, and remains, a highly economically depressed area with some 27% of households living on no formal income. The area had an unemployment rate of 26% in 2001. Moqhaka Local Municipality (MLM), on whose border Voorspoed Mine is situated, was also economically depressed though not to the same extent as Ngwathe. Household incomes, the employment rate and standards of living were generally higher in the MLM in 2001 (Shangoni, 2010).

The nearest major town to the mine is Kroonstad which lies approximately 30km to the south. The town has a large service sector and is a retail hub for the region. Household incomes in Kroonstad were generally much higher than in the surrounding areas and the level of unemployment was far lower (Shangoni, 2010).

The Ngwathe LM is defined as the host municipality since the actual mine footprint is located in this Municipality (*note that the mine lease area straddles both the Ngwathe and Moqhaka local municipalities*). Ngwathe LM is located in the northern region of the Fezile Dabi DM, and has a total area of approximately 7,055 km^2. The Ngwathe LM is characterised by a rural agricultural landscape, with five urban centres, namely, Parys, Heilbron, Koppies, Vredefort, and Edenville. An estimated 91 percent of the population live within the urban areas (StatsSA).

According to the 2016 Community Survey, the total population of the Ngwathe LM is approximately 118,907, which equates to a population density of approximately 16 people per km^2. The Ngwathe LM experienced a negative population growth rate of 1 percent between 2011 and 2016. This indicates that people are leaving the area, most likely in search of employment opportunities elsewhere. Although the unemployment rate has decreased within the Ngwathe LM, it remains well-above the national rate at 33.7 percent.

The Ngwathe LM has shown improved access to basic services over the past five years with 94 percent of households now having access to piped water, 95 percent having access to electricity and 82 percent having access to flush toilets.

The provision of formal housing improved between 2011 and 2016 by 17 percent and the number of households living in informal dwellings decreased by 16 percent over the same period. However, there is still a housing backlog in the Municipality, with 5,442 households living in informal dwellings.

The Mine is situated within an agricultural area surrounded by farmers and their farm workers. Another diamond mine, Lace Diamonds is located to the southwest of the Mine, though it is now defunct as it ceased operating in 2017. There are no mine villages, employee housing or informal settlements within a radius of 30km.

3.3.1.2 Economic Baseline

The Free State Province is rich in mineral resources. Important minerals mined in the Free State include gold and its by-products (uranium, silver, platinum, group metals and sulphuric acid), diamonds, coal and bentonite. Other important industrial minerals such as sand, stone aggregate, gypsum, granite and limestone are found at various sites in the north-western parts of the Free State. Once a key contributor to the Provincial economy, mining production and employment have declined since 2003 from 56 000 to 35 000 mineworkers in 2015[18].

In the Fezile Dabi DM the main mining activities are coal and diamond mining. The District has the country's largest deposits of Bentonite, which is mined at Sasolburg and converted into Petrochemicals. Diamond deposits include Lace Diamonds and De Beers. There are still a number of unexploited mineral deposits in the Moqhaka and Ngwathe municipal areas. Prospecting applications have been submitted to and granted by the DMR for uranium and coal by companies such as White Rivers Exploration and Delmas Coal.

The Fezile Dabi DM is located in the northern region of the Free State Province, and has a total area of approximately 20,668 km^2. According to the 2016 Community Survey, the total population of the

[18] The Real Economy Bulletin: Trends, Developments and Data – Free State Provincial Review 2016

Fezile Dabi DM is approximately 494,777 which equates to a population density of approximately 24 people per km^2. The District has experienced a low population growth rate of 0,003 percent between 2011 and 2016. This indicates that people are not moving into the District; rather it is likely that people are leaving the District in search of employment opportunities.

The District is characterised by a rural agricultural landscape, with 13 urban centres. According to the Fezile Dabi DM IDP, up to 80 percent of the District population resides in the urban centres. Cattle and sheep farming, as well as maize, sunflower seed, sorghum and wheat farming are the dominant agricultural activities within the District. The Fezile Dabi DM IDP notes that the District contributes 17 – 18 percent to the national Gross Domestic product (GDP) in terms of agriculture. The IDP highlights the need for more agro-processing initiatives to boost agriculture in the District.

Manufacturing, predominantly in the Sasolburg area plays an important role in the District economy, while pockets of industrial and mining related activities also exist within the District. The tourism industry is noted in the IDP to be underdeveloped in the District.
While the poverty levels within the District have shown improvement, high levels of inequality and poverty still exist within the Fezile Dabi DM.

Both Moqhaka and Ngwathe LM's are largely dependent on an agrarian-based economy, with pockets of industry and commerce existing in the urban centres. On the one hand, the Moqhaka LM IDP identifies mining, construction, mid-skill manufacturing, agriculture and agro-processing, tourism and business services as key sectors to stimulate economic growth; while on the other, according to the Ngwathe LM IDP mining is seen as sector that should be targeted for growth, as it has the potential to absorb a large workforce. Kroonstad is the third-largest city/town of the Free State Province, situated about two hours' drive from Gauteng and is the principal service centre of the Moqhaka region while Heilbron is an important agro-processing hub.

The FDDM has a strong agricultural base producing a big share of the country's maize, sunflowers, wheat and sorghum. Other commodities produced are soya beans, potatoes and groundnuts with livestock farming of cattle, sheep, poultry, pigs and game. These commodities form the basis of the agricultural landscape in the district. The petrochemical industry contributed 49% to the District's GGP in 2011 (Statssa, 2015).

According to Stats SA Census 2011 data, Agriculture contributes 40.7% and 26.4% to the GGP of Moqhaka and Ngwathe LM's respectively. Agriculture was also economic sector that was the largest employer in the Ngwathe and Moqhaka LMs was agriculture. Mining and quarrying accounted for 12% of employment in the Moqhaka LM and less than 1% in Ngwathe LM (Shangoni, 2010). In Kroonstad, the largest sectoral employment was in community, social and personal services (40%) and finance, insurance, real estate and business services (12%) (Shangoni, 2010).

Figure 26 below details the unemployment rates, poverty line statistics and average annual income per Ward area. In line with statistics related to age distribution and educational levels, the highest unemployment rate and the largest number of employed individuals with an income below the Food

Poverty Line[19] (2016 projected), is the area of Wards 4-12,14,15 (the low-income residential areas of Maokeng). While 47 percent of the labour force[20] is unemployed in this area about 7 percent of the employed are earning less than R400 per month or R4,800 per annum (Food Poverty Line). The average annual income[21] per capita in this area is R60,647, which is almost four times lower than the average of Ward 16. The central industrial – business – residential area of Kroonstad (Ward 16) has the highest average annual income per capita.

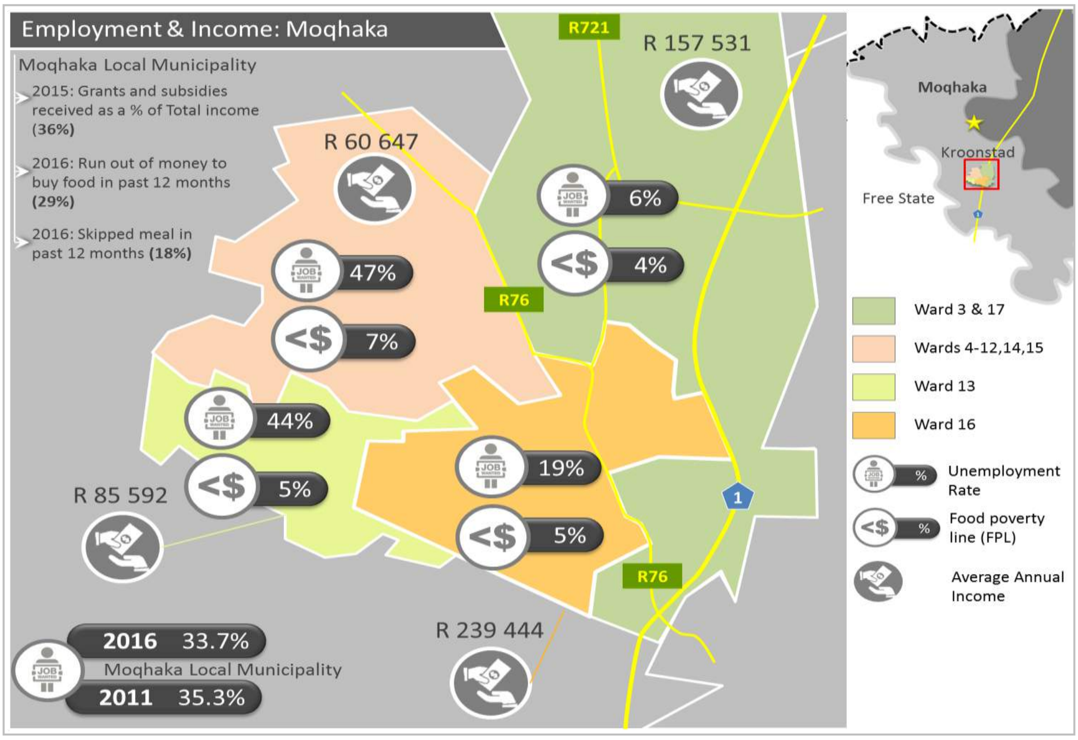


Figure 26. Employment and Individual Income within the Mine Community (from ERM 2019).

The middle to high income area of Ward 3 & 17 has an unemployment rate of 6 percent while only 4 percent of the employed population earns less than R400 per month. Again, the age (more mature) and education profiles (more educated) are aligned to the financial and employment statistics of this particular Ward area.

Figure 26 further illustrates that for the overall Moqhaka LM, although still very high, unemployment decreased since 2011 from 35.3 percent to 33.7 percent in 2016. But what is concerning is the 2016 Community Survey data which shows that 29 percent of the municipal population ran out of money

[19] StatsSa has been updating the poverty lines annually using the consumer price index data, with the latest update estimating that in 2014 the food poverty line (FPL) is R400 per capita per month while the upper bound poverty line is R753 per capita per month. (FPL) - Rand value below which you can't purchase enough food to meet a minimum energy intake, about 2,100 kilo-calories a day. www.statssa.gov.za

[20] We used the strict definition of the term 'labour force' only those people who take active steps to find employment, but fail to do so, are regarded as unemployed. Therefore the employed plus the unemployed equals the labour force and does not include everyone who desires employment, irrespective of whether or not they actively tried to obtain a job.

[21] Census annual income data refers includes all sources of income, for example, housing loan subsidies, bonuses, allowances such as car allowances and investment income before tax. Pension or disability grants are also included.

to buy food in the past 12 months, while 18 percent skipped a meal in the past 12 months. These statistics relate to the risk of urban food security[22] in the applicable wards.

Unemployment rates throughout the Free State were high. According to 2016 Community Survey, these rates were 33.7% for both Ngwathe and Moqhaka LMs.

In September 2016, Kayamandi Development Services (KDS) conducted a study, on behalf of Voorspoed Mine, to examine and analyse the Moqhaka and Ngwathe local municipalities' local economy and business context in an effort to identify leading economic sectors that inform the identification of potential business opportunities.

Key areas of development as highlighted in the Kayamandi Study include business infrastructure, business support and agriculture and agro-processing. Considering the main challenges identified in the Moqhaka IDP there are additional areas for development and support where skilled labour can play a role.

3.3.1.3 Heritage Resources

The archaeological and cultural survey of Voorspoed and the peripheral area (outside the site boundary) revealed several types and ranges of heritage resources, as outlined in the National Heritage Resources Act, 1999 (Act 25 of 1999).

These resources included the following:

- Stone tools that date from the Stone Age (no cultural heritage significance);
- Stone walled settlements that date from the Late Iron Age that can be associated with the predecessors of the Sotho-Tswana;
- Remains associated with either the settlement of the earliest farmers (colonists) in the project area or with the historical Voorspoed Diamond Mine, namely the Historical Building (cultural significance limited as a result of poor state of the building);
- Remains associated with the historical Voorspoed Diamond Mine;
- Remains dating from the Relatively Recent Past, such as a face-brick building with its associated out-buildings, a compound for labourers and an explosives magazine (no cultural significance); and
- Two graveyards, located outside of the mining area, are considered to be of "outstanding significance".

The Heritage Assessment recommended that De Beers prepared a display relating to the historical Voorspoed Mine and to maintain this either in a museum in the Free State Province or at a De Beers office. This would contribute to De Beers' fulfilment of its social obligations and to the company's expression of its commitment to the conservation of South Africa's natural and man-made environment (heritage) (Pistorius, 2004).

[22] Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (WFS, 1996).

3.3.2 Operational Management

3.3.2.1 Municipal Profiles

The key statistics for the Moghaka and Ngwathe LMs as at 2016 are presented in Figure 27.

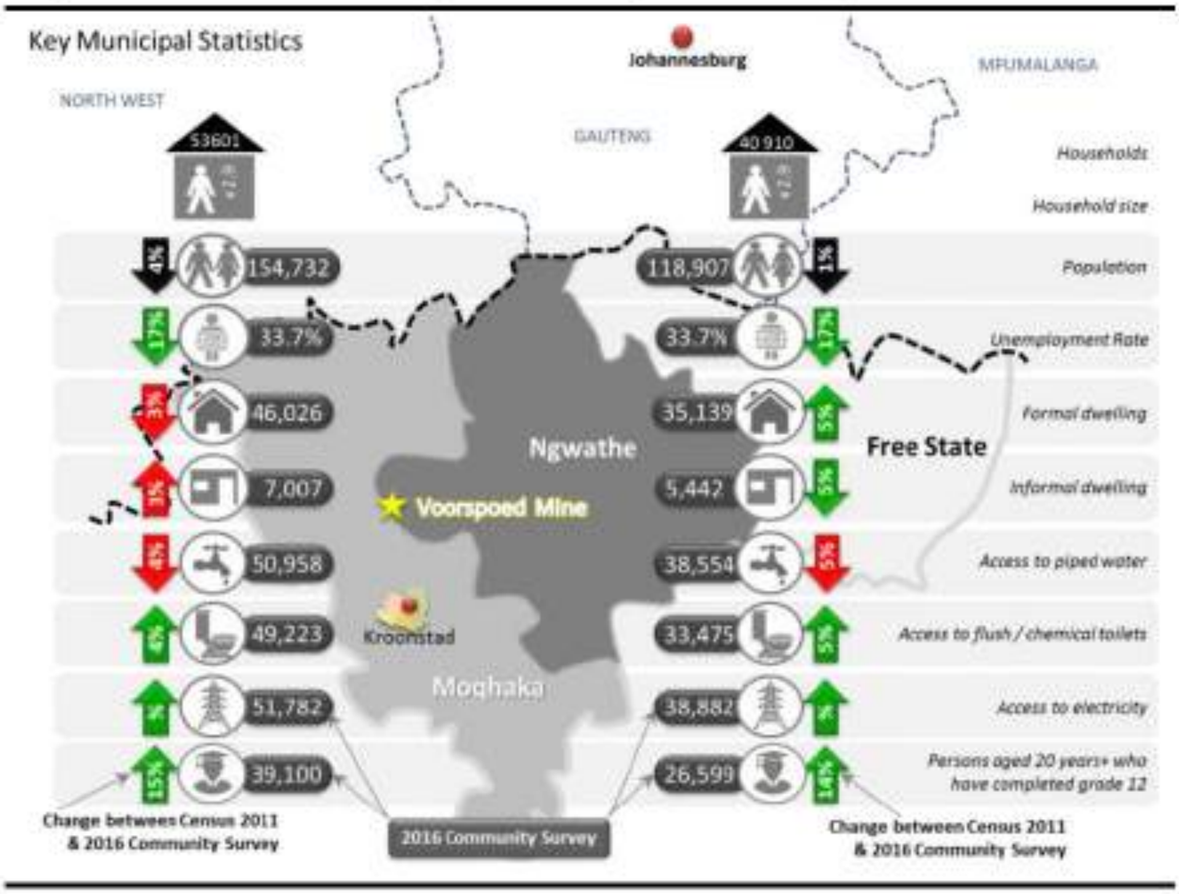


Figure 27. Key municipal statistics (from ERM, 2017)

3.3.2.2 Employee Profile

Voorspoed Mine provided employment for about 962 people comprising 488 permanent and 474 contractor employees. A socio-economic baseline, impact assessment and social management plan were compiled for Voorspoed Mine by ERM in 2017 and updated in 2019. That report serves as the basis for the information described in this section.

The primary labour-sourcing area for Voorspoed Mine was the Moqhaka LM where a total of 89% of the mine labour compliment resided. Almost a third of those who migrated to Kroonstad came from De Beers' operations in Kimberley, Musina, Lime acres and Kleinzee. The permanent workforce was relatively young and single with an average age of 35 years. The average age of contractor employees was 31.7 years.

The demographics of the labour force indicated that a significant proportion of the workforce were Black and largely residing within the Maokeng Area. In contrast, White employees comprised a relatively low percentage of the workforce. The bulk of the permanent workforce (69%) was male and the remaining 31% female. Half of the permanent employees, whether married or single, had children. The average household size for the Voorspoed Mine permanent employee was 2.8 which is slightly lower than that of the Moqhaka LM of 2.9. The average length of service of Voorspoed's employees was 5.6 years. Only 5% of the permanent workforce has more than 10 years of service with De Beers.

The permanent workforce was relatively well educated with 99% of workers having completed matric and more than 30% of the workforce holding a tertiary education qualification. Contractors, on the other hand, had proportionally less tertiary qualifications. Women had higher educational levels than their male counterparts.

The Moqhaka LM was home to 89% of the mine employees. Of this number, only 2% were sourced from outside of the town of Kroonstad.

In terms of labour-sending areas, 49% of permanent employees originated from the Moqhaka LM – a total of 66% originally came from the host province of the Free State. The remaining 34% came from other provinces in South Africa, in particular the Northern Cape (15%) which accounts for De Beers' employees that worked at the Company's operations in Kimberley, Lime Acres, Kleinzee, etc.

3.3.2.3 Housing

DBCM's recruitment strategy from the inception of the Voorspoed Mine was to recruit local labour and promote worker integration into the local community of Kroonstad. As a result there are no hostels at the mine or any informal settlements in the vicinity mainly because the Mine provides transport for employees between home and work.

To adhere to the objectives of the Mining Charter and to ensure the sustainability of the mine community post life of mine, DBCM developed a Housing Plan that comprises of:

- Facilitated Home Ownership Programme: eight employees in the bargaining unit (B-band and C-lowers) currently participate in the company Facilitated Home Ownership Programme;
- Housing Allowances: 264 B-band employees receive a monthly housing allowance; and
- Home Ownership Subsidies: 14 employees in the bargaining unit (B-band and C-lowers) who have registered properties in the local sourcing area and are paying mortgages, currently receive home ownership subsidies.

Considering the life of mine of Voorspoed most employees migrating to Kroonstad opted to rent rather than buy property. Mine statistics indicate that out of ±350 B and C band permanent employees living in Kroonstad, only 56 own a home. It is important to note that renting must be understood in the widest sense of the word as there are a lot of employees that are still staying with their parents or living with extended family. In these instances they might be staying for free or paying rent in non-monetary forms like performing some cleaning duties or buying groceries etc.

3.3.2.4 Corporate Social Investment Programmes

Voorspoed Mine has invested in community development projects and supported needy communities within the Moqhaka and Ngwathe LMs since its inception in 2008. The Mine is guided by its Socio-economic Development (SED) Plan that comprises the following components:

- Corporate Social Investment (CSI);
- Enterprise Development;
- Local Employment;
- Local Procurement; and
- Employee Volunteering.

Within its CSI realm, Voorspoed focuses on three components:

- Social and Labour Plan (SLP) projects;
- Local Area Committee (LAC) projects; and
- Contractor CSI.

The Mine's main community interventions are guided by the legislated SLP process, which makes provision for the implementation of what the DMR refers to as 'Local Economic Development' (LED) projects. Voorspoed Mine's current LED Plan was developed in line with the IDPs of the Moqhaka and Ngwathe LMs. The Mine will soon start to develop its next SLP for the period 2017- 2021.

A very important platform for CSI is LAC which has been instituted by Voorspoed Mine in 2009, contributing towards the social upliftment in the communities of the Moqhaka and Ngwathe LMs. LAC's CSI interventions are directed specifically at the towns of Kroonstad, Steynsrus, Viljoenskroon, Vredefort, Parys, Koppies, Heilbron and Edenville. It funds are directed at skills development and income generation projects, education, welfare and HIV/AIDS.

It is a requirement for all contractors to the Mine to contribute 0.5 percent of their contract value towards social investment – called Contractor CSI.

The Mine's CSI initiatives are greatly appreciated by stakeholders especially its contribution to improve the quality of education and performance of schools in the local area. Figure 28 provides an overview of the kind of CSI interventions and support Voorspoed Mine provided to local communities. DBCM invested on average R4 million per annum over the last eight years through Mine specific interventions and Group Foundation projects.

Figure 28. Voorspoed Mine CSI between 2008 and 2015.

3.3.2.5 Bordering Landowners

The land surrounding the Mine is used for commercial agricultural purposes. The main agricultural activities being undertaken are cattle and sheep farming, as well as crops such as maize, sunflower seed, sorghum and wheat farming. The land currently owned by the Mine was previously zoned as agricultural land and owned by one of the farmers in the area. Since the Mine was not using the entire land it acquired, it reached an agreement with the previous owner to lease some of the portions of the land back to the previous owner to continue farming.

The community of Doornspruit, situated about 15km by road from the Mine, is the only neighbouring community to the Mine apart from the commercial farmers that surround the mine land. The community of Doornspruit was established by a local farmer for his farm workers that had been working on his family farms for generations and is currently comprised of nine households with an average household size of six persons per household.

3.3.2.6 Indirect and Induced Employment

Indirect employment refers to those jobs that are created by off-site contractor employees working for the Mine, employees of suppliers whose employment is attributable to business generated by the Mine, and employment generated in the region by the Mine's community social investment activities. These people and organisations employ and remunerate their employees and in this manner indirect employment and subsequent fiscal flows have an economic impact in the area.

Error! Reference source not found. *Total employment created by Voorspoed Mine.*

Induced employment is generated thought the consumption spending of direct and indirect employees. It is estimated that an additional 2,953 jobs can be added to Kroonstad as a result of induced employment. Adding the current workforce to both indirect and induced employment, it is estimated that the Mine creates 5,799 jobs in the mine community. Note that these numbers exclude employment created by the De Beers Zimele Business Hub, which has funded over 70 companies and created job opportunities in the region of 1,000 individuals[23].

3.3.3 Current state

For the purposes of evaluating the impact of Voorspoed Mine on the local socio-economic environment, the town of Kroonstad was agreed to be considered the "mine community" (ERM, 2017). The broader socio-economic influence of the Mine however extends to a larger area that encompasses the Ngwathe and Moqhaka Local Municipalities within the FDDM. This is illustrated in Figure 29.

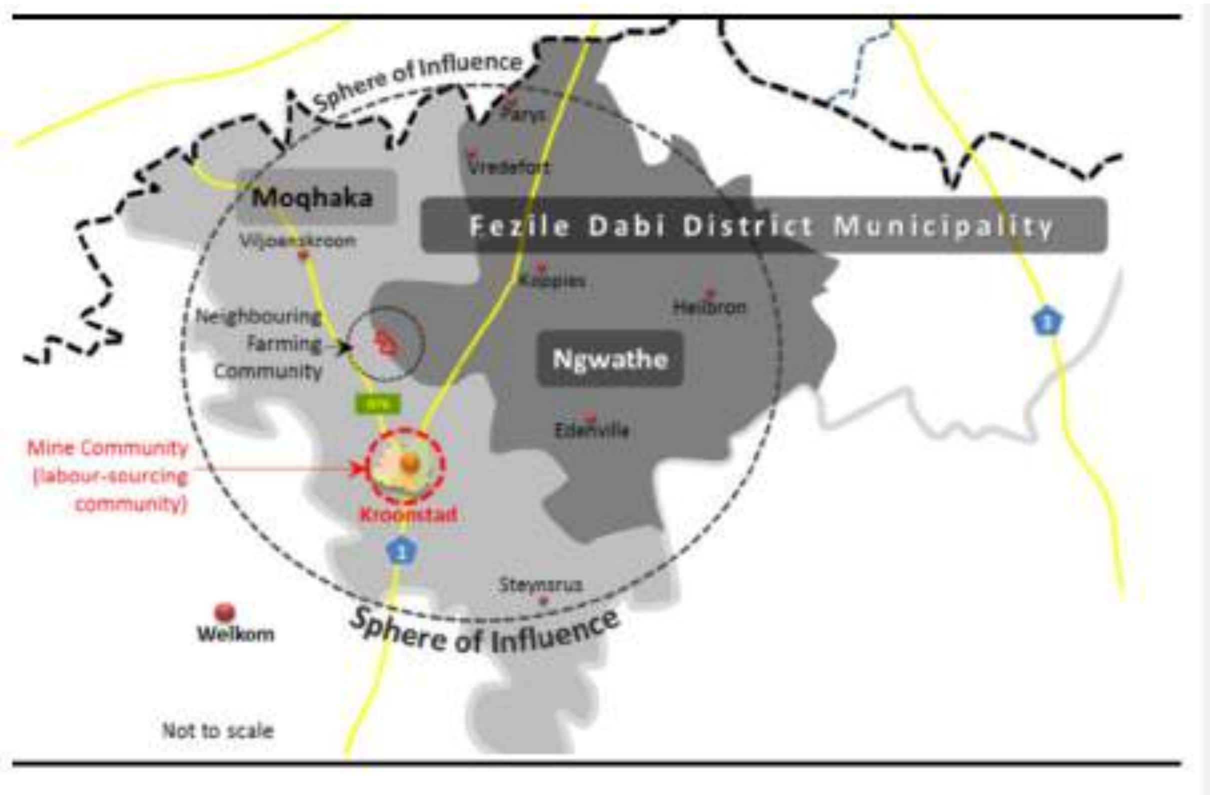


Figure 29. Voorspoed's Mine Community and socio-economic Zone of Influence (from ERM, 2017)

[23] Demographic information for these 77 companies were not available and therefore the place of residence of employees working for these companies could not be determined.

3.3.4 Mine Community

3.3.4.1 Unemployment

The highest unemployment rate and the largest number of employed individuals with an income below the Food Poverty Line, are in the area of Wards 4-12, 14 and 15 (the low-income residential areas of Maokeng). The 47% unemployment rate in this area is significantly higher than the 6% of Wards 3 & 17.

3.3.4.2 Local Economic Benefit

When comparing Mine employee salaries with those of the local employed residents of Kroonstad, the data shows that income generated by the average Voorspoed mineworker is significantly higher than what the average working resident in Kroonstad earns – in some Ward Areas up to four times as much. About R149 million per annum of disposable income is being earned by workers from Voorspoed Mine living in Kroonstad. This represents 12% of the total disposable income being earned by the employed population in Kroonstad. Of this disposable income, about R126 million is retained for household consumption expenditure, which is primarily directed at food, imputed rentals and insurance. There is a significant contribution to the purchasing of vehicles, the actual operation of personal transportation vehicles and transport services such as taxis.

3.3.4.3 Mine Community Dependency

Direct and indirect community dependency for the town of Kroonstad has been calculated at 13%. This means that 11 507 livelihoods out of a population of 88 489 are financially dependent on the Mine. It means that every job on the Mine accounts for the livelihood of at least 13.7 people.

3.3.4.4 Supply Chain

The direct economic impact of Voorspoed Mine is mostly the result of operational expenditures by the mining operation. The Mine supports various local and national industries through its supply chain processes by creating wealth, jobs and taxable income. Although certain equipment and technical services are highly specialised and provided by national companies, some type of goods and services are sourced locally.

Procurement data for 2015 indicated that the Mine spent approximately R791 million within this period. The main industrialised areas of Gauteng received 48% of that expenditure while 49% was spent in the host province of the Free State. About 5% of the total purchases in 2015 were procured from 67 vendors in the town of Kroonstad to the value of R40.3 million. In terms of Black Economic Empowerment, 58% of Voorspoed Mine's vendors in Kroonstad are Black Owned while only seven percent are White Owned. The remaining 35% are Black Empowered.

The De Beers Zimele Hub in Kroonstad has been operational since 2009 and has been providing funding for the development of local enterprises in the mine community. Since inception, the Hub has disbursed loans to 72 local business entities to the value of R26.5 million. Voorspoed Mine procured services and consumables in 2015 from seven of the business entities that were supported by Zimele to the value of R7.5 million.

The Mine, in partnership with Zimele, has been instrumental in the development of local Black-owned suppliers and service providers. One such company, Blue Motion General Construction CC was appointed in January 2016 to provide onsite cleaning services to Voorspoed Mine. Blue Motion employs 21 employees of whom 19 are working currently at its only client, Voorspoed Mine.

3.3.4.5 Social Environment

According to the Department of Social Development (DSD) in Kroonstad, the key antisocial behaviours experienced in the town include substance abuse amongst the youth; child abuse; sexual abuse; neglect of children; increasing unemployment; abuse of elderly pensions and neglect of the elderly by grandchildren. There is a resultant demand for placement of children in foster care.

There are currently no rehabilitation centres within the town to address the high levels of substance and various other forms of abuse prevalent in Kroonstad. Due to the lack of public health facilities patients have to seek services located a considerable distance from Kroonstad. Owing to the high levels of unemployment and distance of services, patients cannot access medical care. There is a significant lack of social development structures to manage and address social development issues within Kroonstad. These include a lack of facilities for children with disabilities such as schools or homes for the disabled as well as shelters for children who are living on the street. These children do not have access to services or support structures if they are neglected by their family.

3.3.4.6 Crime

The crime trends over the last five years indicate a decrease in most crimes apart from driving under the influence of alcohol or drugs and the illegal possession of firearms and ammunition. The top three crimes in the mine community in 2015 were: common assault; burglary at residential premises; drug-related crime. These crimes are related to the high unemployment, high rates of substance abuse and lack of social development services.

There are a number of police stations distributed across the greater northern Free State area including correctional services. However, there is no police station located near the Voorspoed Mine. In light of the lack of a formal police station in the area a community-based organisation has been founded in order to address issues around safety and security. The organisation works with the Mine and farmers in the area and is referred to as the Mine Crime Combatting Forum (MCCF). It is currently led by one of the brigadiers' in Kroonstad and supported by local police officers.

3.3.4.7 Health Care Sector

There are limited numbers of health care facilities located across the northern Free State including the greater area of Kroonstad. The location and capacity of health facilities across the province place considerable stress on existing facilities to treat patients.

Kroonstad plays an important role concerning providing health services in the broader District, due to the limited number of primary and secondary health care facilities in the District. There are two hospitals and one clinic within Kroonstad; one regional (Boitumelo Hospital), one private (Kroon Netcare Private Hospital) and one clinic (Seeisoville Clinic). The limited number of primary and secondary health care facilities places significant strain on existing facilities to cope with the needs of the population. This is reflected in the various health related issues faced within the broader District. The FDDM has performed poorly in terms of the following health related indicators: maternal mortality rate, malnutrition, HIV/Aids, and TB. The District currently has the highest proportion of TB patients dying of TB in the country.

3.3.4.8 Benefit to Government

The analyses of economic benefits to Government indicated that over R100 million per annum is benefiting Government on a national level. The Voorspoed employees that are living in Kroonstad contribute almost R20 million per annum to the Moqhaka LM's revenue. This represents around 5% of the total revenue (2015) generated in the town of Kroonstad which was around R600 million.

3.3.4.9 Total Local Economic Benefit

The overall economic impact of the Mine's expenditure on labour and intermediate inputs on the mine community of Kroonstad amounts to roughly R170 million per annum (Figure 30).

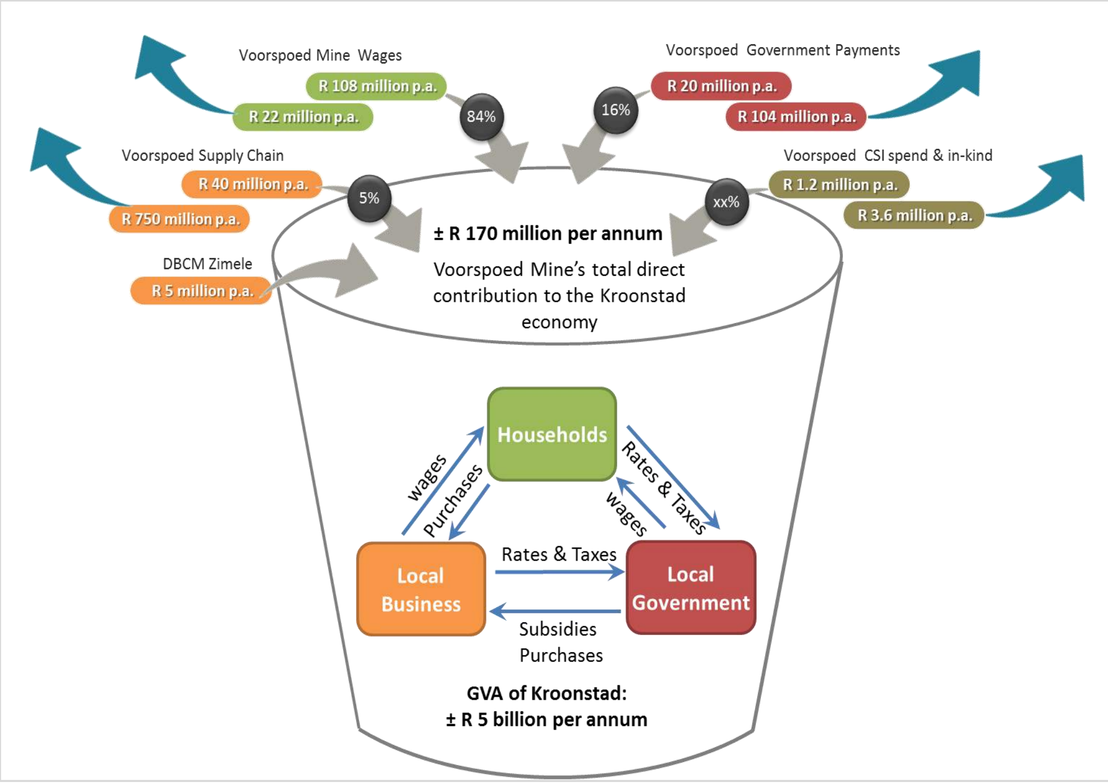


Figure 30. Total Local Economic Benefit

3.3.5 Anticipated Mine Closure Impacts

Within the Mine's sphere of influence there are two specific geographic areas that will be impacted as a result of the closure of the Mine:

- The Neighbouring Farming Community: This area is relevant from an end land use perspective and includes those farmers neighbouring the Mine's lease area; and
- The Mine Community: The town of Kroonstad is the nearest major urban centre and is a significant source of labour for the Mine. ERM (2017) concluded that the town of Kroonstad will be impacted directly and more significantly than any other area.

3.3.5.1 Community Viability Assessment

ERM (2017) provided an opinion on the extent to which the town of Kroonstad will remain viable following mine closure. Their conclusion was that whilst every job at Voorspoed provides the livelihoods for 13.7 people, the impacts to Kroonstad would be felt however the town would remain viable following mine closure.

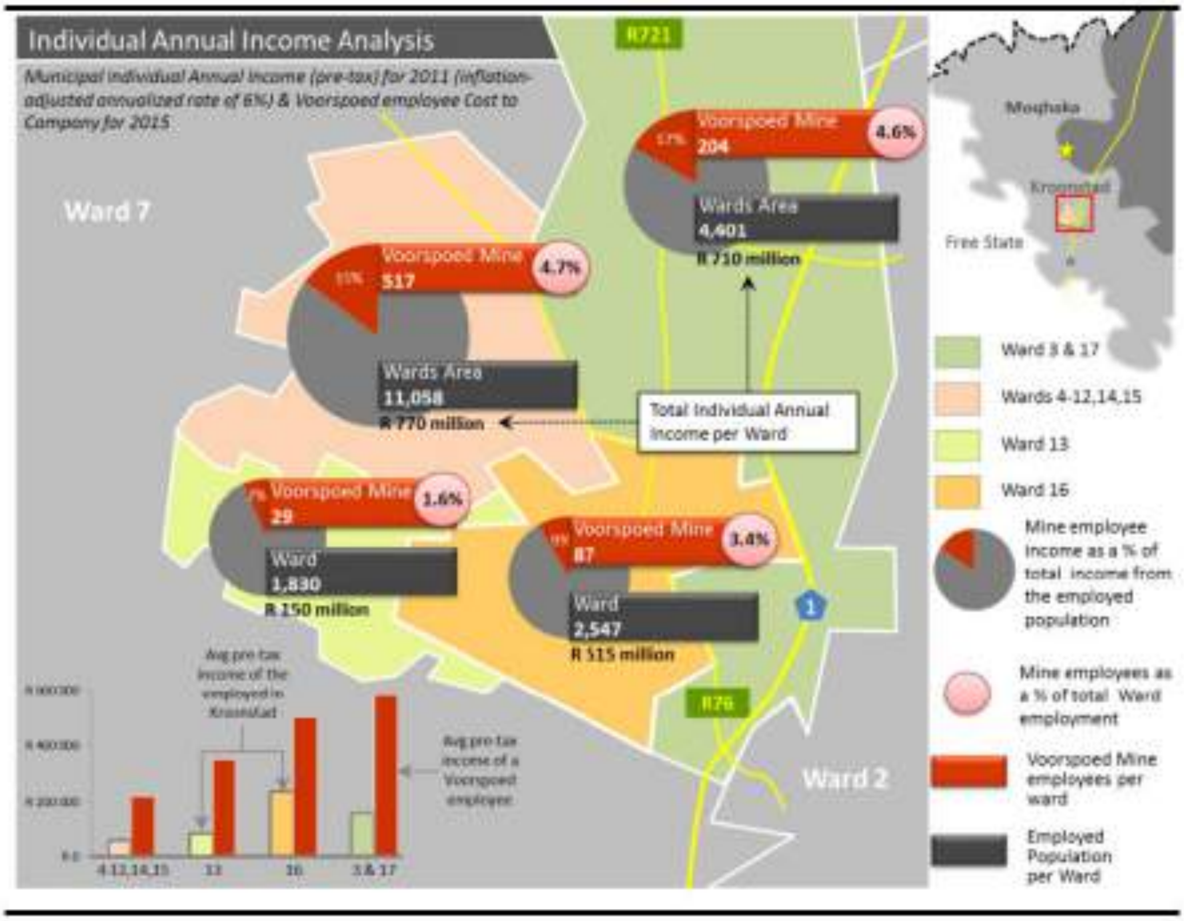


Figure 31. Dependencies of Wards on income received by Voorspoed Mine employees (from ERM, 2017).

ERM undertook a detailed socio-economic impact assessment as part of their work in 2017. The impacts described below originate from this risk assessment (Table 17). Socio-economic risks can result in impacts to either the Mine directly (including DBCM as the holding company) or to members of the mine community (including employees and their dependents, neighbouring farmers and other interested and affected parties). Where the same issue could present impacts to both the company and mine community, these impacts have been reflected under the same issue.

The anticipated post closure issues for social issues and associated management measures are presented in Table 17.

Table 17. Socio-economic mine closure issues and social closure management measures.

Impact	Issue addressed	Closure criteria	Mitigation/ management measures	Coincidental Impact *(- / +)*	Key Impacted Stakeholders	Responsibility
Phased closure (ramp down) management measures						
1. Loss of jobs	Raising employee awareness of closure and retrenchment process	■ Communicate the retrenchment process effectively and transparently ■ Employees understand the process to be followed	**Retrenchment Process & Employee Engagement** ■ Continuously engage and communicate with all employees regarding the process and plans for retrenchment, including any support that will remain available to employees after they have been retrenched, aligned to both the Mine's SLP and the Company's retrenchment policies which are in line with the Labour Relations Act (66) of 1995 as amended (see step 2e of Anglo American Closure Legal Framework). ■ Via engagements in line with the regulatory requirements, Voorspoed Mine will agree with unions and employees on the consultation process / stakeholder engagement approach which will be followed during the retrenchment process. ■ If appropriate, use the Future Forum (FF) as required in terms of the SLP as a vehicle for engagements.	None	■ Organized Labour Union (NUM) ■ Permanent Mine employees ■ Full-time Contractors employees	Senior HR Manager
	Retrenchment implementation	■ Retrenchment process is undertaken in accordance with all applicable legislation and company standards ■ All retrenchment related commitments made to employees are fulfilled	**Implementation of Retrenchment** ■ Finalise and implement retrenchment plan, aligned to both the Mine's SLP and the Company's retrenchment policies, which are in line with the Labour Relations Act (66) of 1995 as amended (see step 2e of Anglo American Closure Legal Framework). ■ Ensure a grievance mechanism is in place to address any concerns around retrenchment process during and post retrenchment. ■ Monitor the outcomes of the retrenchment engagement process and subsequent awareness of	None	■ Organized Labour Union (NUM) ■ Permanent Mine employees ■ Full-time Contractors employees	Senior HR Manager

Impact	Issue addressed	Closure criteria	Mitigation/ management measures	Coincidental Impact (- / +)	Key Impacted Stakeholders	Responsibility
			ex-employees on how to access provided support after retrenchment. This should include specific consideration for potentially vulnerable groups such as female employees, older workers or lower skilled and illiterate staff if applicable.			
	Increasing employability of retrenched workers elsewhere	Provide employees with portable skills training to enable meaningful competition for opportunities post mining activities	**Re-skilling programme** ▪ Engage service providers for portable skills programmes focusing on non-mining related training, entrepreneurial programmes and other in line with the Workplace Skills Plans. ▪ Implement the re-skilling plan, which includes portable skills training from 2017 until end of life of mine or as agreed. ▪ Engage and share with relevant stakeholders the portable skills profile as and when employees successfully complete various programmes. **Employee Assistance Programme (EAP)** ▪ Ensure the EAP meets modern economic needs such as by integrating training on internet access and use, CVs and interviews, etc.	Newly skilled employee pursuing a career in a less rewarding profession than mining OR Newly skilled employee pursuing a career in a more rewarding profession than mining	▪ Permanent Mine employees ▪ Full-time Contractor employees	Senior HR Manager
	Assisting employees to deal with psychological and financial	Support employees to access services to deal with potential indirect impacts of job losses related to mental wellbeing and financial management. Where necessary continue to provide	**Employee Assistance Programme (EAP)** ▪ Implement integrated EAP to support employees to deal with significant changes such as trauma of job loss and debt management. ▪ Assess public services available through local government and municipal entities, for example	None	▪ Permanent Mine employees ▪ Immediate/ family	Senior HR Manager

Impact	Issue addressed	Closure criteria	Mitigation/ management measures	Coincidental Impact *(- / +)*	Key Impacted Stakeholders	Responsibility
	stresses of loss of jobs	assistance to employees and their family members beyond retrenchment	around health and education, and provide information and support for retrenched employees to access these services if necessary. ■ Provide information to the workforce around their right to social security, including social insurance and how to access it as relevant locally. ■ Determine and communicate the eligibility criteria for the EAP, especially for extended family members of the affected employees and contractors, as well as the period during which the EAP will be available during and post retrenchment. ■ Continue to make grievance mechanism available to employees, their families and the wider community. Communicate this so that all stakeholders are aware of its continuation after the retrenchment process. ■ Monitor employees after retrenchment to track their wellbeing and debt levels. Extend EAP programme or investigate and provide additional support, if needed, based on outcomes of monitoring.		■ Full-time Contractor employees	
	Improving employee access to alternative work/ employment	Provide retrenched employees with access to services that will support them to access alternative work and employment	**Outplacement services at the Zimele Hub** ■ Provide an outplacement centre at the Zimele Hub for retrenched individuals to access a database and contact details of placement agencies and local business directory for possible job opportunities. ■ Engage and share with relevant stakeholders the portable skills profile of enrolled employees. ■ Provide, through Zimele Hub, guidelines on how to prepare a curriculum vitae (CV) and how to prepare oneself for an interview. ■ Provide information about workers' rights through the Zimele Hub and ensure any work promoted to	Overcrowded outplace centre in Kroonstad that are exploited by non-Voorspoed workers and creating a burden for	■ Permanent Mine employees ■ Full-time Contractors employees ■ Service Providers	Corporate Affairs Manager

Impact	Issue addressed	Closure criteria	Mitigation/ management measures	Coincidental Impact *(- / +)*	Key Impacted Stakeholders	Responsibility
			employees via the Zimele Hub would ensure rights are respected especially rights to 'decent work' (that respects human rights and which they freely choose or accept).	neighbouring businesses or an opportunity for sales		
	Potential opportunities for redeployment or Voorspoed employees	Investigate and advertise potential opportunities at other De Beers / Anglo American operations, other nearby mines and within other sectors	■ Any opportunities for employment at the Voorspoed Mine to execute closure should be advertised to ex-employees who will be given preference to access where there is a skills match. All closure execution contracts should cover human rights and where deemed appropriate specific measures such as training or audits to ensure compliance should be put in place. ■ Skills transfer of talent within the Group (De Beers and Anglo American) from time to time depending on business requirements. ■ Determine business talent requirements for post closure in order to retain required skills. ■ Hold discussions with neighbouring mines within the District Municipality about employment opportunities at their mines, communicate this information back to retrenched employees, and also share the portable skills profile of employees with the neighbouring mines. ■ Hold formal discussions with local government about the profile of retrenched employees including their portable skills profile. ■ Help employees to understand their work rights and conduct due diligence towards ensuring work promoted to employees would ensure rights are respected especially rights to 'decent work' (that respects human rights and which they freely choose or accept).	Increase in non-local employment for the respective operations / projects that will absorb Voorspoed workers	■ Labour Unions ■ Permanent Mine employees ■ Full-time Contractors employees	Senior HR Manager

Impact	Issue addressed	Closure criteria	Mitigation/ management measures	Coincidental Impact *(- / +)*	Key Impacted Stakeholders	Responsibility
	Entrepreneurial/ SMME opportunities	Extend SMME support programmes to retrenched employees with viable entrepreneurial initiatives	▪ Extend SMME support programmes to accommodate employees who are interested in establishing their own businesses. ▪ Continue operating the Zimele hub to support local SMMEs and employees until 2021. Kayamandi feasibility study to continue to be used to look at viable opportunities for business: o For retrenched employees, o For community members.	Potential conflict if employees feel that all should benefit equally from commercial opportunities and not a select few entrepreneurs.	▪ Permanent Mine employees ▪ Full-time Contractors employees	Corporate Affairs Manager
	Quality of life and wellbeing after mining	Provide support to help employees and local communities avoid or manage negative impacts on their lives after retrenchment, including potential adverse impacts on rights to an adequate standard of living, education, health, etc. (It is anticipated that by supporting ex-employees to cope post loss of jobs, this will assist the broader community to manage indirect and induced loss of jobs.)	**Post-Retrenchment Employee Support Plan** ▪ Develop post retrenchment support plan to support employees with dealing with the potential impacts on their wellbeing and quality of life post mining which will address as appropriate: o Financial counselling (especially debt counselling in line with the National Credit Act); o Psychological support especially in relation to substance abuse and relationship/ marital issues; o Communications and advise services to access public services, such as health, education, unemployment and welfare benefits, homeless shelters etc. Where possible this should be focused on vulnerable individuals; o Engagement and partnerships with other stakeholders such as local government and Department of Health and Education to address potential impacts to ex-employees and	Interventions may create a level of dependency for those impacted employees and their families	▪ Permanent Mine employees ▪ Full-time Contractors employees ▪ Immediate/ extended family of affected employees ▪ Wider community	Corporate Affairs Manager

Impact	Issue addressed	Closure criteria	Mitigation/ management measures	Coincidental Impact *(- / +)*	Key Impacted Stakeholders	Responsibility
			contractors, especially in terms of providing information for employees to access public services. ■ Considering CSI/SLP initiatives in next SLP version if appropriate (2021 to 2025) to support welfare centres and services. ■ Engage with DSD to assess the availability and quality of Substance Abuse Treatment services and centres in Kroonstad and provide information for ex-employees to access where relevant. ■ Ensure access to confidential worker hotline grievance mechanisms which allow both reporting of issues and access to basic counselling for those uncomfortable with face to face counselling provision. ■ Provide a grievance mechanism to ex-employees to raise potential issues post closure. ■ Provide the public, specifically mining affected communities, with free and accessible access to information regarding closure that affect the economic, social and environmental well-being of communities.			
2. Loss of revenue of local suppliers and service providers	Sustainability of dependent local suppliers	Support suppliers to take up opportunities outside the Mine in alignment and support from the Enterprise and Supplier Development Hub	■ Identify local suppliers and services providers that are dependent on Voorspoed Mine. ■ Maintain proportion of procurement from local enterprises and reduce proportionately over time as the needs for goods and services decreases. ■ Support dependent providers to develop the necessary skills to diversify their businesses, for example business development/ marketing skills. ■ Compile a list of suppliers and circulate to other mines / businesses in the area for consideration. ■ Continue to communicate to these suppliers regarding the closure and ensure they and their	None	■ Local suppliers and service providers to Voorspoed Mine ■ Employees of local suppliers ■ Immediate/ extended family of	Corporate Affairs Manager

Impact	Issue addressed	Closure criteria	Mitigation/ management measures	Coincidental Impact *(- / +)*	Key Impacted Stakeholders	Responsibility
			workforces are provided access to suitable grievance mechanisms. ■ Explore opportunities with other Anglo American Group operations to make use of these contractors' services. ■ Provide the public, specifically mining affected communities, with free and accessible access to information regarding closure that affect the economic, social and environmental well-being of communities.		local suppliers ■ Local business chamber ■ Local municipality	
3. Loss of revenue for ED beneficiaries (Zimele Business Hub)	Sustainability of SMMEs funded and supported by the Hub	Minimise impact on ED beneficiaries once the services of the Enterprise and Supplier Development Hub are terminated	■ In line with the objectives of this initiative, assess the financial sustainability of SMMEs that are funded and supported. ■ Develop action plans for those SMMEs that require further support over the Phased-Closure period. ■ Share our ESD beneficiaries list with other SMME institutions like SEDA, DESTEA, FDC , NYDA.	Potential dependency on DBCM and the need for additional support beyond closure	■ Enterprises benefitting from the HUB venture ■	Corporate Affairs Manager & Commercial Manager
4. Loss of financial support for CSI / LED beneficiaries	Sustainability of CSI and LED beneficiaries supported by the Mine	Sustainably withdraw support for CSI and LED beneficiaries, especially: ■ Mathematics and Science, Teacher Development and Winter School Programmes ■ Higher Education and Training Support	■ Assess impact of each LED/Mine Community Development (MCD) project funded by Voorspoed Mine. ■ Communicate the LoM, MCD projects and Final Mine Closure Plan to LED beneficiaries and interested and affected parties. ■ Develop an exit strategy framework for CSI and LED interventions, considering the following: o Explore opportunities to forge partnerships with stakeholders who can provide future support for current LED/MCD projects; o Enter into MoU/MoA with applicable parties; o Establish feasibility of whether training in new technologies and other online education might support mitigation, or focus efforts on	None	■ Beneficiaries of CSI and LED programmes ■ Local municipality ■ Government departments	Corporate Affairs Manager & Commercial Manager

Impact	Issue addressed	Closure criteria	Mitigation/ management measures	Coincidental Impact (- / +)	Key Impacted Stakeholders	Responsibility
			supporting basic schooling funding needs if technology access is insufficient. All measures should reinforce that students and parents understand their right to access to free primary schooling for primary age children.			
Decommissioning (closure execution) management measures						
5. Changes in traffic patterns during closure execution	Health & safety of local communities	Avoid and limit the risks of injury and fatalities due to increased road traffic associated with the closure project	■ Develop a Road Traffic Management Plan for the decommissioning phase which will provide detail on major traffic risks for decommissioning and the mitigation measures and controls that will be put in place to address. ■ Collaborate with Road Traffic Law enforcement to implement Road Traffic Management Plan. ■ Engage with community stakeholders to communicate high/ significant traffic risks and agree any impact mitigation measures e.g. re timing of heavy vehicle movements, use of safety signage.	None	■ Road users of the project affected roads ■ Department of transport ■ Road Traffic Law Enforcement	Security
Post closure (monitoring) management measures						
6. Reduced levels of security/ presence at the mine	Controlling access and provision of security services in the closed mine area	■ To prevent unauthorised entry to mine premises and the illegal occupation of mine land (see also Table 17 in the Closure Plan) including for illegal mining ■ To prevent human injury or death due to uncontrolled access to the open pit or other Mine areas	Security services and measures to be included into the **Mine Closure Security Plan**: ■ Develop a Security Plan for decommissioning and rehabilitation phases of the mine closure track provision of security services in line with this Security Plan. The Security Plan will: o be communicated to neighbouring landowners and stakeholders; o identify stakeholders that are potentially more vulnerable to	None	■ Neighbouring landowners ■ MCCF ■ Local law enforcement	Security

Impact	Issue addressed	Closure criteria	Mitigation/ management measures	Coincidental Impact *(- / +)*	Key Impacted Stakeholders	Responsibility
			security risks and outline any additional efforts to avoid and minimise impacts on these stakeholders; o include a protocol for the provision of security in the area post-rehabilitation; o include assignment of roles and responsibilities, timeframes and reference the mine's incident and grievance mechanism; and o address risks associated with artisanal miners trying to access the site. ■ Continue to implement the incident and grievance mechanism for communities to report any concerns they may have in relation to site security or the security services. ■ Communicate to the community about why access is restricted, safety risks of entering the site without permission and how allowing the remediation of the mine respects their rights in the longer term. ■ Sensitise the community about how to report any incidents or suspicions of others entering restricted areas without permission to security staff. ■ Contracts with private security providers will reference VPSHR and any security providers engaged will be trained on human rights issues (VPSHR). **Physical measures** to control access to Mine post closure as per closure plan: ■ Blast the pit access ramps and final bench to cover the remaining resource.			

Impact	Issue addressed	Closure criteria	Mitigation/ management measures	Coincidental Impact *(- / +)*	Key Impacted Stakeholders	Responsibility
			■ Allow the pit to flood and form a pit lake. Active pit dewatering will cease once mining stops. This will allow the groundwater levels an opportunity to rebound (although rebound is expected to be slow). Surface water run-off from selected WRD areas will be diverted to the open-pit. ■ The Security fence around mining area will remain, reducing the risk of free access to the area by people. ■ Construction of a fence around the pit perimeter, outside the calculated zone of relaxation. ■ Construction of an enviroberm and trench around the pit perimeter. ■ Erection of clear signage at all entrances to highlight risks of entering the open pit area. ■ Implement fencing, enviroberm and trench maintenance programme.			
7. Reduced emergency response capacity	Health and safety of local communities in relation to emergencies	To sustainably withdraw support to stakeholders around emergency response	■ The impact of reducing emergency response support to communities especially in relation to fire should be considered in the Security Plan and communicated to stakeholders. ■ Wherever possible, emergency response equipment will be transferred to stakeholders. ■ Communicate with stakeholders on the timeline for transitioning out of emergency response support so that they can plan for alternative provisions in a timely manner Vulnerable groups will be identified and engaged separately on this issue as required.	None	■ Neighbouring landowners ■ MCCF ■ Local law enforcement	Security

4 CLOSURE PLANNING

4.1 Closure Vision

The closure vision for Voorspoed Mine is:

To close the mine in line with the relevant legal requirements and do this in such a way that the mining area can be utilised in a sustainable manner after closure has been achieved.

4.2 Closure Objectives and Principles

Voorspoed Mine's overarching closure objective is to ensure sustainability beyond mine closure and leaving a positive legacy. This is supported by the following specific objectives:

- Restore as much as possible of the mining area to a condition consistent with the pre-determined post closure land use objectives;
- Ensure that the area is left in a condition which poses an acceptable level of risk to public health and safety; and
- Reduce as far as is practicably possible the need for post closure intervention, either in the form of monitoring or on-going remedial work.

The Closure Objectives are based on the following Principles:

- Legal compliance;
- Continuous, inclusive (internal and external) stakeholder engagement;
- Structural and ecological stability of the landforms;
- Protection of the slopes against erosion;
- Pollution control (ground and surface water);
- Clean and dirty water separation;
- Concurrent rehabilitation;
- Mitigating the visual impact of the waste rock dump and residue disposal facilities;
- A post closure land use with no long term liabilities;
- Mitigate and, where appropriate, remediate adverse social impacts;
- Portable skills; and
- The Mine is closed efficiently, peacefully and cost effectively.

4.3 Assessment of Alternatives

A detailed investigation and comparative assessment of the alternative options for the Voorspoed Mine decommissioning and closure alternatives was undertaken, including the positive and negative implications of the proposed activity and identified alternatives.

A number of alternatives were identified for the project including:

- Strategic Mine Closure Alternatives;
- End Land Use Alternatives; and
- Rehabilitation Design Alternatives.

4.3.1 Strategic Mine Closure Alternatives

Voorspoed Mine identified a series of alternatives for detailed investigation in an attempt to minimise, or mitigate the impacts of mine closure, as follows:

1. Execution of the current Business Plan, including execution of the closure plan after operations have ceased;
2. Assessment of key value driver improvements on potential economically feasible life extension scenarios; and
3. Divestment of the mine via the investigation of a sale option to identify suitable buyers.

4.3.1.1 Execution of the current Business Plan

The final mine model resulted in the economic resources being depleted in the 4th Quarter of 2018. The projected mine life until 2020 was thus not achieved. The economics and life of the Voorspoed Mine was significantly impacted by the weak and geo-technically complex country rock, as well as unexpected changes in geology.

In spite of the numerous challenges and the high proportion of inferred resources, Voorspoed Mine has largely achieved its targets since commencement of mining activities in 2008.

4.3.1.2 Potential economically feasible life extension scenarios

Various Life of Mine extension scenarios were formally considered and investigated:

- <u>Open Pit Cut 3 extension scenarios</u> – Three Cut 3 extension scenarios were considered:
  - Pit extension via contractor mining;
  - Pit extension via capital expenditure where De Beers purchases and owns the equipment; and
  - Pit extension via leasing equipment.

All Cut 3 extension options evaluated for DBCM are commercially unattractive and erode NPV by between ZAR 239 million and ZAR 1,357 million. Economic studies therefore indicate that there are no reasonable prospects for any economically viable LoM extension opportunity by DBCM at Voorspoed Mine. The Whittle analyses indicate that another pushback will not be feasible if the costs of a replacement fleet or contractor operations are taken into account.

- Open Pit Cut 4 Scenario – This scenario entails a Cut 4 pushback of the open pit (open pit radius increase of approximately 120 metres). The Cut 4 design is commercially unattractive and erodes NPV by an estimated ZAR 413 million (-195%).

- Underground Mine scenario - The underground scenario is deemed to be commercially unattractive and may erode NPV by an estimated ZAR 1.7 billion.

4.3.1.3 Divestment of the mine

A divestment scenario was considered by De Beers, which entails pursuing a divestment option as a going concern, along with all its associated assets and liabilities. It was envisaged that this option would assist with continued economic activity and operational job retention from a community perspective. From a commercial perspective, the objective was to obtain the full value of the operation with limited remaining liabilities.

Following a comprehensive bidding process where proposals were received from more than 20 bidders, no commercially viable bid was presented, and the divestment option is, therefore, not considered to be feasible.

4.3.1.4 Mine Closure Scenario Alternatives

The strategic alternatives assessment concluded that the Base Case scenario (LoM until 2018) followed by a mine closure phase reflects the only commercially attractive option for De Beers (Figure 33).

Three strategic mine closure scenario alternatives were considered, primarily related to the end land state of the open pit and MRDs (Golder 2019):

1. Development of a Pit Lake under current conditions i.e. direct rainfall to the pit footprint area, groundwater ingress and evaporation. Runoff from the pit catchment area will be diverted from the pit perimeter area, including, runoff from other impacted areas. The pit will be left to fill/re-water by direct rainfall recharge and local runoff from the pit footprint area;
2. Development of a Pit Lake where, in addition to Scenario 1 above, the development of a pit lake with a specifically engineered local runoff catchment area to enhance runoff to the pit mainly to enhance development of a deeper pit lake during the initial re-watering period. This scenario addresses a larger "engineered" local catchment that will enhance the runoff to the pit and subsequently the re-watering progress; and
3. Open Pit Backfill Scenario using the current waste rock dump as the main source of fill material and back filling the pit excavation to current ground elevation level.

The technical evaluation assessed all options in terms of hydrogeology, hydrology, geochemistry and legal aspects to guide a risk-based assessment in selecting the most appropriate closure strategy for the pit lake development. The scenarios described above are illustrated in Figure 32.

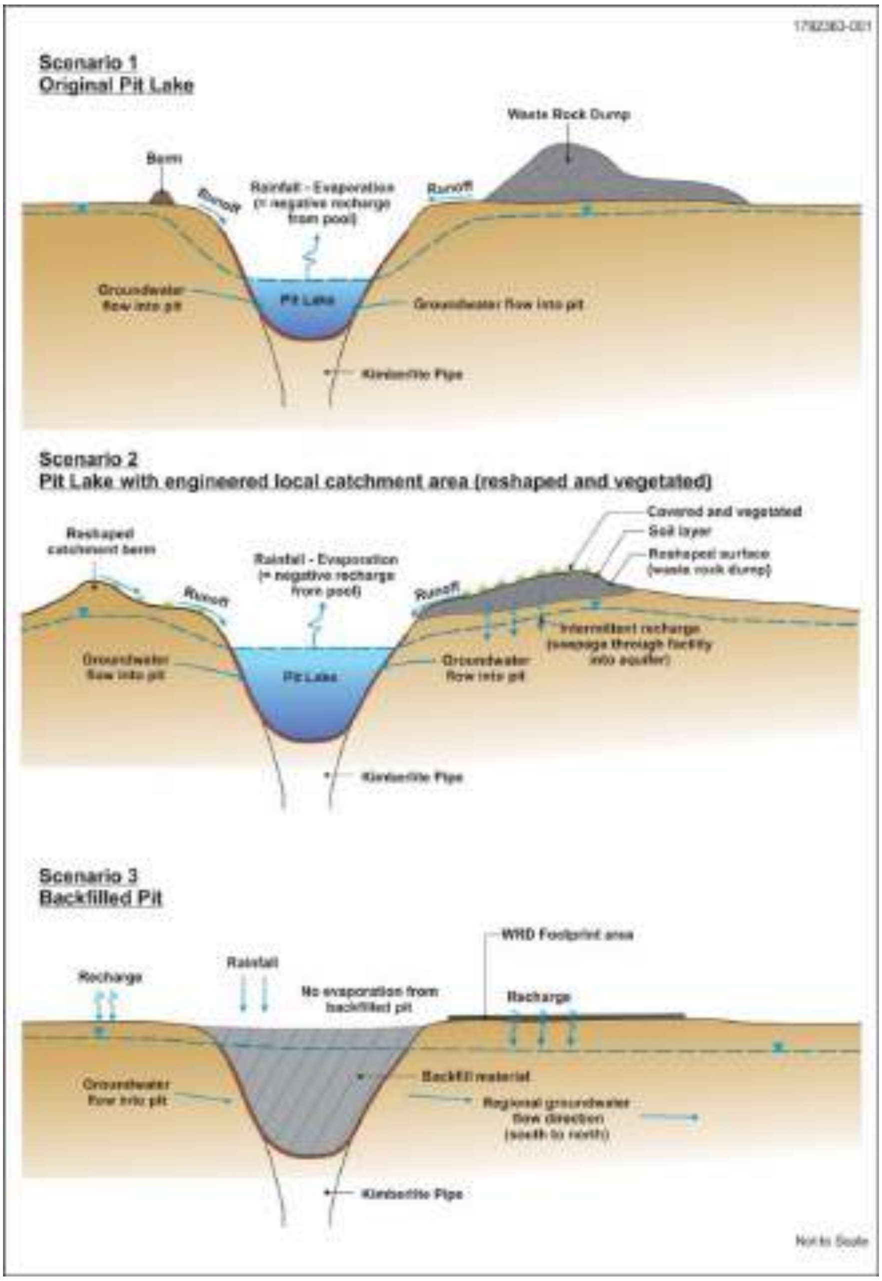


Figure 32. Three scenarios considered during the mine closure strategic alternatives assessment (from Golder 2019).

All information in the following section has been derived from the report ***Golder Associates Africa (Pty) Ltd.*** *February 2019.* ***.*** *Technical Evaluation of the Risks, Impacts and Management Requirements into Pit Backfilling versus Current Mine Plan (Pit Lake), Report 1792363-318923-1_Rev1*. Where relevant, content in this section may either have been reproduced verbatim or extracted from this source and edited.

Evaporation in the Voorspoed region is much higher than the total rainfall and groundwater ingress into the pit, the pit lake water level elevation is predicted to remain as a local piezometric sink i.e. the final water level elevation will settle several metres below the surrounding natural groundwater level elevation.

Due to the high surface elevation of the mine, i.e. situated close the runoff-water divides of three quaternary catchments, the local runoff is directed away from the pit area; thus, any contribution from local runoff to enhance the development of a deep pit lake, is limited. The only physical contribution to the rewatering process is from (i) direct rainfall recharge, and (ii) local groundwater ingress. The numerical modelling, however, confirms the impact of the high evaporation rate and the low groundwater ingress observed during LoM and that the rewatering rate in terms of Scenarios 1 and 2 will be retarded [under the current climate conditions, 200 years after close the water table could be in the order of 94 m below ground surface]. In the case of Scenario 2, where a "local catchment" feeding local runoff into the pit excavation is engineered, the simulated rewatering water level elevation over a 200-year period will be ~75 m below ground surface. The gain is in the order of 19 m.

Rewatering of the back filled pit excavation (Scenario 3) will be driven by recharge from local rainfall infiltration and groundwater ingress and could reach the pre-mining water level elevation in ~32 years – this is mainly due to the absence of the evaporation component. This scenario puts a risk on migration of poorer quality groundwater from the filled excavation to the local groundwater resources due to leaching of dissolved substances from the waste rock filling – now a semi-consolidated mass. A long-term responsibility for observations/monitoring on the mine site and surrounding land is required, followed by mitigation procedures, for example designing a special pollution plume borehole capturing system and subsequent storage/treatment procedures. In the latter case several water resources and environmental regulations will comply.

The water quality characteristics [modelling] in the cases of Scenario 1 and 2 for the Pit Lake water body shows that the initial TDS concentration is generally below the water quality limits for life stock water quality limits. Other important hydrochemical constituents such as Sodium, Sulphate and Calcium for Scenario's 1 and 2, however, indicates a long-term increase due to the evaporation impact. This water quality characteristic is based by the groundwater quality of the Pit water source, i.e. seepages in the pit floor area which can be regarded as deep, crustal/Kimberlite type water. As noted above, the water level elevation will remain as a local "sink" under the current drier climate conditions regulated by a low groundwater inflow and high evaporation rate.

Regarding the legal consequences, there no significant differences between Scenario 1 & 2, except the amendment of Part 2 of the 2017 EIA Regulations to change the closure condition from backfilling to a pit lake scenario. In the case of Scenario 2 (specifically the "engineered catchment"), diverting part of the catchment's clean water into the pit excavation, ensues a loss to the catchment's water budget – this will have to part of the EIA Regulation update and notifying the Department of Water and Sanitation). Scenario 3, however, requires a new water use license for pit excavation back filling using waste rock material, as well as a Contaminated Land Assessment of the waste rock foot print. In addition, a full EIA will be required (i.e. a waste management activity in terms of the 2017 EIA regulations) and subsequently a waste management license (GN R.633, Activity 34(11)). In addition, Scenario 3 requires an additional EIA compliance in the case of polluted groundwater capturing down gradient of the backfilled pit through a set of capturing waterholes and their abstracted water. Regarding GN 704, Scenarios 1 and 2 are compliant, but with Scenario 3, exemption is required.

4.3.1.5 Preferred Option

The preferred option for closure of the Voorspoed Pit excavation is Scenario 1, considering costs and long-term environmental impacts. Considering that special mitigation in terms of security and protection of the property against illegal mining and unauthorised trespassing with potential fatal consequences, are required and should be managed and funded for a considerable time after final closure. The latter requirement also accounts for Scenario 2, which is regarded as benefitting the social aspects above Scenario 1, and to some degree the environmental aspects. Redirecting local runoff, i.e. Scenario 2, to enhance the development of the Pit Lake may not be supported by the Department of Water and Sanitation and a special motivation will be required. Scenario 3 offers the best option towards the social aspects (specifically public safety and is close to having a pre-mining environment established), however, the economic and environmental significances overrides Scenario 1 and 2 benefits considerably, therefore, Scenario 3 is not regarded as an economic-environmental executable option.

In considering the positive/negative risk impacts and management requirements of all the above-mentioned scenarios, several important aspects were considered and may be sourced in the report ***Golder Associates Africa (Pty) Ltd.*** *February 2019***.** *Technical Evaluation of the Risks, Impacts and Management Requirements into Pit Backfilling versus Current Mine Plan (Pit Lake), Report 1792363-318923-1_Rev1*. Aspects considered include:

- Legislative requirements for Scenarios 1, 2 and 3;
- Geochemical source term of the pit structure (i.e. rock faces incl. side walls);
- Geochemical source term of the backfilling material (i.e. mainly the waste rock dump);
- Water level elevation and water quality signatures of Pit Lake waterbody and rate of rewatering;
- Risk of polluting the surrounding aquifer system(s) based on the final hydraulic nature/relief of the rehabilitated site, and
- The socio-economic (potential costing) and environmental aspects related to the three scenarios.
- Address post closure risks and management requirements related to the pit excavation as exposed in the three scenario assessments.

Table 18 presents advantages and disadvantages associated with each scenario.

Table 18. Advantages and disadvantages associated with each scenario (from Golder 2019).

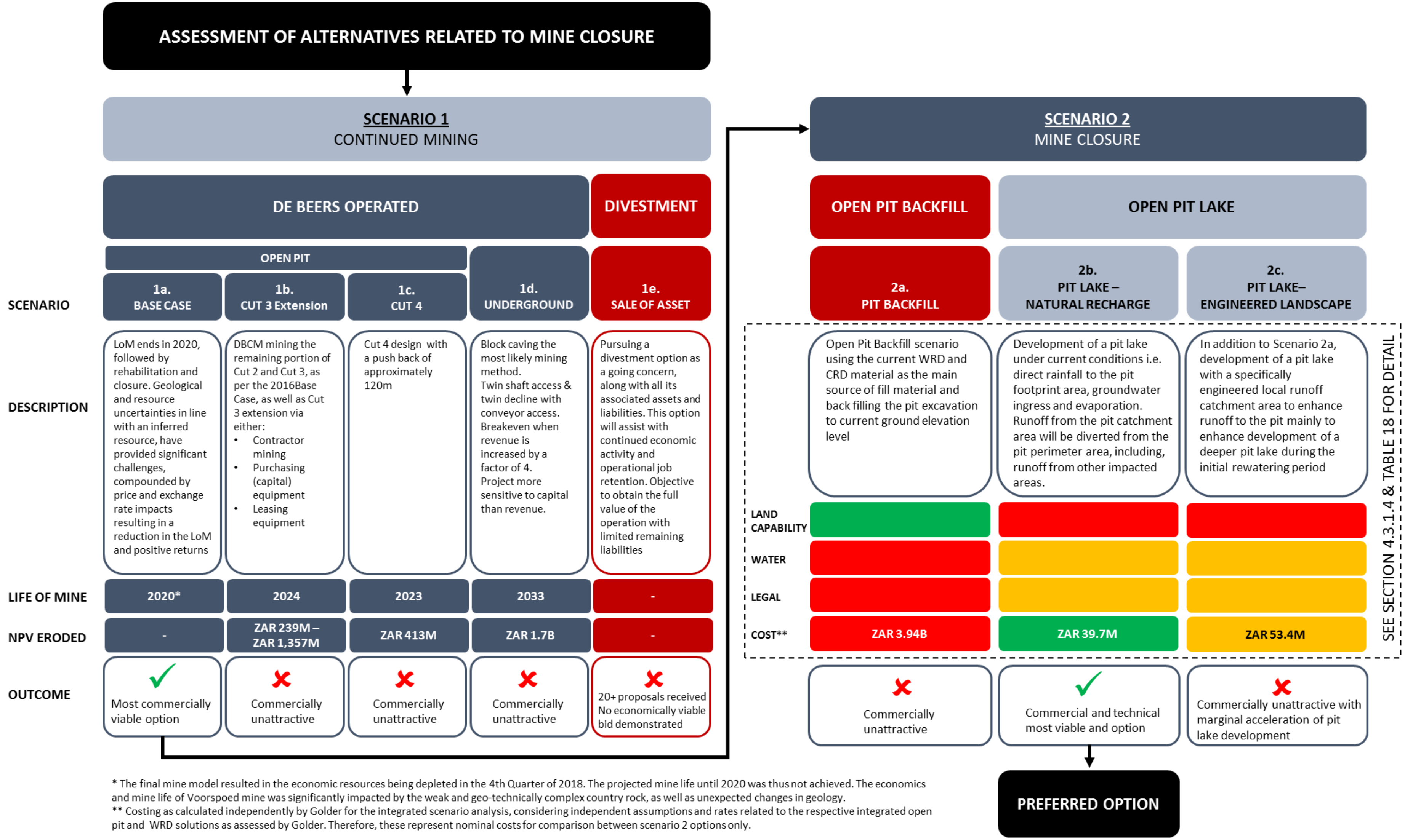
Scenario 1: Pit lake status quo	Scenario 2: Pit lake with enhanced drainage	Scenario 3: Backfilled pit
Advantages		
• Low cost for option development • Groundwater quality largely within domestic and livestock limits, only selenium could be a problem for domestic use • Water level below natural ground level so pit will continue to act as a sink with no plume migration	• Higher cost for WRD reworking but still much less than backfilling • Groundwater quality largely within domestic and livestock limits, only selenium could be a problem for domestic and livestock use • Water level below natural ground level so pit will continue to act as a sink with no plume migration • Possible vegetation failure and soil erosion losses of the WRD will report to the pit and not to the environment	• Reuse of the post-closure WRD footprint • Increase in catchment yield • WRD will no longer pose a contamination risk, and the pit will no longer pose a safety risk
Disadvantages		
• Pit crest instability with associated break back, posing a safety risk requiring proper protection • Possibility of illegal mining taking place immediately post-closure • Continuous monitoring of WRD. Possible vegetation failure and soil erosion losses on the WRD would result in silt and other contaminants reporting to the environment	• Pit crest instability with associated break back, posing a safety risk requiring proper protection • Possibility of illegal mining taking place immediately post-closure although the period for water to fill the pit will be marginally shorter than for Scenario 1 • Reduction of catchment yield from the WRD	• WRD foot print waste classification and rehabilitation • Extreme cost to backfill and possible additional cost of abstraction and treatment of contaminated groundwater plume • Groundwater quality exceeds constituents of concern. Although the qualities within the pit improve after ±30 years the contaminants will have simply moved to the surrounds in a contaminated groundwater plume • Water level will rebound to the natural water table level and the contaminated groundwater plume will migrate down gradient to the surrounding aquifer system(s)

In terms of economic and environmental considerations, Scenario 1 is the best option due to the lower cost (land form rehabilitation included in the overall mine rehabilitation program) and environmental aspects (i.e. limited runoff from surrounding unprotected land and prohibit migration of contaminated water to the surrounding environment). Final environmental conditions won't be comparable directly with pre-mining conditions, as there would be limited aesthetic improvements.

In Scenario 2, rewatering of the pit will be quicker than Scenario 1 but the water quality in the Pit Lake is expected to be impacted more than Scenario 1. However, Scenario 2 will improve the protection of the Pit Lake area over a shorter period than Scenario 1. Final conditions won't be comparable directly with pre-mining conditions, as there would be limited aesthetic improvements and land access will not be re-gained specifically on the engineered local catchment. Possibility that the Department of Water and Sanitation might argue against the development of a local engineered catchment directing the runoff in to the Pit Lake instead of discharging into the catchment.

Scenario 3 is not recommended due to extraordinary costs of backfilling activity, the creation of a potential pollution footprint (i.e. remaining foot print of the current waste rock dump) and the potential impact on the surrounding environment due to polluted groundwater migration from the saturated backfilled excavation as early as ~32 years after closure towards surrounding users.

Figure 33 presents a summary of the strategic alternatives assessment process and the preferred mine closure option.



* The final mine model resulted in the economic resources being depleted in the 4th Quarter of 2018. The projected mine life until 2020 was thus not achieved. The economics and mine life of Voorspoed mine was significantly impacted by the weak and geo-technically complex country rock, as well as unexpected changes in geology.
** Costing as calculated independently by Golder for the integrated scenario analysis, considering independent assumptions and rates related to the respective integrated open pit and WRD solutions as assessed by Golder. Therefore, these represent nominal costs for comparison between scenario 2 options only.

Figure 33. Strategic Alternatives assessment process and preferred options

4.3.2 End Land Use Alternatives

Voorspoed Mine commissioned a study (Neka 2017) to develop an ELUP that is aligned with:

- The mine's closure planning initiatives;
- The mine's Preliminary Mine Closure Plan (2011 and 2014);
- The mine's Rehabilitation Plan (2014);
- Social Closure Plan; and
- The Fezile Dabi district municipality's Integrated Development Plan (IDP).

The study aimed to:

- Develop a comprehensive list of potential end land uses for evaluation to determine which of the options had the highest likelihood of succeeding beyond closure; and
- Evaluate the business case (financial viability) for the selected end land use (ELU) options.

The land capability assessment indicated that the Voorspoed properties could be utilised for extensive sheep, cattle and game farming, with limited cropping on existing cultivated lands. The general shortage of surface and groundwater in the area mitigated against the selection of intensive agriculture in the form of large-scale centre pivot irrigation of maize and vegetables, and the greenhouse cultivation of vegetables and cut flowers. The high cost of importing/pumping irrigation water from remote water sources, if this water use could be licenced, would render the irrigation enterprises marginal to unprofitable.

Some of the potential end land use options that were considered, but not evaluated further, were those that required environmental authorisation under the NEMA EIA regulations (for example cattle feed lots, commercial piggeries, or large chicken farms). These ELU options would be more difficult to implement because of the protracted timeline for permitting and the likely strong opposition from neighbouring stakeholders because of nuisance odours. In addition, the limited surface and groundwater resources on Voorspoed would likely be insufficient to water the high densities of livestock kept, with a further compounding factor being that these intensive farming enterprises would have a far greater pollution impact on the existing surface and groundwater resources in the area.

The study concluded that, in terms of next land use, the Voorspoed properties can be used for profitable gain if integrated into existing and established farming enterprises in close proximity to the mine, and particularly where any start-up capital needed is kept as low as possible (Neka 2017).

4.3.2.1 End Land Use Alternatives Considered

Following a key stakeholder workshop held at Voorspoed Mine on 25 August 2016, Voorspoed Mine had identified a number of potentially viable end land use options as part of its closure planning process, as listed below:

- Extensive cattle farming;
- Extensive sheep farming;
- Intensive cattle farming (feedlot);
- Intensive sheep farming;
- Commercial piggery;
- Chicken farming (broilers and layers);
- Dryland maize and other crops (sunflower/soya);
- Maize under centre pivot irrigation (utilising pit lake water);
- Vegetable production under centre pivot irrigation (utilising pit lake water)
- Vegetable production in greenhouses.
- Sunflower, soya bean and other alternative oil producing crops (for bio-fuel);
- Cut flower production;
- Conservation - wetlands/biodiversity;
- Game farming - high value species;
- Game farming;
- *Aggregate production – WRD;*
- *Brick making CRD;*
- *Brick making FRD;*
- Solar farm;
- Mining tourism; and
- Pecan nut plantation

The options in italics were captured, but were deemed unsuitable for post-closure activities as they would work against finalising rehabilitation of these facilities. Processing of waste rock could be practiced, but this would best be done during the remaining life of mine.

Further detail regarding the ELU options and their feasibility assessments is available in the report entitled '*Proposed End Land Use Plan for Voorspoed Diamond Mine*' as prepared by Dr M. E. Aken of NEKA Sustainability Solutions.

Amongst the wide variety of potential ELU options proposed, the agricultural use of the Voorspoed properties post-closure was deemed to be the most appropriate in the regional context, and the most likely to be sustainable in the long term. The agricultural ELU options that were selected for economic evaluation included the production of selected crops (maize and sunflower), domestic livestock farming (cattle and sheep), and also game farming, and combinations of these.

4.3.3 Rehabilitation Design Alternatives

In addition to the Strategic and End Land Use alternatives, Voorspoed assessed various rehabilitation design alternatives (Table 19).

Table 19. Voorspoed Mine rehabilitation design alternatives.

Mine closure element	Alternative 1	Alternative 2	Alternative 3
ON SITE INFRASTRUCTURE			
Treatment plant and associated equipment	Maintain plant *in situ* for future use	Demolish and remove all infrastructure	Sell plant to another mine
OUTCOMES	The resource is depleted and there is no commercially viable option for continued mining by De Beers. No commercially viable bids were received from prospective future operators, (see Figure 33).		If the plant is successfully sold by De Beers, the plant will be demolished and removed (aligned with alternative 2).
PREFERRED OPTION	✗	✓	As for Alternative 2, if sold
Offices, workshops, stores	Maintain use of infrastructure for third parties	Demolish and remove all infrastructure	
OUTCOMES	Due to the mine's location and nature of the infrastructure (e.g. temporary offices), no opportunities for sustainable re-use of the infrastructure have been identified.		
PREFERRED OPTION	✗	✓	
OFF-SITE INFRASTRUCTURE			
	Retain all off-site infrastructure for use by third parties post closure	Demolish and remove all off-site infrastructure	Retain selected off-site infrastructure for use by third parties post closure
OUTCOMES	No opportunities have been identified and no agreed handover / maintenance agreements have been achieved	Selected infrastructure (e.g. external road, *Eskom* owned substations and the Renoster River weir) will be demolished.	Selected infrastructure (e.g. external road, *Eskom* owned substations and the Renoster River weir) will not be demolished.
PREFERRED OPTION	✗	✗	✓
WASTE ROCK DUMPS (WRD)			
Profiling	24° single slope per lift with benches between lifts	18° single slope per lift with benches between lifts	
OUTCOMES	Stable, non-eroding slopes with sustainable vegetation establishment may not be achievable and has not been demonstrated	Flatter angle facilitates improved chance of establishing sustainable slopes. Success has been demonstrated on short slopes	
PREFERRED OPTION	✗	✓	
Surface Water Management	Contain all runoff on top area; contain all runoff from upper slopes on benches	Shed all runoff from top area; shed all runoff from upper slopes and benches	Shed all runoff from top area; contain all runoff from upper slopes on benches

OUTCOMES	Reduce the risk and cost of ongoing maintenance of water control structures. Increase biodiversity and sustainability of vegetation by creating more diverse and wetter habitats	Erosion risk are introduced and surface water management structures may be required, attracting cost and ongoing maintenance	Erosion risk are introduced and surface water management structures may be required, attracting cost and ongoing maintenance
PREFERRED OPTION	✓	✗	✗
Growth Medium	300 mm soil cover layer on entire facility	200 mm soil cover layer on slopes and 100 mm soil cover layer on top area, both areas with soil amelioration	
OUTCOMES	Waste rock material can sustain vegetation and a thinner layer of growth medium has been proven to be successful.	Waste rock material can sustain vegetation and a thinner layer of growth medium has been proven to be successful. Cost are reduced without compromise in long term sustainability.	
PREFERRED OPTION	✗	✓	
COARSE REVENUE DEPOSIT (CRD)			
Profiling	Short slope (45m) with 2x benches; Intra bench slope at 18°	Long (up to 140 m) single slope at 16°	
OUTCOMES	Risk of sedimentation of benches attracting ongoing maintenance.	Flatter angle facilitates improved chance of establishing sustainable slopes.	
PREFERRED OPTION	✗	✓	
Surface Water Management	Non-water shedding except for lower slope	Slopes water shedding and only contain runoff on top area	
OUTCOMES	Risk of benches overtopping during extreme storm events	Reduce the risk and cost of ongoing maintenance of water control structures. Increase biodiversity and sustainability of vegetation by creating more diverse and wetter habitats. Larger of the facility remains free-draining.	
PREFERRED OPTION	✗	✓	
Growth Medium	Soil cover of 300 mm	Basalt armour of 300mm; Soil cover of 200 mm	
OUTCOMES	Reduced stability and combatting of erosion	Increased stability and combatting of erosion	
PREFERRED OPTION	✗	✓	

FINE RESIDUE DEPOSIT (FRD)			
Profiling	Short slope (45m) with 1x benches on longer slopes, other slopes single 18°slope; Intra bench slope at 18°	Long (up to 80 m) single slope at 16°; shorter slopes at 18° single slope with only soil cover	
OUTCOMES	Risk of sedimentation of benches attracting ongoing maintenance. Risk of benches overtopping during extreme storm events	Flatter angle facilitates improved chance of establishing sustainable slopes.	
PREFERRED OPTION	✗	✓	
Surface Water Management	Contain less than 50,000m^3 water on facility and construct emergency spillways	Slopes water shedding and contain runoff on top areas	
OUTCOMES	Risk of spillway failures and ongoing maintenance.	Reduce the risk and cost of ongoing maintenance of water control structures.	
PREFERRED OPTION	✗	✓	
Growth Medium	Slopes: Soil cover of 300mm	Slopes: Basalt armour of 300mm; Slopes: Soil cover of 200 mm	
OUTCOMES	Reduced stability and combatting of erosion	Increased stability and combatting of erosion	
PREFERRED OPTION	✗	✓	
OPEN PIT			
Open pit status post closure	The development of a pit lake under current conditions i.e. direct rainfall to the pit footprint area, groundwater ingress and evaporation. Runoff from the pit catchment area will be diverted from the pit perimeter area, including, runoff from other impacted areas.	In addition to Alternative 1, the development of a pit lake with a specifically engineered local runoff catchment area to enhance runoff to the pit mainly to enhance development of a deeper pit lake during the initial rewatering period.	Open pit backfill using the current WRD and CRD material as the main source of fill material and back filling the pit excavation to current ground elevation level
PREFERRED OPTION	✓	✗	✗

4.4 Final End Land Use Plan

Amongst the wide variety of potential ELU options proposed, the agricultural use of the Voorspoed properties post-closure was deemed to be the most appropriate in the regional context, and the most likely to be sustainable in the long term. The agricultural ELU options that were selected for economic evaluation included the production of selected crops (maize and sunflower), domestic livestock farming (cattle and sheep), and also game farming, and combinations of these.

The proposed end land use for Voorspoed Mine is based on recent studies, previous commitments, land capability, the extent of disturbance and the need to address certain residual risks as described in the Final Closure Plan (Redco, December 2017) and illustrated in Figure 34. The following end land uses are proposed:

- Retain the arable land use on existing croplands;
- Reinstate the grazing potential of the land over a large as possible portion of the site;
- Reinstate the grazing potential on the mining area (including the WRD, CRD and infrastructure footprints), but control the grazing utilisation to protect the rehabilitated areas that will remain more sensitive than the surrounding natural or other grazing areas;
- Allow grazing on the more sensitive biodiversity rich areas, but control the grazing utilisation to protect the biodiversity; and
- Restrict any access to the open pit and top of the FRD due to the safety risk; these areas will therefore have a very limited land use.

The following land use categories and associated areas are proposed (Figure 34):

- **Croplands**
  Existing croplands where crop cultivation practices have historically occurred.

- **Grazing**
  Grassland areas suitable, and historically utilised for pasturage, outside of the fenced mining area.

- **Controlled grazing (Safety and restoration objectives)**
  Post closure grazing within the fenced mining area. Grazing practices, areas, densities and durations are determined and managed to:
  - Ensure the safety of humans and animals
  - Avoid damaging restoration areas introducing safety risks
  - Avoid damaging areas that are sensitive due to being in the process of ecological succession / restoration

- **Controlled grazing (Biodiversity objectives)**

  Post closure grazing within areas identified by specialists to be ecologically sensitive or worthy of conservation status. Grazing practices, areas, densities and durations are determined and managed to:
  - Ensure that ecosystems are not damaged or overgrazed
  - Avoid damaging sensitive species
  - Avoid damaging areas that are sensitive due to being in the process of ecological succession / restoration

Factors influencing controlled grazing management include:
  - The ecological quality of grazing resources;
  - The ecological carrying capacity of grazing resources;
  - Ecological succession of re-established grazing resources
  - Potential erosion to substrate material

- **Restricted Areas**

  Areas where access to humans and animals is restricted and /or strictly controlled for maintenance or servicing activities, primarily for safety reasons. Restricted areas provide limited to no post closure end land use benefit.

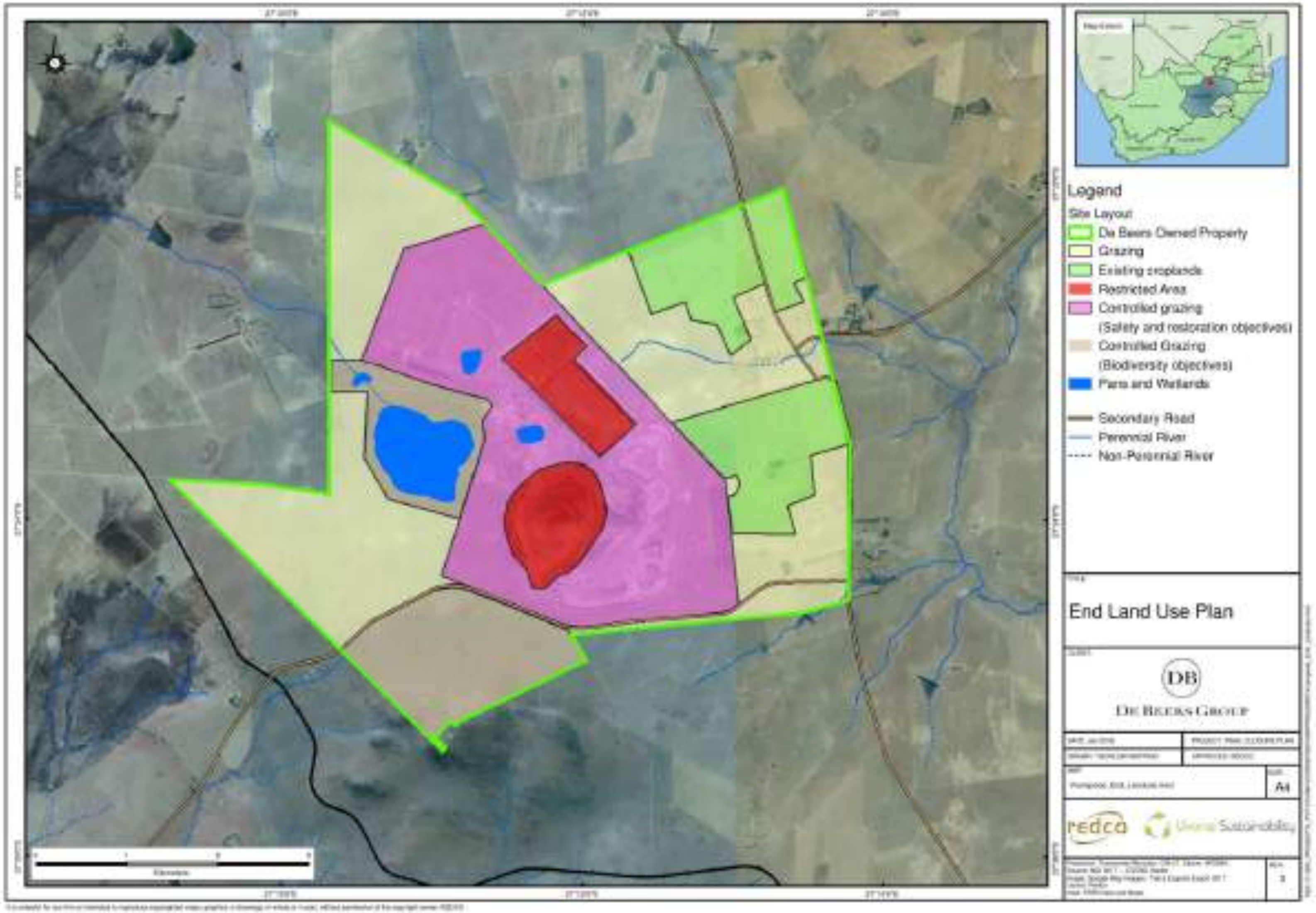


Figure 34. Proposed End Land Use Plan for Voorspoed Mine.

4.5 Interested and Affected Parties (I&AP) Consultation

Relevant government departments have not yet been consulted regarding the mine's proposed (most recent) physical, bio-physical and social closure criteria and objectives. It is intended for this to be addressed via the updated Stakeholder Engagement Plan (SEP) and associated processes.

In addition to all closure criteria, specific aspects of the closure plan which are considered high-risk in terms of regulator consultation include:

- The proposed closure criteria and final land use for the open pit;
- The proposed rehabilitation plan (extent of restoration relative to the extent of disturbance and proposed remediation actions) to address impacts to the pans;
- Proposed actions to address the socio-economic aspects of mine closure including future funding for municipal LED projects and education programmes; and economic impacts on the town of Kroonstad.

The engagements that have taken place to date relate to the social impact assessment, undertaken by ERM in 2016, and more recently (November 2017) to communicate the outcomes of the three-scenario assessment undertaken by Voorspoed Mine that concluded in the recommendation to divest the Mine.

4.5.1 Social impact assessment engagement

During the social impact assessment process, a number of stakeholder meetings were held. In addition, ERM contacted other stakeholders telephonically. The consultation events were planned to take place over three phases, each with specific objectives and different responsibilities for the engagement process (Table 20). Consultation with local government authorities was separated from the other engagement activities as a result of the local government elections that were held in 2016.

Table 20. Social impact assessment stakeholder engagement phases, objectives and responsibilities (from ERM, 2017)

Phases	Stakeholder Group	Objectives of Engagement	Engagement method	Responsible party for engagement
Phase 1: Early engagement	o Labour Unions o Voorspoed Employees o National Government o Provincial Government o District Municipality o Local Municipality	Inform stakeholder of the social closure assessment study.	Group meeting On-on-one meeting	Voorspoed Mine - Corporate Affairs
Phase 2: Pre-local government elections engagement	o Labour Unions o Voorspoed Employees o Local Suppliers / service providers o Voorspoed Critical Suppliers/ Contractors	Inform stakeholders of the social closure assessment study.	Focus Group Discussion On-on-one meeting	ERM

Phases	Stakeholder Group	Objectives of Engagement	Engagement method	Responsible party for engagement
	o Key Contractors o Business o Farmers o Youth Organisations o Women's groups o Koppies Water Scheme o Health institutions o LED/ CSI Beneficiaries	Collect data for the baseline and impact assessment.		
Phase 3: Post-local government elections engagement	o District Municipality o Local Municipality o Schools o LED/ CSI Beneficiaries o NGOs / CBO	Inform stakeholders of the social closure assessment study. Collect data for the baseline and impact assessment.	On-on-one meeting Focus Group Discussion	ERM

The outcomes of these consultation events raised positive and negative issues that will need to be considered by Voorspoed Mine. The issues raised have been used to inform the social risks that have been identified in the Social Risk Assessment that forms part of this MCP.

A summary of the issues raised is presented in Table 21. The full descriptions can be found in the ERM (2017) report.

Table 21. Issues raised by stakeholders.

Positive Comments	Negative Comments
Employees expressed an interest in understanding how they could become more involved in the mine closure process;	Employees expressed emotional distress when contemplating imminent mine closure for reasons including lack of retirement financial stability; misunderstanding of the phased nature of retrenchments; realisation that mine closure is imminent and expected lack of family support during the mine closure process;
Some employees have accrued healthy savings and investments during their tenure at the mine;	Concern that the retrenchments will not only impact mine employees but their families and the indirect jobs arising as a result of employment at Voorspoed Mine (e.g. domestic helpers);
Some employees are positive about their futures post the closure of Voorspoed. The DSD is available to provide support to others who may need it;	Rumours circulating amongst mine employees, and resultant perceptions need to be managed;
Highly and multi-skilled employees are optimistic that they will secure future employment elsewhere;	A large proportion of employees have limited savings or investments and have accrued large debts which will not be fully serviced by the time the mine closure process commences;

Positive Comments	Negative Comments
Restoration of mine land to agricultural use (especially cattle farming) would be positively received;	Some employees are concerned that there is not adequate time for them to acquire non-mining skills prior to retrenchment;
There are some opportunities for employees and contractors from Voorspoed to obtain employment at Lace Mine;	Concerns were expressed regarding the safety and security of neighbouring farmers post-closure if illegal miners access the mine area;
Employees proactively requested that Voorspoed provide further assistance to the employees in the form of financial planning, psychological counselling and study assistance;	Concern was expressed regarding the fate of wildlife currently residing on Voorspoed property
Local guesthouses do not foresee major business impacts as a result of mine closure;	Farmers who sold their land to DBCM expressed the view that they would have first option to acquire this land at mine closure;
The Zimele Hub has made a positive contribution to the Kroonstad area; and	Concern was expressed regarding schooling for children of mine employees who would be retrenched;
Employees expressed their desire for Voorspoed to be sold and further developed into an underground mine.	The local municipalities expressed concern regarding the economic viability of previously mine-funded projects; the viability of Kroonstad once Voorspoed employees move away; the impact of no future support for social projects by Voorspoed and the impacts on property prices in Kroonstad;
	Lace Mine indicated that they will only be able to accommodate limited numbers of employees as their mine is an underground mine; and
	Employees expressed concern about relocating to Lace Mine due to the company's poor health and safety record.

4.5.2 Further Stakeholder engagement

More stakeholder engagements were undertaken by Voorspoed Management from November 2017 to November 2018 to communicate the outcomes of the three-scenario assessment undertaken by Voorspoed Mine that concluded in the recommendation to divest the Mine.

A diverse range of stakeholders have been identified and engaged during the Social Impact Assessment phase as discussed above. Different issues are concerning different stakeholders, and so different types of stakeholders have been grouped based on their connections to Mine Closure as outlined in Table 22 and

Table 23. It is also important to understand how each stakeholder may be affected – in particular employees – so that engagement can be tailored to inform them and address their views and concerns in an appropriate manner.

The purpose of the SEP is to engage stakeholders about Voorspoed Mine's closure assumptions, alternative land uses and other closure related issues and concerns during the period leading up to final Closure. The SEP has been developed to describe DBCM's strategy and programme for engaging with stakeholders in line with the Draft Mine Closure Plan as at 2017.

Against this background the overarching goals of this SEP are to:

- Ensure regular, timely, accessible and appropriate dissemination of information regarding mine closure, in an appropriate manner, to all stakeholders;
- Have an open and inclusive approach to employee consultation in particular that will allow employees to comment on the Closure process, and to voice their concerns;
- Identify structures through which information can be disseminated to stakeholders; and
- Provide all stakeholders with the means to address concerns and grievances with the Mine Closure process, in a structured, reliable and responsive manner.

Details of individual stakeholders have been compiled in a stakeholder register which will be periodically updated throughout the Mine Closure engagement process.

Table 22 and

Table 23 present details of the internal and external stakeholders.

Table 22. Stakeholder Identification: Internal Stakeholder Groups

Stakeholder Categories	Stakeholder Groups	Connection to Mine Closure
Employees	• Voorspoed Employees	Employees that are working on a permanent basis for Voorspoed Mine will be directly affected as they will be losing their jobs. The broad category of employees include: • Permanent Mine Employees • Full-time contractor Employees • Beneficiaries of Home Ownership Subsidies • Facilitated Home Ownership Programme beneficiaries • Employees who receive schooling support (Included in this category are the families of employees)
Unions	• Labour Unions	The National Union of Mineworkers represents the interest of mineworkers and through existing forums will be a key stakeholder during the Closure Process.
Contractors	• Local suppliers • Local service providers	Various local suppliers and service providers have contractual relationships with the Voorspoed Mine. These businesses and potentially their employees will be impacted by the Closure of the Mine depending on their level of dependency on the Mine.

Table 23. Stakeholder Identification: External Stakeholder Groups

Stakeholder Categories	Stakeholder Groups	Connection to Mine Closure
Government	• National Government	National government are of primary importance in terms of establishing policy, granting permits or other approvals for the Voorspoed Mine, and monitoring and enforcing compliance with South African law throughout all stages of the Mine life-cycle. The primary stakeholder is the Department of Mineral Resources (DMR).
	• Provincial Government	Several provincial authorities are impacted by the proposed Closure of the Mine and will be informed of progress and plans in their areas, to consider the Closure activities in their duties and activities. Stakeholders include: • Department of Mineral Resources • Department of Education • Department of Health • Department of Labour • Department of Social Development • Department of Transport
Local Municipalities	• Ngwathe Local Municipality • Moqhaka Local Municipality	The host Ngwathe Local Municipality (Ngwathe LM), the labour-sending Moqhaka Local Municipality (Moqhaka LM) are impacted by the Closure of the Mine and will be informed of progress and plans in their areas, to consider the Closure activities in their policy-making, regulatory and other duties and activities.
Neighbouring landowners	• Farmers • Farmworkers	Neighbouring farmers and their farmworkers will be impacted by the Closure of the Mine especially during decommissioning (traffic) and post closure rehabilitation (safety and security).
SLP/ CSI Beneficiaries	• SLP Beneficiaries • CSI Beneficiaries	SMMEs, households and community members that are direct or indirect beneficiaries of the Mine's CSI and/or SLP projects. Once funding of these interventions, in particular sustained support by the Mine, have dried up the beneficiaries will be negatively impacted. Beneficiaries of once-off interventions will not be impacted by Mine Closure.
Vulnerable groups	• Women Groups • Youth Organisations	Vulnerable groups may be affected by the Closure of the Mine by virtue of their physical disability, social or economic standing, limited education, etc. They may also have difficulty in engaging with the stakeholder consultation process and thus may not be able fully express their concerns regarding the proposed Closure of the Mine. Specific vulnerable groups also include: • Women headed households • Children headed households • Elderly, physically, mentally disabled • Low-income households
Educational Institutions	• Schools • Colleges	Local primary and secondary schools will be impacted by the outmigration of employees as well as a potential migration of children from the more expensive private and model C schools to

		the cheaper government schools. Local colleges will play a role the Mine's post-closure skills development measures.
Health Institutions	• Hospitals • Clinics	Local hospitals and clinics will be impacted by the potential migration of employees from private to government supported healthcare. Both will play a role the Mine's pre and post-closure management measures.
Civil Society	• Community Based Organisations (CBOs)]	Organisations with direct interest in the proposed Closure of the Mine and its social and environmental aspects and that are able to influence the Closure Process directly or through public opinion.
Non-governmental Organisations (NGOs)	• National NGOs • Local NGOs	NGOs with direct interest in the Closure Process, and its social and environmental aspects and that are able to influence the Closure Process directly or through public opinion.
Local Businesses	• Local businesses • Entrepreneurs • Kroonstad Chamber of Commerce	Individuals or organisations with direct economic interest in the Mine. This may be through gaining contracts with the Mine or due to economic impacts caused by the Closure of the Mine (eg reduce spending of employee salaries on household goods and food).
Law enforcement	• Road Traffic Law Enforcement • MCCF • Private security providers	Law enforcement agencies that will be involved in protecting the assets of the mining operation and those that will be negatively affected by traffic and crime through decommissioning and beyond closure

Table 24. Mapping of Key Stakeholders

Stakeholder	Stakeholder Short	Stakeholder Group	Level of influence	Level of interest / Stake in Mine	Stakeholder Impact
Heuningspruit Environmental Protection Society (HEPS)	HEPS	Civil Society Organizations	Med	Med	Low
Kroonstad Primary & Secondary Schools	Edu-S	Educational Institutions	Low	Med	Med
Community Police Forum (CPF)	CPF	Farmers / Farming Associations	Med	High	Low
National Union of Mineworkers (NUM)	NUM	Labour Organisations	High	High	High
Moqhaka Taxi Association	Taxi Assoc	Local Businesses	Med	Med	Med
Fezile Dabi District Municipality	FDDM	Local Government	High	High	Med
Moqhaka Local Municipality	MLM	Local Government	High	High	High
Ngwathe Local Municipality	NLM	Local Government	High	High	Med
Mining Crime Combating Forum (MCCF)	MCCF	Local Security and Emergency Services	Med	Low	Low
South Africa Police Service (SAPS)	SAPS	Local Security and Emergency Services	High	High	Low
Department of Minerals and Resources	DMR (N)	National Government	High	High	Low
Mining Qualifications Authority	MQA	National SOEs and Development Agencies	High	Med	Low
National Regulator for Compulsory Specifications	NRCS	National SOEs and Development Agencies	High	Med	Low
National Youth Development Agency	NYDA	National SOEs and Development Agencies	Low	Low	Low
Small Enterprise Development Agency	SEDA	National SOEs and Development Agencies	Med	Low	Low
South African Heritage Resource Agency	SAHRA	National SOEs and Development Agencies	High	Low	Low
Department of Education	DoE	Provincial Government	High	High	Low
Department of Environmental Affairs	DOEA	Provincial Government	High	High	Low
Department of Labour	DoL	Provincial Government	Med	Med	Low
Department of Minerals and Resources	DMR (P)	Provincial Government	High	High	Low
Department of Public Works and Infrastructure	DPWI	Provincial Government	High	High	Low
Department of Water and Sanitation	DWS	Provincial Government	High	High	Low
Department: Economic, Small Business Development, Tourism and Environmental Affairs (DESTEA)	DESTEA	Provincial Government	High	High	Low
Free State Provincial Government	FSGov	Provincial Government	High	High	Low

Stakeholder	Stakeholder Short	Stakeholder Group	Level of influence	Level of interest / Stake in Mine	Stakeholder Impact
Community Based Organisations (CBOs)	CBOs	Civil Society Organizations	Med	Med	Low
Non-Governmental Organisations (NGOs)	NGOs	Civil Society Organizations	Med	Med	Low
Kroonstad Tertiary Education Facilities	Edu-C	Educational Institutions	Low	Low	Low
Voorspoed Permanent Ex-Employees	Ex-Empl	Employees	High	High	High
Farmers & Farmworkers	Farmers	Farmers / Farming Associations	Med	High	Med
Kroonstad Hospitals & Clinics	Health	Health Institutions	Low	Low	Low
Ex-Voorspoed Mine Vendors and Contractors	Contractors	Local Businesses	Med	High	High
Kroonstad Chamber of Commerce	Chamber	Local Businesses	Med	High	Med
SMMEs supported by Zimele	SMMEs	Local Businesses	Low	High	High
Road Traffic Law Enforcement	Road Traffic	Local Security and Emergency Services	High	Med	Low
Women Groups	Women G	Vulnerable Groups	Low	Low	Low
Youth Organisations	Youth G	Vulnerable Groups	Med	Med	Low

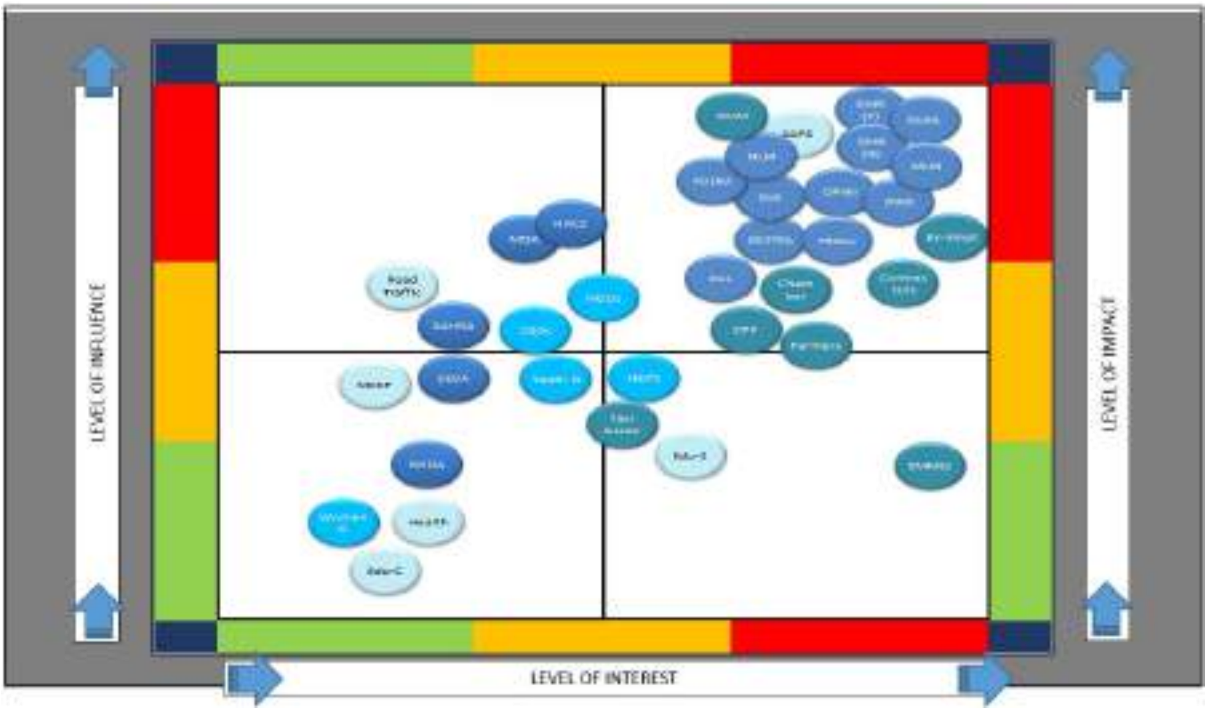


Figure 35. Stakeholder mapping matrix (from ERM 2019).

Table 25. Post-SIA stakeholder engagement phases, objectives and responsibilities

Phases	Stakeholder Group	Objectives of Engagement	Engagement method	Responsible party for engagement
Phase 1: Post SIA Engagement: Jan – May 2017	o Moqhaka LM o Ngwathe LM o Moqhaka IDP Steering Committee o FS Department of Health – Fezile Dabi District o FS Department of Education – Fezile Dabi District o DMR Welkom Regional Office o CSI beneficiaries – LAC o National Union of Mineworkers	Formulation of the 2017 – 2021 Social and Labour plan ahead of mine closure	Meetings	Corporate Affairs
Phase 2:Draft Mine Closure engagement – September 2017	o Moqhaka LM o Ngwathe LM o Moqhaka IDP Steering Committee o FS Department of Health – Fezile Dabi District o FS Department of Education – Fezile Dabi District o CSI beneficiaries / Vulnerable Groups o National Union of Mineworkers o DESTEA o SEDA	To update external stakeholders on the Draft Mine Closure Plan, particularly social impacts, risks and proposed mitigation measures	Town Hall	GM & Corporate Affairs

Phase 2: N28 Ramp Failure Engagement – September 2017	o Employees o National Union of Mineworkers o DMR Welkom	To communicate the N28 Failure, its potential impact on the life of mine and next steps to investigate the incident.	Meetings & Presentations	GM & Voorspoed Management
Phase 5: Three Scenario & Sale Decision engagement -	o Voorspoed Employees o NUM National o NUM Regional & Local o DMR National o DMR Regional o Moqhaka LM – Exec Mayor o Ngwathe LM – Exec Mayor o FS Department of Health – Fezile Dabi District o FS Department of Education – Fezile Dabi District o DMR Welkom Regional Office	Update on the three scenario assessment Announcement about the decision to formally explore the option of selling Voorspoed Mine to a responsible third party.	Meetings	CEO, GM and Voorspoed Mine
Phase 5: Sale Outcome & Closure Decision Engagement – July 2018	o DBCM Board o Voorspoed Employees o Future Forum o Voorspoed Contractors o NUM National o NUM Regional & Local o DMR National o DMR Regional o Moqhaka LM o Ngwathe LM o	Announcement of Board decision pertaining to close Voorspoed Mine After unsuccessful disposal process has had been concluded		CEO, GM and Voorspoed Management
Phase 6: Post closure Decision Engagemenrs - November 2018	o Minister of Mineral Resources o Director General of Mineral Resources o MSEC o Moqhaka LM o Ngwathe LM o NUM National o NUM Regional	MPRDA Section 52 engagement to explore all possible options proposed by DMR to avoid job losses	Meetings & Presentations	CEO, GM & Voorspoed Mine

The SEP aimed at focussing specifically on mine closure aspects and addressing the stakeholder engagement gaps highlighted in this closure plan. The SEP aims to:

- Confirm and update stakeholder mapping;
- Communicate updated mine closure criteria following the completion of this Mine Closure Plan. Commitments as documented in this report and the Voorspoed Mine Social and Labour Plan (SLP) will form the basis of the SEP;
- Engage with stakeholders and authorities to obtain an agreed Final Closure Plan, towards authority approval of the Plan; and
- Develop agreed Success Criteria via consultation with relevant stakeholders.

5 CLOSURE RISK ASSESSMENT

5.1 Approach

A formal risk assessment process based on the requirements of the AA MCT was conducted in order to adequately understand risks pertaining to mine closure that need to be mitigated by the closure planning process. The risk assessment process involved:

- An assessment of potential mine closure risks based on:
  - All activities and areas of the mine where impacts are known to occur
  - Existing knowledge of site and operational risks
  - Review of specialist reports and studies
  - Identification of anticipated post-closure impacts as identified during the bio-physical context review of this study (presented in Section 3.2)
- Risk assessment engagement with mine staff; and
- Development of iterative rehabilitation criteria trade-offs in order to address gaps and risks that have been identified.

The risk assessment process is aligned to the requirements of the AA MCT and was conducted according to the approach presented in Figure 36, where the risk of potential events / impacts occurring are assessed via a series of risk categories, before and after the application of mitigation measures.

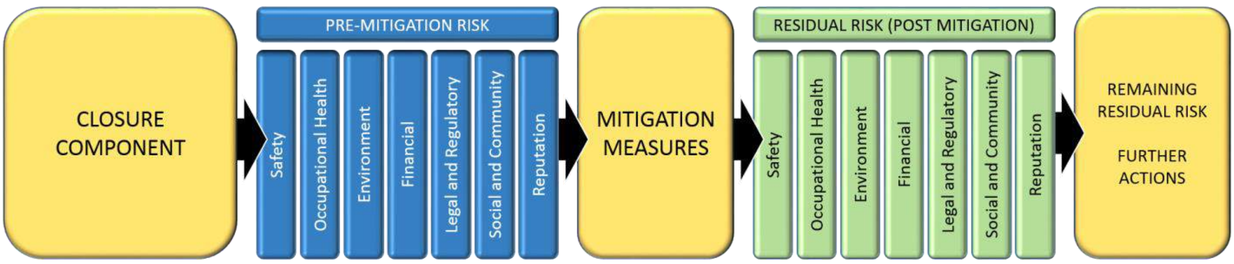


Figure 36. Mine Closure Toolbox Risk Assessment approach.

5.2 Methodology

The AA MCT risk assessment approach was adopted by using the Anglo American 5x5 matrix to conduct a mine closure risk assessment (Table 28). The matrix assesses the consequence of an identified event or impact in relation to the probability that the event or impact will occur.

5.2.1 Consequence Rating

Five risk categories were assessed during the risk assessment, where the risk of an event / impact occurring was rated according to the applicable risk category/ies. Risk categories included:

- Environment

- Safety and Health
- Financial
- Legal and Regulatory
- Reputation / Social / Community

Table 26. Consequence assessment table

Symbol	Probability of the risk occurring
1	Insignificant
2	Minor
3	Moderate
4	High
5	Major

The definitions associated with each consequence type, for each risk category, are presented in Table 26.

5.2.2 Probability Rating

The probability of an identified event or impact occurring post mine closure was rated according to the AA 5x5 matrix categories, where one of the following probability categories was selected (Table 27):

Table 27. Probability assessment table

Symbol	Probability of the risk occurring
5	Almost Certain >90%
4	Likely 30% – 90%
3	Possible 10% - 30%
2	Unlikely 3% - 10%
1	Rare <3%

5.2.3 Final Risk Rating

The consequence type and probability rating for an identified event or impact was assessed according to the AA 5x5 risk assessment matrix, delivering a risk rating and associated risk level for the identified event / impact. Risk ratings occur in quantified categories, where one the following risk levels and associated actions were identified for each identified event or impact (Table 28):

- High risk – Appropriate mitigation strategy to be devised immediately
- Significant risk - Appropriate mitigation strategy to be devised as soon as possible
- Medium risk - Appropriate mitigation strategy to be devised as part of the normal management process
- Low risk – Monitor risk, no further mitigation required

Table 28. AA 5x5 Risk Level Matrix

Consequence Type	1 - Insignificant	2 - Minor	3 - Moderate	4 - High	5 - Major
Schedule	Less than 1% impact on overall project timeline	May result in overall project timeline overrun equal to or more than 1% and less than 3%	May result in overall project timeline overrun of equal to or more than 3% and less than 10%	May result in overall project timeline overrun of equal to or more than 10% and less than 30%	May result in overall project timeline overrun of 30% or more
Cost	Less than 1% impact on the overall budget of the project	May result in overall project budget overrun equal to or more than 1% and less than 3%	May result in overall project budget overrun of equal to or more than 3% and less than 10%	May result in overall project budget overrun of equal to or more than 10% and less than 30%	May result in overall project budget overrun of 30% or more
Quality and Technical Integrity	No significant impact on quality of deliverables or effect on production	Quality issues that can be addressed prior to handover or could affect production by more than 1% and less than 3%	Quality issues that can be addressed during ramp-up or could affect production by more than 3% and less than 10%	Quality issues that require significant intervention to maintain performance or could affect production by more than 10% and less than 30%	Quality issues that require significant intervention to achieve performance or could affect production by 30% or more
Safety	First aid case	Medical treatment case	Lost time injury	Permanent disability or single fatality	Numerous permanent disabilities or multiple fatalities
Occupational Health	Exposure to health hazard resulting in temporary discomfort	Exposure to health hazard resulting in symptoms requiring medical intervention and full recovery (no lost time)	Exposure to health hazards/ agents (over the OEL) resulting in reversible impact on health (with lost time) or permanent change with no disability or loss of quality of life	Exposure to health hazards/ agents (significantly over the OEL) resulting in irreversible impact on health with loss of quality of life or single fatality	Exposure to health hazards/ agents (significantly over the OEL) resulting in irreversible impact on health with loss of quality of life of a numerous group/population or multiple fatalities
Environment	Lasting days or less; affecting small area (metres); receiving environment highly altered with no sensitive habitats and no biodiversity value (e.g. urban / industrial areas).	Lasting weeks; affecting limited area (hundreds of metres); receiving environment altered with little natural habitat and low biodiversity value	Lasting months; affected extended area (kilometres); receiving environment comprising largely natural habitat and moderate biodiversity value	Lasting years; affecting area on sub-basin scale; receiving environment classified as having sensitive natural habitat with high biodiversity value	Permanent impact; affecting area on a whole basin or regional scale; receiving environment classified as highly sensitive natural habitat with very high biodiversity value
Legal & Regulatory	Technical non-compliance. No warning received; no regulatory reporting required	Breach of regulatory requirements; report/involvement of authority. Attracts administrative fine	Minor breach of law; report/investigation by authority. Attracts compensation/ penalties/ enforcement action	Breach of the law; may attract criminal prosecution, penalties/ enforcement action. Individual licence temporarily revoked	Significant breach of the law. Individual or company law suits; permit to operate substantially modified or withdrawn
Social / Communities	Minor disturbance of culture/ social structures	Some impacts on local population, mostly repairable. Single stakeholder complaint in reporting period	On going social issues. Isolated complaints from community members/ stakeholders	Significant social impacts. Organized community protests threatening continuity of operations	Major widespread social impacts. Community reaction affecting business continuity. "License to operate" under jeopardy
Reputation	Minor impact; awareness/ concern from specific individuals	Limited impact; concern/ complaints from certain groups/ organizations (e.g. NGOs) period	Local impact; public concern/ adverse publicity localised within neighbouring communities	Suspected reputational damage; local/ regional public concern and reactions	Noticeable reputational damage; national/ international public attention and repercussions

PROBABILITY		RISK LEVEL				
5 - Almost Certain **>90%**	90% and higher likelihood of occurring	**11 (Medium)**	**16 (Significant)**	**20 (Significant)**	**23 (High)**	**25 (High)**
4 - Likely **30%-90%**	Between 30% and less than 90% likelihood of occurring	**7 (Medium)**	**12 (Medium)**	**17 (Significant)**	**21 (High)**	**24 (High)**
3 - Possible **10%-30%**	Between 10% and less than 30% likelihood of occurring	**4 (Low)**	**8 (Medium)**	**13 (Significant)**	**18 (Significant)**	**22 (High)**
2 - Unlikely **3%-10%**	Between 3% and less than 10% likelihood of occurring	**2 (Low)**	**5 (Low)**	**9 (Medium)**	**14 (Significant)**	**19 (Significant)**
1 - Rare **<3%**	Less than 3% likelihood of occurring	**1 (Low)**	**3 (Low)**	**6 (Medium)**	**10 (Medium)**	**15 (Significant)**

Risk Rating	**Risk Level**	**Guidelines for Risk Matrix**
21 to 25	High	A high risk exists that management's objectives may not be achieved. Appropriate mitigation strategy to be devised immediately.
13 to 20	Significant	A significant risk exists that management's objectives may not be achieved. Appropriate mitigation strategy to be devised as soon as possible.
6 to 12	Medium	A moderate risk exists that management's objectives may not be achieved. Appropriate mitigation strategy to be devised as part of the normal management process.
1 to5	Low	A low risk exists that management's objectives may not be achieved. Monitor risk, no further mitigation required.

5.3 Risks Identified

The risk assessments associated with the Closure Planning Risk Management are presented in **Error! Reference source not found.**. The results demonstrate the following:

- Current risks identified during the process;
- Risk assessment rating (by assessing the consequence and likelihood of an event / impact occurring) for the existing scenario;
- Proposed mitigation measures to address the risks identified;
- Residual risk assessment rating for identified risks after mitigation measures have been applied and that require further actions. These include mine closure gaps that remains and that need to be addressed via future / alternative actions.

5.4 Residual Risks

Significant residual risks (risks that remain at a significant risk rating post the implementation of mitigation measures) derived from the Closure Planning Risk Management process are presented in Table 29. This table includes a description of the risk, the associated mitigation measures and additional measures that are required in order to reduce the significance of the risk prior to finalisation of the mine closure process. In some instances these risks will remain significant even after the additional measures have been implemented. Risk numbers presented in Table 29 may be referenced in the risk assessment sheets in **Error! Reference source not found.**.

Table 29. Residual Risks

RISK AREA	RISK NUMBER	RISK	RESIDUAL RISK CATEGORY/IES	MITIGATION	ADDITIONAL MEASURES
Open Pit	OP2	Human injury or death due to uncontrolled access to the pit (falling into the pit) (Including illegal miners)	Safety Reputation	1. The Security fence around mining area will remain, reducing the risk of free access to the area by people. 2. Construction of a fence around the pit perimeter, outside the calculated zone of relaxation. 3. Construction of an enviroberm and trench around the pit perimeter. 4. Erection of clear signage at all entrances to highlight risks of entering the open pit area.	Implement fencing, enviroberm and trench maintenance programme.
Open Pit	OP7	Attempted illegal mining of the remaining resource once the site has been decommissioned impacting on human safety, integrity of rehabilitation efforts, increased financial liability, reputational damage and possible inability to obtain a closure certificate.	Safety Legal & Regulatory Social / Community Reputation	1. Blast the pit access ramps and final bench to cover the remaining resource. 2. Allow the pit to flood and form a pit lake. Active pit dewatering will cease once mining stops. This will allow the groundwater levels an opportunity to rebound (although rebound is expected to be slow). 3. The Security fence around mining area will remain, reducing the risk of free access to the area by people. 4. Construction of a fence around the pit perimeter, outside the calculated zone of relaxation. 5. Construction of an enviroberm and trench around the pit perimeter. 6. Erection of clear signage at all entrances to highlight risks of entering the open pit area.	Implement fencing, enviroberm and trench maintenance programme.
Fine Residue Deposit	FRD3	Possibility of outer slope (embankment) failure resulting in environmental and safety threats, due to saturation caused by the concentration of surface water to low areas.	Reputation	1. Maintain freeboard in excess (approx. 200%) of minimum requirements. 2. Construct buttress on identified sections of FRD 1B with higher risk of instability.	

RISK AREA	RISK NUMBER	RISK	RESIDUAL RISK CATEGORY/IES	MITIGATION	ADDITIONAL MEASURES
				3. Reshape the slopes to lower gradients (16°) to provide factor of safety higher than minimum requirements. 4. Reshape the slopes to lower gradients (16°) and cover long slopes with coarse basalt and soil and vegetate to reduce erosion. 5. Monitor seepage and bank stability. **(see Rehabilitation Plan - Addendum A).**	
Fine Residue Deposit	FRD5	Impact to soil, groundwater and / or surface water, due to contaminated seepage/leachate from FRD. Current seepage qualities indicate elevated levels of SO_4, Na, EC, TDS, Nitrates, Ca, Cl and SAR. Trends in Na, SO_4, TDS and EC concentrations in SWM01 (downstream of the FRD) show increasing concentrations over the LOM. Concentrations of Na, Cl, and TDS in the closest borehole (VDBH01) show increasing trends over the LOM. The FRD has been built over a non-perennial stream which will likely be impacted by seepage from this facility and the WRD. Downstream water quality impacts are predicted post-closure.	Environment Social / Community Reputation	1. Reshape embankment slopes to 16° to construct a single slope. 2. Cover long slopes with 300mm coarse basalt material. 3. Cover all reshaped slopes with 200mm soil to form growth medium together with underlying material. 4. Rip covered slopes on contour to mix cover layers with underlying material. 5. The construction of toe paddocks at seepage points to capture and evaporate seepage until seepage stops. 6. Ameliorate and vegetate all covered slopes. 7. Seal all penstocks and contain all runoff (Probable Maximum Precipitation) on top of FRD 1B (FRD 1A discharge to 1B) and FRD 2. More than 50 000 m^3 will be stored on the top surface. 8. Construct emergency spillway from FRD 1B to FRD 2 and from FRD 2 towards open pit. 9. Spread ameliorants and seeds by hand on portions of top surface that are accessible to facilitate natural succession of vegetation.	Implement post-closure surface water and groundwater quality monitoring programme.

RISK AREA	RISK NUMBER	RISK	RESIDUAL RISK CATEGORY/IES	MITIGATION	ADDITIONAL MEASURES
				10. The return water dam will remain 5 yrs. post-closure to capture any seepage and decant from the FRD. 11. Groundwater pollution modelling predicts a SO_4 pollution plume migrating outside the mine boundary however impacts will not impede use of water for human or animal consumption. 12. Post-closure ground water quality monitoring. 13. Due to the low solubility of the COC (Al, Ca, Fe, K, Mg, Na and Si) the leachate from the MRDs is considered to be non-hazardous to the environment. **(see Rehabilitation Plan - Addendum A).**	
Fine Residue Deposit	FRD7	If the FRD retains water on the surface post closure, it remains a dam with safety risk, due to: - Having a water holding capacity of > 50 000m3 - Having walls >5m in height.	Safety Legal & Regulatory Social / Community Reputation	1. Seal all penstocks and contain all runoff (Probable Maximum Precipitation) on top of FRD 1B (FRD 1A discharge to 1B) and FRD 2. More than 50 000 m3 will be stored on the top surface. 2. Construct emergency spillway from FRD 1B to FRD 2 and from FRD 2 towards open pit.	
Coarse Residue Deposit	CRD4	Impact to soil, groundwater and / or surface water, due to contaminated seepage/leachate from the CRD. Seepage from the CRD indicates elevated concentrations of EC, TDS, Cl, SO_4, Nitrate and Na. There is also evidence of hydrocarbon-influenced seepage. Groundwater qualities in GDH-04 do not yet appear to be impacted however GHD-03 indicates contamination of groundwater - elevated concentrations of Cl, SO4, Na. TDS and EC are above baseline of MBH03 (closest baseline	Environmental Social / Community Reputation	1. Reshaped slopes are covered with soil to form growth medium together with underlying material. 2. All rainfall and runoff only to be contained on the top surface. Reshaped side slopes to be free draining. 3. Crest berm walls and paddocks are constructed on top of the facility. 4. The top of the CRD facility is reshaped to drain inward, i.e. away from edge.	1. Implement post-closure groundwater quality monitoring programme. 2. Extent and nature of impacts of seepage on adjacent soils to be determined.

RISK AREA	RISK NUMBER	RISK	RESIDUAL RISK CATEGORY/IES	MITIGATION	ADDITIONAL MEASURES
		borehole). Pollution from seepage will in part migrate beyond the mine boundary but will not inhibit use of groundwater for human or animal consumption.		5. The construction of toe paddocks towards the northern pan to contain any possible sediment. 6. Rehabilitated surfaces to be covered with soil, ameliorated and vegetated. 7. Groundwater pollution modelling predicts a SO4 pollution plume migrating outside the mine boundary however impacts will not impede use of water for human or animal consumption. 8. Post-closure ground water quality monitoring. 9. Due to the low solubility of the COC (Al, Ca, Fe, K, Mg, Na and Si) the leachate from the MRDs is considered to be non-hazardous to the environment. **(see Rehabilitation Plan - Addendum A).**	
Coarse Residue Deposit	CRD7	The existing rehabilitated slope on the eastern side of the CRD has been profiled to have a single slope (without benches) with a slope length that may not facilitate a stable and sustainable end land use status. The slope currently has inadequate surface water management measures, which may facilitate erosion.	Environment Financial	1. Reshape steep slopes of CRD in balanced cut and fill operations to reduce gradient to 16°. 2. Cover reshaped slopes with a mixture of coarse basalt and soil to form growth medium together with underlying material. 3. Establish vegetation by: • Ameliorating soil as specified based on soil analysis of final growth medium. • Seeding the rehabilitated areas with a mixture of local indigenous grass and tree seeds that are adapted to the area. • Applying follow-up fertiliser where specified. • Controlling weeds and invader plant species.	

RISK AREA	RISK NUMBER	RISK	RESIDUAL RISK CATEGORY/IES	MITIGATION	ADDITIONAL MEASURES
				• Fencing the area into camps to control grazing. 4. CRD, FRD and WRD materials do not pose a health hazard.	
Pre-1912 Tailings Dump	CRD8	The remaining material within the Pre-1912 tailings dump may contain a diamond grade that is relatively higher than other discard dumps, potentially attracting illegal miners post closure, resulting in potential safety incidents, legal consequences and reputational damage to De Beers.	Legal & Regulatory Reputation	1. The dump will be reshaped, covered with growth medium and vegetated to support the proposed end land use. 2. The security fence around the property perimeter will remain to control unauthorised access.	Develop a Security Plan for decommissioning and rehabilitation phases of the mine closure (see Social Risk Assessment Risk S8).
Waste Rock Dump	WRD4	Impact to soil, groundwater and / or surface water, due to contaminated seepage/leachate from the WRDs. Seepage from the WRD contains elevated concentrations of EC, TDS, SO_4, Na and Nitrate. SWM05 is the nearest surface water sampling point downstream of the WRD. This point shows increasing concentrations of Na over the LOM. The closest borehole (VDBH04) showed frequent instances of exceeding various DWS drinking water parameters over the LOM.	Environment Legal & Regulatory	1. Reshaped slopes are covered with soil to form growth medium together with underlying material. 2. All rainfall and runoff to be contained on rehabilitated facility, except for bottom slopes. 3. Benches and cross-paddocks are constructed on the slopes during re-shaping to contain 1:200 year 24h rainfall event surface water runoff on the bench. 4. Crest berm walls and paddocks are constructed on top of the facility. 5. Existing low lying areas on top surface will be retained to contain the runoff and enhance evaporation. 6. Low lying areas next to dump edge will be reshaped or filled to drain away from edge. 7. The construction of toe paddocks at seepage points to capture and evaporate seepage until seepage stops. 8. Rehabilitated surfaces to be covered with soil, ameliorated and vegetated. 9. Groundwater pollution modelling predicts a SO_4 pollution plume migrating outside the mine boundary however	1. Implement post-closure groundwater quality monitoring programme. 2. Extent and nature of impacts of seepage on adjacent soils to be determined.

RISK AREA	RISK NUMBER	RISK	RESIDUAL RISK CATEGORY/IES	MITIGATION	ADDITIONAL MEASURES
				impacts will not impede use of water for human or animal consumption. 10. Post-closure ground water quality monitoring. 11. Due to the low solubility of the COC (Al, Ca, Fe, K, Mg, Na and Si) the leachate from the MRDs is considered to be non-hazardous to the environment. **(see Rehabilitation Plan - Addendum A).**	
Infrastructure	INF1	Potential hydrocarbon contaminated material at the plant, workshops and oil & fuel handling facilities that: • Potentially pollutes the natural environment. • Needs to be decontaminated; or • Needs to be disposed of legally at a registered waste disposal facility.	Financial Social / Community Reputation	1. Develop a formalised bio-remediation site and activity protocol to adequately deal with hydrocarbon-contaminated material volumes. 2. A Waste License may be required in terms of the NEM: Waste Act for the proposed bioremediation site.	1. Develop a formalised bio-remediation site and activity protocol to adequately deal with hydrocarbon-contaminated material volumes. 2. A Waste License may be required in terms of the NEM: Waste Act for the proposed bioremediation site.
Infrastructure	INF2	Possibility of not obtaining permission to dispose building rubble (inert demolition waste) on-site (exemption from regulator). If a disposal permit is not granted, a suitable certified offsite disposal facility must be utilised for rubble disposal.	Financial	An engagement plan for authority and relevant stakeholder engagement must be developed and implemented. To be conducted as part of the updated SEP.	To be addressed as part of the updated, ongoing SEP process
Infrastructure	INF4	Off-site infrastructure that has been identified to remain / not be demolished post mine closure will attract (i) ongoing care and maintenance or (ii) demolition costs if the infrastructure cannot be transferred to (and maintained by) 3rd parties. To date, post closure end-land use, ownership and associated maintenance of applicable infrastructure have not been confirmed or agreed to with relevant stakeholders. Specific infrastructure includes: • External access roads. • Electrical transmission and distribution infrastructure.	Financial Legal & Regulatory Social / Community Reputation	A plan for authority and relevant stakeholder engagement must be developed and implemented.	To be addressed as part of the updated, ongoing SEP process

RISK AREA	RISK NUMBER	RISK	RESIDUAL RISK CATEGORY/IES	MITIGATION	ADDITIONAL MEASURES
		• The Renoster River weir and/or associated infrastructure.			
Infrastructure	INF5	The revised closure criteria for the raw water pipeline (above surface infrastructure demolished; sub surface infrastructure remains in situ) may not meet farmers expectations (or perceived commitments made to farmers during the Mine project development phase), where pipeline infrastructure adjacent to farm properties will become the property of farmers post-closure. It remains unclear whether or not farmer expectations are that the pipeline maintains a water provision capability post closure. Applicable water use licencing will need to be addressed dependent on the ultimate outcome.	Social / Community Reputation	1. A plan for authority and relevant stakeholder engagement must be developed and implemented. 2. Delay the decommissioning activities of the pipeline to allow for stakeholder engagement and required legal actions towards the potential continued use of the water pipeline post closure by 3rd parties.	To be addressed as part of the updated, ongoing SEP process
Bio-Physical - Biodiversity	BD2	Surface water runoff to the wetland and pans has (i) decreased due to surface runoff being diverted away from the wetlands / pans (e.g. through stormwater management structures) and (ii) deteriorated in quality, causing a reduction in the ecological integrity / functioning of these systems. These impacts were not contemplated in the original EIA or approved WUL and will need to be rehabilitated before the site is relinquished. The liability assumes that the rehabilitation actions to address unauthorised impacts to the pans will focus on remediating indirect causes of impacts only. No cost estimation for earthworks within the pan / wetland areas has been included. Additionally, the liability estimate does not make provision to recreate the eastern area of the Southern Pan (below plant footprint).	Financial Legal & Regulatory	1. Impacts of the mining activities on the wetland and pans will be addressed by the rehabilitation plan, including: i. restoration of surface flow to feed the wetland / pans ii. removal of terrestrial alien invader species iii. routing of dirty stormwater to prevent impacts to the wetland / pans water quality and erosion of the wetland / pans. iv. restricting access (controlled access via fencing) to the wetland/ pans. v. implementation of sediment traps to ensure that mining-related sediment contained in stormwater does not settle in the wetland / pans. vi. maintain a 50m (1:100 year floodline) buffer around the pan as a no-go area	1. Implementation of a water and biodiversity (aquatic) monitoring programme (see Section 8) 2. An engagement plan for authority engagement must be developed and implemented. To be conducted as part of the updated SEP.

RISK AREA	RISK NUMBER	RISK	RESIDUAL RISK CATEGORY/IES	MITIGATION	ADDITIONAL MEASURES
				vii. ensure no excavation or infilling of the pan takes place. viii. introduction / re-introduction of wetland plant species to aid in the wetland / pan rehabilitation. ix. implementation of a water and aquatic bio-monitoring programme. 2. Engagement with authorities regarding: i. Unauthorised impacts. ii. Acceptability of proposed mitigation measures.	
Bio-Physical - Biodiversity	BD4	Although there are no areas classified to be 'protected areas', specialist studies identify various areas of high biodiversity value worthy of conservation status, given the distinct nature of the vegetation relative to the surrounding land and the relatively pristine nature thereof. Specific areas to be noted include: • Renosterkop area. • Pans and wetland. • Undisturbed grassland areas.	Environmental Legal & Regulatory Social / Community Reputation	The end land use plan focusses primarily on an agricultural end land use, with biodiversity sensitive areas being subjected to controlled grazing via the use of cattle and /or security fencing. There are no formal conservation objectives or actions in the end land use plan.	1. Formally identifying ecological important / sensitive areas (e.g. Wetlands, Renosterkop, remaining natural grasslands, ecological corridors). 2. Determine control measures to facilitate sound and responsible biodiversity management strategies for these areas, in the context of the end land use plan. 3. Implement identified control measures via contractual agreements and activities with land users, operator or tenants in the context of the end land use plan scenarios. 4. Implementation of a biodiversity monitoring programme to assess and analyse post closure impacts to biodiversity management (see MCP Section 8) 5. Engage with stakeholders, where relevant, towards identification of potential conservation areas, and mechanisms to implement conservation objectives (e.g.

RISK AREA	RISK NUMBER	RISK	RESIDUAL RISK CATEGORY/IES	MITIGATION	ADDITIONAL MEASURES
					conserving Renosterkop area and Heuningspruit conservation organisations / initiatives). To be conducted as part of the updated SEP.
Bio-Physical – Surface water	SW1	Surface water quality impacts to the non-perennial stream running to the north-east of the mining area.	Legal & Regulatory	1. Implementation of rehabilitation measures in order to restore contaminant sources to a stable physical state with indigenous species, according to stated closure criteria. 2. FRD will not be free draining. 3. Implementation of surface water monitoring programme (as per Golder report).	1. Implementation of surface water monitoring programme (as per Golder report). 2. Confirm monitoring results in relation to catchment RWQO.
Bio-Physical – Surface water	SW3	Contamination of off-site surface water resources as a result of run-off from MRDs is expected. However, due to incomplete monitoring data there is a lack of understanding of the significance of current and post-closure impacts on offsite surface water receptors as a result of run-off from the MRDs. The C70H catchment has been identified to be located in a River National Freshwater Ecosystem Priority Area (NFEPA) catchment.	Environmental Legal & Regulatory	1. Surface & groundwater impacts will be addressed through implementation of proposed rehabilitation strategies and monitoring programmes. 2. Run-off and toe seepage from the MRDs will be captured and contained in the mine's dirty water system. 3. Implementation of post closure Maintenance & Monitoring programmes. 4. Further studies including post closure salt balance.	1. Implementation of surface water monitoring programme. 2. Further studies including post closure salt balance.
Bio-Physical – Surface water	SW4	The volume and quality of water that will dewatered post-closure is unknown at present. The quantities and qualities may influence disposal options for this water when the RWD is decommissioned.	Legal & Regulatory	1. Complete salt balance and determine management plan for the water when RWD is decommissioned. 2. Potential to dispose into the open pit. 3. Determine if a Water Use authorisation is required.	Determine management plan and permit requirements.
Bio-Physical – Soils	SL1	The extent of hydrocarbon contamination on site, and the associated quantities of contaminated material to be bio-remediated / disposed is unknown. Soil hydrocarbon and salt contamination will impact negatively on land capability.	Financial Legal & Regulatory	1. Implementation of a sampling programme to determine the extent of the hydrocarbon contamination. 2. Cost trade-off between contaminated material treatment or disposal.	1. Implementation of a sampling programme to determine the extent of the hydrocarbon contamination.

RISK AREA	RISK NUMBER	RISK	RESIDUAL RISK CATEGORY/IES	MITIGATION	ADDITIONAL MEASURES
				3. In the event of material treatment being considered, design of an adequate and appropriate bio-remediation facility including the identification of required permits. 4. Implementation of a soil contamination monitoring programme.	2. Cost trade-off between contaminated material treatment or disposal. 3. In the event of material treatment being considered, design of an adequate and appropriate bio-remediation facility including the identification of required permits. 4. Implementation of a soil contamination monitoring programme.
Bio-Physical – Land Use and Land Capability	LU2	Risk of liabilities reverting back to De Beers should the end land users / tenants (post closure) not adhere to agreements/ contracts or do not implement proper maintenance / management of the property.	Environmental Financial Legal & Regulatory Reputation	1. Identification and implementation of adequate and appropriate post closure Maintenance & Monitoring programmes. 2. Determine control measures to facilitate sound and responsible biodiversity management strategies for these areas, in the context of the end land use plan. 3. Implement identified control measures via contractual agreements and activities with land users, operator or tenants in the context of the end land use plan scenarios. 4. Implementation of a biodiversity monitoring programme to assess and analyse post closure impacts to biodiversity management.	1. Formally identifying ecological important / sensitive areas (e.g. Wetlands, Renosterkop, remaining natural grasslands, ecological corridors). 2. Determine control measures to facilitate sound and responsible biodiversity management strategies for these areas, in the context of the end land use plan. 3. Implement identified control measures via contractual agreements and activities with land users, operator or tenants in the context of the end land use plan scenarios. 4. Implementation of a biodiversity monitoring programme to assess and analyse post closure impacts to biodiversity management (see MCP Section 8) 5. Engage with stakeholders, where relevant, towards identification of potential conservation areas, and mechanisms to implement conservation objectives (e.g. conserving Renosterkop area and

RISK AREA	RISK NUMBER	RISK	RESIDUAL RISK CATEGORY/IES	MITIGATION	ADDITIONAL MEASURES
					Heuningspruit conservation organisations / initiatives). To be conducted as part of the updated SEP.
Bio-Physical - Topography	TG2	The open pit will significantly alter the local topography	Legal & Regulatory Social / Community Reputation	Access will be controlled via a trench, enviroberm and fence surrounding the open pit	The open pit will remain and access will be controlled.
Social – Interested and Affected Parties	S10	Inability to obtain approval/ endorsement of land uses and closure plan by communities and/ or authorities	Legal & Regulatory Reputation	1. Active engagement and on-going consultation with I&AP's to ensure that the liabilities are clear at closure as well as post-closure. Agreements should be put in writing; 2. Memorandum of understanding; 3. Compile a Community and Stakeholder Engagement plan.	1. Stakeholder engagement on closure plans 2. Final Mine Closure Plan in line with stakeholder expectations and builds on prior stakeholder engagements on closure
Social – Authorities	S15	Relevant government departments and stakeholders have not been consulted regarding the mine's proposed (most recent) physical, bio-physical and social closure criteria and objectives. Failure to obtain agreement from the regulators on the proposed closure criteria may impact the closure period and final relinquishment of the site. In addition to all closure criteria, specific aspects of the closure plan which are considered high-risk in terms of regulator consultation include: i. The proposed closure criteria and final land use for the open pit; ii. The proposed rehabilitation plan (extent of proposed restoration relative to the extent of disturbance) to address the impacts to the pans; iii. The proposed thickness of topsoil to be applied (to all rehabilitation areas) during the restoration process, given the sentiment of Mr Johan Zeelie	Financial Legal & Regulatory Social / Community Reputation	An engagement plan for authority and stakeholder engagement must be developed and implemented to address identified risks. Residual risk will be determined by the outcomes and agreements following stakeholder engagement. The status and alignment of the EMP (relative to the mine closure plan) should be confirmed with authorities relative to the closure plan, following submission of the decommissioning Impact Assessment (Basic Assessment Report) process.	An engagement plan for authority engagement must be developed and implemented. To be conducted as part of the updated SEP. Residual risk will be determined by the outcomes and agreements following stakeholder engagement.

RISK AREA	RISK NUMBER	RISK	RESIDUAL RISK CATEGORY/IES	MITIGATION	ADDITIONAL MEASURES
		of the Department of Agriculture (DA), Free State Province, as per memorandum dated 03 August 2005; iv. Proposed actions to address the socio-economic aspects of mine closure including future funding for municipal LED projects and education programmes; and economic impacts on the town of Kroonstad. v. Voorspoed is located within (and impacts on) two threatened grassland ecosystems listed in the National Environmental Management: Biodiversity Act (National list of ecosystems that are threatened and in need of protection, Gov. Gazette 34809, Gov. Notice 1002, 9 December 2011). In addition, the Voorspoed site has been identified to be located in a River National Freshwater Ecosystem Priority Area catchment and includes area identified as Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) in the 2015 Free State Provincial Biodiversity Plan (DESTEA, 2015 Free State Terrestrial CBAs [Vector] 2015). The endorheic pans are listed and identified as Natural Wetlands (NWCS L4 class) within the National Freshwater Ecosystem Priority Areas project (NFEPA) and form part of a NFEPA wetland cluster Given the lack of stakeholder consultation regarding proposed closure criteria, assumptions driving the development of closure criteria and associated designs may not be approved or deemed adequate by authorities leading to additional/amended closure criteria that may attract additional cost. This should be considered in the context that selected closure criteria developed as part of the Final Closure Plan deliverables are not aligned to the approved EMP.			

RISK AREA	RISK NUMBER	RISK	RESIDUAL RISK CATEGORY/IES	MITIGATION	ADDITIONAL MEASURES
Social – Authorities	S16	Various pieces of legislation require Voorspoed to apply for permits, licences and / or environmental authorisation as part of the mine closure process. A detailed understanding of permit requirements will be required to ensure that the decommissioning and closure schedule can be implemented as planned. Examples include, but may not be limited to: i. An Environmental Authorisation in terms of the NEMA EIA Regulations 2014 is required for the decommissioning of a mine; ii. A Waste License may be required in terms of the NEM: Waste Act for the proposed bioremediation site; iii. A Water Use Licence may be required in terms of the National Water Act for rehabilitation activities adjacent to / within the pans and wetland; iv. Approval of this final closure plan, risk assessment and determination of financial provision as per the NEMA Financial Provisioning Regulations of 2017 (once these come into effect); and v. Procedures for the relinquishment or transfer of the Water Use Licence for abstraction of water from the Koppies Dam.	Legal & Regulatory Reputation	An Impact Assessment Process (Basic Assessment Report) has been commissioned. The BAR needs to be reviewed to establish whether all legal requirements have been identified. Residual risk will depend on this outcome.	Relevant applications for environmental authorisation to be prepared and submitted.

6 CLOSURE GOALS, CLOSURE CRITERIA AND SUCCESS CRITERIA

6.1 Physical Infrastructure Closure Criteria

The overall rehabilitation goal is to manage the mine site and implement concurrent rehabilitation in order to meet the end land use of grazing for game and stock after final closure. In doing so, it will ensure a land capability comparable to local habitat types that will be supported by natural resources. This can be achieved by:

- The physical rehabilitation and water management of disturbed areas due to mining activities; that includes the following:
  - Prepare areas, i.e. implement earthworks, to create suitable habitats and support the ecological stability (e.g. erosion resistant) of rehabilitated areas.
  - Establish vegetation that will have the desired ecological functioning and be stable over the long term, but also provide suitable diversity of species for utilisation by animals.

It is aimed for rehabilitated areas to be self-sustainable over the long term with limited on-going care and maintenance. The above rehabilitation goal will be achieved by implementing the following key interventions:

- Reshape the steep slopes of the MRDs in a balanced cut and fill operation in order to minimize the effects of water erosion on the slopes;
- Rip rehabilitation areas to alleviate compaction and/or mix the cover layer with the underlying material;
- Cover the disturbed areas with suitable soil or material that can serve as growth medium to establish vegetation that can reach the planned carrying capacity;
- Ameliorate, fertilise and cultivate the area with products as specified based on soil analysis of the growth medium at the time of rehabilitation.
- Cover all mining related residues to ensure that potentially contaminated material is isolated from the environment;
- Reinstate affected surface drainage lines and catchment areas to pans as far as possible after mining operations;
- Rehabilitate areas to allow access to top surfaces of MRDs;
- Conduct on-going monitoring programmes to provide key data to show biodiversity responses to current and planned rehabilitation management practices; and
- Stimulate the vegetation on rehabilitated areas by selective and controlled grazing; this will also aid to spread seeds to increase bio-diversity over the area.

Success criteria are the agreed standards that must be met to facilitate lease relinquishment. They include physical, biophysical and socio-economic parameters and are generally defined through engagement with regulators and other external stakeholders. The following principles for the development of success criteria are identified:

- Meet rehabilitation objectives;
- Landforms are integrated into the surrounding landscape and are non-polluting;
- Rehabilitation exhibits sustained growth and is resilient;
- Management of rehabilitation can be integrated with surrounding areas and requires no additional on-going resources; and
- Social closure has left a positive legacy and sustainable post-mining livelihoods.

Table 30 presents the Closure Criteria associated with physical infrastructure and facilities at Voorspoed Mine.

Table 30. Closure Criteria associated with physical infrastructure and facilities at Voorspoed Mine.

PHYSICAL			
CLOSURE CRITERIA			**SUCCESS CRITERIA**
Decommissioning / Earthworks	Water Control	Amelioration / Vegetation / Fences	
ON-SITE INFRASTRUCTURE			
PLANT, WORKSHOPS, OFFICES, ROADS, POWER LINES, PIPELINES			
End Land Use / Goal: Grazing			
Demolition & dismantling: • Clear all infrastructure from site • Dismantle all steel structures in a safe manner; • Remove all salvageable equipment and material to make available for selling; • Auction off all salvageable equipment and remove from site; • Transport steel to scrap metal dealer (allow 50km) for resale; • Demolish and remove all concrete and brick structures to a depth of 500mm below ground level; dispose all inert concrete and building rubble in primary crusher void; • Break and remove all walkways and paved areas and dispose with other inert building rubble in primary crusher void; • Remove all container and mobile buildings and transport off site (allow 50km) for resale; **Hydro carbon contaminated areas:** • In-situ bio-remediation: Apply bio-remediation agent, wet, aerate, mix until thresholds have been reached; **Earthworks:**	• Backfill low laying areas to make free draining; • Decommission existing trenches from plant area to SWCD / RWD • Make the area free draining and fit in with surrounding drainage patterns; • Remove all culvert structures from roads; • Construct water control berms / contour drains on covered area; final alignment of drains to be confirmed after earthworks	• Ameliorate soil based on soil analysis of final mixture of growth medium; • Seed the area with a mixture of local indigenous grass and tree seeds that are adapted to the area; • Apply follow-up fertiliser where specified; • Control weeds and invader plant species; • Fence the area to fit in with the rest of the camp system	• No infrastructure remains on site; • No safety hazards remain on site; • All artificial barriers removed; • Limited erosion – will not deteriorate to large dongas and unsafe area; • Water control structures remain functional and stable; • No sediment transport from the area; • Sediment does not reach Southern Pan; • Vegetation cover similar to natural comparable surrounding environment; • Effective soil cover ensure the agreed land capability; • Vegetation cover ensure the agreed grazing capacity; • No weed invasion to the extent that it will outcompete or overgrow the palatable grass species and reduce the grazing potential

• Shape the area to fill excavations and be free draining; • Rip all plant footprint areas to a depth of 500mm to alleviate compaction; • Rip all other building footprint areas to a depth of 300mm to alleviate compaction; • Rip roads outside the plant and buildings footprint to a depth of 500mm; • Cover all plant and related footprint areas with 300mm soil; • Cover all building and related footprint areas with 200mm soil; • Cover roads outside the plant and buildings footprint with 200mm soil			
WATER MANAGEMENT (SWCD / RWD)			
End Land Use / Goal: Grazing			
SWCD (Raw Water Dam): • Dewater the dam and use the water for dust suppression if the quality is acceptable, otherwise pump the water to the pit; • Cut embankments to the surrounding ground level in a balanced cut and fill action; • Cover the dam basin with a 300 mm coarse basalt rip-rap layer to act as sink to contain runoff from the basin area; • Cover surrounding areas with 200mm soil; • Construct a storm water berm on the upstream side above the reshaped dam embankment to divert all storm water around the rehabilitated dam area. **RWD:** • Remove HDPE liner and dispose at registered waste site;	• Contain all direct rainfall on the dam footprint in the dam basin within the coarse basalt layer; • Provide a coarse basalt rip-rap layer to reduce the risk of muddy conditions and free standing water.	• Ameliorate soil based on soil analysis of final mixture of growth medium; • Seed the area with a mixture of local indigenous grass and tree seeds that are adapted to the area; • Apply follow-up fertiliser where specified; • Control weeds and invader plant species; • Fence the area in with the rest of the FRD area	• The bottom of the PCD's have a solid layer that only contain standing water after rain events; • Vegetation cover of the embankments and surrounding area similar to natural comparable surrounding environment; • Effective soil cover ensure the agreed land capability; • Vegetation cover ensure the agreed grazing capacity; • No weed invasion to the extent that it will outcompete or overgrow the palatable grass species and reduce the grazing potential

• Cut embankments to the surrounding ground level in a balanced cut and fill action; • Cut embankments to ground level and cover basin with available material; • Cover the dam basin with a 300 mm coarse basalt rip-rap layer to act as sink to contain runoff from the basin area; • Cover surrounding areas with 200mm soil; • Construct a storm water berm on the upstream side above the reshaped dam embankment to divert all storm water around the rehabilitated dam area.			
OFF-SITE INFRASTRUCTURE			
ROADS, POWER LINES, PIPELINES			
End Land Use / Goal: Grazing & fit in with surrounding land use			
Gravel access road up to security fence: • Remain for other users. **Power line to Eskom substation:** • Remain as part of Eskom responsibility; **Main supply pipeline from Renoster River weir up to security fence:** • Remain as per agreement with landowners; • Break and remove all manholes and backfill to ground level; **Pump station at Renoster River weir:** • Dismantle all steel structures in a safe manner and transport to mine area; • Remove all salvageable equipment and material to make available for selling and transport to mine;	• Do not obstruct natural drainage patterns	• Ameliorate soil based on soil analysis of final mixture of growth medium; • Seed the area with a mixture of local indigenous grass and tree seeds that are adapted to the area; • Apply follow-up fertiliser where specified; • Control weeds and invader plant species; • Fence the area in several separate camps to control grazing	• No infrastructure above ground remains on site; • No safety hazards remain on site; • All artificial barriers removed; • Limited erosion – will not deteriorate to large dongas and unsafe area; • Water control structures remain functional and stable; • No sediment transport from the area; • Vegetation cover similar to natural comparable surrounding environment; • Effective soil cover ensure the agreed land capability; • Vegetation cover ensure the agreed grazing capacity; • No weed invasion to the extent that it will outcompete or overgrow the palatable grass species and reduce the grazing potential

• Demolish and remove all concrete and brick structures to a depth of 500mm below ground level; dispose all inert concrete and building rubble in primary crusher void; • Shape the area to fill excavations and be free draining			
MINE RESIDUE DEPOSITS (MRD)			
WASTE ROCK DUMP (WRD)			
End Land Use / Goal: Grazing			
• Reshape steep slopes in balanced cut and fill operation to form single slope to reduce gradient and slope length: o Slope gradient = max 18°; o Slope length = ±45m; o Slope surface to be uniform and rather concave than convex; • Cover reshaped slopes with 200mm soil to form growth medium together with underlying material; • Cover reshaped top area with 100mm soil; (see Rehabilitation Plan for motivation for reduced depth of growth medium) • Rip top area to alleviate compaction and mix soil with underlying material	• Contain rainfall and runoff on rehabilitated facility, except for bottom slopes; • Reshape or fill low laying areas next to dump edge to drain away from edge; • Construct crest berm walls and paddocks (or low points) on top of facility; • Construct cross berm walls on existing bench between lifts 1 and 2; • Construct toe paddocks at seepage points to capture and evaporate seepage until seepage stops; decommission toe paddocks during maintenance period	• Ameliorate soil based on soil analysis of final mixture of growth medium; • Seed the area with a mixture of local indigenous grass and tree seeds that are adapted to the area; • Apply follow-up fertiliser where specified; • Control weeds and invader plant species; • Fence the area in several separate camps to control grazing	• Limited erosion – will not deteriorate to large dongas and unsafe area; • Sediment transport limited to toe of dump; • Capacity of benches remain sufficient; • Vegetation cover similar to natural comparable surrounding environment; • Effective soil cover ensure the agreed land capability; • Vegetation cover ensure the agreed grazing capacity; • Deep rooted tree species established on benches at least; • No weed invasion to the extent that it will outcompete or overgrow the palatable grass species and reduce the grazing potential
COARSE RESIDUE DEPOSIT (CRD)			
End Land Use / Goal: Controlled Grazing			
• Reshape steep slopes in balanced cut and fill operation to reduce gradient and form single slope: o Slope gradient = max 16°; o Slope length = ±145m; • Cover reshaped slopes with 300mm coarse basalt material;	• The reshaped slopes will be free draining; • Contain all rainfall and runoff on the top of the rehabilitated facility; • Construct crest berm walls and paddocks on top of facility;	• Ameliorate soil based on soil analysis of final mixture of growth medium; • Seed the area with a mixture of local indigenous grass and tree seeds that are adapted to the area; • Apply follow-up fertiliser where specified;	• Limited erosion – will not deteriorate to large dongas and unsafe area; • Sediment transport limited to toe of dump; • Sediment does not reach Northern Pan; • Vegetation cover similar to natural comparable surrounding environment;

• Cover the 300mm basalt armour layer with 200mm soil; • Cover reshaped top area with 200mm soil to form growth medium together with underlying material; • Rip top area and slopes on contour to a depth of at least 500mm to alleviate compaction and mix soil and basalt material with underlying material	• Reshape top of facility to drain inwards, i.e. away from edge; • Construct toe paddocks on eastern side towards the Northern Pan to prevent sediment transport into the pan; • Construct toe paddocks at seepage points to capture and evaporate seepage until seepage stops; decommission toe paddocks during maintenance period; • Decommission existing seepage trenches to SWCD / RWD – backfill and cover with surrounding material	• Control weeds and invader plant species; • Fence the area in several separate camps to control grazing	• Effective soil cover ensure the agreed land capability; • Vegetation cover ensure the agreed grazing capacity; • No weed invasion to the extent that it will outcompete or overgrow the palatable grass species and reduce the grazing potential; • Area fenced off and grazing controlled to agreed carrying capacity
FINE RESIDUE DEPOSIT (FRD)			
End Land Use / Goal: Controlled Grazing & retain minimum runoff on top area			
North-eastern Embankment: • Cut top of FRD 2 embankment off to specified level and use as buttress material at toe of embankment of FRD 1B to reduce cutting back into starter wall during reshaping; • Reshape steep outside slopes of FRD 1B & 2 in balanced cut and fill operation to reduce gradient and form single slope: o Slope gradient = max 16°; o Maximum slope length = ±75m; • Reshape inside slopes in balanced cut and fill operation to form single slope to reduce gradient (to 18°) and slope length (to ±45m); • Cover reshaped slopes with 200mm soil to form growth medium together with underlying material **South-western Embankment: Outer and inner slopes of FRD 1A & 2:** • Cut top of FRD 2 embankment off to specified level and doze material over	• The reshaped slopes will be free draining; • Contain all runoff on the top of the facility (do not spill more than once in 100 years); o Construct waterway (unlined) in north-eastern corner of FRD 1A to spill into FRD 1B; o Contain all runoff from 1A and 1B in 1B; o Construct waterway in south-eastern corner of FRD 1B to spill into FRD 2 in case of extreme floods; o Construct waterway in south-western corner of FRD 2 to spill into the open pit in case of extreme floods; o Stabilise waterways with gabions and reno mattresses; • Construct crest berm walls on outside of inspection road on top of embankments; • Construct toe paddocks at seepage points to capture and evaporate seepage until seepage stops;	**Slopes:** • Ameliorate soil based on soil analysis of final mixture of growth medium; • Seed the area with a mixture of local indigenous grass and tree seeds that are adapted to the area; • Apply follow-up fertiliser where specified; • Control weeds and invader plant species; • Fence the area in two separate camps to control grazing **Top Area:** • Spread fertiliser and seeds by hand on the top areas that can be safely accessed on foot	**Slopes:** • Limited erosion – will not deteriorate to large dongas and unsafe area; • Vegetation cover similar to natural comparable surrounding environment; • Effective soil cover ensure the agreed land capability; • Vegetation cover ensure the agreed grazing capacity; • No weed invasion to the extent that it will outcompete or overgrow the palatable grass species and reduce the grazing potential; **Top Area:** • All runoff is contained on the facility and does not spill more than once in 100 years; • Gabion waterway show no signs of undercutting, excessive sedimentation or subsidence; • Top area is fenced off with security fence

<table>
<tr>
<td>outer slopes to reduce reshaped slope lengths;
• Reshape inside and outside slopes in balanced cut and fill operation to form single slope to reduce gradient and slope length:
o Slope gradient = 18°;
o Slope length = ±45m;
• Cover reshaped slopes with 200mm soil to form growth medium together with underlying material

All top areas:
• No earthworks due to safety risk (fine tailings remain wet for very long)

Specified portion of north-western slope of FRD 1B:
• Cover bottom portion of slope with soil, ameliorate and vegetate</td>
<td>• Decommission existing seepage trenches to SWCD / RWD – backfill and cover with surrounding material</td>
<td></td>
<td></td>
</tr>
<tr><td colspan="4">OPEN PIT</td></tr>
<tr><td colspan="4">End Land Use / Goal: Restricted Area</td></tr>
<tr>
<td>• Construct 2m high waste rock barriers / berms at top of remaining access ramps;
• Erect security fence 10m outside of indicated ZOR;
• Construct trench and enviroberm in balanced cut and fill operation outside of security fence;
o Berm top width / trench bottom width = 5m;
o Height / Depth = 5m;
o Side slopes = 1:5</td>
<td>• Align trench and berm to divert clean storm water away from the pit towards the wetland area</td>
<td>• No action between the enviroberm and pit perimeter;

Establish vegetation on enviroberm and trench:
• Ameliorate soil based on soil analysis of final mixture of growth medium;
• Seed the area with a mixture of local indigenous grass and tree seeds that are adapted to the area;
• Apply follow-up fertiliser where specified;
• Control weeds and invader plant species</td>
<td>• Access deterred with security fence around mine;
• Access deterred with security fence around pit perimeter;
• Trench and enviroberm functional and stable;
• Vegetation criteria outside the security fence similar to other areas;
• No weed invasion outside pit perimeter to the extent that it will outcompete or overgrow the palatable grass species and reduce the grazing potential</td>
</tr>
</table>

6.2 Bio-physical Closure Criteria

Table 31 present the Closure Criteria associated with bio-physical features at Voorspoed Mine.

Table 31. Closure Criteria associated with bio-physical features at Voorspoed Mine.

BIO-PHYSICAL			
CLOSURE CRITERIA			SUCCESS CRITERIA
Decommissioning / Earthworks	Water Control	Amelioration / Vegetation / Fences	
PANS & WETLANDS			
SOUTHERN PAN, WETLAND, NORTHERN PAN			
End Land Use / Goal: Controlled Grazing			
Southern Pan: • Construct compacted berm wall on existing walkway alignment to separate undisturbed western portion from disturbed and rehabilitated eastern portion; • Cover disturbed eastern portion with 500mm soil to prevent impact to the western portion **Wetland:** • No direct earthworks **Northern Pan:**	**Southern Pan:** • Route runoff from rehabilitated plant and buildings areas within the catchment to the undisturbed eastern portion; • Make a shallow channel from the southern pan to the wetland on the estimated full level **Wetland:** • Divert clean runoff from the southern WRD area to the catchment of the wetland to reinstate original catchment as far as possible • Construct a drift in the main access road to the mine to ensure hydraulic connection to the downstream pan system **Northern Pan:**	**Southern Pan:** • Remove alien tree and weed species mechanically with selective chemical stem treatment with approved herbicides; • Spread the seeds of available selected wetland grass species in the pan area **Wetland:** • Remove weed and invader plant species mechanically within the catchment of the wetland; • Spread the seeds of available selected wetland grass species in the pan area **Northern Pan:**	• No sediment transport to pan areas; • Clean runoff volumes to pans are close to original condition; • Vegetation species composition reflects increased wetland species; • No weed invasion to the extent that it will outcompete or overgrow the palatable grass species and reduce the grazing potential; • Increase in wetland fauna and flora species (from monitoring surveys)

BIO-PHYSICAL			
CLOSURE CRITERIA			SUCCESS CRITERIA
Decommissioning / Earthworks	Water Control	Amelioration / Vegetation / Fences	
• Construct a coarse filter berm wall of basalt between the rehabilitated plant footprint and the pan to prevent sediment from entering the pan area; • Construct toe paddocks at the toe of the reshaped eastern slope of the CRD to contain any possible seepage and sediment laden runoff until the area has stabilised	• Route runoff from the northern portion of the rehabilitated plant area towards the northern pan	• Spread the seeds of available selected wetland grass species in the pan area	

6.3 Social Closure Criteria

The social closure and success criteria have been developed based on the SIA undertaken by ERM in 2016/2017. That process identified the key socio-economic risks that could result in impacts to the company and / or employees and other stakeholders. The purpose of Table 32 is to provide criteria against which the success of implementing the management actions identified in the social risk assessment can be measured.

Table 32. Social closure and success criteria (from ERM 2019).

Impact	Issue addressed	Success criteria	Input	Output	Outcome
Phased closure (ramp-down) management measures					
1. Loss of jobs	Retrenchment and communications	■ Retrenchment is undertaken in line with all applicable legislation ■ Communicate the retrenchment process effectively and transparently in order for employees to understand the process to be followed	■ Action plan and communication plans defined in terms of legislation and implemented (weekly tracking) ■ Retrenchment as a core agenda item for each quarterly FF Meeting prior to closure (quarterly) ■ Grievance mechanism is in place during and post retrenchment process (period to be confirmed) (monthly and tracking close out of grievances - new, open, resolved)	■ Agreed communication process endorsed by employees and in line with regulatory requirements prior to retrenchment - implemented as per plan ■ Retrenchment complete in time	■ No (0) legal grievances relating to retrenchment ■ All (100%) of grievances resolved ■ No negative press/ reputational impacts from retrenchment
	Re-skilling	■ Provide employees with portable skills to enable meaningful competition for opportunities post mining activities. ■ Develop Portable skills framework to include Non-Mining Related Skills Programmes, Entrepreneurial Skills Programmes and other.	■ Service provider selected for delivery of Portable Skills Programme – complete Q3 2017 ■ Report on the implemented portable skills training is maintained, including a register tracking employees re-skilled to closure (monthly) ■ # of stakeholders engaged on the portable skills programme and profile of re-skilled employees (monthly)	■ # of portable skills sessions held (monthly) ■ # of employees trained (monthly)	■ All (100%) employees are provided with portable skills training ■ Workforce report benefits of portable skills training ■ Portable skills help ex-workforce to access new opportunities
	Employees to deal with loss of jobs	■ Support employees to access services to deal with potential impacts of job losses and where appropriate to provide assistance to employees and their family members beyond retrenchment	■ Service Provider identified and appointed in line with the retrenchment timeline – proposed initially Q4 2017 ■ Roll out and implementation of the EAP programme to enable employees (contractors) to deal with impacts of job loss during retrenchment process (and following retrenchment process as appropriate) (monthly tracking for a period of 12 months) ■ Communicate the EAP service plan to affected parties and monitor the utilisation of the service after commencement via output metrics (monthly tracking for a period of 12 months)	■ # of sessions run - during and post retrenchment phase (monthly for period of 12 months) Scope of sessions covered ■ # of employees that attended sessions (monitored according to age, gender, skill level and permanent vs. full time contractors)	■ All (100) employee grievances tied to loss of jobs are resolved ■ All employee human rights are preserved ■ All vulnerable groups are monitored for a period of 12 months to ensure they are able to deal with loss of jobs

Impact	Issue addressed	Success criteria	Input	Output	Outcome
	Redeployment and entrepreneurial/ SMME opportunities	■ Provide retrenched employees wtih access services that will support them to access alternative work and employment ■ Investigate and advertise potential opportunities to redeploy workers, including to other opportunities at other De Beers / Anglo American operations, other nearby mines and within other sectors ■ Extend SMME support programmes to retrenched employees with viable entrepreneurial initiatives	■ # of engagement with HR Leaders (CHQ & Operations) (monthly) ■ Retrenchment agreement in place clearly articulates the business position on transfers for bargaining unit employees (by retrenchment process finalisation) ■ # and scope of engagements with internal (De Beers, Anglo American) and external stakeholders (e.g. DoL, employment agencies) on potential employment opportunities delivered in line with stakeholder engagement plan ■ Provision of support services at Zimele Hub post retrenchment, including CV writing, interview skills training, worker/ human rights awareness and advertised job opportunities (monthly tracking of service delivery in line with commitments for period agreed, tbc. 2021)	■ # of opportunities for transfer/ redeployment identified (monthly) ■ # of employment opportunities advertised at the Zimele Hub during and post retrenchment as appropriate (monthly) ■ # of people that uptake Zimele Hub services around CV writing and interviews and access information around worker/ human rights. monitored according to age, gender, skill level	■ Ex-employees are able to find new employment (% target to be confirmed based on identified opportunities). The number of employees redeployed and accessing commercial opportunities tied to closure/ support from Zimele Hub must be tracked.
	Quality of life and wellbeing after mining	■ Reduce the negative impact on the lives of individuals and local communities ■ Prevent adverse impacts on rights to an adequate standard of living, education, health, etc.	■ Concept policy framework and partnership agreement in place by January 2019 to provide post retrenchment support to retrenched employees ■ # of engagements with local and other government stakeholders on the support they can provide to retrenched employees (as per engagement plan) ■ Delivery of EAP support post retrenchment, tracking # of sessions provided vs. plan, communication campaigns (e.g. sms) completed with ex-employees, scope of sessions provided, period provided	■ # and scope of information/ communication campaigns with retrenched workforce, e.g. to provide information on public services available/ workers rights etc. ■ Use metrics of the EAP, inc. # of ex-employees accessing (if possible monitored according to age, gender, skill level), type of services accessed	■ Retrenched employees report ability to deal with impacts of loss of jobs - tracked periodically as appropriate

Impact	Issue addressed	Success criteria	Input	Output	Outcome
2. Loss of revenue of local suppliers and service providers	Sustainability of dependent local suppliers	■ Support suppliers to take up opportunities outside the Mine in alignment and support from the Enterprise and Supplier Development Hub	■ Identify suppliers and service providers that are dependent on Voorspoed (proposed by end of Q2 2017) ■ Develop Action Plan to support identified dependent providers (by end of Q3 2017) ■ Circulate list of suppliers to other mines and businesses (by end of Q4 2017) ■ Amended reskilling targets/ plan in line with Action Plan (by Q4 2017)	■ # of dependent suppliers pre- mitigation ■ # of dependent suppliers supported ■ Actions - scope/timing taken to support suppliers - are monitored in line with Action plan (monthly)	■ All (100%) of dependent suppliers are sustained post closure (timeline tbc) ■ Additional targets on new suppliers developed?
3. Loss of revenue for ED beneficiaries (Zimele Business Hub)	Sustainability of SMMEs funded and supported by the Hub	■ Minimise impact on ED beneficiaries once the services of the Enterprise and Supplier Development Hub are terminated	■ Confirm the appropriate timeline for the Zimele Hub to remain open (tbc. 2021) and ensure all programmes are aligned to proposed timeline (by Q2 2019) ■ # of internal and external stakeholders engaged on ED beneficiaries list to promote their potential services (from 2017) (tracked monthly as per the engagement plan)	■ Zimele Hub post closure services are implemented within 6 months of retrenchment completion ■ # of identified opportunities recorded from engagements and # actioned (monthly) ■ All (100%) Zimele Hub beneficiaries complete their defined programmes	■ All (100%) of De beneficiaries are sustained post closure (timeline tbc)
4. Loss of financial support for CSI / LED beneficiaries	Sustainability of CSI/LED beneficiaries supported by the Mine	■ Minimise impact on CSI and LED beneficiaries, especially: ■ Mathematics and Science, Teacher Development and Winter School Programmes ■ Higher Education and Training Support	■ Complete impact assessments for each LED intervention (by Q4 2018) ■ # of engagements with CSI/ LED beneficiaries (especially likely dependent ones) on closure timelines and transition plans (monthly as per engagement as per plan) ■ Exit strategy framework for all interventions (Q2 2019) ■ Deliver any commitments and interventions in line SLP during and post closure (tracking of SLP actions monthly)	■ # of opportunities identified via stakeholder engagements and # actioned (monthly) ■ # of SLP projects delivered and related output metrics	■ All (100) CSI/ LED beneficiaries are left with clear transition plan for support post closure (where relevant)
Decommissioning (closure execution) phase					
5. Restricted post closure land uses	Acceptability of post closure land uses	■ Engage with stakeholders to identify post- closure land uses in line with stakeholder expectations, where possible	■ # of engagements with stakeholders on post closure land uses (track in line with closure plan)	■ Final Mine Closure Plan is defined in line with stakeholder expectations for post closure land uses and all safety/ environmental risks are adequately addressed	■ Broad stakeholder support for post closure land uses

Impact	Issue addressed	Success criteria	Input	Output	Outcome
6. Changes in traffic patterns during closure execution	Health & safety of local communities	■ Avoid and /limit the risks of injury and fatalities due to increased road traffic associated with the closure project	■ Development and implementation of Road Traffic Management Plan for closure execution in collaboration with relevant stakeholders by Q2 2019 ■ # of engagements with road traffic department (tracked as per plan, e.g. quarterly from closure execution)	■ # of actions stemming from engagement and # of actions closed out (monthly) ■ # of grievances or stakeholder complaints received in relation to traffic and # closed out (monthly) ■ # of traffic incidents (monthly)	■ No (0) fatalities/ injuries tied to road traffic during closure execution
Post closure (monitoring) management measures					
7. Reduced levels of security/ presence at the mine	Controlling access and provision of security services	■ To prevent unauthorised entry to mine premises and the illegal occupation of mine land including for illegal mining ■ To prevent human injury or death due to uncontrolled access to the open pit or other Mine areas	■ Security risk assessment as part of closure planning, complete Q1 2019 ■ Security plan defined in line with final Mine Closure Plan by Q2 2019 ■ # of engagements with SAPS, MCCF, neighbouring landowners and local municipality (tracked as per engagement plan, proposed bi-annual engagements) ■ Training in Human Rights delivered - annual with revised "curriculum" to reflect changes in risks tied to closure/ inactive operation e.g. dealing with illegal land invasion Completion of physical closure project by 2020 and monitoring of maintenance programme in line with closure plan (monthly tracking)	# of security staff trained (tracked annually against whole force) # of complaints/ grievances received from stakeholders in relation to security and # resolved (monthly) # of illegal entries into site recorded (monthly)	■ No illegal invasion of the site post closure ■ No (0) fatalities/ injuries post closure in Mine
8. Reduced emergency response capacity	Health and safety of local communities in relation to emergencies	■ To support stakeholders continue to respond to emergencies	■ Emergency response risk assessment completed as part of closure planning, complete Q1 2019 ■ Handover of emergency response equipment to stakeholders Q2 2019 ■ # of engagements with stakeholders on the timeline for transitioning out of emergency response support (in line with SEP)	Monitor use of emergency response equipment (tbc)	■ No (0) fatalities/ injuries relating to emergency response ■ Stakeholders report feeling able to address emergency responses

7 REHABILITATION PLAN

The rehabilitation plan that was developed with this Closure Plan presents details and proposals to address environmental risks, translate closure criteria into rehabilitation designs and implement works to reach the planned end land use after operations. The rehabilitation plan describes the rehabilitation proposals to rehabilitate the current footprint of Voorspoed Mine to a sustainable state and to align with the predetermined end land use. It supports and provides information for the estimation of the closure liability as presented in this report.

The detailed Voorspoed Mine Rehabilitation Plan is presented in ANNEXURE A.

7.1 Rehabilitation Actions

Rehabilitation actions for all facilities and footprints on the Voorspoed mining area were designed with the land capability and end land use in mind. The rehabilitation actions for this site are outlined below:

7.1.1 Plant, buildings and other infrastructure

The objective for the dismantling and demolition of physical infrastructure is to ensure that a clear footprint area will remain. Once rehabilitation of the disturbed footprint areas are complete these areas should return to an area with grazing potential. Handling of main aspects during rehabilitation is discussed within this report, e.g. Steel, conveyors, pipelines, power lines, fencing, walkways & roads. Detail related to the rehabilitation actions for infrastructure is presented in ANNEXURE A.

7.1.2 Pans and wetlands

Minimal work within and around the pans and wetland areas will be required to reinstate its natural state. Controlled grazing is proposed for these areas due to its sensitive biodiversity. Reinstate the natural drainage patterns and divert clean runoff from rehabilitated areas towards the pans and wetland as far as possible. Reintroduce wetland grass species to support this sensitive area and install a stock proof fence to control animal and vehicle access. Detail related to the rehabilitation actions for the pans and wetland is presented in ANNEXURE A.

The pan areas under consideration are:

- The Northern Pan just east of the CRD;
- The Southern Pan just west of the primary crusher area; and
- The Wetland Area to the west of the offices area.

The mitigation actions for all the three pan areas are presented below. Any further disturbance and impacts to these areas will be avoided and the existing impacts will be addressed as follows:

Northern Pan (Table 33):

Table 33: Closure Actions for the Northern Pan

Closure Action.	
Rehabilitation Plan Report Figure Reference:	Error! Reference source not found.
Drawing Reference No:	**DB037_8A & 8D**
• Contain any possible sediment from the rehabilitated CRD with toe paddocks and prevent it from entering the pan area; • Divert clean runoff from the rehabilitated northern portion of the plant area towards the Northern Pan to reinstate the catchment as close as possible to the original area; • Construct a coarse filter wall on the southern side of the pan area to capture any possible sediment from the rehabilitated northern portion of the plant area; • Remove alien vegetation with mechanical methods and targeted herbicide application on the stems only; • Identify wetland grass species in the other wetland areas and harvest seeds to seed the pan area or transplant some wetland grasses to this area; and • Erect a stock proof fence around the full supply level of the pan to control animal and vehicle access to the area or include the pan within the larger fenced off area around the CRD	

Southern Pan (Table 34):

Table 34: Closure Actions for the Southern Pan

Closure Action	
Rehabilitation Plan Report Figure Reference:	Error! Reference source not found.
Drawing Reference No:	**DB037_8A, 8C & 8E**
• Construct a berm wall on the existing footpath to separate the area to be rehabilitated to the east with the western portion of the pan that is still functional; • Shape the eastern portion to reduce ponding and allow runoff to the western portion of the pan; • Fill the eastern portion with 500mm soil and compact to cap the underlying footprint and reduce future infiltration to reduce possible affected seepage to the pan area to the west; o Use material from the nearest soil stockpile, i.e. TS11; or o Use the excavated material from the waterway from FRD2 to the open pit); • Cover the eastern portion with 300mm growth medium from soil stockpile TS11 (max haul distance 1km) during the covering of the rest of the plant footprint; • Excavate and form a shallow wide waterway from the western side of the Southern Pan at the estimated full supply level to the Wetland to allow drainage away from the rehabilitated plant footprint during extreme rain events; • Remove the eucalyptus trees and other alien vegetation with mechanical methods and targeted herbicide application on the stems only; • Identify wetland grass species in the other wetland areas and harvest seeds to seed the pan area or transplant some wetland grasses to this area; and • Erect a stock proof fence around the full supply level of the pan to control animal and vehicle access to the area	

Wetland Area (Table 35):

Table 35: Closure Actions for the Wetland

Closure Action	
Rehabilitation Plan Report Figure Reference:	Error! Reference source not found.
Drawing Reference No:	**DB037_8A & 8E**
• Reinstate the natural drainage patterns and runoff as far as possible by diverting runoff from clean rehabilitated areas from upstream of the southern WRD and the open pit; • Remove alien vegetation with mechanical methods and targeted herbicide application on the stems only; • Identify wetland grass species in the other wetland areas and harvest seeds to seed the pan area or transplant some wetland grasses to this area; • Retain the existing stock proof fence around the full supply level of the pan to control animal and vehicle access to the area;	

Closure Action
• Allow additional surface flow to the wetland from the Southern Pan by constructing a spillway to link the two pans; and • Construct a shallow drift in the main access road to ensure that the Southern Pan is linked to the downstream system

7.1.3 Mine residue facilities

WASTE ROCK DUMP (WRD)

The actions to rehabilitate the WRD are presented in
Table 36 with reference to the applicable line items in the cost estimate sheets. Detail related to the rehabilitation actions for WRDs is presented in ANNEXURE A. In summary, the WRD will be addressed as follows:

Reshape slopes to a single 18° slope by means of a balanced cut to fill action. Cover the reshaped slopes with 200 mm and the top or level areas with 100 mm suitable growth medium. Construct water control structures and establish indigenous grass species suitable to improve the grazing potential of the area. Supply and install stock proof fencing to control grazing and protect rehabilitation works.

Table 36: Closure Actions for the WRD

Closure Action	
Reshaping	
Rehabilitation Plan Report Figure Reference:	Error! Reference source not found., Error! Reference source not found.
Drawing Reference No:	**DB037_07, 08A & 08E**
Reshaping of steep slopes is required to ensure long-term stability, to reach the end land use by limiting erosion, and effectively cover the area with a suitable growth medium. The following actions will be implemented: • Reshape all steep slopes from the current angle of repose (± 37°) to the design gradient of 18° (1:3) in a balanced cut and fill operation as far as possible; • Reshaped slopes must be even and rather concave than convex and without any windrows in any direction or deep tracks remaining up and down the slope; • Reshape all uneven surfaces (general reshaping) to even out the areas (mostly the top area) to the extent that the placing of cover material can be controlled at the average specified depth, as well as to improve the drainage pattern of the areas where needed; • Note: The closure liability estimate allows for only 50% of the top area for general reshaping at an average depth of 100mm over the areas to be reshaped, because the rest of the area is fairly even and can receive a soil cover immediately; the final areas requiring reshaping must be confirmed on site; • Reshape all prominent dumps or heaps on the WRD as stated above to improve the integration of the final landform into the surrounding landscape or use the material to construct berms; • Reshape and cut a bench on a portion of the dump in the north-eastern corner where the slope length becomes very long.	
Growth Medium Cover	
Rehabilitation Plan Report Figure Reference:	Error! Reference source not found., Error! Reference source not found.
Drawing Reference No:	**DB037_07, 08A & 08E**
The disturbed and reshaped area must be covered with a suitable growth medium for the establishment of the vegetation cover to ensure the end land use. The growth medium will also support resistance against erosion to ensure long-term stability of areas susceptible to erosion. The following actions will be implemented: • Cover all reshaped slopes with a suitable growth medium up to a minimum average depth of 200 mm; • Cover all reshaped and prepared top areas with a suitable growth medium up to a minimum average depth of 100 mm; • Source suitable soil from the topsoil stockpiles as follows:	

Closure Action	
o Cover the northern and central portions of the WRD from the southern portion of topsoil stockpile TS8 (located to the east of the main WRD); o Cover the western and southern portions of the WRD from stockpile TS9 (located to the west of the main WRD); o Cover the separate southern WRD from topsoil stockpile TS8 (located to the east of this WRD); • Cover the areas to the east of the WRD where seepage is visible with 300mm soil from the nearest stockpile; • Rip the covered top areas on contour (depth 300 mm, tine spacing = 1 m) to alleviate any compaction during placing of the material (usually only on flat areas) and mix the underlying material with the cover layer to increase coarseness and infiltration.	
Water Control	
Rehabilitation Plan Report Figure Reference:	Error! Reference source not found.**,** Error! Reference source not found.
Drawing Reference No:	**DB037_07, 08A & 08E**
The reshaping of steep slopes and covering of erodible material will reduce the erodibility of the surface layer, but a critical component is the construction of suitable water control structures. The following actions will be implemented: • Maintain a bench width of about 10 m after reshaping with the correct deposition of successive lifts and reshaping of the slopes; • Shape the benches inwards to a depth of about 2 m to provide sufficient capacity for the 24 hour 1:100 year runoff event from the slope above, as well as sediment capturing; alternatively construct 2m high berm walls on the outside edge of the bench; • Construct cross berms on the benches at an interval of 50 m to prevent all runoff from a large slope catchment accumulating in one low point. The cross berms must be about 500 mm lower than the level of the crest of the berm. Identify the existing low points between Lift 1 and 2 and construct the cross berms on both sides of these low points; • Construct crest berm walls on the top edge of the dump or on the edge of large flat areas to prevent accumulated runoff from flowing over the slopes. Obtain material by dozing material from the inside area of the dump (about 30 m away from the edge) to create a low laying area away from the edge of the dump to prevent ponding of runoff against the crest berms; • Reshape the top of the dump to slope inwards without moving an excessive amount of material to form low laying areas at several positions to prevent water ponding against the crest berms. The final design should be evaluated based on the final surface topography of the top area of the dump after all depositing has ceased; • Construct toe paddocks on the eastern side of the WRD where seepage is visible at the moment to contain and evaporate the seepage. It is expected that the seepage will stop after rehabilitation of the WRD. The toe paddocks can be removed during the post closure monitoring and maintenance period. It should be noted from the above that the rehabilitated WRD's will not be free draining, except for the bottom slopes. Rainfall and runoff will be contained on the top area and on the benches as described. The impact on the yield of the catchment is considered negligible and the advantage may be that additional groundwater recharge may occur. Containing runoff on the dump will improve the establishment and long-term stability of the vegetation cover and improve the bio-diversity.	
Fencing	
Rehabilitation Plan Report Figure Reference:	Error! Reference source not found.
Drawing Reference No:	**DB037_07, 08A & 08E**
Fencing The mitigation measures to address the risks associated with the successful establishment of vegetation and maintenance of newly rehabilitated areas requires that the rehabilitated areas be fenced off. This will include the following actions: • Construct a stock fence along the perimeter of the rehabilitated dumps and across the dump to divide the area into smaller camps for grazing management; and • Construct and maintain a firebreak along the existing security fence.	
Vegetation	
Rehabilitation Plan Report Figure Reference:	Error! Reference source not found.
Drawing Reference No:	**DB037_07, 08A & 08E**
Soil amelioration to provide a suitable growth medium and the establishment of vegetation is the same for all rehabilitated areas and is discussed in Section Error! Reference source not found..	

COARSE RESIDUE DEPOSIT (CRD)

The actions to rehabilitate the CRD are presented in Table 37 with reference to the applicable line items in the cost estimate sheets. Detail related to the rehabilitation actions for the CRD is presented in ANNEXURE A. In summary, the CRD will be addressed as follows:

Reshape slopes to a single 16° slope by means of a balanced cut to fill action. Import and spread 300 mm coarse basalt material as armour layer on the reshaped slopes only. Import and spread 200 mm suitable growth medium on the reshaped slopes and top area. Rip the covered areas on contour to a depth of 500 mm to mix the cover materials with each other and form a good bond with the underlying material. Ameliorate the growth medium and establish indigenous vegetation. Retain runoff on top of the facility by constructing crest walls and sloping the top area inwards. Fence off the area to control grazing to the specified carrying capacity and for the specified period only.

Table 37: Closure Actions for the CRD

<table>
<tr><th colspan="2">Closure Action</th></tr>
<tr><th colspan="2">Reshaping</th></tr>
<tr><td>Rehabilitation Plan Report Figure Reference:</td><td>Error! Reference source not found., Error! Reference source not found.</td></tr>
<tr><td>Drawing Reference No:</td><td>DB037_04, 05, 06, 08A & 08D</td></tr>
<tr><td colspan="2">Reshaping of steep slopes is required to ensure long-term stability, to reach the end land use by limiting erosion, and effectively cover the area with a suitable growth medium. The following actions will be implemented:
• Reshape all steep slopes from the current angle of repose (± 37°) to the design gradient of 16° (1:3.5) in a balanced cut and fill operation to reduce the gradient and make the slope accessible for other rehabilitation actions.
• Reshaped slopes must be even and rather concave than convex and without any windrows in any direction or deep tracks remaining up and down the slope;
• Reshape all uneven surfaces (general reshaping) to even out the areas (mostly the top area) to the extent that the placing of cover material can be controlled at the average specified depth, as well as to improve the drainage pattern of the areas where needed. This action was not costed separately, because it was assumed that this material forms an even surface after reshaping and that the preparation of surfaces are also included in the rate for load, haul and place of growth medium material.</td></tr>
<tr><th colspan="2">Growth Medium Cover</th></tr>
<tr><td>Rehabilitation Plan Report Figure Reference:</td><td>Error! Reference source not found., Error! Reference source not found.</td></tr>
<tr><td>Drawing Reference No:</td><td>DB037_04, 05, 06, 08A & 08D</td></tr>
<tr><td colspan="2">The disturbed and reshaped area must be covered with a suitable growth medium for the establishment of the vegetation cover to ensure the end land use. The growth medium will also support resistance against erosion to ensure long-term stability of areas susceptible to erosion. The following actions will be implemented:
• Cover the reshaped slopes with a 300 mm coarse basalt armour layer to reduce the erodibility of the surface layer;
• Cover the reshaped slopes and top area with 200 mm soil to form a growth medium together with the underlying material;
• Source suitable soil from the topsoil stockpiles as follows:
o Cover the northern, eastern and top portions from the topsoil stockpile TS1 (located to the north of the CRD) and TS3 (located directly to the north of the dump);
o Cover the northern, western and top portions from stockpile TS1 (located to the north of the CRD) and TS4 (located directly to the northwest of the dump);
o Cover the remainder of the CRD from topsoil stockpile TS2 (located to the north of the CRD);
• Rip the covered areas on contour (depth 300 mm, tine spacing = 1 m) to alleviate any compaction during placing of the material, mix the cover layers with each other and with the underlying material to increase coarseness and infiltration.</td></tr>
<tr><th colspan="2">Water Control</th></tr>
<tr><td>Rehabilitation Plan Report Figure Reference:</td><td>Error! Reference source not found., Error! Reference source not found.</td></tr>
<tr><td>Drawing Reference No:</td><td>DB037_04, 05, 06, 08A & 08D</td></tr>
<tr><td colspan="2">The reshaping of steep slopes and covering of erodible material will reduce the erodibility of the surface layer, but a critical component is the construction of suitable water control structures. The following actions will be implemented:
• The rehabilitated slopes will drain freely to the surrounding environment;</td></tr>
</table>

<table>
<tr><th colspan="2">Closure Action</th></tr>
<tr><td colspan="2">

- Contain all rainfall and runoff on the top of the rehabilitated facility;
- Construct crest berm walls at the edge of the top of the facility;
- Reshape the top of the facility to drain inwards, i.e. away from edge. This can be done during the construction of the crest berm walls;
- Construct additional paddock walls on the top area to divide the catchment and spread the runoff over several areas to increase evapotranspiration;
- Construct toe paddocks at seepage points on the specified sections on the eastern toe of the facility to capture and evaporate seepage until seepage stops; decommission toe paddocks during maintenance period; the toe paddocks on the eastern side will also prevent any possible sediment transport from the newly rehabilitated slope into the Northern Pan;
- Decommission the existing seepage trenches from the CRD to the SWCD / RWD once seepage has stopped – backfill the trenches and cover with surrounding material. Seepage is expected to stop soon after depositing has stopped as experienced on the eastern and northern sides where the area at the toe of the dump is already dry.

It should be noted from the above that the top of the rehabilitated CRD will not be free draining. Rainfall and runoff will be contained on the top area. The impact on the yield of the catchment is considered negligible. Groundwater recharge may increase. Containing runoff on the dump will improve the establishment and long-term stability of the vegetation cover and improve the bio-diversity.
</td></tr>
<tr><th colspan="2">Fencing</th></tr>
<tr><td>Rehabilitation Plan Report Figure Reference:</td><td>Error! Reference source not found., Error! Reference source not found.</td></tr>
<tr><td>Drawing Reference No:</td><td>DB037_04, 05, 06, 08A & 08D</td></tr>
<tr><td colspan="2">The mitigation measures to address the risks associated with the successful establishment of vegetation and maintenance of newly rehabilitated areas requires that the rehabilitated areas be fenced off. This will include the following actions:

- Construct a stock fence along the perimeter of the rehabilitated dump and across the dump to divide the area into smaller camps for grazing management; and
- Construct and maintain a firebreak along the existing security fence.
</td></tr>
<tr><th colspan="2">Vegetation</th></tr>
<tr><td>Rehabilitation Plan Report Figure Reference:</td><td>Error! Reference source not found., Error! Reference source not found.</td></tr>
<tr><td>Drawing Reference No:</td><td>DB037_04, 05, 06, 08A & 08D</td></tr>
<tr><td colspan="2">Soil amelioration to provide a suitable growth medium and the establishment of vegetation is the same for all rehabilitated areas and are discussed in Section Error! Reference source not found..</td></tr>
</table>

PRE-1912 TAILINGS DUMP

The actions to rehabilitate the Pre-1912 tailings dump area are presented in Table 38 with reference to the applicable line items in the cost estimate sheets. Detail related to the rehabilitation actions for the dump is presented in ANNEXURE A.

Table 38: Closure Actions for the Pre-1912 Tailings Dump.

<table>
<tr><th colspan="2">Closure Action</th></tr>
<tr><th colspan="2">Reshaping</th></tr>
<tr><td>Rehabilitation Plan Report Figure Reference:</td><td>Error! Reference source not found., Error! Reference source not found.</td></tr>
<tr><td>Drawing Reference No:</td><td>DB037_07A, 07B, 11</td></tr>
<tr><td colspan="2">Reshaping of steep slopes is required to ensure long-term ecological stability, to reach the end land use by limiting erosion, and effectively cover the area with a suitable growth medium. The following actions will be implemented:

- Reshape all steep slopes from the current angle of repose (± 37°) and steeper gradients (where material was loaded) to the design gradient of 18° (1:3) to reduce the gradient and make the slope accessible for other rehabilitation actions;
- Cut the top of the two high dumps up to the design elevation to avoid the construction of peaks and provide workspace during reshaping. Load and haul the material to fill the low laying area between the high dumps;
- Reshape the slopes on the southern side in a balanced cut and fill operation to the design gradient;
</td></tr>
</table>

Closure Action	
• Reshaped slopes must be even and rather concave than convex and without any windrows in any direction or deep tracks remaining up and down the slope; • Reshape all uneven surfaces (general reshaping) to even out the areas to the extent that the placing of cover material can be controlled at the average specified depth, as well as to improve the drainage pattern of the areas where needed. This action was not costed separately, because it was assumed that this material forms an even surface after reshaping and that the preparation of surfaces are also included in the rate for load, haul and place of growth medium material.	
Growth Medium Cover	
Rehabilitation Plan Report Figure Reference:	Error! Reference source not found., Error! Reference source not found.
Drawing Reference No:	**DB037_07A, 07B, 11**
The disturbed and reshaped area must be covered with a suitable growth medium for the establishment of the vegetation cover to ensure the end land use. The growth medium will also support resistance against erosion to ensure long-term stability of areas susceptible to erosion. The following actions will be implemented: • Cover all reshaped slopes with a suitable growth medium up to a minimum average depth of 200 mm; • Cover all reshaped and prepared top areas with a suitable growth medium up to a minimum average depth of 100 mm; • Source suitable soil from the topsoil stockpiles as follows: o Cover the reshaped areas from topsoil stockpile TS9 (located to the south of the pit between the Main and Southern WRD); o Cover the remainder of the area from topsoil stockpile TS11 (located to the west of the pit) or TS8 (located to the east of the WRD) if TS9 does not have sufficient material; • Cover the low gradient eastern portion of the area by selectively dumping material in open areas and spreading material between trees to minimise the disturbance to large trees; • Rip the covered areas on contour (depth 300 mm, tine spacing = 1 m) to alleviate any compaction during placing of the material, mix the cover layers with each other and with the underlying material to increase coarseness and infiltration.	
Water Control	
Rehabilitation Plan Report Figure Reference:	Error! Reference source not found., Error! Reference source not found.
Drawing Reference No:	**DB037_07A, 07B, 11**
The reshaping of steep slopes and covering of erodible material will reduce the erodibility of the surface layer, but a critical component is the construction of suitable water control structures to control runoff. The following actions will be implemented: • The rehabilitated slopes will drain freely to the surrounding environment; • Construct crest berms on the edge of the remaining flat top areas to contain runoff and prevent uncontrolled concentrated flow over the edges and slopes; • Construct contour berms on the indicated position on the longer slopes to reduce the slope length. The contour berms must drain freely at a gradient of 1:100 to a stable discharge position. There will be a remaining low laying area to the east of the Pre-1912 area against the western slopes of the WRD where some runoff will accumulate and pond before infiltration and evapotranspiration. This is outside the ZOR of the pit and assumed not to be a risk to future pit stability. This area cannot be made free draining without excessive amounts of earthworks.	
Fencing	
Rehabilitation Plan Report Figure Reference:	-
Drawing Reference No:	-
The mitigation measures to address the risks associated with the successful establishment of vegetation and maintenance of newly rehabilitated areas requires that the rehabilitated areas be fenced off. This will include the following actions: • The Pre-1912 area will not be fenced off separately, but fit in with the fencing layout of the WRD; and • Construct and maintain a firebreak along the existing security fence.	
Vegetation	
Rehabilitation Plan Report Figure Reference:	Error! Reference source not found., Error! Reference source not found.
Drawing Reference No:	**DB037_07A, 07B, 11**
Soil amelioration to provide a suitable growth medium and the establishment of vegetation is the same for all rehabilitated areas and are discussed in Section Error! Reference source not found..	

Closure Action

FINE RESIDUE DEPOSIT (FRD)

The actions to rehabilitate the FRD are presented in Table 39 with reference to the applicable line items in the cost estimate sheets. Detail related to the rehabilitation actions for the FRD is presented in ANNEXURE A. In summary, the FRD will be addressed as follows:

Reshape the south-western slope of FRD1A and FRD2 to a single 18° slope. Construct a buttress on the north-eastern slope of FRD1B for stability with material that is cut from the top of the north-eastern embankment of FRD2. Reshape the buttress at FRD1B and remaining embankment of FRD2 to a single 16° slope by means of a balanced cut to fill action. Import and spread 300 mm coarse basalt material as armour layer on the reshaped slopes only. Import and spread 200 mm suitable growth medium on the reshaped slopes. Rip the covered areas on contour to a depth of 500 mm to mix the cover materials with each other and form a good bond with the underlying material. Contain all runoff on top of the FRD facility so that it does not spill more than once in 100 years. Construct emergency spillways from FRD1B to FRD2 and from FRD2 to the open pit in case of extreme flood events.

Table 39: Closure Actions for the FRD.

Closure Action	
Reshaping	
Rehabilitation Plan Report Figure Reference:	Error! Reference source not found., Error! Reference source not found., Error! Reference source not found., Error! Reference source not found. Error! Reference source not found., Error! Reference source not found., Error! Reference source not found. Error! Reference source not found., Error! Reference source not found., Error! Reference source not found. **&** Error! Reference source not found.
Drawing Reference No:	**DB037_01, 02, 03, 08A & 08D**
Reshaping of steep slopes is required to ensure long-term stability, to reach the end land use by limiting erosion, and effectively cover the area with a suitable growth medium. The following actions will be implemented: • Cut off the top of the north-eastern embankment of FRD 2 to the specified level (allow for enough freeboard above the slimes level) to prevent the sharp crest as described in "Limitations". • Use the excess cut material from FRD 2 and construct a buttress on the north-eastern side of FRD 1B to improve the factor of safety for stability, reduce the amount of reshaping and avoid a sharp crest; • Cut off the top of the south-western embankment of FRD 2 to the specified level (allow for enough freeboard above the LOM slimes level) to prevent the sharp crest as described in "Limitations". Doze the excess cut material to fill the outside slopes of FRD 2 on the south-western side; • Reshape the steep slopes on the north-eastern side of the facility (existing slopes on FRD 2 and additional buttress on FRD 1B) from the current angle of repose (± 37°) to the design gradient of 16° (1:3.5) (due to the longer slopes) in a balanced cut and fill operation to reduce the gradient and make the slopes accessible for other rehabilitation actions; • Reshape the south-western slopes of FRD 2 to a single 16° slope due to the length of the reshaped slopes; • Reshape the south-western slopes of FRD 1A to a single 18° slope; • Reshape the slope between FRD 1 and FRD 2 to a single 18° slope; • Reshape all inside slopes to a single 18° slope; • Maintain the current elevation of the embankments on FRD 1A and 1B; • The bottom of the inner slopes around the penstocks or pool at the time of construction may be saturated and present a safety risk during reshaping. These slopes should not be reshaped if there is a risk that the bottom of the	

Closure Action	
slopes may slump or fail. The slopes are indicated on the drawings, but the cost for reshaping is still included in the closure liability; • The reshaped slopes must be even and rather concave than convex and without any windrows in any direction or deep tracks remaining up and down the slope; • Reshape all uneven surfaces (general reshaping) to even out the areas to the extent that the placing of cover material can be controlled at the average specified depth, as well as to improve the drainage pattern of the areas where needed. This action was not costed separately, because it was assumed that this material forms an even surface after reshaping and that the preparation of surfaces are also included in the rate for load, haul and place of growth medium material.	
Growth Medium Cover	
Rehabilitation Plan Report Figure Reference:	Error! Reference source not found., Error! Reference source not found., Error! Reference source not found., Error! Reference source not found. Error! Reference source not found., Error! Reference source not found., Error! Reference source not found. Error! Reference source not found., Error! Reference source not found., Error! Reference source not found. **&** Error! Reference source not found.
Drawing Reference No:	**DB037_01, 02, 03, 08A & 08D**
The disturbed and reshaped area must be covered with a suitable growth medium for the establishment of the vegetation cover to ensure the end land use. The growth medium will also support resistance against erosion to ensure long-term stability of areas susceptible to erosion. The following actions will be implemented: • Cover the reshaped slopes of FRD 1B NE, FRD 2 NE and FRD 2 SW with a 300 mm coarse basalt armour layer to reduce the erodibility of the surface layer; • Cover the reshaped slopes (including those covered with coarse basalt), top of the embankments and inner slopes with 200 mm soil to form a growth medium together with the underlying material; • Source suitable soil from the topsoil stockpiles as follows: o Cover FRD 1A and 1B from topsoil stockpile TS2 (located to the north of the CRD); o Cover FRD 2 from the northern portion of topsoil stockpile TS8 (located to the east of the WRD); • Rip the covered areas on contour (depth 300 mm, tine spacing = 1 m) to alleviate any compaction during placing of the material, mix the cover layers with each other and with the underlying material to increase coarseness and infiltration.	
Water Control	
Rehabilitation Plan Report Figure Reference:	Error! Reference source not found., Error! Reference source not found., Error! Reference source not found., Error! Reference source not found. Error! Reference source not found., Error! Reference source not found., Error! Reference source not found. Error! Reference source not found., Error! Reference source not found., Error! Reference source not found. **&** Error! Reference source not found.
Drawing Reference No:	**DB037_01, 02, 03, 08A & 08D**
The reshaping of steep slopes and covering of erodible material will reduce the erodibility of the surface layer, but a critical component is the construction of suitable water control structures. The following actions will be implemented: • The single outer slopes of the facility will be free draining to the environment and does not require additional water control structures. Erosion control will rely on the lower gradient and coarser basalt material mixed with the topsoil and underlying waste rock material, as well as a good vegetation cover; • Contain all runoff on the top of the facility in view of the excessive capacity available and to contain all dirty water (top of the facility will not be rehabilitated due to safety risks during implementation). The facility should not spill more than once in 100 years; o Excavate a spillway in the northern corner of FRD 1A to drain into FRD 1B that has sufficient capacity to contain runoff from both FRD 1A and 1B;	

Closure Action	
• Construct emergency spillways only to reduce the risk of failure in case of extreme flood events, i.e. above the design floods (climate change risk): o Construct two spillways on the facility, i.e. one in the south-eastern corner of FRD 1B (into FRD 2) and one in the south-western corner of FRD 2 (towards the pit); o Excavate through the embankments after the facility has dried out and during the dry season. Use the excavated material from the FRD 1B embankment to fill the surrounding slopes to lower gradients. Use the excavated material from the FRD 2 embankment to construct an embankment to keep runoff from the FRD separate from the rest of the rehabilitated plant area (low laying stockpile footprint); o Construct gabion reinforced spillways / weirs as designed; • Construct crest berm walls on top of the embankments on the outside and inside edges, except where the top is too narrow to allow any traffic (south-western embankment of 1A). In this case construct outside crest berms and slope the top of the reshaped embankments to the inside; • Retain the seepage and penstock trench from the south-eastern corner of FRD 2 until seepage has stopped and rehabilitate the trench at that stage. Seepage is expected to stop during the decommissioning phase; • Construct evaporation paddocks at the toe of the reshaped outer slopes of FRD 2 if on-going seepage is expected in view of the increase water volume that will be contained on the facility; • Decommission the existing seepage trenches from the CRD to the SWCD / RWD once seepage from the CRD has stopped – backfill and cover with surrounding material; • Decommission the penstock system according to the specifications: o Seal the penstock pipe outlet by constructing a concrete seal over the outlet; o Fill the entire horizontal outlet pipe with high slump concrete; o Fill the vertical penstock pipe with concrete	
Fencing	
Rehabilitation Plan Report Figure Reference:	Error! Reference source not found., Error! Reference source not found., Error! Reference source not found., Error! Reference source not found. Error! Reference source not found., Error! Reference source not found., Error! Reference source not found. Error! Reference source not found., Error! Reference source not found., Error! Reference source not found. **&** Error! Reference source not found.
Drawing Reference No:	**DB037_01, 02, 03, 08A & 08D**
The mitigation measures to address the risks associated with the successful establishment of vegetation and maintenance of newly rehabilitated areas requires that the rehabilitated areas be fenced off. This will include the following actions: • Erect a security fence along the perimeter of the rehabilitated dump as well as on the crest of the facility to prevent access on areas where water may be standing after rain events; and • Construct and maintain a firebreak along the existing security fence around the current mine area.	
Vegetation	
Rehabilitation Plan Report Figure Reference:	Error! Reference source not found., Error! Reference source not found., Error! Reference source not found., Error! Reference source not found. Error! Reference source not found., Error! Reference source not found., Error! Reference source not found. Error! Reference source not found., Error! Reference source not found., Error! Reference source not found. **&** Error! Reference source not found.
Drawing Reference No:	**DB037_01, 02, 03, 08A & 08D**
Soil amelioration to provide a suitable growth medium and the establishment of vegetation is the same for all rehabilitated areas, i.e. reshaped slopes and are discussed in Section Error! Reference source not found., with the exception of the top of the FRD facility. The top of the facility is not stable enough to allow access with heavy machinery to reshape, cover or rip the area. It is expected that the top of the area will be colonised by vegetation over time as seen on similar dormant facilities, but the establishment of vegetation will be enhanced by the following actions:	

Closure Action
• Ensure that the inner slopes are effectively vegetated with the desired species to serve as seed bank from where vegetation can migrate over time; • Spread fertiliser and compost by hand over the top areas that can be safely accessed on foot; • Spread seed of grass and tree species by hand over the top area that can be safely accessed on foot; • Pack branches as mulch by hand over the top area that can be safely accessed on foot.

OPEN PIT

The closure actions for the open pit are aimed at restricting access to the pit to mitigate long-term safety and security risks. The open pit is located within the larger area where access will be controlled based on the end land use, i.e. private owned land. The existing security fence around the mining area will also remain to restrict access to the area. Limited closure actions are proposed for the area between the security fence around the pit and the pit perimeter, because the land use of the area will be 'Restricted'. The actions associated with the open pit are presented in
Table 40. Detail related to the rehabilitation actions for the open pit is presented in ANNEXURE A. In summary, the open pit will be addressed as follows:

Construct a high-grade security fence, storm water trench and an enviro berm outside the ZOR. The open pit void will not be backfilled, but measures will be put in place to restrict access to the pit as far as possible.

Table 40: Closure Actions for the Open Pit

Closure Action	
Restrict Access	
Rehabilitation Plan Report Figure Reference:	Error! Reference source not found. **and** Error! Reference source not found.
Drawing Reference No:	**DB037_07, 08A & 08E**
Access to the open pit will be restricted or deterred by implementing the following closure actions: • Construct 2 m high berms with coarse waste rock material at the remaining entrance ramps to the pit; • Erect a high-grade security fence 10 m outside the ZOR around the entire perimeter of the open pit; • Construct a trench and enviroberm on the western and northern sides of the pit in a balanced cut and fill operation, i.e. use the cut material from the trench to construct the enviroberm. The specifications for the trench and enviroberm are the following: o Berm top width / trench bottom width = 5 m; o Height / Depth = 2 m; o Side slopes = 1:5 • Connect the enviroberm to the WRD on the eastern side and to the Southern WRD on the southern side; • Remove topsoil before cutting the trench and filling the berm and spread the soil over the disturbed area after construction; • Establish natural indigenous vegetation on the trench and enviroberm as for other areas; • Align the trench and berm to divert clean storm water away from the pit towards the wetland areas; • Reshaping of the top bench or other slopes of the open pit will not contribute to addressing the residual risks (i.e. illegal access to the open pit) and no action is proposed.	
Pit Stability	
Rehabilitation Plan Report Figure Reference:	Error! Reference source not found. **and** Error! Reference source not found.
Drawing Reference No:	**DB037_07, 08A & 08E**
Support the pit stability or prevent any unplanned deterioration of the stability of the pit side walls by implementing the following actions: • Remove existing water control structures, e.g. trenches and berms that can cause the ponding of water by backfilling the trenches with material from the berms or other imported material. Shape the backfilled trenches and berm footprints to make the areas free draining;	

Closure Action	
• Reinstate the berms on the pit perimeter where concentrated runoff is entering the pit at the moment and divert runoff away from the pit perimeter with low level contour drains if the topography allows; • Rip compacted areas to reduce runoff and allow the establishment of a good vegetation cover and deep rooted species; • Establish vegetation and deep rooted species between the new security fence and pit perimeter to enhance evapotranspiration.	
Protect Resource	
Rehabilitation Plan Report Figure Reference:	Error! Reference source not found. **and** Error! Reference source not found.
Drawing Reference No:	**DB037_07, 08A & 08E**
There is still a resource at the bottom of the pit albeit not feasible to continue with mining at these depths. Access to the resource must be restricted to prevent unlawful mining activities. This will be achieved by the mitigation measures as described above, but also by covering the remaining resource in the bottom of the pit up to an elevation of 1200 mamsl. It is not feasible to cover the bottom of the pit with large volumes of earth and it was proposed (E-Tek Consulting / Redco, June 2016) to flood the bottom of the pit as quickly as possible. • Access to the remaining resource can be prevented by covering the bottom of the pit as soon and quickly as possible with water. The recharge to the pit from natural rainfall and runoff will start filling the pit as soon as dewatering stops. The area inside the enviroberm will generate runoff into the pit. The catchment area of the pit is ±106 ha; • The technical evaluation (Golder Associates Africa (Pty) Ltd, February 2019) of pit closure options (i.e. backfilling vs. pit lake formation) indicated that the water level will reach 1200 mamsl in less than 10 years without any additional catchment.	

7.1.4 Implementation of the Rehabilitation Plan

Implementation of the rehabilitation works are based on bulk volumes and will need to be updated during the detail design phase. It is assumed that the required resources, in the form of contractors, will be available for rehabilitation implementation. It is planned that the contractors could be finished with all rehabilitation works by 2022. To ensure implementation on the scheduled plan is realistic, detail planning should be conducted in conjunction with the client's planners.

Further detail regarding the implementation of the Rehabilitation Plan is presented in ANNEXURE A.

8 MONITORING REQUIREMENTS

The post closure monitoring plan addresses the following key components:

- Monitoring objectives;
- Monitoring scope; and
- Monitoring frequency.

  The proposed monitoring frequency has been assumed based on existing information and experience at Voorspoed Mine. In the case of vegetation, the existing rehabilitated areas have stabilised to an acceptable and stable vegetation cover within 4 years. Specialists contracted to conduct monitoring surveys and analysis should update and recommend a detailed monitoring plan and frequency, based on results and risk presented by the monitoring data.

The monitoring requirements for Voorspoed Mine is provided in Table 41. The monitoring objectives, scope and frequencies presented in Table 41 should be structured in order to measure compliance with success criteria as documented in Table 30 and Table 31.

Table 41. Monitoring requirements for Voorspoed Mine.

Monitoring aspects	Monitoring objectives	Monitoring scope	Monitoring Frequency	Success Criteria
Water Quality – Groundwater	• Legal compliance • Ensure groundwater is fit for current and future domestic and other uses consistent with agreed current and future land use • Conduct surface and groundwater studies to refine closure strategies and determine remediation methods should that be required • 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 • Pollution control • A post closure land use with no long-term liabilities	Continuation of existing Ground water monitoring programme and amendment of the programme as addressed by Golder (2017).	Bi-annual monitoring for a 5 year period	• Discharge / groundwater quality within authorised / specified quality limits • No valid complaints from I&APs regarding discharge / groundwater qualities • Groundwater qualities do not adversely impact on End Land Use objectives
Water Quality – Surface water	• Legal compliance • Ensure surface water is fit for agreed current and future basic human needs and aquatic ecosystems requirements. • Conduct surface and groundwater studies to refine closure strategies and determine remediation methods should that be required • 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	• Development and implementation of a surface water monitoring programme, including existing sampling points and the following sampling points: • Increased seepage from FRD 1B and 2 due to water retention on top surface • Stream running east from the FRD • Water sources / catchments feeding the pans and wetland	Bi-annual monitoring for a 5 year period	• Discharge / surface water quality within authorised / specified quality limits • No valid complaints from I&APs regarding discharge / surface water qualities • Surface water qualities do not adversely impact on End Land Use objectives • Ecosystem (wetland and pans, grasslands) functioning not adversely impacted by surface water quality (as determined by biodiversity monitoring)

Monitoring aspects	Monitoring objectives	Monitoring scope	Monitoring Frequency	Success Criteria
	cannot be contended with by the installed measures. • Pollution control • A post closure land use with no long-term liabilities	• Water feeding and within the RWD / SWCD • Farmer's dam to the east of the WRD • Existing sampling point SWM05		
Surface water control	• Structural and ecological stability of the landforms; • Protection of the slopes against erosion	• Monitor stability of water control structures and erosion. • Monitor and inspect sediment control structures • Inspect water control structures especially after intense rain events and increased erosion • Identify reduced capacity due to sedimentation • Monitor for long-term stability, e.g. scouring • Monitor condition of low laying areas that were constructed on the top of dumps and other flat areas	Annual monitoring for a 5 year period	• Structurally stable landforms post rehabilitation • Limited erosion – will not deteriorate to large dongas and unsafe area • Water control structures remain functional and stable • No sediment transport from the area
Biodiversity – Restoration	• Legal compliance • Restore as much as possible of the mining area to a condition consistent with the pre-determined post closure land use objectives • Restore the land to a final, sustainable end land-use that has been defined by the interaction with the regulating agencies and communities affected. • Protection of the slopes against erosion	• Monitor vegetation on rehabilitated areas (species diversity, plant density, vegetation structure, abundance, cover) • Monitor soil coverage • Monitor extent and severity of erosion • Identify footpath creation during utilisation of area • Identify unwanted concentration of runoff over large areas	Bi-annual monitoring for a 5 year period	• Vegetation cover similar to natural comparable surrounding environment • Effective soil cover ensure the agreed land capability • Vegetation cover ensure the agreed grazing capacity • No weed invasion to the extent that it will outcompete or overgrow the palatable grass species and reduce the grazing potential

Monitoring aspects	Monitoring objectives	Monitoring scope	Monitoring Frequency	Success Criteria
	• A post closure land use with no long-term liabilities	• Monitor for vegetation dormancy		
Biodiversity – Aquatic	• Legal compliance • A post closure land use with no long-term liabilities	Aquatic biodiversity studies within the Pans & Wetland: • Flora • Fauna	Bi-annual monitoring for a 5 year period	• No sediment transport to pan areas • Clean runoff volumes to pans are close to original condition • Vegetation species composition reflects increased wetland species • No weed invasion to the extent that it will outcompete or overgrow the palatable grass species and reduce the grazing potential • Increase in wetland fauna and flora species (from monitoring surveys)
Biodiversity – Alien invasive vegetation	• Legal compliance • A post closure land use with no long-term liabilities	• Extent of alien invasive establishment across Voorspoed site • Effectiveness of eradication programme • Determination of priority areas	Annual monitoring for a 5 year period	• No weed invasion to the extent that it will outcompete or overgrow the palatable grass species and reduce the grazing potential • Weed establishment does not adversely impact on End Land Use objectives • Ecosystem (wetland and pans, grasslands) functioning not adversely impacted by weed establishment (as determined by biodiversity monitoring)
Air Quality	• Legal compliance • Pollution control • A post closure land use with no long-term liabilities	• Continuation of exiting dust monitoring programme to monitor and measure fall-out dust • Alterations to sampling programme as determined by specialist	Bi-annual monitoring for a 5 year period	• Fall-out dust levels within authorised / legal limits for the area • No valid complaints from I&APs regarding fall-out dust emanating from mine facilities and surfaces • Fall-out dust does not adversely impact on End Land Use objectives
Open Pit Stability	• Legal compliance • The safety and health of humans and animals are safeguarded from hazards resulting from mining operations.	Monitoring with open pit ZoR	Bi-annual monitoring for a 5 year period	• Pit stable and safe post closure • Zone of relaxation within anticipated and acceptable limits • Access deterred with security fence around mine;

Monitoring aspects	Monitoring objectives	Monitoring scope	Monitoring Frequency	Success Criteria
				• Access deterred with security fence around pit perimeter; • Trench and enviroberm functional and stable.
FRD stability	• Legal compliance • The safety and health of humans and animals are safeguarded.	Monitoring of FRD side wall stability	To be determined by responsible engineers / specialists	Stable and acceptable integrity of FRD side walls as determined by responsible engineers / specialists

9 CLOSURE MAINTENANCE AND MANAGEMENT

Areas that are rehabilitated to address risks and achieve the closure objectives are susceptible to degradation during the post closure period while it is still sensitive or due to adverse conditions. Management and maintenance of rehabilitated areas are therefore required to ensure that the success criteria are met. Maintenance actions for rehabilitated areas are summarised in Table 42.

Table 42: Management and maintenance actions for rehabilitated areas

Aspect		Maintenance Actions
Mine Residue Deposits	Sedimentation of benches	• De-silt sediment control structures where capacity has been compromised • Remove sediment from especially contour paddocks until sediment generation has reduced to acceptable levels • Repair damages to berms or channels • Revisit SWMP after evaluation of drainage pattern after rehabilitation and construct additional structures where needed
	Erosion on profiled / rehabilitated areas / slopes	• Gullies – backfill where needed by importing material to backfill from stockpiles • Reinstate / upgrade water control structures • Spread runoff where concentration occurs • Improve vegetation cover and reinstate vegetation on newly repaired areas
	Slope failures	• Repair immediately after determining appropriate designs
	Crest walls / berms	• Maintain free-board • Repair / reinstate berms where integrity is compromised
	MRD water control / management structures (Engineered waterways and gabions)	• Repair structural damage • Maintain design capacities • Repair uneven settlement • Check for, and mitigate tunnelling
Open Pit	Fence	• Maintain fence integrity, particularly areas where the fence traverses pit water inlet structures
	Enviroberm	• Maintain enviroberm vegetation • Repair erosion to the enviroberm
	Trench around pit perimeter	• Remove sediment from trench
Toe Paddocks		• Maintain the capacity of toe seep paddocks by removing silt and controlling vegetation within the paddocks
Vegetation	Ecological restoration (poorly established and bare areas)	• Cover bare areas with growth medium • Ameliorate with fertilizer / compost • Re-seed areas once soil quality is addressed • Re-seed with selected species if diversity is not acceptable • Stimulate growth with controlled grazing
	Alien Invasives	• Continue with eradication control programme as per eradication programme • Address priority areas as determined by the eradication programme
Roads	Road along perimeter of security fence	• Maintain road by removing vegetation and maintaining surface • Maintain as fire break

Aspect		Maintenance Actions
	Main access road	• Maintain road by removing vegetation and maintaining surface • Maintain water management structures
Fencing	Control access to controlled grazing or restricted areas, as per the End Land Use Plan	• Maintain fences • Regular fence inspections

10 PROPOSED CLOSURE ORGANISATIONAL STRUCTURE

The Rehabilitation programme will be executed in line with a detailed Project Execution Plan (PEP), detailing the project resourcing, scheduling and execution costing.

Refer to the PEP for further information and detail.

11 CLOSURE GAP ANALYSIS AND ACTION PLAN

During the compilation of this final mine closure plan, a number of gaps were identified. These gaps arise as a result of an absence of:

- Specialist studies that would provide clarity on the nature and / or extent of an identified risk or inherent uncertainties in specialist studies undertaken to date;
- Adequate consultation with relevant authorities and / or stakeholders thus placing uncertainty on the acceptability of the proposed closure and success criteria; and / or
- Proven results that demonstrate the effectiveness of planned success criteria.

Table 43 details these gaps and the aspect of the closure plan to which they relate.

Table 43. Closure gaps and associated action plans.

Closure Plan Element	Identified Gap	Recommended Actions
Mine surface area structures	The presence and extent of hydrocarbon contaminated soil near the plant, workshops and oil and fuel handling facilities is unknown.	Develop a formalised bio-remediation site and activity protocol to adequately deal with hydrocarbon-contaminated material volumes. A Waste License may be required in terms of the NEM: Waste Act for the proposed bioremediation site. This needs to be confirmed.
	The acceptability to the relevant authorities of disposing of building rubble (inert demolition waste) on-site is not known e.g. into the pit.	A plan for authority and relevant stakeholder engagement must be developed and implemented. This should be addressed as part of the updated (2019), ongoing SEP process.

Closure Plan Element	Identified Gap	Recommended Actions
Mineral Residue Facilities (WRD, CRD and FRD)	A groundwater pollution plume has developed as a result of seepage from the various MRDs. The rate of movement and potential impact to surface water systems and offsite groundwater users has been modelled but the actual changes in quality and resultant impacts can only be tracked through regular monitoring of groundwater qualities.	Implement post-closure groundwater quality monitoring programme. Based on the risk, it is not anticipated that any additional mitigation to address water quality will be required.
Coarse Residue Deposit	The nature and extent of impacts to soil as a result of seepage from the CRD is unknown.	A soil sampling programme needs to be undertaken to determine if and to what extent soils have been contaminated.
Fine Residue Deposit	The duration that the RWD will need to remain post closure to capture and retain decant from the FRD is unknown. The anticipated quality of water in the dam post-closure is unknown therefore the final management plan to handle this water once the facility is decommissioned is uncertain.	A water and salt balance for post-closure scenario needs to be developed. The duration that the RWD must be retained in order to mitigate any water quality impacts needs to be determined. Management measures to dispose of water contained in the RWD at the time of decommissioning need to be determined.
Off-site surface infrastructure	To date, the post closure end-land use, ownership and associated maintenance of applicable infrastructure has not been confirmed or agreed with relevant stakeholders. Specific infrastructure includes: • External access roads. • Electrical transmission and distribution infrastructure. • The Renoster River weir.	A plan for authority and relevant stakeholder engagement must be developed and implemented. This will be addressed as part of the updated (2019), ongoing SEP process.
	The revised closure criteria for the raw water pipeline (above surface infrastructure demolished; sub surface infrastructure remains in situ) may not meet farmers' expectations (or perceived commitments made to farmers during the Mine project development phase). The commitment was that pipeline infrastructure adjacent to farm properties will become the property of the farmer post-closure. It remains unclear whether or not the farmers' expectations are that the pipeline maintains a water provision capability post closure. Applicable water use licencing will need to be addressed dependent on the ultimate outcome.	A plan for authority and relevant stakeholder engagement must be developed and implemented. This will be addressed as part of the updated (2019), ongoing SEP process.
Open pit	Failure of the pit sidewalls is expected. The extent of the back-break zone has been estimated but may not be completely accurate.	Implement a post-closure pit stability monitoring programme.

Closure Plan Element	Identified Gap	Recommended Actions
	Based on experience at other closed diamond mines, unauthorised access to the open pit is likely despite every effort to remove the possibility or incentive for people to access the mine illegally. Ongoing monitoring and maintenance of access control structures will be required to minimise the likelihood of human injury or death.	A fencing, enviroberm and trench maintenance programme will need to be developed and implemented.
Authority Engagement regarding Closure Criteria	Applicable authorities (who will need to authorise the mine closure plan) have not been consulted on the proposed mine closure and success criteria.	A plan for authority and relevant stakeholder engagement must be developed and implemented. This will be addressed as part of the updated (2019), ongoing SEP process.
Surface water	The FRD has been built over a non-perennial stream. Seepage from the FRD and WRD are modelled to impact the water quality in this stream post-closure. The actual impact can only be determined through the implementation of a post-closure ground and surface water monitoring programme. Authorities and potentially affected stakeholders have not been engaged on this issue.	Implement a post-closure ground and surface water monitoring programme. A plan for authority and relevant stakeholder engagement must be developed and implemented. This will be addressed as part of the updated (2019), ongoing SEP process. This will be addressed as part of the updated (2019), ongoing SEP process.
	Contamination of off-site surface water resources as a result of run-off from MRDs is expected. However, due to incomplete monitoring data there is a lack of understanding of the significance of current and post-closure impacts on offsite surface water receptors	Regular and consistent surface water monitoring at offsite sensitive receptors needs to be undertaken during the remaining LOM and post-closure. Potential impacts and the planned management measures (if required) need to be communicated to stakeholders. This will be addressed as part of the updated (2019), ongoing SEP process.

12 CLOSURE LIABILITY ESTIMATE

The previous itemised closure liability was calculated in 2018 as forerunner to the 2019 Final Closure Plan update. Redco updated the rates and quantities during this study to calculate market related costs for the region, but also to reflect changes in designs and the resultant effects on rates. Rates for dismantling and demolition of infrastructure were obtained from a national demolition contractor that visited the site to assess local conditions. The rates for earthworks were calculated based on site conditions and a combination of local and typical plant hire rates. The quantities for earthworks were calculated on a volume basis (m^3), because this is more in line with the standard method of measurement for civil engineering quantities, tendering and volume balances. The quantities for earthworks were modelled and calculated from a DTM of a lidar survey that was done in September

2018, with subsequent updated surveys of selected areas that changed since the lidar survey. The closure liability sheets should be read in conjunction with the reference drawings in ANNEXURE F. The closure liability sheets are included in ANNEXURE E. The closure liability has decreased slightly since 2018 and is due to the net variance of factors increasing and decreasing the costs. The following changes caused the closure liability to increase:

- The emergency CRD stockpile remained when the operations ceased at the end of 2018 and allowance must be made for the rehabilitation of the dumps and footprint;
- Design changes for the CRD, i.e. reshape the slopes to single 16° slopes instead of benches and 18° intra-bench slopes and an additional coarse basalt cover layer to reduce erosion; this also increased the footprint area that must be covered;
- The same design changes were applied to the eastern side of FRD1B and FRD2, i.e. increased reshaping costs to reshape to 16° and an additional coarse basalt armour layer;
- The cost for the rehabilitation of the plant footprint increased, because of the remaining stockpile dumps at the DMS and crushed ore stockpile areas;
- The backfilling cost of the primary crusher void increased based on more accurate calculations and to allow sufficiently for the consolidation and settlement of the backfilled material, especially inert concrete and building rubble;
- A portion of the Pre-1912 tailings facility remains and must be reshaped and covered with growth medium;
- The cost of the remaining basalt dump increased based on the expected remaining material after suitable graded material was removed for the armouring of the CRD and FRD slopes;
- The cost of rehabilitating certain of the general disturbed areas increased to allow for weed and invader plant control on areas outside the mine disturbed footprint, but on the property of the mine;
- The monitoring cost was increased to allow for a minimum of 10 years and increased pit stability monitoring; and
- Some of the maintenance cost increased, e.g. invader control and follow-up vegetation.

The following liabilities reduced since 2018:

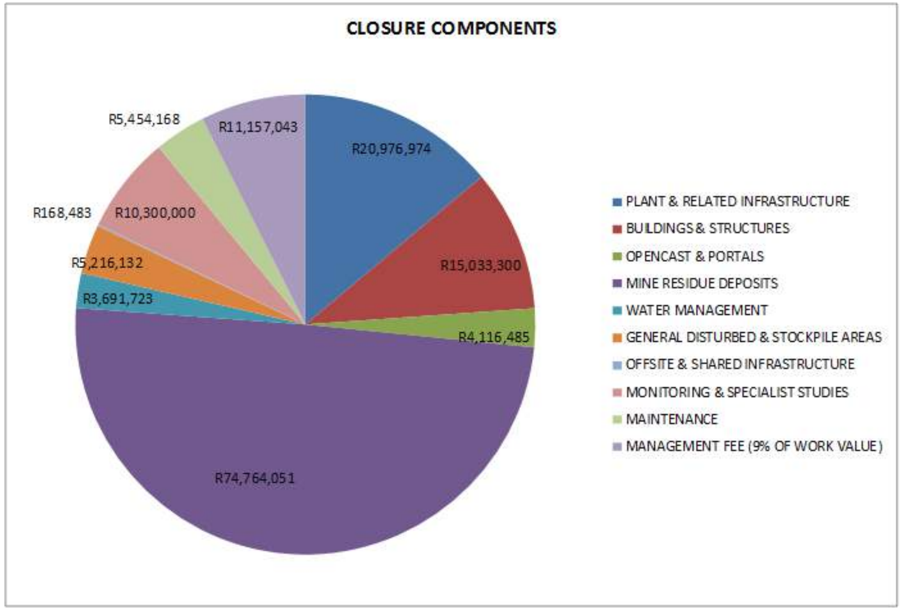
- The cost for the closure of the buildings category reduced, because some infrastructure has already been removed from site;
- The cost for the remainder of the WRD rehabilitation reduced, because some of the works have already been implemented by the mine;
- The cost for the reshaping of the FRD2 outer slopes reduced, because of the change in design and changes to the volume of buttress material that was used for FRD1B;
- The covering and water control on the top of the FRD facility was removed from the liability, because it is not deemed practical to work safely on the top area. It remains uncertain as to when the top area will be dry enough to allow any possible earthworks actions;
- The cost of the rehabilitation of the RWD and SWCD reduced, because it was changed to a partial backfill designs instead of making the facilities free draining;

- The closure liability of the open pit reduced, because the security fence was already delivered on site; and
- Some of the maintenance cost reduced, e.g. cleaning of sediment from benches (benches removed due to design change).

A summary of the unscheduled closure liability (2019) and the 10-year closure liability forecast is presented in Figure 37. The figure below is for the scenario where the implementation management cost is based on external engineering consultancy rates.

SUMMARY

Zone	CLOSURE COMPONENTS – Area	UNSCHEDULED CLOSURE – Decommissioning	UNSCHEDULED CLOSURE – Restoration	UNSCHEDULED CLOSURE – 2019 Total	10-YEAR FORECAST – 2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
A	PLANT & RELATED INFRASTRUCTURE	R 13,925,026.31	R 7,051,948.02	R 20,976,974.33	R 20,976,974.33	R 12,480,031.00	R -	R -	R -	R -	R -	R -	R -	R -
B	BUILDINGS & STRUCTURES	R 11,683,896.68	R 3,349,403.76	R 15,033,300.44	R 15,033,300.44	R 15,033,300.44	R -	R -	R -	R -	R -	R -	R -	R -
C	OPENCAST & PORTALS	R 524,339.27	R 3,592,145.72	R 4,116,484.99	R 3,268,691.12	R -	R -	R -	R -	R -	R -	R -	R -	R -
D	MINE RESIDUE DEPOSITS	R -	R 74,764,050.51	R 74,764,050.51	R 57,882,686.77	R 26,510,166.06	R 1,764,317.54	R -	R -	R -	R -	R -	R -	R -
E	WATER MANAGEMENT	R 192,849.00	R 3,498,874.33	R 3,691,723.33	R 3,691,723.33	R 3,691,723.33	R -	R -	R -	R -	R -	R -	R -	R -
F	GENERAL DISTURBED & STOCKPILE AREAS	R -	R 5,216,132.37	R 5,216,132.37	R 5,216,132.37	R 5,216,132.37	R -	R -	R -	R -	R -	R -	R -	R -
G	OFFSITE & SHARED INFRASTRUCTURE	R 165,568.90	R 2,913.75	R 168,482.65	R 168,482.65	R 168,482.65	R 168,482.65	R -	R -	R -	R -	R -	R -	R -
H	MONITORING & SPECIALIST STUDIES	R -	R 10,300,000.00	R 10,300,000.00	R 8,931,000.00	R 6,023,200.00	R 3,983,000.00	R 3,414,000.00	R 2,845,000.00	R 2,276,000.00	R 1,707,000.00	R 1,138,000.00	R 569,000.00	R -
J	MAINTENANCE	R -	R 5,454,168.41	R 5,454,168.41	R 5,454,168.41	R 2,080,760.56	R 1,413,951.05	R 1,018,537.60	R 29,413.00	R 29,413.00	R 29,413.00	R 29,413.00	R 29,413.00	R 29,413.00
I	MANAGEMENT FEE (9% OF WORK VALUE)	R -	R 11,157,043.38	R 11,157,043.38	R 9,561,419.19	R 5,678,985.23	R 173,952.02	R -	R -	R -	R -	R -	R -	R -
	Sub Total #1	R 26,491,680.16	R 124,386,680.25	R 150,878,360.41	R 130,184,578.62	R 76,882,781.64	R 7,503,703.25	R 4,432,537.60	R 2,874,413.00	R 2,305,413.00	R 1,736,413.00	R 1,167,413.00	R 598,413.00	R 29,413.00
	Preliminary & General	R 6,622,920.04	R 25,732,409.22	R 32,355,329.26	R 27,923,039.86	R 16,295,149.10	R 836,687.81	R 254,634.40	R 7,353.25	R 7,353.25	R 7,353.25	R 7,353.25	R 7,353.25	R 7,353.25
	Contingencies	R 1,324,584.01	R 5,661,481.84	R 6,986,065.85	R 6,031,157.97	R 3,560,189.82	R 366,487.56	R 221,626.88	R 143,720.65	R 115,270.65	R 86,820.65	R 58,370.65	R 29,920.65	R 1,470.65
	Total (excl VAT; incl P&G's and contingencies)	R 34,439,184.21	R 155,780,571.31	R 190,219,755.52	R 164,138,776.45	R 96,738,120.56	R 8,706,878.63	R 4,908,798.88	R 3,025,486.90	R 2,428,036.90	R 1,830,586.90	R 1,233,136.90	R 635,686.90	R 38,236.90
	15%	R 5,165,877.63	R 23,367,085.70	R 28,532,963.33	R 24,620,816.47	R 14,510,718.08	R 1,306,081.79	R 736,319.83	R 453,823.04	R 364,205.54	R 274,588.04	R 184,970.54	R 95,353.04	R 5,735.54
	Total (incl VAT)	R 39,605,061.84	R 179,147,657.01	R 218,752,718.85	R 188,759,592.92	R 111,248,838.64	R 10,012,910.42	R 5,645,118.71	R 3,479,309.94	R 2,792,242.44	R 2,105,174.94	R 1,418,107.44	R 731,039.94	R 43,972.44



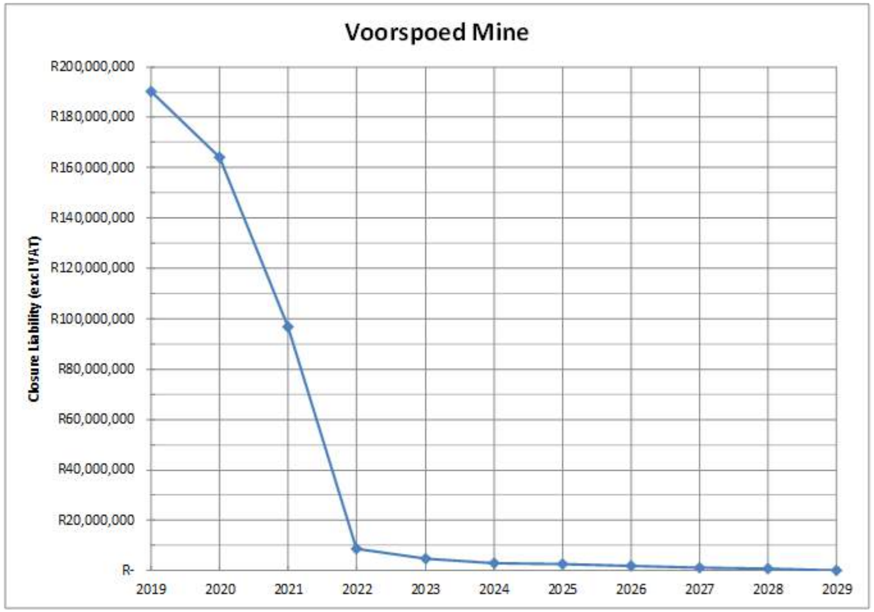


Figure 37. Summary of Voorspoed Mine Closure Liability

12.1 Basis of Estimate (BoE)

This BoE provides the information that was used to calculate the closure liability estimate and should be read in conjunction with the closure liability estimate calculation sheets as included in ANNEXURE E. The closure liability calculation sheets have been developed to provide as much as possible information to indicate the actions, conditions and assumptions related to each cost item. The BoE is summarised in Table 44 and will give an understanding of factors that influenced the cost calculation. The actual quantities, rates and liability calculations are provided in the liability calculation sheets. The rates used for the calculation of the closure liability can be updated to improve confidence and the required accuracy closer to the end of LoM by keeping records of works that are implemented on site and feeding this back into the rate calculations. Typical actions that are highly variable from site to site and can value from work studies include the following:

- The actual work rate for spreading ameliorants and cultivating slopes by hand;
- Bio-remediation of hydrocarbon contaminated soil at specific depths, especially the duration required and the need for regular watering in the dry climate;
- Ripping of different compacted or other areas; ripping is typically a difficult action to estimate due to the variability of materials to be ripped and relies on actual work studies;
- Covering a reshaped slope by dozing material uphill from a stockpile at the bottom of the slope;
- The rate for the construction of gabion structures, including the collection and screening of rock from available sources on site;
- The cost for the rehabilitation of pans or wetlands is highly variable and depends on the required actions; and
- The cost of spreading and mixing the mixed coarse basalt armour and topsoil layer on the CRD and FRD slopes.

Table 44. Basis of Estimate for the Voorspoed Mine Closure Liability Calculation

Activity	Closure Criteria	Quantities	Rates
PLANT & BUILDING INFRASTRUCTURE & RELATED AREAS	Assume all plant and building infrastructure will be removed in total from site. Infrastructure to remain for post closure land use still to be confirmed & consulted with I&AP's. The infrastructure footprints will be rehabilitated to end land use of grazing.		
Dismantle Large Steel Structures	• Remove all salvageable equipment & take to salvage / auction yard • Prepare structure to safely bring down • Pull structure over • Cut steel into smaller sections to load to trucks • Scrap metal dealer collect on site as arranged by demolition contractor and part of that contract	• Quantities confirmed by on-site verification by demolition expert • Determined during previous closure plan & updated based on design or as-built drawings & BOQ's • Site visited by demolition estimator to add outstanding infrastructure	• Site visit by demolition estimator • Updated market related rates from supplier as adjusted for site • P&G's not included in unit rates, but indicated separately • The client to make the area safe, disconnect services & points of stored energy (e.g. belt tensioners) • Rates for steel dismantling include preparation of steel structure, pulling over & loading onto truck • Transport cost included within radius of 50 km • Credit for salvage value not included
Dismantle Steel Framed Buildings/Stores	• De-sheet the building with grapple or long reach excavator and treat as part of scrap steel; • Demolish any brick offices or dwarf walls; • Break out any slabs and foundations • Dismantle steel components as described for large steel structures	• Quantities confirmed by on-site verification by demolition expert • Determined during previous closure plan & updated based on design or as-built drawings & BOQ's • Site visited by demolition estimator to add outstanding infrastructure	• Site visit by demolition estimator • Updated market related rates from supplier as adjusted for site • P&G's not included in unit rates, but indicated separately • The client to make the area safe, disconnect services & points of stored energy (e.g. belt tensioners) • Rates separate for de-sheeting, concrete & brick demolition & steel dismantling • Transport cost included within radius of 50 km • Credit for salvage value not included
Demolish Concrete Components	• Remove all concrete foundations, slabs & footings to 0.5 m below ground level in view of limited cover material to effectively cover remaining concrete • Break concrete on site to rubble size >300 mm • Remove reinforcement as it becomes loose, otherwise cut reinforcement between rubble blocks	• Determined during previous closure plan & based on design or as-built drawings & BOQ's • Site visited by demolition estimator • Quantities re-calculated to confirm • Additional structures estimated based on typical quantities per structures after site inspection • Quantity of concrete rubble to haul to void increased with swell factor of 70%	• Site visit by demolition estimator • Updated market related rates from supplier as adjusted for remoteness of site • P&G's not included in unit rates, but indicated separately • Rates for concrete demolition includes breaking, stockpiling, loading & hauling to primary crusher void

Activity	Closure Criteria	Quantities	Rates
	• Load & haul all inert concrete rubble to designated void area & cover with waste rock to 2 m above surrounding ground level		• Cover of rubble includes load from emergency stockpile (coarse residue) dump, haul @ 1 km & spreading
Demolish Brick Buildings	• Soft stripping, i.e. remove fittings, partitions, ceilings, wooden frames etc. • Remove roof sheeting • Lift off trusses • Break brick walls • Remove all foundations • Load & haul all inert concrete rubble to designated void area & cover with waste rock to 2 m above surrounding ground level	• Determined during previous closure plan & based on design or as-built drawings & BOQ's • Site visited by demolition estimator & spot checks • Quantities re-calculated to confirm • Additional structures estimated based on typical quantities per structures after site inspection • Quantity of concrete rubble to haul to pit increased with swell factor of 70%	• Site visit by demolition estimator • Updated market related rates from supplier as adjusted for remoteness of site • P&G's not included in unit rates, but indicated separately • Rates for concrete demolition includes breaking, stockpiling, loading & hauling to primary crusher void • Cover of rubble includes load from emergency stockpile (coarse residue)dump, haul @ 1 km & spreading
Contaminated Material (hydrocarbons)	Assume that hydrocarbon contaminated soil can be rehabilitated in situ & that depth is not more than 1 m • Rip contaminated soil area across at max depth of 1m with spacing 1 m • Wet material to required moisture content • Apply bio-remediation agent • Weekly rip the area to aerate & wet to maintain moisture levels • Continue for required duration based on analysis • Cover the area with 200 mm growth medium & vegetate	• Area estimated from plans at possible contaminated areas & volume determined by assuming depth of 1m • Quantities & degree of contamination to be confirmed	• Rate calculated for assumed ripping depth of 1m • Allow for 9 weeks of treatment • Rate includes dozer for ripping at about 2 km/h & water truck • Covering of area not included in base rate • Cover of area includes load from stockpile, haul @ 1 km & spreading
Roads & Disturbed Footprints	HAUL ROADS Assume haul roads with "Dust-A-Side" sealant can be rehabilitated in situ • Rip to 500 mm depth & 1m spacing if underlying rock formations allow • Cover with 200 mm growth medium by dozing safety berms on sides inwards • Vegetate OTHER ROADS & COMPACTED AREAS • Rip to 300 mm depth & 1m spacing • Cover with 200 mm growth medium from nearest borrow pit	• Road lengths scaled from DTM and drawings provided by client	• Rate for ripping haul road include cost for D10 dozer ripping at 2 km/h • Cover of haul roads includes D6 dozer for spreading road side berms inwards over road surface • Rate for ripping other roads & include cost for D10 dozer ripping at 3 km/h • Cover for disturbed footprints include load from stockpile, haul from nearest stockpile & spreading

Activity	Closure Criteria	Quantities	Rates
	• Vegetate		
EARTHWORKS	• Assume external contractor will be required to implement works	• Production of equipment teams determined from site & material conditions, experience from similar operations & guidance from suppliers	• Plant hire rates obtained from suppliers – include all costs except ground engagement tools (GET) & tyres • Wet rates calculated based on fuel price of R15.50/l • Allow for mark-up on hire rates for profit & replacement of GET & tyres • Hourly rates used in conjunction with estimated production to determine volume unit rates • Calculated unit rates compared with rates requested from local contractor • Calculated unit rates compared with database of rates from other closure projects
WASTE ROCK DUMP (WRD)	WRD will be rehabilitated to support end land use of grazing		
Reshape steep slopes	• Reshape dump slopes to 18° in balanced cut & fill operation where slopes lengths will be about 45 m • Reshape all other uneven areas & heaps to a minimum to blend in with surrounding areas and drainage patterns	• DTM developed of all dumps from data provided by client • Reshaping modelled from DTM & cut & fill volumes calculated for final closure liability	• Reshape rate for D10 dozer at maximum average dozing distance of 60 m for WRD slopes • Dozer production adjusted with factors to account for dozer operator ability, bank or stockpile source, slot or side by side dozing, dust that can affect visibility, job efficiency, material density, dozing gradient & swell factor
Cover reshaped areas	• Import suitable growth medium from nearest stockpile • Spread at an average depth of 200 mm on slopes of WRD and 100mm on top areas of WRD • Rip slopes on contour to mix soil cover with underlying material, increase surface roughness and increase infiltration	• Area to be covered scaled from DTM • Volume calculated based on average cover depth specified • No allowance for swell or compaction factor • No allowance for allowable deviation from average specified depth	• Cost for load & haul team includes loading (differentiate between stockpile loading & borrow pit excavation), hauling at different distances, maintenance of haul roads, dumping & spreading of material • Compaction not included or indicated separately where applicable • Load & haul teams optimised for production
Construct water control structures	• Construct structures as far as possible with dozers or single machine actions, otherwise load & haul material	• Layout & number of structures modelled based on expected post rehabilitation contour plan	• Rate for D6 dozer at maximum average dozing distance of 30 m • Dozer production adjusted with factors to account for dozer operator ability, bank or

Activity	Closure Criteria	Quantities	Rates
	• Retain existing benches as far as possible to contain and evaporate runoff from slopes • Contain all runoff on top area and benches with crest berms and paddocks walls on selected areas to spread runoff • Lower slopes will be free draining to receiving environment		stockpile source, slot or side by side dozing, dust that can affect visibility, job efficiency, material density, dozing gradient & swell factor
COARSE RESIDUE DEPOSIT (CRD)	CRD will be rehabilitated to support end land use of grazing		
Reshape steep slopes	• Reshape dump slopes to 16° in balanced cut & fill operation where slopes lengths will be about 145 m • Reshape all other uneven areas & heaps to a minimum to blend in with surrounding areas and drainage patterns	• DTM developed of all dumps from data provided by client • Reshaping modelled from DTM & cut & fill volumes calculated for final closure liability	• Reshape rate for D10 dozer at maximum average dozing distance of 60 m for WRD slopes & 100 m for CRD slopes • Dozer production adjusted with factors to account for dozer operator ability, bank or stockpile source, slot or side by side dozing, dust that can affect visibility, job efficiency, material density, dozing gradient & swell factor
Cover reshaped areas	• Import coarse basalt waste rock and place as 300 mm armour layer; load material selectively from stockpile to obtain suitable grading • Import suitable growth medium from nearest stockpile • Spread at an average depth of 200 mm on slopes and top area • Rip slopes on contour to mix coarse basalt and soil cover with underlying material, increase surface roughness and increase infiltration	• Area to be covered scaled from DTM • Volume calculated based on average cover depth specified • No allowance for swell or compaction factor • No allowance for allowable deviation from average specified depth	• Cost for load & haul team includes loading (differentiate between stockpile loading & borrow pit excavation), hauling at different distances, maintenance of haul roads, dumping & spreading of material • Compaction not included or indicated separately where applicable • Load & haul teams optimised for production
Construct water control structures	• Construct structures as far as possible with dozers or single machine actions, otherwise load & haul material • Contain all runoff on top area with crest berms and paddocks walls to spread runoff • Slopes will be free draining to receiving environment • Construct toe paddocks on Northern Pan side to prevent sediment from slope during establishment phase impacting on pan	• Layout & number of structures modelled based on expected post rehabilitation contour plan	• Rate for D6 dozer at maximum average dozing distance of 30 m • Dozer production adjusted with factors to account for dozer operator ability, bank or stockpile source, slot or side by side dozing, dust that can affect visibility, job efficiency, material density, dozing gradient & swell factor

Activity	Closure Criteria	Quantities	Rates
FINE RESIDUE DEPOSIT (FRD)	FRD will be restricted area as for the Open Pit		
Reshape steep slopes	• Construct stability buttress on north-eastern side of FRD 1B; construct larger than required for stability to facilitate reshaping of embankment to retain a minimum top width; obtain material for buttress from excess cut on FRD 2 north-eastern embankment • Reshape longer dump slopes (FRD 1B and FRD 2) to 16° in balanced cut & fill operation where slopes lengths will be about 75 m • Reshape shorter slopes (FRD 1A) to 18° single slope • Reshape all other uneven areas & heaps to a minimum to blend in with surrounding areas and drainage patterns • Reshape inside slopes to 18° single slope, except where lower portion of slopes may be unstable due to saturation from standing water on facility	• DTM developed of all dumps from data provided by client • Reshaping modelled from DTM & cut & fill volumes calculated for final closure liability	• Reshape rate for D10 dozer at maximum average dozing distance of 70 m for FRD slopes • Dozer production adjusted with factors to account for dozer operator ability, bank or stockpile source, slot or side by side dozing, dust that can affect visibility, job efficiency, material density, dozing gradient & swell factor
Cover reshaped areas	LONGER SLOPES • Import coarse basalt waste rock and place as 300 mm armour layer; load material selectively from stockpile to obtain suitable grading • Import suitable growth medium from nearest stockpile • Spread at an average depth of 200 mm on slopes and top area • Rip slopes on contour to mix coarse basalt and soil cover with underlying material, increase surface roughness and increase infiltration SHORTER SLOPES • Cover with 200 mm suitable growth medium from nearest soil stockpile • Rip slopes on contour to mix soil cover with underlying material, increase surface roughness and increase infiltration	• Area to be covered scaled from DTM • Volume calculated based on average cover depth specified • No allowance for swell or compaction factor • No allowance for allowable deviation from average specified depth	• Cost for load & haul team includes loading (differentiate between stockpile loading & borrow pit excavation), hauling at different distances, maintenance of haul roads, dumping & spreading of material • Compaction not included or indicated separately where applicable • Load & haul teams optimised for production
Construct water control structures	• Construct structures as far as possible with dozers or single machine actions, otherwise load & haul material	• Layout & number of structures modelled based on expected post rehabilitation contour plan	• Rate for D6 dozer at maximum average dozing distance of 30 m

Activity	Closure Criteria	Quantities	Rates
	• Contain all runoff in the existing compartments on top of the facility • FRD 1A will drain into FRD 1B that will contain all runoff to prevent spilling more than once in 100 years; construct an emergency spillway from FRD 1B to FRD 2 to mitigate risk in case of extreme flood events • FRD 2 will have no emergency spillway, but has excessive capacity		• Dozer production adjusted with factors to account for dozer operator ability, bank or stockpile source, slot or side by side dozing, dust that can affect visibility, job efficiency, material density, dozing gradient & swell factor
OPEN PIT	Open pit will have limited land use & focus is to prevent access to address safety risk, i.e. restricted land use		
Security fence outside ZOR **Trench and enviroberm outside security fence on western side of pit** **WRD form barrier on eastern side of pit**	• No need to reshape top bench, because assume it does not contribute to reduce safety risk • Cut material for trench and use in one action as fill to construct enviroberm • Erect high-grade security fence • Keep pit perimeter as dry as possible by vegetating disturbed areas between ZOR and pit perimeter, planting deep rooted trees and fill / reshape all areas where runoff can pond to be free draining	• Trench and enviroberm quantity based on 5 m depth/height, bottom/top width = 5 m, side slopes 1:5	• Rate for trench and enviroberm based on balanced cut and fill with D10 bulldozer
ESTABLISH VEGETATION	Assume slope areas cannot be done mechanically due to safety policies & considerations		
Amelioration	• Spread organic material • Spread buffer agents where needed (e.g. gypsum) • Spread inorganic fertiliser • Cultivate / till slope areas by hand to a minimum depth of 5 mm • Cultivate / till flat areas mechanically to a minimum depth of 100 mm, unless restricted by coarse cover material	• The following application rates were assumed – to be confirmed with soil analysis of final growth medium: o Organic material (compost) = 10 t/ha o 1:0:1 = 300 kg/ha o LAN = 150 kg/ha	• Compost supply rate based on matured kraal manure delivered at distance of 50 km • Fertiliser supply rate from local supplier at transport distance of 50 km • Spreading of ameliorants by hand based on work rate of 500 kg/ha/person • Cultivation by hand based on work rate of 250 m^2/day/person
Vegetation	• Spread specified grass seed mixture by hand • Rake the area to cover the seeds with a thin layer of soil	• The following species mix were assumed – to be confirmed with availability: o *Cencrus ciliaris (Malopo)* o *Digitaria eriantha* o *Heteropogon contortus* o *Enneapogon cenchroides*	• Application rate = 25 kg/ha • Quote from local supplier for mixture as indicated

Activity	Closure Criteria	Quantities	Rates
		o *Cynodon dactylon* o *Antephora pubescens* o *Schmidtia kalhariensis* o *Stipagrostis uniplumis* o *Eragrostis tef* o *Urochloa panicoides*	
Maintenance - Amelioration	• Spread fertiliser after grass establishment to account for possible high leaching properties of growth medium • No cultivation required	• Assume the following is required for 2 years after establishment: o LAN = 150 kg/ha per application	• Fertiliser supply rate from local supplier at transport distance of 50 km • Spreading of ameliorants by hand based on work rate of 500 kg/ha/person
Maintenance - Vegetation	• Large bare areas with no growth – follow the same approach as for initial establishment • Smaller areas with limited species diversity – spread species mix & rake by hand	• Assume 5% of area will required re-vegetation	• Similar to initial establishment
FENCING			
Game Proof Fence **Stock Fence**	• Assume game proof fence is required around mining right to manage area as conservation area • Assume stock fence is required around rehabilitated WRD's to protect newly rehabilitated areas	• Mining right perimeter • Scale off distance around each WRD	• Estimated rate based on average industry rate
WEED & INVADER CONTROL			
General weed control	• Spray weeds with specified herbicide • Spray yearly • Rucksack application	• Assume typical infestation will allow work rate of 5 ha/day	• Rate from contractor
CONTINGENCIES & P&G'S			
Contingencies	Based on level of detail with which quantities could be calculated and therefore the anticipated variation in quantities was reduced	Quantities of physical infrastructure (e.g. steel, sheeting, concrete, bricks) were measured from on-site measurements, drawings and available quantities; Quantities of physical infrastructure were itemised and not taken as estimates per footprint area; Quantities of earthworks were based on recent surveys and modelling of rehabilitation works; footprints of disturbed areas were scaled off more accurately	5%

Activity	Closure Criteria	Quantities	Rates
P&G's	• Based on calculated cost of typical project (i.e. if CRD will be rehabilitated by external contractor over 12 month period) and include high costs associated with on-boarding of contractors, cost for mine compliant equipment, establishment of large fleets of equipment, health & safety requirements etc.	• Variable based on the implementation model, e.g. can be reduced if all earthworks are handled as one project, but can also increase if work is implemented fragmented	• 25% for all large civil construction works; • 0% on specialist or consultancy works that do not attract P&G cost

Final or detail designs could not be done as part of this project. This implies that certain assumptions were made to plan and design for the closure liability estimate. These assumptions or knowledge gaps will be addressed over time by the proposed action plan, but those that have an influence on rehabilitation planning and costing and should be addressed to develop the closure plan to the next level can be summarised as follows:

- Do detailed designs for storm water management;
- Do detailed planning and designs for the implementation plan and schedule to improve the liability forecast, but also to develop a more structured implementation plan; this is dependent on the strategy to use internal resources or external contractors.

12.2 Social Closure Liability

In line with the commitments included in the Social and Labour Plan, Voorspoed Mine has, and will provide financially for the following programmes:

- Human Resources Development (HRD) Programme;
- Mine Community Development Programme; and
- Process to manage downscaling and retrenchment.

Although socio-economic baselines and impacts are addressed by this closure plan, costs associated with the implementation of proposed mitigation measures are excluded from the liability estimate presented in Figure 37. Social Closure costs are calculated and provisioned separately by Voorspoed Mine.

13 REFERENCES

Anglo American. 2013. Mine Closure Performance Standard (and associated Mine Closure Toolbox).

Aquatico Scientific (Aquatico). 2014. De Beers Consolidated Mines Ltd – Voorspoed Mine annual water quality assessment, January – December 2014.

Bucandi Environmental Solutions (Bucandi). 2013. A determination of floristic biodiversity at De Beers Voorspoed Mine, Free State, South Africa.

De Beers Consolidated Mines Proprietary Limited (DBCM). 2017. Voorspoed Mine, Social and Labour Plan (2017-2021), Version 03

De Beers Voorspoed Mine. 2017. De Beers Voorspoed – From Start Rev 2.xlsx

Environmental Resources Management (ERM). 2019. **Error! Use the Home tab to apply DocTitle to the text that you want to appear here.**. **Error! Use the Home tab to apply DocSubtitle to the text that you want to appear here.**. **Error! Use the Home tab to apply DocDate to the text that you want to appear here.**.

Environmental Resources Management (ERM). 2017. Social impact assessment of the closure of the Voorspoed Mine.

Exigo Sustainability. 2016a. An alien invasive management plan for the De Beers Voorspoed Mine, Free State Province.

Exigo Sustainability. 2016b. A wetland [2 pans] delineation, management and rehabilitation plan for the De Beers Voorspoed Mine, Free State Province.

Exigo Sustainability. 2016c. A wetland delineation, management and rehabilitation plan for the De Beers Voorspoed Mine, Free State Province.

Free State Department of Tourism, Environmental and Economic Affairs (DTEEA). 2008. Free State Environment Outlook: A report on the state of the environment.

Golder Associates Africa (Pty) Ltd. February 2019**.** Technical Evaluation of the Risks, Impacts and Management Requirements into Pit Backfilling versus Current Mine Plan (Pit Lake), Report 1792363-318923-1_Rev1.

Golder Associates (Golder). 2017. De Beers Consolidated Mines (Pty) Ltd – Voorspoed Mine: Summary of Surface and Groundwater Study for Mine Closure. Report number 1663605-31647-5.

Jacobs, E.O., Boshomane, M.A.W. and D.G. Paterson. 2004. ARC-Institute for Soil, Climate and Water. Soil Survey for Voorspoed Diamond Mine, near Kroonstad. Report Number GW/A/2004/65.

Jones and Wagener Consulting Civil Engineers (Jones & Wagener). 2012. Water balance investigation report. Report No JW044/12/C746-Rev B.

Lockwood, G and I. Ginsberg. 2004**.** Delta Environmental Consultants. An Ecological Assessment of the Farms Voorspoed 401, Voorspoed 2480, Geldenhuys 1477 and Morgenster 772.

Malherbe, F. 2003. Noise Study for the Voorspoed Diamond Mine. Report No 04/9/2.

Metago Environmental Engineers (Metago). 2005a. Environmental Management Programme Report for Voorspoed Diamond Mine.

Metago Environmental Engineers (Metago). 2005b. An assessment of the pollution potential from mine waste residues for Voorspoed Diamond Mine. Project No 181-010.

Mucina & Rutherford. 2006 The Vegetation of South Africa, Lesotho and Swaziland.

Neka Sustainability Solutions (Neka). 2017. Proposed end land use plan for Voorspoed Diamond Mine.

Newtown Landscape Architects (Newtown). 2004. Voorspoed Diamond Mine near Kroonstad, Free State: Visual Assessment.

North West University (NWU). 2014. Vegetation surveys of selected rehabilitated sites at Voorspoed Mine.

Omni eko. 2017. Vegetation survey of rehabilitated sites at Voorspoed Mine.

Pistorius, J. 2004**.** A Heritage Impact Assessment (HIA) Study for an EMP for the Voorspoed Diamond Mine near Kroonstad in the Free State Province of South Africa.

Redco. 2014. Draft Voorspoed Mine Improved preliminary closure plan. August 2014.

Redco. 2017. Voorspoed Mine rehabilitation plan – 2017.

Shangoni Management Services (Shangoni). 2010. De Beers Consolidated Mine: Voorspoed Mine Amended Environmental Management Programme.

Shangoni Management Services (Shangoni). 2011. De Beers Consolidated Mines, Voorspoed Mine Draft Closure Plan.

South African National Biodiversity Institute (SANBI). 2007. National freshwater ecosystem priority areas (NFEPA) project.

Southern Africa GeoConsultants (SAGC). 2004. Geohydrological specialist investigation at the De Beers Voorspoed Diamond Mine. Report No G/R/04/10/12.

Strategic Environmental Focus. 2004a. Endorheic pan assessment of the farm Voorspoed 401, Free State.

Strategic Environmental Focus. 2004b. Wetland assessment of the farm Voorspoed 401, Free State.

Voorspoed Diamond Mine (Voorspoed). 2012. Integrated Water and Waste Management Plan for Voorspoed Diamond Mine Draft.

ANNEXURE A Rehabilitation Plan

ANNEXURE B Drawings & Plans Illustrating Rehabilitation Proposals & Planning

(Attached)

Drawing register:

DRAWING NO	DESCRIPTION
DB037_1	General Arrangement: FRD Facility
DB037_2	Details & Sections: FRD Facility
DB037_3	Set of Sections: FRD Facility
DB037_4	General Arrangement: CRD Facility
DB037_5	Details & Sections: CRD Facility
DB037_6	Set of Sections: CRD Facility
DB037_7	General Arrangement: WRD
DB037_9	Details & Sections: SWD and RWD
DB037_10	Details & Sections: Enviro Berm & Crusher Void

ANNEXURE C Drawings & Plans for Implementation Plan

(Attached)

Drawing Register:

DRAWING NO	DESCRIPTION
DB037_01C	Implementation plan for FRD Facility
DB037_04C	Implementation plan for CRD Facility
DB037_07C	Implementation plan for WRD Facility

ANNEXURE D Risk Assessment

ANNEXURE E Closure Liability Estimate

ANNEXURE F Reference Drawing

(Attached)

Drawing Register:

DRAWING NO	DESCRIPTION
DB037_8A	General arrangement: Site overview
DB037_8B	Reference drawing: Plant, Buildings & Structures (1 of 2)
DB037_8C	Reference drawing: Plant, Buildings & Structures (2 of 2)
DB037_8D	Reference drawing: CRD & FRD Areas
DB037_8E	Reference drawing: WRD Area

APPENDIX D

Voorspoed Mine Final Rehabilitation Plan, Redco and Uvuna Sustainability, 2019

DE BEERS GROUP

VOORSPOED MINE

REHABILITATION PLAN 2019

(Annexure A to Final Closure Plan)

August 2019

redco

Uvuna Sustainability

Client:	DeBeers Group – Voorspoed Mine
Project number:	DB037
Project reference:	4100764961
Contact Person:	Mr Hans Kgasago Manager: Rehabilitation DeBeers Group of Companies Voorspoed Mine *Office:* +27 56 216 8605 *Mobile:* +27 72 093 0126 *Email:* Hans.Kgasago@debeersgroup.com
Contract:	**UPDATED FINAL CLOSURE PLAN 2019**
Service Provider:	Rehabilitation Design & Construction Services (Pty) Ltd t/a Redco 3 Fabriek Street PO Box 19214 Parys Noordbrug 9585 2522 Office: +27 56 811 5335 Fax: +27 86 768 3221 Email: dp@redcoservices.co.za VAT no: 4370210595
Project Team:	*Project Team & Specialists:* DP van der Merwe Pr.Eng. (Redco) Antoinette Scheepers (Redco) Ralton Maree (Uvuna Sustainability)
REVISION: *Date Issued:*	Rev 1: Draft for Review 2 August 2019

EXECUTIVE SUMMARY

This Rehabilitation Plan supports the Updated Final Closure Plan (Redco / Uvuna Sustainability, June 2019) and updated closure liability estimate for 2019. The rehabilitation plan describes the rehabilitation proposals to rehabilitate the current footprint of Voorspoed Mine to a sustainable state and to align with the predetermined end land use.

Closure Vision

To close the mine in line with the relevant legal requirements and do this in such a way that the mining area can be utilised in a sustainable manner after closure has been achieved.

End Land Use

The end land use for Voorspoed Mine is to reinstate as much as possible of the rehabilitated footprint area back to agricultural land, i.e. grazing. The aim is to achieve a sustainable land use, comply with the closure vision and match the rehabilitated footprint with the surrounding area as far as is reasonably practical. Arable land within the property will be retained as croplands while it is proposed that the grazing potential over the larger portion of the site should be reinstated. However, controlled grazing is proposed for the more sensitive biodiversity rich areas. Areas such as the open pit and top of the FRD facility will be regarded as restricted areas due to the limited land use. Measures will be put in place to prevent access to these facilities as far as possible.

Rehabilitation Actions

Rehabilitation actions for all facilities and footprints on the Voorspoed mining area was designed with the land capability and end land use in mind. The rehabilitation actions for this site are outlined below:

- Plant, buildings and other infrastructure
  The objective for the dismantling and demolition of physical infrastructure is to ensure that a clear footprint area will remain. Once rehabilitation of the disturbed footprint areas is complete, these areas should return to an area with grazing potential. Handling of main aspects during rehabilitation is discussed within this report, e.g. Steel, conveyors, pipelines, power lines, fencing, walkways & roads.
- Pans and wetlands
  Minimal work within and around the pans and wetland areas will be required to reinstate its natural state. Controlled grazing is proposed for these areas due to its sensitive biodiversity. Reinstate the natural drainage patterns and divert clean runoff from rehabilitated areas towards the pans and wetland as far as possible. Reintroduce wetland grass species to support this sensitive area and install a stock proof fence to control animal and vehicle access.
- Mine residue facilities
  - WRD
    Reshape slopes to a single 18° slope by means of a balanced cut to fill action. Cover the reshaped slopes with 200 mm and the top or level areas with 100 mm suitable growth medium. Construct water control structures and establish indigenous grass species suitable to improve the grazing potential of the area. Supply and install stock proof fencing to control grazing and protect rehabilitation works.
  - CRD
    Reshape slopes to a single 16° slope by means of a balanced cut to fill action. Import and spread 300 mm coarse basalt material as armour layer on the reshaped slopes only. Import

and spread 200 mm suitable growth medium on the reshaped slopes and top area. Rip the covered areas on contour to a depth of 500 mm to mix the cover materials with each other and form a good bond with the underlying material. Ameliorate the growth medium and establish indigenous vegetation. Retain runoff on top of the facility by constructing crest walls and sloping the top area inwards. Fence off the area to control grazing to the specified carrying capacity and for the specified period only.

- FRD

  Reshape the south-western slope of FRD1A and FRD2 to a single 18° slope. Construct a buttress on the north-eastern slope of FRD1B for stability with material that is cut from the top of the north-eastern embankment of FRD2. Reshape the buttress at FRD1B and remaining embankment of FRD2 to a single 16° slope by means of a balanced cut to fill action. Import and spread 300 mm coarse basalt material as armour layer on the reshaped slopes only. Import and spread 200 mm suitable growth medium on the reshaped slopes. Rip the covered areas on contour to a depth of 500 mm to mix the cover materials with each other and form a good bond with the underlying material. Contain all runoff on top of the FRD facility so that it does not spill more than once in 100 years. Construct emergency spillways from FRD1B to FRD2 and from FRD2 to the open pit in case of extreme flood events.

- Open pit area

  Construct a high-grade security fence, storm water trench and an enviro berm outside the ZOR. The open pit void will not be backfilled, but measures will be put in place to restrict access to the pit as far as possible.

- Topsoil stockpiles

  Once topsoil stockpiles are used on other facilities as growth medium the remaining footprint area should be rehabilitated by shaping the area to be free draining, rip to alleviate compaction and then establish vegetation. The material balance indicate that there is a surplus of material on site, therefore some stockpiles will remain after closure. Remaining stockpiles need to be reshaped and vegetated.

<u>Implementation</u>

Implementation of the rehabilitation works are based on bulk volumes and will need to be updated during the detail design phase. It is assumed that the required resources, in the form of contractors, will be available for rehabilitation implementation. It is planned that the contractors could be finished with all rehabilitation works by 2022. To ensure implementation on the scheduled plan is realistic, detail planning should be conducted in conjunction with the client's planners.

Table of Contents

List of Figures

List of Tables

Definitions and Acronyms

DEFINITIONS

Latent environmental impact: Any environmental impact that may develop from natural events or disasters after a closure certificate has been issued;

Rehabilitation: The process of returning the environment in a given area to some degree of its former state, after some process has resulted in its damage;

Remediation: The process of removing pollutants or contaminants from the environment;

Residual environmental impact: The environmental impact remaining after physical closure and before a closure certificate has been issued;

Sensitive Area: A sensitive area or environment can be described as an area or environment where a unique ecosystem, habitat for plant and animal life, wetlands or conservation activity exists or where there is a high potential for eco-tourism;

Sustainable: Capable of being sustained; using a resource so that the resource is not depleted or permanently damaged (Source: http://www.merriam-webster.com/ dictionary/);

Sustainability: A state in which the demands placed on the environment can be met without compromising the environment and reducing its capacity to allow all people to live well now and in the future;

Sustainable environmental rehabilitation: The process to rehabilitate disturbed areas by the implementation of the necessary rehabilitation designs, plans and practises to an end state and land capability which will ensure the requirements of a sustainable environment is satisfied.

ACRONYMS

Acronym	Description	Units
AA MCT	Anglo American Mine Closure Toolbox	
BoQ	Bill of Quantities	
CCE	Critical Control Effectiveness (Anglo American)	
CRD	Coarse Residue Deposit	
dBA	Decibel (A-weighted)	
DTM	Digital Terrain Model	
EIA	Environmental Impact Assessment	
EMP	Environmental Management Programme	
FRD	Fine Residue Deposit	
HDPE	High Density Polyethylene	
ICPS	Integrated Closure Planning System (Anglo American)	
LED	Local Economic Development	
LOM	Life of Mine	
mamsl	Metres above mean sea level	m
mbgl	Metres below ground level	m
MSDS	Material Safety Data Sheet	
NEMA	National Environmental Management Act (No 107 of 1998)	
NEM:WA	National Environmental Management Waste Act (Act 59 of 2008)	
ORM	Operation Risk Management (Anglo American)	
PCD	Pollution Control Dam	
PM_{10}	Particulate Matter less than ten microns	
$PM_{2.5}$	Particulate Matter less than 2.5 microns	
PUE	Priority Unwanted Events (Anglo American)	
RCCA	Risk and Critical Control Analysis (Anglo American)	

Acronym	Description	Units
RWD	Return Water Dam to recycle water to process	
SEAT	Socio-Economic Assessment Toolbox (Anglo American)	
SEP	Stakeholder Engagement Plan	
SLP	Social & Labour Plan	
SOW	Scope of Work	
Sv_{50}	Flood volume, in this example for 1:50 year return period	m^3
SWCD	Storm Water Control Dam to handle dirty storm water	
SWMP	Storm Water Management Plan	
TDS	Total Dissolved Solids	
TIF	Tailings Impoundment Facility	
VAT	Value Added Tax	
WRAC	Workplace Risk Assessment and Control (Anglo American)	
WRD	Waste Rock Dump	
ZOR	Zone of Relaxation	

Detail of Person That Prepared the Plan:

Specialist	Contact Details	Professional Registration
DP van der Merwe Pr. Eng. Redco	OFFICE: +27 56 811 5335 MOBILE: +27 82 903 1428 EMAIL: dp@redcoservices.co.za	Engineering Council of South Africa (ECSA) No: 990132
EXPERIENCE		
Mr van der Merwe has over 25 year experience as engineer with over 21 years experience in the field of rehabilitation and closure planning and storm water management for mines and other disturbed areas. This includes the planning, design and implementation of storm water and rehabilitation works. His practical experience underpins his ability to do closure liability assessments. He is a registered professional engineer with the Engineering Council of South Africa and member of the South African Institute of Agricultural Engineers and the South African Institution of Civil Engineering. He has worked on projects in South Africa, Botswana, Angola, Zimbabwe, Zambia, Mozambique and Liberia. He has experience in the asbestos, iron, manganese, diamond, coal, chrome and platinum industries.		

1 INTRODUCTION

This rehabilitation plan presents details and proposals to address environmental risks, translate closure criteria into rehabilitation designs and implement works to reach the planned end land use after operations. It furthermore supports and provides information for the estimation of the closure liability as presented in the Updated Final Closure Plan 2019 (Redco / Uvuna Sustainability, June 2019). The closure liability as presented in the Final Closure Plan was reviewed and updated. An updated survey was obtained in September 2018 and used to update the Digital Terrain Model (DTM). Voorspoed Mine stopped operations and all deposition of mine residue facilities in December 2018 and started with final rehabilitation and closure. New volumes for all facilities were calculated taking into account the growth of all the facilities as well as areas where rehabilitation has been implemented to date. The design team, estimator from an independent demolition contractor and estimators from independent construction companies visited the site to determine site conditions, constraints and opportunities, also measuring certain aspects to cross check with desktop measurements. Market related earthmoving rates, demolition and dismantling rates were obtained and compared with other industry norms.

The main closure components at Voorspoed Mine consist of the Plant infrastructure, other onsite buildings and structures, the open pit, mine residue facilities such as the Waste Rock Dump (WRD), Coarse Residue Deposit (CRD) and Fine Residue Deposit (FRD) as well as water management facilities, e.g. dams, storm water trenches and pans. These closure components are indicated in Figure 1.

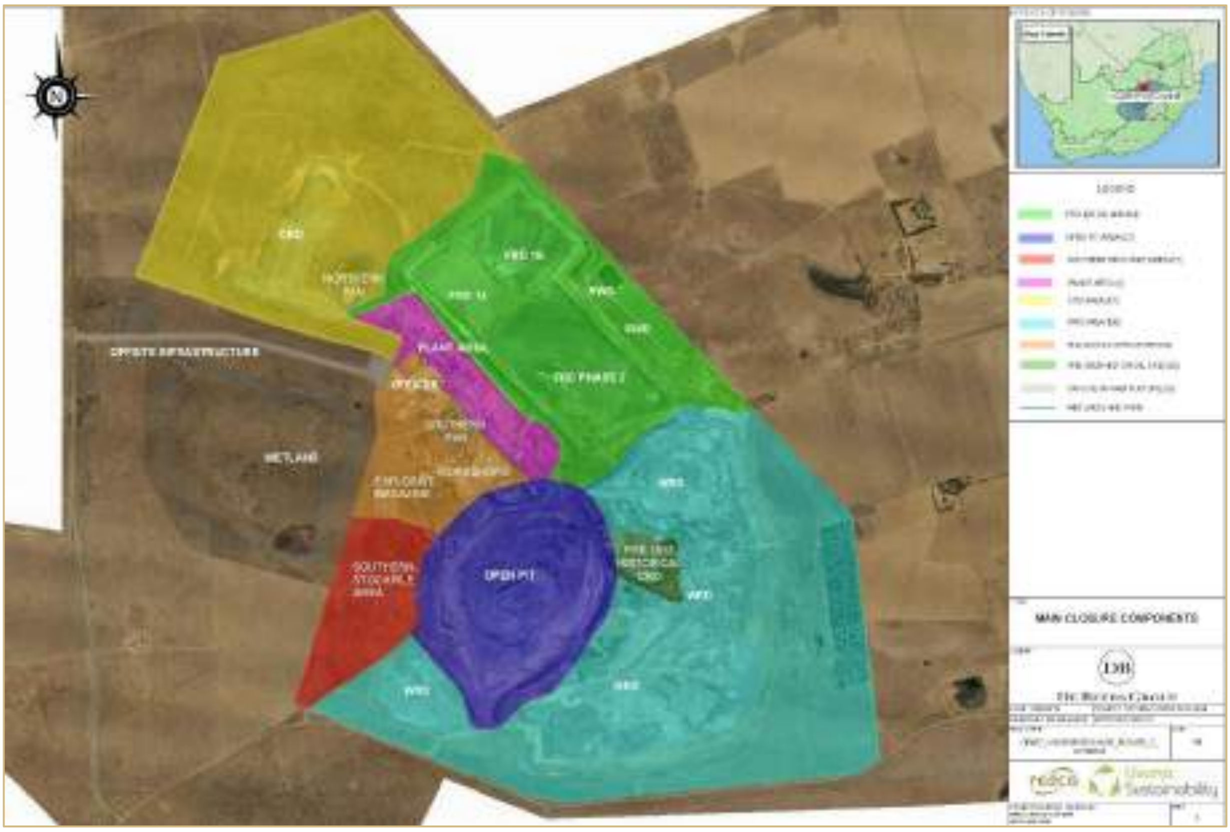


Figure 1: Main Closure Components at Voorspoed Mine

2 END LAND USE

The end land use for Voorspoed Mine is based on recent studies, previous commitments, land capability, the extent of disturbance and the need to address certain residual risks as described in the Final Closure Plan (Redco / Uvuna Sustainability, June 2019) and illustrated in Figure 2. The following end land uses are proposed:

- Retain the arable land use on existing croplands;
- Reinstate the grazing potential of the land over a large as possible portion of the site;
- Reinstate the grazing potential on the mining area (including the WRD, CRD and infrastructure footprints), but control the utilisation and stocking rate to protect the rehabilitated areas that will remain more sensitive than the surrounding natural or other grazing areas for some time;
- Allow grazing on the more sensitive biodiversity rich areas, but control the utilisation and stocking rate to protect the biodiversity; and
- Restrict any access to the open pit and top of the FRD; these areas are therefore classified as restricted land use.

The rehabilitation designs were developed to ensure that these end land uses can be achieved and sustained.

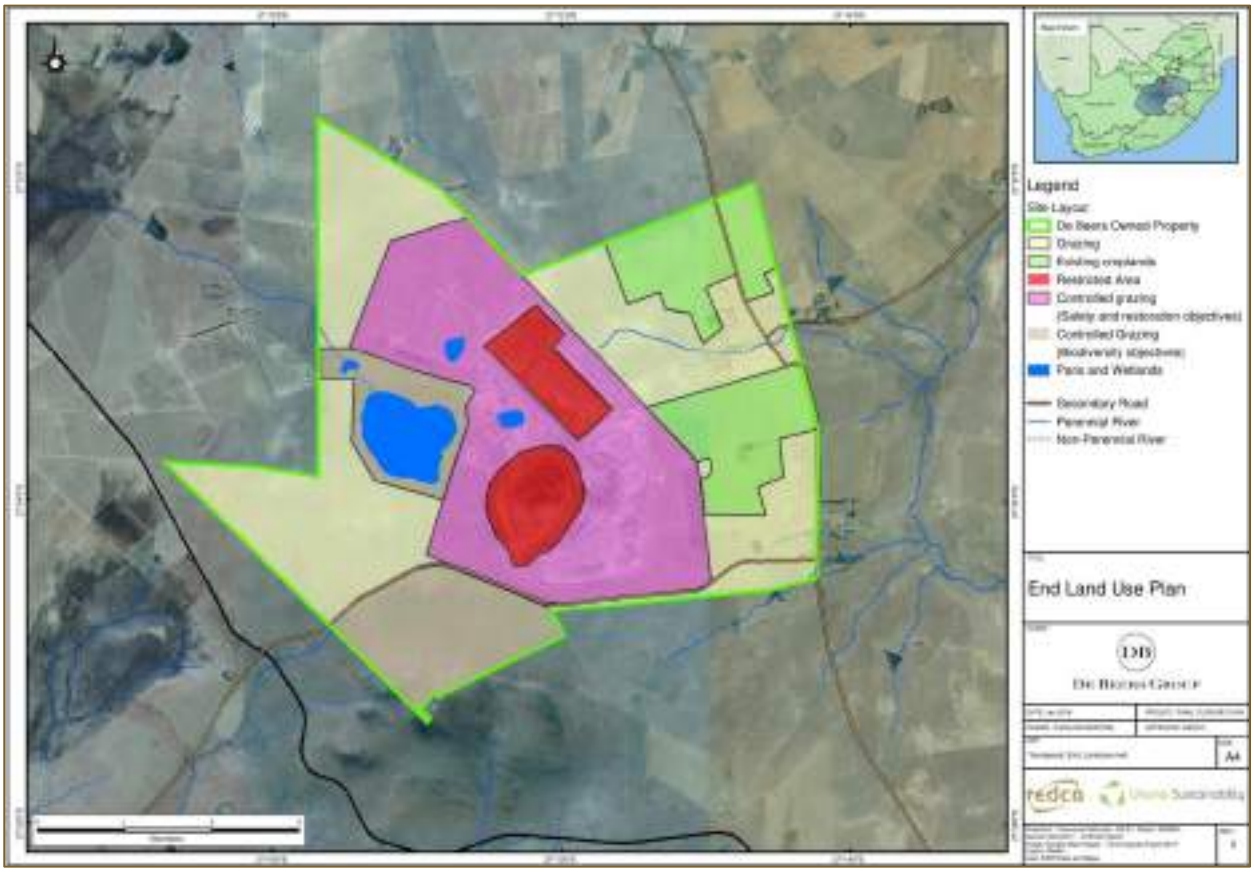


Figure 2: End Land Use for Voorspoed Mine

3 CLOSURE VISION AND OBJECTIVES

The closure vision for Voorspoed Mine is:

To close the mine in line with the relevant legal requirements and do this in such a way that the mining area can be utilised in a sustainable manner after closure has been achieved.

Voorspoed Mine's overarching closure objective is to ensure sustainability beyond mine closure and leaving a positive legacy. This is supported by the following specific objectives:

- Restore as much as possible of the mining area to a condition consistent with the pre-determined post closure land use objectives;
- Ensure that the area is left in a condition which poses an acceptable level of risk to public health and safety; and
- Reduce as far as is practicably possible the need for post closure intervention, either in the form of monitoring or on-going remedial work.

The Closure Objectives are based on the following Principles:

- Legal compliance;
- Continuous, inclusive (internal and external) stakeholder engagement;
- Structural and ecological stability of the landforms;
- Protection of the slopes against erosion;
- Pollution control (ground and surface water);
- Clean and dirty water separation;
- Concurrent rehabilitation;
- Mitigating the visual impact of the waste rock dump and residue disposal facilities;
- A post closure land use with no long term liabilities;
- Mitigate and, where appropriate, remediate adverse social impacts;
- Portable skills; and
- The Mine is closed efficiently, peacefully and cost effectively.

The rehabilitation designs were developed to support the closure vision and objectives.

4 CLOSURE CRITERIA

Closure criteria are the agreed tasks/measures involved in mitigating identified closure risks. This involves activities such as removal of infrastructure, erecting fencing, installing drainage structures, reshaping, top soiling, ripping, seeding and planting, maintenance and monitoring. The closure criteria, as well as success criteria are presented in Table 1 for the physical closure components and Table 2 for the bio-physical components.

Table 1: Voorspoed Mine Closure Criteria for Physical Components

PHYSICAL			
CLOSURE CRITERIA			SUCCESS CRITERIA
Decommissioning / Earthworks	Water Control	Amelioration / Vegetation / Fences	
ON-SITE INFRASTRUCTURE			
PLANT, WORKSHOPS, OFFICES, ROADS, POWER LINES, PIPELINES			
End Land Use / Goal: Grazing			
Demolition & dismantling: • Clear all infrastructure from site; • Dismantle all steel structures in a safe manner; • Remove all salvageable equipment and material to make available for selling; • Auction off all salvageable equipment and remove from site; • Transport steel to scrap metal dealer (allow 50km) for resale; • Demolish and remove all concrete and brick structures to a depth of 500mm below ground level; dispose all inert concrete and building rubble in primary crusher void; • Break and remove all walkways and paved areas and dispose with other inert building rubble in primary crusher void; • Remove all container and mobile buildings and transport off site (allow 50km) for resale; **Hydro carbon contaminated areas:** • In-situ bio-remediation: Apply bio-remediation agent, wet, aerate, mix until thresholds have been reached; **Earthworks:** • Shape the area to fill excavations and be free draining; • Rip all plant footprint areas to a depth of 500mm to alleviate compaction;	• Backfill low laying areas to make free draining; • Decommission existing trenches from plant area to SWCD / RWD • Make the area free draining and fit in with surrounding drainage patterns; • Remove all culvert structures from roads; • Construct water control berms / contour drains on covered area; final alignment of drains to be confirmed after earthworks	• Ameliorate soil based on soil analysis of final mixture of growth medium; • Seed the area with a mixture of local indigenous grass and tree seeds that are adapted to the area; • Apply follow-up fertiliser where specified; • Control weeds and invader plant species; • Fence the area to fit in with the rest of the camp system	• No infrastructure remains on site; • No safety hazards remain on site; • All artificial barriers removed; • Limited erosion – will not deteriorate to large dongas and unsafe area; • Water control structures remain functional and stable; • No sediment transport from the area; • Sediment does not reach Southern Pan; • Vegetation cover similar to natural comparable surrounding environment; • Effective soil cover ensure the agreed land capability; • Vegetation cover ensure the agreed grazing capacity; • No weed invasion to the extent that it will outcompete or overgrow the palatable grass species and reduce the grazing potential

• Rip all other building footprint areas to a depth of 300mm to alleviate compaction; • Rip roads outside the plant and buildings footprint to a depth of 500mm; • Cover all plant and related footprint areas with 300mm soil; • Cover all building and related footprint areas with 200mm soil; • Cover roads outside the plant and buildings footprint with 200mm soil			
WATER MANAGEMENT (SWCD / RWD)			
End Land Use / Goal: Grazing			
SWCD (Raw Water Dam): • Backfill the dam basin up to the lowest surrounding ground level with poor quality soil, waste rock material or tailings from the emergency stockpile; • Cut embankments to ground level and cover basin with available material; • Cover surrounding areas with 200mm soil; **RWD:** • Remove HDPE liner and dispose at registered waste site; • Backfill the dam basin up to the lowest surrounding ground level with poor quality soil, waste rock material or tailings from the emergency stockpile; • Cut embankments to ground level and cover basin with available material; • Cover surrounding areas with 200mm soil	• Shape the backfilled dam basin to drain freely to the north-eastern side	• Ameliorate soil based on soil analysis of final mixture of growth medium; • Seed the area with a mixture of local indigenous grass and tree seeds that are adapted to the area; • Apply follow-up fertiliser where specified; • Control weeds and invader plant species	• The PCD's are backfilled to ground level and cannot contain any water; • Vegetation cover similar to natural comparable surrounding environment; • Effective soil cover ensure the agreed land capability; • Vegetation cover ensure the agreed grazing capacity; • No weed invasion to the extent that it will outcompete or overgrow the palatable grass species and reduce the grazing potential
OFF-SITE INFRASTRUCTURE			
ROADS, POWER LINES, PIPELINES			
End Land Use / Goal: Grazing & fit in with surrounding land use			
Gravel access road up to security fence: • Remain for other users **Power line to Eskom substation:**	• Do not obstruct natural drainage patterns	• Ameliorate soil based on soil analysis of final mixture of growth medium;	• No infrastructure above ground remains on site; • No safety hazards remain on site; • All artificial barriers removed;

• Remain as part of Eskom responsibility **Main supply pipeline from Renoster River weir up to security fence:** • Remain as per agreement with landowners; • Break and remove all manholes and backfill to ground level **Pump station at Renoster River weir:** • Dismantle all steel structures in a safe manner and transport to mine area; • Remove all salvageable equipment and material to make available for selling and transport to mine; • Demolish and remove all concrete and brick structures to a depth of 500mm below ground level; dispose all inert concrete and building rubble in primary crusher void; • Shape the area to fill excavations and be free draining		• Seed the area with a mixture of local indigenous grass and tree seeds that are adapted to the area; • Apply follow-up fertiliser where specified; • Control weeds and invader plant species; • Fence the area in several separate camps to control grazing	• Limited erosion – will not deteriorate to large dongas and unsafe area; • Water control structures remain functional and stable; • No sediment transport from the area; • Vegetation cover similar to natural comparable surrounding environment; • Effective soil cover ensure the agreed land capability; • Vegetation cover ensure the agreed grazing capacity; • No weed invasion to the extent that it will outcompete or overgrow the palatable grass species and reduce the grazing potential
MINE RESIDUE DEPOSITS (MRD)			
WASTE ROCK DUMP (WRD)			
End Land Use / Goal: Grazing			
• Reshape steep slopes in balanced cut and fill operation to form single slope to reduce gradient and slope length: o Slope gradient = max 18°; o Slope length = ±45m; o Slope surface to be uniform and rather concave than convex; • Cover reshaped slopes with 200mm soil to form growth medium together with underlying material; • Cover reshaped top area with 100mm soil; • Rip top area to alleviate compaction and mix soil with underlying material	• Contain rainfall and runoff on rehabilitated facility, except for bottom slopes; • Reshape or fill low laying areas next to dump edge to drain away from edge; • Construct crest berm walls and paddocks (or low points) on top of facility; • Construct cross berm walls on existing bench between lifts 1 and 2; • Construct toe paddocks at seepage points to capture and evaporate seepage until seepage stops; decommission toe paddocks during maintenance period	• Ameliorate soil based on soil analysis of final mixture of growth medium; • Seed the area with a mixture of local indigenous grass and tree seeds that are adapted to the area; • Apply follow-up fertiliser where specified; • Control weeds and invader plant species; • Fence the area in several separate camps to control grazing	• Limited erosion – will not deteriorate to large dongas and unsafe area; • Sediment transport limited to toe of dump; • Capacity of benches remain sufficient; • Vegetation cover similar to natural comparable surrounding environment; • Effective soil cover ensure the agreed land capability; • Vegetation cover ensure the agreed grazing capacity; • Deep rooted tree species established on benches at least; • No weed invasion to the extent that it will outcompete or overgrow the

			palatable grass species and reduce the grazing potential
COARSE RESIDUE DEPOSIT (CRD)			
End Land Use / Goal: Controlled Grazing			
• Reshape steep slopes in balanced cut and fill operation to reduce gradient and form single slope: o Slope gradient = max 16°; o Slope length = ±145m; • Cover reshaped slopes with 300mm coarse basalt material; • Cover the 300mm basalt armour layer with 200mm soil; • Cover reshaped top area with 200mm soil to form growth medium together with underlying material; • Rip top area and slopes on contour to a depth of at least 500mm to alleviate compaction and mix soil and basalt material with underlying material	• The reshaped slopes will be free draining; • Contain all rainfall and runoff on the top of the rehabilitated facility; • Construct crest berm walls and paddocks on top of facility; • Reshape top of facility to drain inwards, i.e. away from edge; • Construct toe paddocks on eastern side towards the Northern Pan to prevent sediment transport into the pan; • Construct toe paddocks at seepage points to capture and evaporate seepage until seepage stops; decommission toe paddocks during maintenance period; • Decommission existing seepage trenches to SWCD / RWD – backfill and cover with surrounding material	• Ameliorate soil based on soil analysis of final mixture of growth medium; • Seed the area with a mixture of local indigenous grass and tree seeds that are adapted to the area; • Apply follow-up fertiliser where specified; • Control weeds and invader plant species; • Fence the area in several separate camps to control grazing	• Limited erosion – will not deteriorate to large dongas and unsafe area; • Sediment transport limited to toe of dump; • Sediment does not reach Northern Pan; • Vegetation cover similar to natural comparable surrounding environment; • Effective soil cover ensure the agreed land capability; • Vegetation cover ensure the agreed grazing capacity; • No weed invasion to the extent that it will outcompete or overgrow the palatable grass species and reduce the grazing potential; • Area fenced off and grazing controlled to agreed carrying capacity
FINE RESIDUE DEPOSIT (FRD)			
End Land Use / Goal: Controlled Grazing & retain minimum runoff on top area			
North-eastern Embankment: • Cut top of FRD 2 embankment off to specified level and use as buttress material at toe of embankment of FRD 1B to reduce cutting back into starter wall during reshaping; • Reshape steep outside slopes of FRD 1B & 2 in balanced cut and fill operation to reduce gradient and form single slope: o Slope gradient = max 16°; o Maximum slope length = ±75m; • Reshape inside slopes in balanced cut and fill operation to form single slope to reduce gradient (to 18°) and slope length (to ±45m);	• The reshaped slopes will be free draining; • Contain all runoff on the top of the facility (do not spill more than once in 100 years); o Construct waterway (unlined) in north-eastern corner of FRD 1A to spill into FRD 1B; o Contain all runoff from 1A and 1B in 1B; o Construct waterway in south-eastern corner of FRD 1B to spill into FRD 2 in case of extreme floods; o Construct waterway in south-western corner of FRD 2 to spill into the open pit in case of extreme floods;	**Slopes:** • Ameliorate soil based on soil analysis of final mixture of growth medium; • Seed the area with a mixture of local indigenous grass and tree seeds that are adapted to the area; • Apply follow-up fertiliser where specified; • Control weeds and invader plant species; • Fence the area in two separate camps to control grazing **Top Area:** • Spread fertiliser and seeds by hand on the top areas that can be safely accessed on foot •	**Slopes:** • Limited erosion – will not deteriorate to large dongas and unsafe area; • Vegetation cover similar to natural comparable surrounding environment; • Effective soil cover ensure the agreed land capability; • Vegetation cover ensure the agreed grazing capacity; • No weed invasion to the extent that it will outcompete or overgrow the palatable grass species and reduce the grazing potential; **Top Area:**

• Cover reshaped slopes with 200mm soil to form growth medium together with underlying material **South-western Embankment: Outer and inner slopes of FRD 1A & 2:** • Cut top of FRD 2 embankment off to specified level and doze material over outer slopes to reduce reshaped slope lengths; • Reshape inside and outside slopes in balanced cut and fill operation to form single slope to reduce gradient and slope length: o Slope gradient = 18°; o Slope length = ±45m; • Cover reshaped slopes with 200mm soil to form growth medium together with underlying material **All top areas:** • No earthworks due to safety risk (fine tailings remain wet for very long) **Specified portion of north-western slope of FRD 1B:** • Cover bottom portion of slope with soil, ameliorate and vegetate	o Stabilise waterways with gabions and reno mattresses; • Construct crest berm walls on outside of inspection road on top of embankments; • Construct toe paddocks at seepage points to capture and evaporate seepage until seepage stops; • Decommission existing seepage trenches to SWCD / RWD – backfill and cover with surrounding material		• All runoff is contained on the facility and does not spill more than once in 100 years; • Gabion waterway show no signs of undercutting, excessive sedimentation or subsidence; • Top area is fenced off with security fence
OPEN PIT			
End Land Use / Goal: Restricted Area			
• Construct 2m high waste rock barriers / berms at top of remaining access ramps; • Erect security fence 10m outside of indicated ZOR; • Construct trench and enviroberm in balanced cut and fill operation outside of security fence; o Berm top width / trench bottom width = 5m; o Height / Depth = 5m;	• Align trench and berm to divert clean storm water away from the pit towards the wetland area	**Area between enviroberm and pit perimeter:** • Rip compacted area; • Establish vegetation including 50 trees per ha. Assume only 50 % of the area require deep rooted trees **Enviroberm and trench:** • Ameliorate soil based on soil analysis of final mixture of growth medium;	• Access deterred with security fence around mine; • Access deterred with security fence around pit perimeter; • Trench and enviroberm functional and stable; • Vegetation criteria outside the security fence similar to other areas; • No weed invasion outside pit perimeter to the extent that it will outcompete or

o Side slopes = 1:5		• Seed the area with a mixture of local indigenous grass and tree seeds that are adapted to the area; • Apply follow-up fertiliser where specified; • Control weeds and invader plant species	overgrow the palatable grass species and reduce the grazing potential

Table 2: Voorspoed Mine Closure Criteria for Bio-Physical Components

BIO-PHYSICAL			
CLOSURE CRITERIA		SUCCESS CRITERIA	
Decommissioning / Earthworks	Water Control	Amelioration / Vegetation / Fences	
PANS & WETLANDS			
SOUTHERN PAN, WETLAND, NORTHERN PAN			
End Land Use / Goal: Controlled Grazing			
Southern Pan: • Construct compacted berm wall on existing walkway alignment to separate undisturbed western portion from disturbed and rehabilitated eastern portion; • Cover disturbed eastern portion with 500mm soil to prevent impact to the western portion **Wetland:** • No direct earthworks **Northern Pan:** • Construct a coarse filter berm wall of basalt between the rehabilitated plant footprint and the pan to prevent sediment from entering the pan area;	**Southern Pan:** • Route runoff from rehabilitated plant and buildings areas within the catchment to the undisturbed eastern portion; • Make a shallow channel from the southern pan to the wetland on the estimated full level **Wetland:** • Divert clean runoff from the southern WRD area to the catchment of the wetland to reinstate original catchment as far as possible • Construct a drift in the main access road to the mine to ensure hydraulic connection to the downstream pan system **Northern Pan:** • Route runoff from the northern portion of the rehabilitated plant area towards the northern pan	**Southern Pan:** • Remove alien tree and weed species mechanically with selective chemical stem treatment with approved herbicides; • Spread the seeds of available selected wetland grass species in the pan area **Wetland:** • Remove weed and invader plant species mechanically within the catchment of the wetland; • Spread the seeds of available selected wetland grass species in the pan area **Northern Pan:** • Spread the seeds of available selected wetland grass species in the pan area	• No sediment transport to pan areas; • Clean runoff volumes to pans are close to original condition; • Vegetation species composition reflects increased wetland species; • No weed invasion to the extent that it will outcompete or overgrow the palatable grass species and reduce the grazing potential; • Increase in wetland fauna and flora species (from monitoring surveys)

BIO-PHYSICAL			
CLOSURE CRITERIA		SUCCESS CRITERIA	
Decommissioning / Earthworks	Water Control	Amelioration / Vegetation / Fences	
• Construct toe paddocks at the toe of the reshaped eastern slope of the CRD to contain any possible seepage and sediment laden runoff until the area has stabilised			

5 REHABILITATION ACTIONS

This rehabilitation plan presents the actions proposed in order to mitigate risk, and achieve the End Land Use plan objectives, as documented in the Updated Final Closure Plan 2019 (Redco / Uvuna Sustainability, June 2019) report. The Rehabilitation actions presented below are based on the mine closure criteria that were developed during this Updated Final Closure Plan 2019, as presented above.

5.1 INFRASTRUCTURE

All infrastructure have reference numbers that are linked to the closure liability spreadsheets and are indicated on reference drawings as included in Appendix F of the Final Closure Plan (Redco / Uvuna Sustainability, June 2019) report. The closure liability assessment is discussed in further detail in the Final Closure Plan report.

5.1.1 Steel Structures

Dismantle all heavy steel structures in a safe manner for resale as salvageable material or disposal to scrap metal dealers. The following work plan will be followed:

- Establish the required equipment, inter alia mobile cranes, cutting equipment, grabbing and loading equipment, waste bins, trucks with enclosed trailer bins;
- Remove all salvageable equipment, inter alia pumps, electrical motors, substations, drives etc.;
- Drain hydraulic driven equipment and drives or seal to limit the risk of oil spillage during dismantling;
- Remove all waste materials that must be disposed on registered waste sites and place separate;
- It is usually not economical to de-sheet this type of structure and also introduces the hazard of working at heights; sheets come down with the structure and is balled with a grapple;
- Dismantle separate structure units and remove where it can be done safely;
- Cut / prepare steel structure footings (according to specifications to keep the structure safe before pulling over) and pull structure over;
- Cut steel structures to manageable sizes (larger than foundry size) for loading into trucks;
- Clean material from contaminants (e.g. oil) or most of the remaining mine residue to avoid transport of pollutants;
- Place different types of steel (according to salvage or waste value) separate on demarcated already disturbed area or load directly during dismantling where it can be done safely;
- Load and transport to nearest scrap metal dealer or invite scrap dealers to tender and collect the scrap steel from site; and
- Sell salvageable material from auction yard.

Dismantle light steel framed structures in the following manner:

- De-sheet the building and stockpile the sheets at the auction yard;
- Demolish any brick offices or dwarf walls;
- Cut / prepare steel structure footings (according to specifications to keep the structure safe before pulling over) and pull structure over;
- Cut steel structures to manageable sizes (larger than foundry size) for loading into trucks; and
- Break out any slabs and foundations.

5.1.2 Concrete Structures

Concrete structures typically include reinforced mass concrete foundations, plinths, piling, tip and tunnels, retaining walls and thick slabs at the plant and related structures, product stockpiles, workshop floors and other areas subjected to heavy vehicle traffic. Demolish all inert concrete and related building materials to be disposed on site in the specified areas:

- Break all reinforced concrete in manageable sizes (min <300 mm) to load and transport to the disposal area;
- Separate reinforcement from concrete as it become loose or cut steel where exposed;
- Cut reinforcement where it limits the breaking of mass concrete in manageable sizes;
- Break and remove all reinforced concrete structures (bases and footings) up to a depth of 500 mm below ground level;
- Break and remove all slabs, i.e. no concrete to remain below ground level; and
- Load and haul all inert and cleaned concrete and building rubble and dispose of into the primary crusher void.

Brick buildings will be demolished as follows:

- Soft strip, i.e. remove all fittings, partitions, ceilings etc.
- Loosen and remove all roof sheeting by hand and stockpile at auction yard, lift off roof trusses;
- Break out all brick walls between steel structure or break brick walls up to foundations;
- Break and remove all slabs and foundations, i.e. no concrete to remain below ground level;
- Break all reinforced concrete in manageable sizes (min 300 mm) to load with the available equipment; and
- Load and haul all inert and cleaned concrete and building rubble and dispose of into the primary crusher void.

Remove all paving bricks, kerbstones or other precast concrete items and handle with rest of concrete waste. These can be salvaged if in good condition or otherwise will be disposed into the primary crusher void.

The primary crusher void (see Figure 3) has a capacity of about 25,000m^3. The void must be filled to at least 2 m above the surrounding ground level in a dome shape to allow for future consolidation and subsidence depending on the final bulking factor of the crushed material. An additional of 30% was allowed for in the volume calculations and closure liability cost estimate due to the uncertainty of final material size. The volume of inert concrete and bricks amounts to ±10,574m^3 of material. The shortfall of material will be sourced from the emergency coarse tailings stockpile that must be removed from the current footprint. The inert concrete and bricks should be co-disposed with the coarse tailings material, allowing the tailings material to fill voids between concrete and bricks.

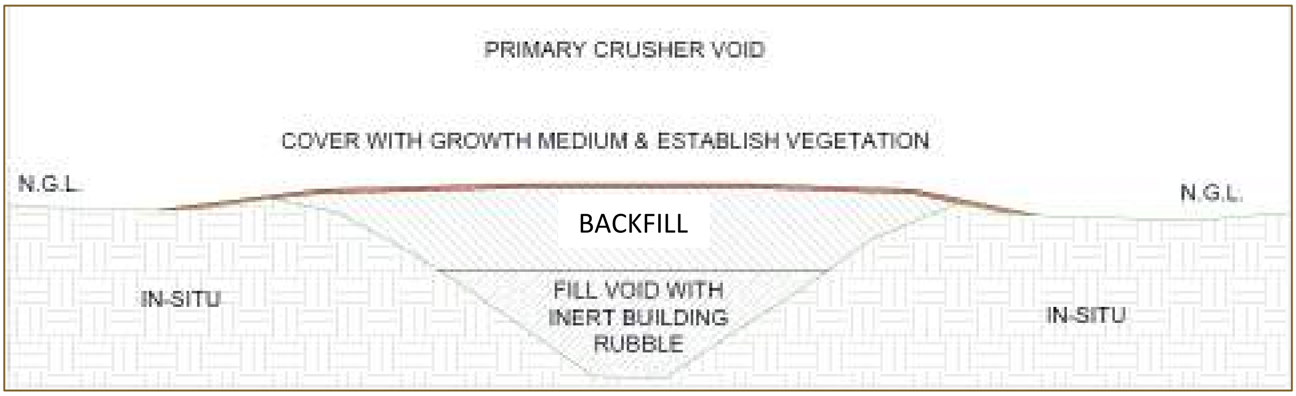


Figure 3: Typical section showing infilling of Primary Crusher Void

5.1.3 Conveyors

The rehabilitation of conveyors follow the same procedure as described for steel and reinforced concrete structures after the removal of conveyor belts. Cut conveyor belts into manageable lengths and stockpile on the auction yard or transport directly to a licensed waste disposal facility.

5.1.4 Pipelines

There are basically two types of pipelines on the terrain, viz. galvanised or treated steel and HDPE pipes.

- Cut steel pipes in standard lengths or manageable lengths and stockpile on auction yard or transport directly to scrap dealers with other steel waste;
- Cut HDPE pipes in manageable lengths and transport to licensed waste facility;
- Remove any concrete plinths in total and handle with other concrete demolition waste; and
- Rehabilitate the footprint of pipelines together with the disturbed footprint as described for other actions.

5.1.5 Off-site Water Supply Infrastructure

The off-site water supply infrastructure from the Rhenoster River weir includes a pump station and 400 mm steel pipeline of ±16.4 km to the SWCD on the mine. The weir was constructed before the mine commenced and the mine only did maintenance during the operations. An agreement with landowners states that the pipeline will be left in place for their use. It is uncertain how the transfer of water rights or establishment of an irrigation board or water users association will affect the post closure use of the pipeline. In order to allow some funds the closure liability is based on the following rehabilitation actions:

- Decommission the pump station, i.e. dismantle the steel gantry, remove the pumps and motors and transport to the mine to be included in the disposal of other steel waste;
- Demolish the pump house and transport the concrete and building rubble to the disposal site on the mine, i.e. the primary crusher void;
- Demolish the manholes to mitigate the risk of uncontrolled access and accidents into the structures;
- Ameliorate and vegetate the disturbed footprints.

The pipeline will therefore remain in place after closure of the mine.

5.1.6 Power Lines and Electrical Infrastructure

Dismantle cable racks as follows:

- Isolate from any power source;
- Dismantle cables from cable rack and cut into manageable lengths;
- Stockpile or remove with other salvageable material, together with cable racks;
- Remove any concrete plinths in total and handle with other concrete demolition waste; and
- Rehabilitate the footprint of pipelines together with the disturbed footprint as described for other actions.

Dismantle overhead power lines as follows:

- Isolate from any power source;
- Disconnect cables from poles or isolators with suitable equipment for working at heights and cut into manageable lengths;
- Stockpile or remove with other salvageable material;
- Cut all poles at ground level and remove to auction yard; and
- Rehabilitate the footprint of power lines together with the disturbed footprint as described for other actions.

5.1.7 Fencing

Fencing will be dismantled as follows:

- Cut all fencing poles up to ground level and cut fence into manageable lengths;
- Transport to licensed waste site together with other non-salvageable waste;
- Cut all palisade sheets from poles and cut poles up to ground level; and
- Stockpile or remove with other salvageable material.

The security fence around the mining area will remain to control access and address the risk of the remaining open pit.

5.1.8 Walkways

Walkways on the mine are either light concrete slabs or paving and will be demolished as described for concrete and brick buildings.

5.1.9 Contaminated Structures

Contaminated structures will mostly be where hydrocarbons were handled and spilled. Soil or earth may be contaminated with hydrocarbons before certain areas were paved. Experience has also shown that hydrocarbons accumulate beneath structures due to long-term seepage through cracks or joints in concrete structures. The soil around the workshops and oil separators were investigated during this study to determine the extent of possible pollution. A soil auger was used, but could only penetrate to about 300mm due to hard soil formations. Very limited hydrocarbon pollution levels were visible and an allowance for the closure cost was only done as contingency. Limited other contaminants and chemicals are present and will mostly be cleaning agents or paints. Implement the following general procedure:

- Drain or empty all sumps containing hydrocarbons into suitable containers;
- Wash all contaminated concrete and structures with high pressure washers after treatment with biological agents to break down oil; contain all runoff within the already contaminated footprint and collect in waste containers;
- Remove hydrocarbon waste containers from site and dispose at registered waste facility;
- Bio-remediate the hydrocarbon contaminated footprint, i.e. earth layer works:
    - Sample the contaminated material at different depths to determine the extent of pollution; analyse for total petroleum hydrocarbons as well as different C-H chain lengths;
    - Rip the contaminated area up to 1 m depth with a spacing of 500 mm to alleviate compaction and aerate the material;
    - Moisten the contaminated material, but do not saturate;
    - Treat the contaminated material with a biological bio-remediation agent;
    - Aerate the treated material weekly up to the depth of contamination and keep the material moist;
    - Allow for treatment up to nine weeks depending on results of regular testing;
- Reshape the disturbed footprints to fill shallow excavations, ensure that the area is free draining without concentration of runoff and to control the placement depth of the cover material; and
- Cover the footprints with 200 mm soil or material suitable to be ameliorated to serve as growth medium.

5.1.10 Hazardous Materials

Hazardous materials include fuel and lubricants, paints, solvents, cleaning agents etc. and will be handled as follows:

- All unused fuel and lubricants will be removed by supplier in sealed containers;
- All used hydrocarbons will be removed by approved service provider to licensed waste or recycling facility;
- All other hazardous material will be removed to licensed waste facility; and
- The footprint or containment areas will be cleaned and treated as already described under contaminated structures.

5.1.11 Infrastructure Area Footprints

The footprints of the plant and other infrastructure areas after removal of the steel and concrete components will be rehabilitated as follows:

- Reshape the area where needed only to ensure the required drainage pattern or make the area more even to control cover material depth;
- Construct water control berms or contour drains only where slopes lengths are too long; this can only be confirmed after final reshaping;

- Rip the footprints up to a depth of 300 mm at a spacing of 1 m in one direction; do cross ripping if the compaction is not alleviated or the surface is too uneven;
- Cover the area with a 200 mm growth medium layer; and
- Establish vegetation as specified.

The plant and other building area footprints and the general drainage pattern are depicted in Figure 4.

Figure 4: Plant and Buildings Area Footprints

5.2 ROADS

The rehabilitation method for the footprint of infrastructure areas as stated above is also applicable to the rehabilitation of compacted service and access roads. All culverts will be removed and the drainage line reinstated. Haul roads for large mining equipment will be rehabilitated as follows:

- Remove all culverts and other obstructions and reinstate drainage lines;
- Cut openings through the roads where it is build up and disturbed the natural surrounding drainage pattern;
- Rip the road up to a depth of 1 m (if not restricted by solid geological formations) along the contour at a spacing of 1 m in one direction; do cross ripping if the compaction is not alleviated or the surface is too rough;
- Cover the area with a 200 mm growth medium layer by dozing in the safety berms on the sides of the road; and
- Establish vegetation as specified.

The only roads that will remain post closure are the main access road up to the access control gate and the service road next to the security fence around the mining area.

5.3 PANS

The pan areas under consideration are:

- The Northern Pan just east of the CRD;
- The Southern Pan just west of the primary crusher area; and
- The Wetland Area to the west of the offices area.

The mitigation actions for all the three pan areas are discussed first with supporting figures that follow. Any further disturbance and impacts to these areas will be avoided and the existing impacts will be addressed as follows:

<u>Northern Pan (Table 3):</u>

Table 3: Closure Actions for the Northern Pan

Closure Action.	
Report Figure Reference:	**Figure 5**
Drawing Reference No:	**DB037_8A & 8D**
• Contain any possible sediment from the rehabilitated CRD with toe paddocks and prevent it from entering the pan area; • Divert clean runoff from the rehabilitated northern portion of the plant area towards the Northern Pan to reinstate the catchment as close as possible to the original area; • Construct a coarse filter wall on the southern side of the pan area to capture any possible sediment from the rehabilitated northern portion of the plant area; • Remove alien vegetation with mechanical methods and targeted herbicide application on the stems only; • Identify wetland grass species in the other wetland areas and harvest seeds to seed the pan area or transplant some wetland grasses to this area; and • Erect a stock proof fence around the full supply level of the pan to control animal and vehicle access to the area or include the pan within the larger fenced off area around the CRD	

Southern Pan (Table 4):

Table 4: Closure Actions for the Southern Pan

Closure Action	
Report Figure Reference:	**Figure 6**
Drawing Reference No:	**DB037_8A, 8C & 8E**
• Construct a berm wall on the existing footpath to separate the area to be rehabilitated to the east with the western portion of the pan that is still functional; • Shape the eastern portion to reduce ponding and allow runoff to the western portion of the pan; • Fill the eastern portion with 500mm soil and compact to cap the underlying footprint and reduce future infiltration to reduce possible affected seepage to the pan area to the west; o Use material from the nearest soil stockpile, i.e. TS11; or o Use the excavated material from the waterway from FRD2 to the open pit); • Cover the eastern portion with 300mm growth medium from soil stockpile TS11 (max haul distance 1km) during the covering of the rest of the plant footprint; • Excavate and form a shallow wide waterway from the western side of the Southern Pan at the estimated full supply level to the Wetland to allow drainage away from the rehabilitated plant footprint during extreme rain events; • Remove the eucalyptus trees and other alien vegetation with mechanical methods and targeted herbicide application on the stems only; • Identify wetland grass species in the other wetland areas and harvest seeds to seed the pan area or transplant some wetland grasses to this area; and • Erect a stock proof fence around the full supply level of the pan to control animal and vehicle access to the area	

Wetland Area (Table 5):

Table 5: Closure Actions for the Wetland

Closure Action	
Report Figure Reference:	**Figure 7**
Drawing Reference No:	**DB037_8A & 8E**
• Reinstate the natural drainage patterns and runoff as far as possible by diverting runoff from clean rehabilitated areas from upstream of the southern WRD and the open pit; • Remove alien vegetation with mechanical methods and targeted herbicide application on the stems only; • Identify wetland grass species in the other wetland areas and harvest seeds to seed the pan area or transplant some wetland grasses to this area; • Retain the existing stock proof fence around the full supply level of the pan to control animal and vehicle access to the area; • Allow additional surface flow to the wetland from the Southern Pan by constructing a spillway to link the two pans; and • Construct a shallow drift in the main access road to ensure that the Southern Pan is linked to the downstream system	

Figure 5: Rehabilitation proposals for the Northern Pan area

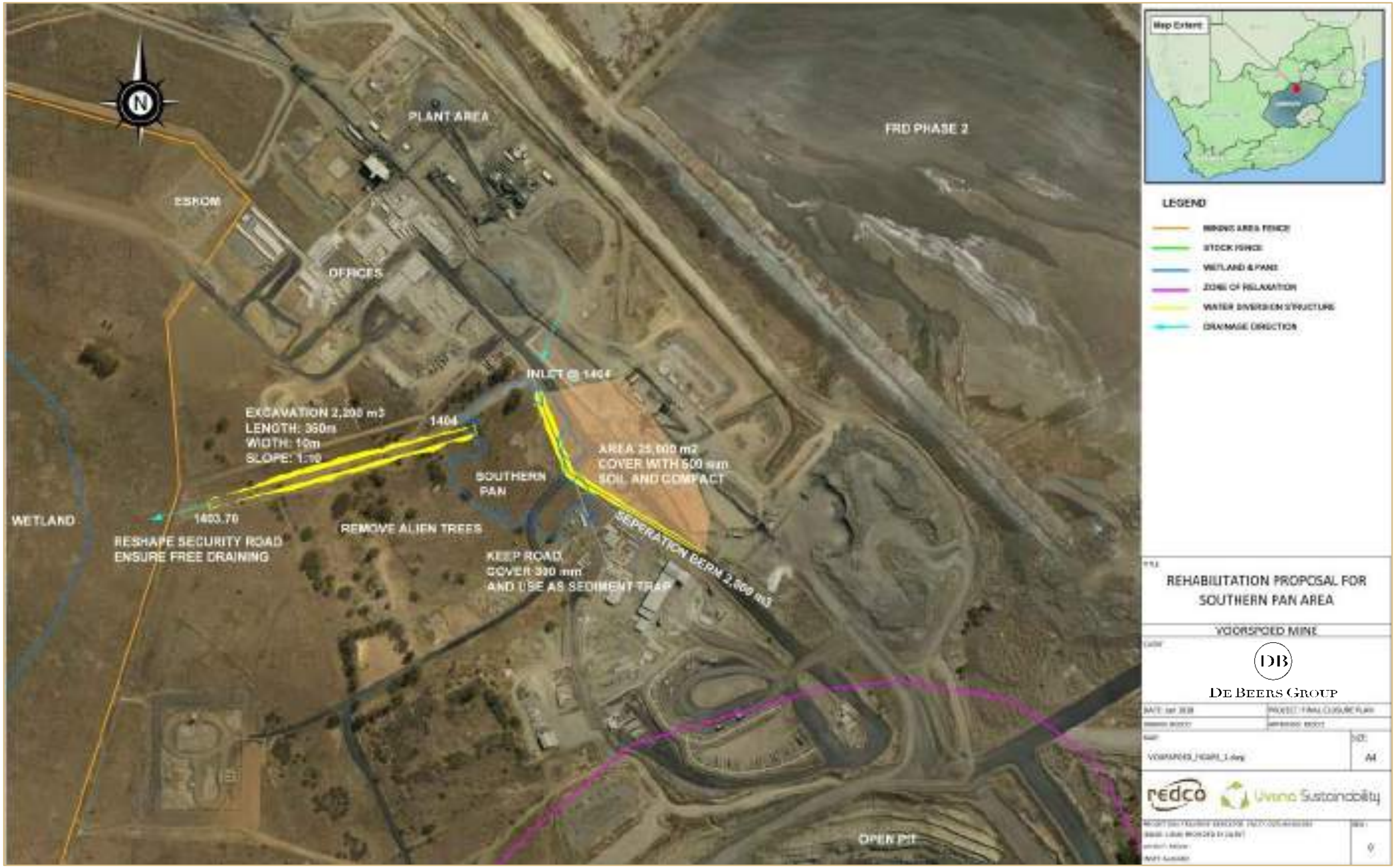


Figure 6: Rehabilitation proposals for the Southern Pan area

Figure 7: Rehabilitation proposals for the Wetland area

5.4 WASTE ROCK DUMP (WRD)

5.4.1 WRD: Current Status

The WRD (D5) (see Figure 8) is located to the east and south of the open pit and it effectively screens off the pit from that side. The current footprint is ±230 ha. The southern portion is a separate dump that has reached full capacity. The dump is deposited in lifts of ±12-13 m high with the highest lift on the eastern side of Lift 1 where the height is ±18 m. These slopes have been rehabilitated already and are ±55 - 60 m long in some places. The slopes show good stability at this stage, despite minor erosion gullies that are visible. Sufficient step back was provided between two lifts to allow the construction of a bench between lifts that can contain runoff from the higher lying slope. Deposition has stopped and the WRD is at its final footprint to all the sides. There are two holes on top of the WRD where Lift 2 has not been filled completely. The top of the WRD is almost level, but has several low laying areas where runoff accumulates. Some of the low laying areas are close to the edge of the dump. The waste rock material consists of highly weathered shale, mudstone and basalt. Very little large solid rocks are visible. The material shows dispersive characteristics and is highly erodible. The waste rock material can however sustain some vegetation on its own with the correct amelioration. It can form part of a growth medium for grass species. Lift 1 has been rehabilitated on the southern and eastern sides and has a good grass cover. Lift 2 has been rehabilitated on the southern and eastern sides in 2017 and vegetation has started to establish. The bench between Lift 1 and 2 still requires cross berms to form paddocks. Most of the slopes on the western side and on Lift 3 have been reshaped, but not covered with growth medium or seeded. The surrounding areas drain predominantly to the east. The slopes of the Southern WRD have been reshaped, covered and seeded towards the end of 2018.

One notable aspect in the closure criteria for the WRD is that the growth medium layer for the top of the facility has been reduced to only 100 mm. This is based on the physical and chemical quality of the waste rock material itself. The waste rock material is predominantly highly weathered material i.e. with a high sand and clay fraction. It will have a high water and nutrient holding capacity. The chemical quality also allows in situ rehabilitation with the correct amelioration. The additional growth medium layer of good quality topsoil from the available stockpiles was specified to allow for variations in soil quality of the waste rock material, reduce amelioration requirements and ensure rapid establishment of vegetation. The existing stockpiles also have a good seed bank of grass. Small trial plots on top of the WRD have proven that vegetation can be established in the material itself and with minimal additional growth medium. The trial areas have unfortunately been covered with advancing lifts of the WRD.

Figure 8: WRD: General Arrangement

5.4.2 WRD: Design Constraints / Limitations

There are minimal rehabilitation design constraints for the WRD. The toe can be moved out during reshaping on all sides and the topsoil stockpiles are located next to the facility. All remaining steep slopes can be reshaped at this stage, except for the following that can only be done when other actions have been completed:

- The areas where basalt are stockpiled can only be reshaped once the basalt material has been removed and placed as armour layer on the CRD and FRD slopes;

5.4.3 WRD: Closure Actions

The actions to rehabilitate the WRD are presented in Table 6 with reference to the applicable line items in the cost estimate sheets. The implementation plan and scheduling is presented later in this report.

Table 6: Closure Actions for the WRD

Closure Action	
Reshaping	
Report Figure Reference:	**Figure 8, Figure 9**
Drawing Reference No:	**DB037_07, 08A & 08E**
Reshaping of steep slopes is required to ensure long-term stability, to reach the end land use by limiting erosion, and effectively cover the area with a suitable growth medium. The following actions will be implemented: • Reshape all steep slopes from the current angle of repose (± 37°) to the design gradient of 18° (1:3) in a balanced cut and fill operation as far as possible; • Reshaped slopes must be even and rather concave than convex and without any windrows in any direction or deep tracks remaining up and down the slope; • Reshape all uneven surfaces (general reshaping) to even out the areas (mostly the top area) to the extent that the placing of cover material can be controlled at the average specified depth, as well as to improve the drainage pattern of the areas where needed; • Note: The closure liability estimate allows for only 50% of the top area for general reshaping at an average depth of 100mm over the areas to be reshaped, because the rest of the area is fairly even and can receive a soil cover immediately; the final areas requiring reshaping must be confirmed on site; • Reshape all prominent dumps or heaps on the WRD as stated above to improve the integration of the final landform into the surrounding landscape or use the material to construct berms; • Reshape and cut a bench on a portion of the dump in the north-eastern corner where the slope length becomes very long.	
Growth Medium Cover	
Report Figure Reference:	**Figure 8, Figure 9**
Drawing Reference No:	**DB037_07, 08A & 08E**
The disturbed and reshaped area must be covered with a suitable growth medium for the establishment of the vegetation cover to ensure the end land use. The growth medium will also support resistance against erosion to ensure long-term stability of areas susceptible to erosion. The following actions will be implemented: • Cover all reshaped slopes with a suitable growth medium up to a minimum average depth of 200 mm; • Cover all reshaped and prepared top areas with a suitable growth medium up to a minimum average depth of 100 mm; • Source suitable soil from the topsoil stockpiles as follows: o Cover the northern and central portions of the WRD from the southern portion of topsoil stockpile TS8 (located to the east of the main WRD); o Cover the western and southern portions of the WRD from stockpile TS9 (located to the west of the main WRD); o Cover the separate southern WRD from topsoil stockpile TS8 (located to the east of this WRD); • Cover the areas to the east of the WRD where seepage is visible with 300mm soil from the nearest stockpile; • Rip the covered top areas on contour (depth 300 mm, tine spacing = 1 m) to alleviate any compaction during placing of the material (usually only on flat areas) and mix the underlying material with the cover layer to increase coarseness and infiltration.	

Closure Action	
Water Control	
Report Figure Reference:	**Figure 8, Figure 9**
Drawing Reference No:	**DB037_07, 08A & 08E**

The reshaping of steep slopes and covering of erodible material will reduce the erodibility of the surface layer, but a critical component is the construction of suitable water control structures. The following actions will be implemented:

- Maintain a bench width of about 10 m after reshaping with the correct deposition of successive lifts and reshaping of the slopes;
- Shape the benches inwards to a depth of about 2 m to provide sufficient capacity for the 24 hour 1:100 year runoff event from the slope above, as well as sediment capturing; alternatively construct 2m high berm walls on the outside edge of the bench;
- Construct cross berms on the benches at an interval of 50 m to prevent all runoff from a large slope catchment accumulating in one low point. The cross berms must be about 500 mm lower than the level of the crest of the berm. Identify the existing low points between Lift 1 and 2 and construct the cross berms on both sides of these low points;
- Construct crest berm walls on the top edge of the dump or on the edge of large flat areas to prevent accumulated runoff from flowing over the slopes. Obtain material by dozing material from the inside area of the dump (about 30 m away from the edge) to create a low laying area away from the edge of the dump to prevent ponding of runoff against the crest berms;
- Reshape the top of the dump to slope inwards without moving an excessive amount of material to form low laying areas at several positions to prevent water ponding against the crest berms. The final design should be evaluated based on the final surface topography of the top area of the dump after all depositing has ceased;
- Construct toe paddocks on the eastern side of the WRD where seepage is visible at the moment to contain and evaporate the seepage. It is expected that the seepage will stop after rehabilitation of the WRD. The toe paddocks can be removed during the post closure monitoring and maintenance period.

It should be noted from the above that the rehabilitated WRD's will not be free draining, except for the bottom slopes. Rainfall and runoff will be contained on the top area and on the benches as described. The impact on the yield of the catchment is considered negligible and the advantage may be that additional groundwater recharge may occur. Containing runoff on the dump will improve the establishment and long-term stability of the vegetation cover and improve the bio-diversity.

Fencing	
Report Figure Reference:	**Figure 8**
Drawing Reference No:	**DB037_07, 08A & 08E**

Fencing

The mitigation measures to address the risks associated with the successful establishment of vegetation and maintenance of newly rehabilitated areas requires that the rehabilitated areas be fenced off. This will include the following actions:

- Construct a stock fence along the perimeter of the rehabilitated dumps and across the dump to divide the area into smaller camps for grazing management; and
- Construct and maintain a firebreak along the existing security fence.

Vegetation	
Report Figure Reference:	**Figure 8**
Drawing Reference No:	**DB037_07, 08A & 08E**

Soil amelioration to provide a suitable growth medium and the establishment of vegetation is the same for all rehabilitated areas and are discussed in Section 5.12.

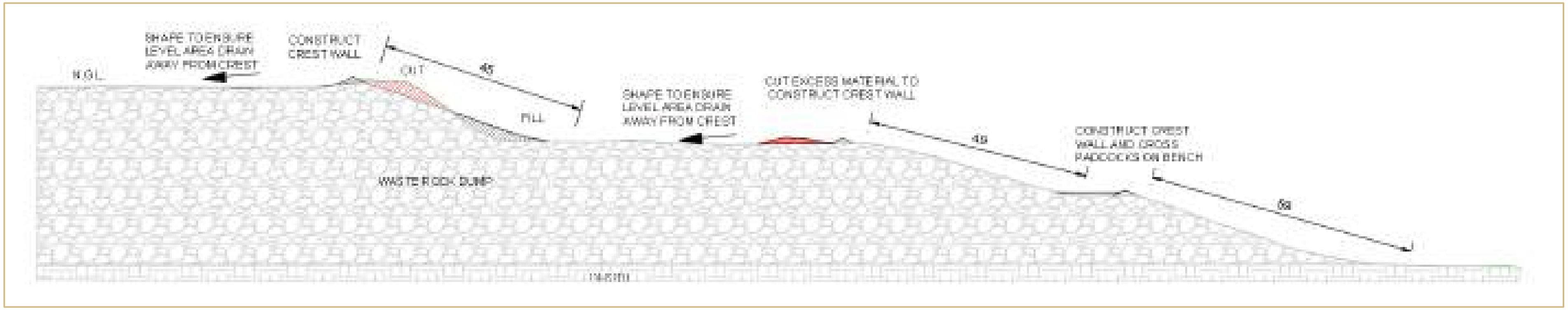


Figure 9: WRD: Typical Sections showing existing and reshaped slopes

5.4.4 WRD: Gaps and Uncertainties

The following uncertainties must be addressed to improve this design and finalise the rehabilitation plan for implementation. Some of these uncertainties are addressed during implementation.

- The remaining footprint and reshaping volumes of the basalt stockpile will only be known once all required material has been removed for the armouring of the CRD and FRD slopes;
- The reshaping volume to prepare the top area for the cover topsoil layer is difficult to plan and predict and must be carefully controlled during implementation. It can be minimised by only shaping areas that cannot receive topsoil immediately. The top area can have an undulating surface after reshaping, which will make it more natural.

5.5 COARSE RESIDUE DEPOSIT (CRD)

5.5.1 CRD: Current Status

The CRD is located to the north of the other mining related activities and the current footprint is ±35 ha with some additional disturbed areas around the perimeter. The dump is constructed by deposition with a conveyor system in a single lift of ±40m high. The dump is stable and limited erosion is visible on the side slopes. Seepage is visible on the western toe of the dump especially near the active deposition area, i.e. the spreader at the end of the leg. The seepage is collected and conveyed to the RWD east of the FRD. Seepage on the northern and eastern side has ceased after deposition stopped on the first extension. The CRD is located on a local watershed and runoff of the surrounding areas is to the west and north with a smaller area draining east to the Northern Pan. Rehabilitating the eastern side of the CRD facility should be a priority to reinstate clean runoff to the pan. Refer to Figure 10 for more information.

5.5.2 CRD: Design Constraints / Limitations

There are minimal rehabilitation design constraints for the CRD. The toe can be moved out during reshaping on all sides and the topsoil stockpiles are located next to the facility. The main limitation is that the conveyor system restricts the amount of rehabilitation that can be implemented before the infrastructure is removed as part of the plant demolition project. The following areas can only be rehabilitated when the conveyor is dismantled and removed:

- The access ramp to the top of the facility;
- The southern slopes of the facility;
- The seepage trench system.

Figure 10: CRD: General Arrangement

5.5.3 CRD: Closure Actions

The actions to rehabilitate the CRD are presented in Table 7 with reference to the applicable line items in the cost estimate sheets. The implementation plan and scheduling is presented later in this report.

Table 7: Closure Actions for the CRD

<table>
<tr><th colspan="2">Closure Action</th></tr>
<tr><th colspan="2">Reshaping</th></tr>
<tr><td>Report Figure Reference:</td><td>Figure 10, Figure 11</td></tr>
<tr><td>Drawing Reference No:</td><td>DB037_04, 05, 06, 08A & 08D</td></tr>
<tr><td colspan="2">Reshaping of steep slopes is required to ensure long-term stability, to reach the end land use by limiting erosion, and effectively cover the area with a suitable growth medium. The following actions will be implemented:
• Reshape all steep slopes from the current angle of repose (± 37°) to the design gradient of 16° (1:3.5) in a balanced cut and fill operation to reduce the gradient and make the slope accessible for other rehabilitation actions.
• Reshaped slopes must be even and rather concave than convex and without any windrows in any direction or deep tracks remaining up and down the slope;
• Reshape all uneven surfaces (general reshaping) to even out the areas (mostly the top area) to the extent that the placing of cover material can be controlled at the average specified depth, as well as to improve the drainage pattern of the areas where needed. This action was not costed separately, because it was assumed that this material forms an even surface after reshaping and that the preparation of surfaces are also included in the rate for load, haul and place of growth medium material.</td></tr>
<tr><th colspan="2">Growth Medium Cover</th></tr>
<tr><td>Report Figure Reference:</td><td>Figure 10, Figure 11</td></tr>
<tr><td>Drawing Reference No:</td><td>DB037_04, 05, 06, 08A & 08D</td></tr>
<tr><td colspan="2">The disturbed and reshaped area must be covered with a suitable growth medium for the establishment of the vegetation cover to ensure the end land use. The growth medium will also support resistance against erosion to ensure long-term stability of areas susceptible to erosion. The following actions will be implemented:
• Cover the reshaped slopes with a 300 mm coarse basalt armour layer to reduce the erodibility of the surface layer;
• Cover the reshaped slopes and top area with 200 mm soil to form a growth medium together with the underlying material;
• Source suitable soil from the topsoil stockpiles as follows:
  o Cover the northern, eastern and top portions from the topsoil stockpile TS1 (located to the north of the CRD) and TS3 (located directly to the north of the dump);
  o Cover the northern, western and top portions from stockpile TS1 (located to the north of the CRD) and TS4 (located directly to the northwest of the dump);
  o Cover the remainder of the CRD from topsoil stockpile TS2 (located to the north of the CRD);
• Rip the covered areas on contour (depth 300 mm, tine spacing = 1 m) to alleviate any compaction during placing of the material, mix the cover layers with each other and with the underlying material to increase coarseness and infiltration.</td></tr>
<tr><th colspan="2">Water Control</th></tr>
<tr><td>Report Figure Reference:</td><td>Figure 10, Figure 11</td></tr>
<tr><td>Drawing Reference No:</td><td>DB037_04, 05, 06, 08A & 08D</td></tr>
<tr><td colspan="2">The reshaping of steep slopes and covering of erodible material will reduce the erodibility of the surface layer, but a critical component is the construction of suitable water control structures. The following actions will be implemented:
• The rehabilitated slopes will drain freely to the surrounding environment;
• Contain all rainfall and runoff on the top of the rehabilitated facility;
• Construct crest berm walls at the edge of the top of the facility;
• Reshape the top of the facility to drain inwards, i.e. away from edge. This can be done during the construction of the crest berm walls;
• Construct additional paddock walls on the top area to divide the catchment and spread the runoff over several areas to increase evapotranspiration;
• Construct toe paddocks at seepage points on the specified sections on the eastern toe of the facility to capture and evaporate seepage until seepage stops; decommission toe paddocks during maintenance period; the toe paddocks on the eastern side will also prevent any possible sediment transport from the newly rehabilitated slope into the Northern Pan;
• Decommission the existing seepage trenches from the CRD to the SWCD / RWD once seepage has stopped – backfill the trenches and cover with surrounding material. Seepage is expected to stop soon after depositing has stopped as experienced on the eastern and northern sides where the area at the toe of the dump is already dry.
It should be noted from the above that the top of the rehabilitated CRD will not be free draining. Rainfall and runoff will be contained on the top area. The impact on the yield of the catchment is considered negligible. Groundwater recharge may increase. Containing runoff on the dump will improve the establishment and long-term stability of the vegetation cover and improve the bio-diversity.</td></tr>
</table>

<table>
<tr><th colspan="2">Closure Action</th></tr>
<tr><th colspan="2">Fencing</th></tr>
<tr><td>Report Figure Reference:</td><td>Figure 10, Figure 11</td></tr>
<tr><td>Drawing Reference No:</td><td>DB037_04, 05, 06, 08A & 08D</td></tr>
<tr><td colspan="2">The mitigation measures to address the risks associated with the successful establishment of vegetation and maintenance of newly rehabilitated areas requires that the rehabilitated areas be fenced off. This will include the following actions:
Construct a stock fence along the perimeter of the rehabilitated dump and across the dump to divide the area into smaller camps for grazing management; and
Construct and maintain a firebreak along the existing security fence.</td></tr>
<tr><th colspan="2">Vegetation</th></tr>
<tr><td>Report Figure Reference:</td><td>Figure 10, Figure 11</td></tr>
<tr><td>Drawing Reference No:</td><td>DB037_04, 05, 06, 08A & 08D</td></tr>
<tr><td colspan="2">Soil amelioration to provide a suitable growth medium and the establishment of vegetation is the same for all rehabilitated areas and are discussed in Section 5.12.</td></tr>
</table>

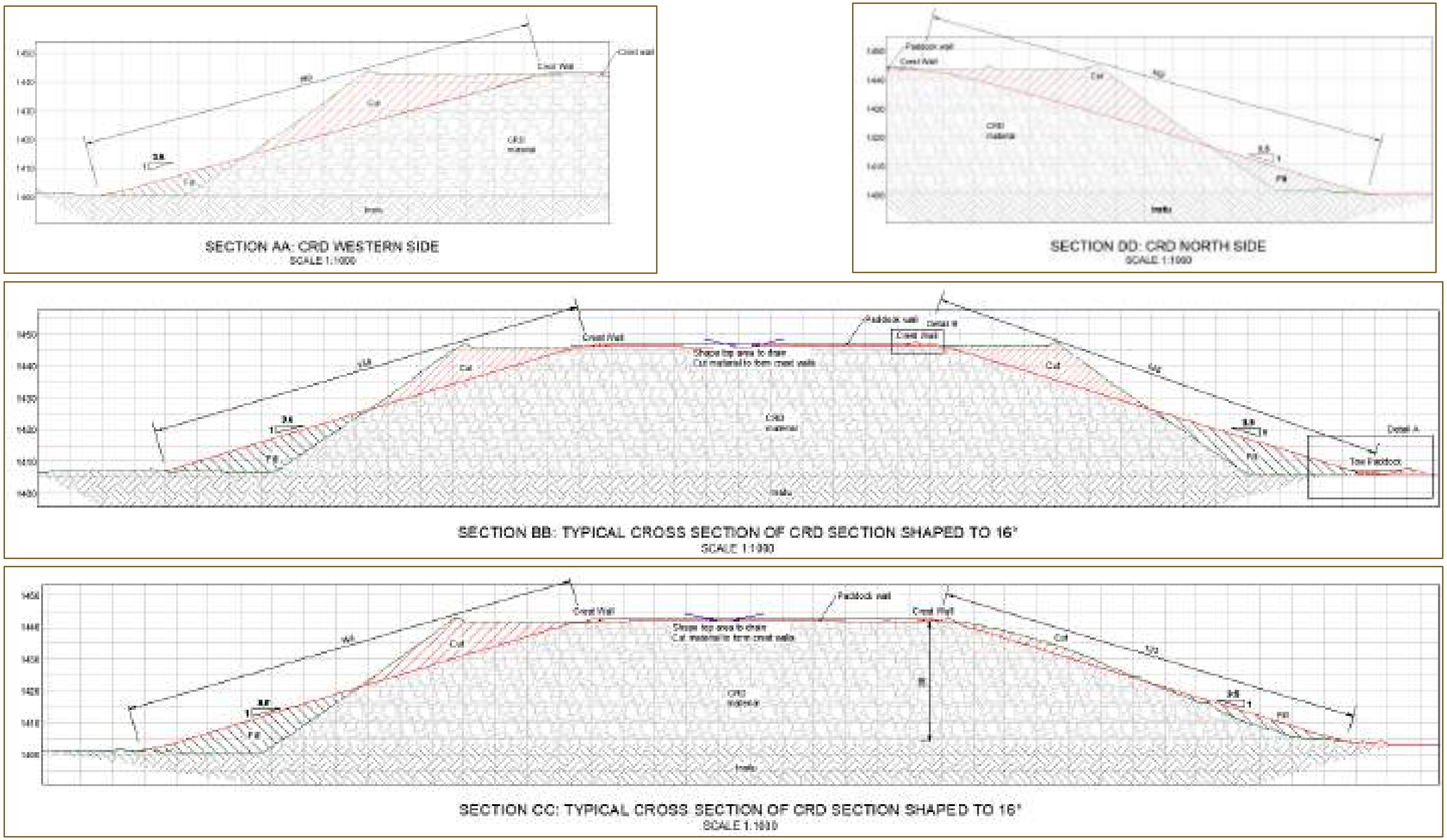


Figure 11: Typical section of reshaping of CRD

5.5.4 CRD: Gaps and Uncertainties

The following uncertainties must be addressed to improve this design and finalise the rehabilitation plan for implementation. Some of these uncertainties are addressed during implementation.

- The duration until seepage stops is uncertain and may affect the scheduling for decommissioning of the seepage trenches;
- The scheduling of the dismantling and removal of the conveyor is part of a separate contract and must be confirmed to determine the final scheduling of the CRD rehabilitation.

5.6 FINE RESIDUE DEPOSIT (FRD)

5.6.1 FRD: Current Status

The FRD is located on the north-eastern boundary of the mine (see Figure 12) and covers an area of ±120 ha. It is an impoundment facility with embankments constructed from waste rock material. The height of the embankment is ±12-18 m on the south-western side and ±20-30 m on the north-eastern side. The facility has three compartments, viz. FRD 1A, FRD 1B and FRD 2. FRD 2 abuts against the northern slopes of the WRD. The north-western slopes of FRD 1A and 1B have been rehabilitated, but the area is still sensitive and the vegetation cover must improve. The bottom portion of the north-western slope of FRD 1B has erosion gullies and must be stabilised. The surrounding area drains predominantly to the eastern side. The FRD is obstructing and located at the start of a poorly defined drainage line area. FRD 1B and FRD 2 were never filled up to the maximum design capacity. FRD 1B has a freeboard of ±3-6 m and FRD 2 has a freeboard of ±8-18 m.

Figure 12: FRD: General Arrangement

5.6.2 FRD: Post Closure Water Management

The preferred post closure water management scenario for rehabilitated mine residue facilities is often to construct a free draining facility that integrates with the surrounding natural drainage pattern as effectively as possible without the construction of expensive water control structures that requires on-going maintenance and can increase the risk of failure in future. This is not practically possible or cost effective in the case of the FRD, especially FRD 1B that will require a long emergency spillway to route runoff off the facility. A scenario was investigated during the 2017 closure plan development to limit the amount of water contained on the facility to less than 50,000 m³ with sufficient emergency spillways, but this was not preferred. In addition, the top of the facility cannot be rehabilitated due to the safety risk for heavy machinery on the unconsolidated material. The fine tailings material will remain wet and unstable for an extended period due to the low permeability of the material (in the order of ±1x10^{-8} m/s). Runoff from the un-rehabilitated top area of the facility cannot be released into the receiving environment. The preferred scenario for this closure plan as discussed with the client, Engineer of Records and related stakeholders is to contain all runoff on the facility post closure in view of the available capacity of the facility. The daily rainfall data for the nearest weather station (0401794) was used to do a simulation of expected inflows (rainfall and runoff) and outflows (mostly evaporation, because infiltration is negligible). 98 years of daily rainfall data is available. The results indicate that 173,000 m³ storage must be provided for FRD 1B (Figure 13) and 265,171 m³ for FRD 2 (Figure 14) to prevent spillages of more than once in 100 years. The maximum water level in FRD 1B will be 1410.6 mamsl and 1402.2 mamsl in FRD 2. In this scenario FRD 1A will be allowed to spill into FRD 1B, because more capacity is available in the latter. An emergency spillway will be constructed from FRD 1B to FRD 2 in case of extreme flood events. This will mitigate the risk of spillage from the entire facility in the case of unforeseen events or climate change. FRD 2 will be allowed to spill from the south-western corner into the open pit in case of extreme events only. The spillway from FRD 2 will be constructed at an elevation of 1406 mamsl, because of the average elevation on the outside of the facility. This will provide capacity up to 1,243,678 m³.

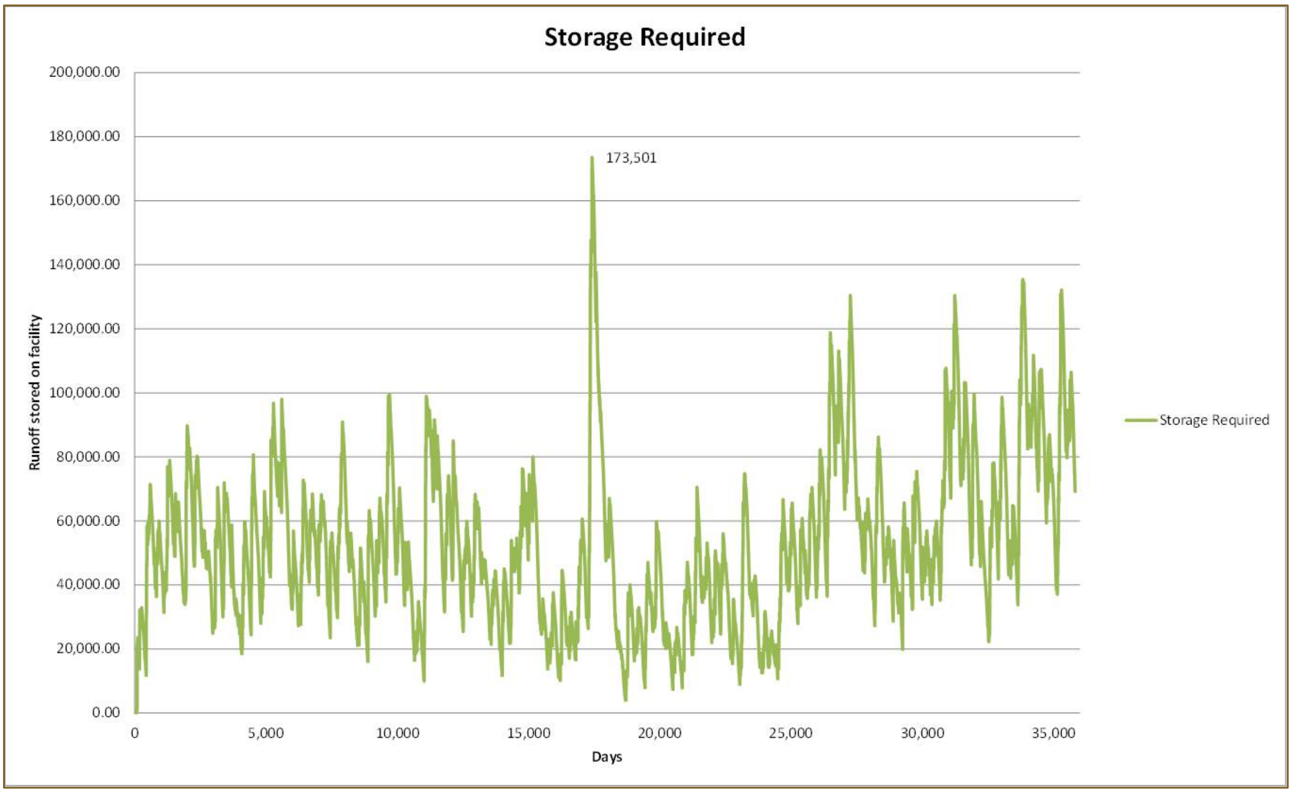


Figure 13: Dam simulation for FRD 1B (including FRD 1A)

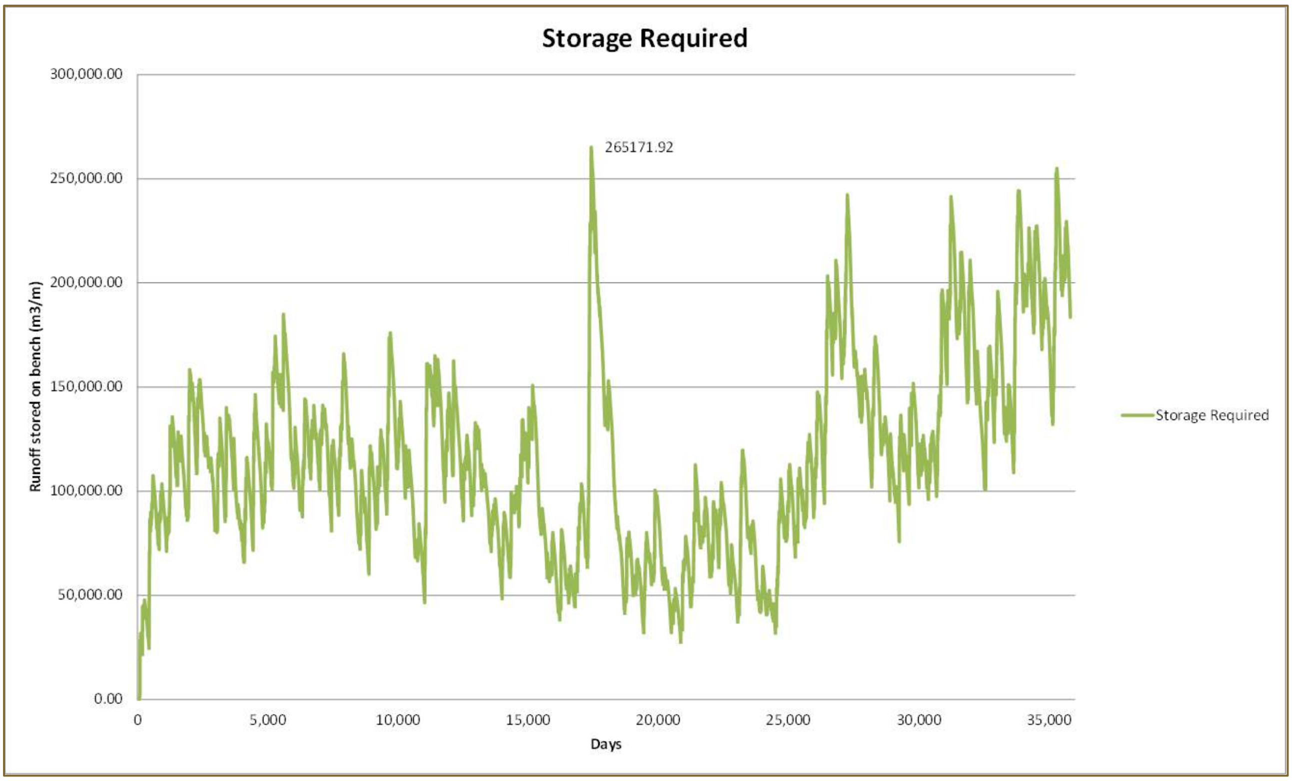


Figure 14: Dam simulation for FRD 2

5.6.3 FRD: Design Constraints / Limitations

There are a number of rehabilitation design constraints at the FRD. There is enough space to move the toe of the facility out during reshaping. The following can be noted:

- The toe of the reshaped slope on the north-eastern side of FRD 1B will extend over the seepage trench and it must be moved or changed to a covered system if seepage is still evident at the time of rehabilitation. No seepage was observed from FRD 1B at the time of the study. Deposition on FRD 1B has already stopped towards in 2018 and the facility was dry in September 2018 (see ortho-image). There was an existing pool on the facility in May 2019 after the rain season that could not be drained by the penstock due to sediment around the penstock inlet. Other stakeholders also agreed that seepage is not expected after closure, but this may change and be an unknown risk if more water is stored on the facility post closure, i.e. containing all runoff on the facility;
- The combination of the top width and height of the embankment on the north-eastern side of the facility means that the top will become a sharp crest without a flat work area if the slopes are simply cut back during reshaping. The top of the embankment on FRD 2 can be cut off to increase the top width and reduce the reshaping, thereby allowing a rehabilitated geometry with a flat work area on top of the reshaped slope. The top of the FRD 1B embankment cannot be cut off that much and the slope cannot be cut back too much or too close to the residue mass inside the impoundment;
- The slimes level in FRD 2 limits the level to where the embankment can be cut off;
- The facility will remain wet for a considerable time and not allow traffic on the top to implement rehabilitation measures;

- The facility has a large top area or catchment area and will retain more than 50,000 m³ of runoff if it remains a containment facility. This means that it will remain a dam with a safety risk (all embankments are higher than 5 m) and be an on-going liability in this regard;
- Work on the proposed emergency spillways can only be done if the area has dried out sufficiently and in the dry season.

5.6.4 FRD: Closure Actions

The actions to rehabilitate the WRD are presented in Table 8 with reference to the applicable line items in the cost estimate sheets. The implementation plan and scheduling is presented later in this report.

Table 8: Closure Actions for the FRD

Closure Action	
Reshaping	
Report Figure Reference:	**Figure 12, Figure 15, Figure 16, Figure 17 Figure 18, Figure 19, Figure 20 Figure 21, Figure 22, Figure 23 & Figure 23**
Drawing Reference No:	**DB037_01, 02, 03, 08A & 08D**
Reshaping of steep slopes is required to ensure long-term stability, to reach the end land use by limiting erosion, and effectively cover the area with a suitable growth medium. The following actions will be implemented: • Cut off the top of the north-eastern embankment of FRD 2 to the specified level (allow for enough freeboard above the slimes level) to prevent the sharp crest as described in "Limitations". • Use the excess cut material from FRD 2 and construct a buttress on the north-eastern side of FRD 1B to improve the factor of safety for stability, reduce the amount of reshaping and avoid a sharp crest; • Cut off the top of the south-western embankment of FRD 2 to the specified level (allow for enough freeboard above the LOM slimes level) to prevent the sharp crest as described in "Limitations". Doze the excess cut material to fill the outside slopes of FRD 2 on the south-western side; • Reshape the steep slopes on the north-eastern side of the facility (existing slopes on FRD 2 and additional buttress on FRD 1B) from the current angle of repose (± 37°) to the design gradient of 16° (1:3.5) (due to the longer slopes) in a balanced cut and fill operation to reduce the gradient and make the slopes accessible for other rehabilitation actions; • Reshape the south-western slopes of FRD 2 to a single 16° slope due to the length of the reshaped slopes; • Reshape the south-western slopes of FRD 1A to a single 18° slope; • Reshape the slope between FRD 1 and FRD 2 to a single 18° slope; • Reshape all inside slopes to a single 18° slope; • Maintain the current elevation of the embankments on FRD 1A and 1B; • The bottom of the inner slopes around the penstocks or pool at the time of construction may be saturated and present a safety risk during reshaping. These slopes should not be reshaped if there is a risk that the bottom of the slopes may slump or fail. The slopes are indicated on the drawings, but the cost for reshaping is still included in the closure liability; • The reshaped slopes must be even and rather concave than convex and without any windrows in any direction or deep tracks remaining up and down the slope; • Reshape all uneven surfaces (general reshaping) to even out the areas to the extent that the placing of cover material can be controlled at the average specified depth, as well as to improve the drainage pattern of the areas where needed. This action was not costed separately, because it was assumed that this material forms an even surface after reshaping and that the preparation of surfaces are also included in the rate for load, haul and place of growth medium material.	
Growth Medium Cover	
Report Figure Reference:	**Figure 12, Figure 15, Figure 16, Figure 17 Figure 18, Figure 19, Figure 20 Figure 21, Figure 22, Figure 23 & Figure 23**
Drawing Reference No:	**DB037_01, 02, 03, 08A & 08D**
The disturbed and reshaped area must be covered with a suitable growth medium for the establishment of the vegetation cover to ensure the end land use. The growth medium will also support resistance against erosion to ensure long-term stability of areas susceptible to erosion. The following actions will be implemented: • Cover the reshaped slopes of FRD 1B NE, FRD 2 NE and FRD 2 SW with a 300 mm coarse basalt armour layer to reduce the erodibility of the surface layer; • Cover the reshaped slopes (including those covered with coarse basalt), top of the embankments and inner slopes with 200 mm soil to form a growth medium together with the underlying material; • Source suitable soil from the topsoil stockpiles as follows:	

Closure Action	
o Cover FRD 1A and 1B from topsoil stockpile TS2 (located to the north of the CRD); o Cover FRD 2 from the northern portion of topsoil stockpile TS8 (located to the east of the WRD); • Rip the covered areas on contour (depth 300 mm, tine spacing = 1 m) to alleviate any compaction during placing of the material, mix the cover layers with each other and with the underlying material to increase coarseness and infiltration.	
Water Control	
Report Figure Reference:	**Figure 12, Figure 15, Figure 16, Figure 17 Figure 18, Figure 19, Figure 20 Figure 21, Figure 22, Figure 23 & Figure 23**
Drawing Reference No:	**DB037_01, 02, 03, 08A & 08D**
The reshaping of steep slopes and covering of erodible material will reduce the erodibility of the surface layer, but a critical component is the construction of suitable water control structures. The following actions will be implemented: • The single outer slopes of the facility will be free draining to the environment and does not require additional water control structures. Erosion control will rely on the lower gradient and coarser basalt material mixed with the topsoil and underlying waste rock material, as well as a good vegetation cover; • Contain all runoff on the top of the facility in view of the excessive capacity available and to contain all dirty water (top of the facility will not be rehabilitated due to safety risks during implementation). The facility should not spill more than once in 100 years; o Excavate a spillway in the northern corner of FRD 1A to drain into FRD 1B that has sufficient capacity to contain runoff from both FRD 1A and 1B; • Construct emergency spillways only to reduce the risk of failure in case of extreme flood events, i.e. above the design floods (climate change risk): o Construct two spillways on the facility, i.e. one in the south-eastern corner of FRD 1B (into FRD 2) and one in the south-western corner of FRD 2 (towards the pit); o Excavate through the embankments after the facility has dried out and during the dry season. Use the excavated material from the FRD 1B embankment to fill the surrounding slopes to lower gradients. Use the excavated material from the FRD 2 embankment to construct an embankment to keep runoff from the FRD separate from the rest of the rehabilitated plant area (low laying stockpile footprint); o Construct gabion reinforced spillways / weirs as designed; • Construct crest berm walls on top of the embankments on the outside and inside edges, except where the top is too narrow to allow any traffic (south-western embankment of 1A). In this case construct outside crest berms and slope the top of the reshaped embankments to the inside; • Retain the seepage and penstock trench from the south-eastern corner of FRD 2 until seepage has stopped and rehabilitate the trench at that stage. Seepage is expected to stop during the decommissioning phase; • Construct evaporation paddocks at the toe of the reshaped outer slopes of FRD 2 if on-going seepage is expected in view of the increase water volume that will be contained on the facility; • Decommission the existing seepage trenches from the CRD to the SWCD / RWD once seepage from the CRD has stopped – backfill and cover with surrounding material; • Decommission the penstock system according to the specifications: o Seal the penstock pipe outlet by constructing a concrete seal over the outlet; o Fill the entire horizontal outlet pipe with high slump concrete; o Fill the vertical penstock pipe with concrete	
Fencing	
Report Figure Reference:	**Figure 12, Figure 15, Figure 16, Figure 17 Figure 18, Figure 19, Figure 20 Figure 21, Figure 22, Figure 23 & Figure 23**
Drawing Reference No:	**DB037_01, 02, 03, 08A & 08D**
The mitigation measures to address the risks associated with the successful establishment of vegetation and maintenance of newly rehabilitated areas requires that the rehabilitated areas be fenced off. This will include the following actions: • Erect a security fence along the perimeter of the rehabilitated dump as well as on the crest of the facility to prevent access on areas where water may be standing after rain events; and • Construct and maintain a firebreak along the existing security fence around the current mine area.	
Vegetation	
Report Figure Reference:	**Figure 12, Figure 15, Figure 16, Figure 17 Figure 18, Figure 19, Figure 20 Figure 21, Figure 22, Figure 23 & Figure 23**
Drawing Reference No:	**DB037_01, 02, 03, 08A & 08D**
Soil amelioration to provide a suitable growth medium and the establishment of vegetation is the same for all rehabilitated areas, i.e. reshaped slopes and are discussed in Section 5.12**,** with the exception of the top of the FRD facility. The top of the facility is not stable enough to allow access with heavy machinery to reshape, cover or rip the area. It is expected that the top of	

Closure Action
the area will be colonised by vegetation over time as seen on similar dormant facilities, but the establishment of vegetation will be enhanced by the following actions: • Ensure that the inner slopes are effectively vegetated with the desired species to serve as seed bank from where vegetation can migrate over time; • Spread fertiliser and compost by hand over the top areas that can be safely accessed on foot; • Spread seed of grass and tree species by hand over the top area that can be safely accessed on foot; • Pack branches as mulch by hand over the top area that can be safely accessed on foot.

A set of drawings is presented in Figure 15 to Figure 21 to illustrate the rehabilitation actions. The water management on top of the facility is presented in Figure 22 and Figure 23.

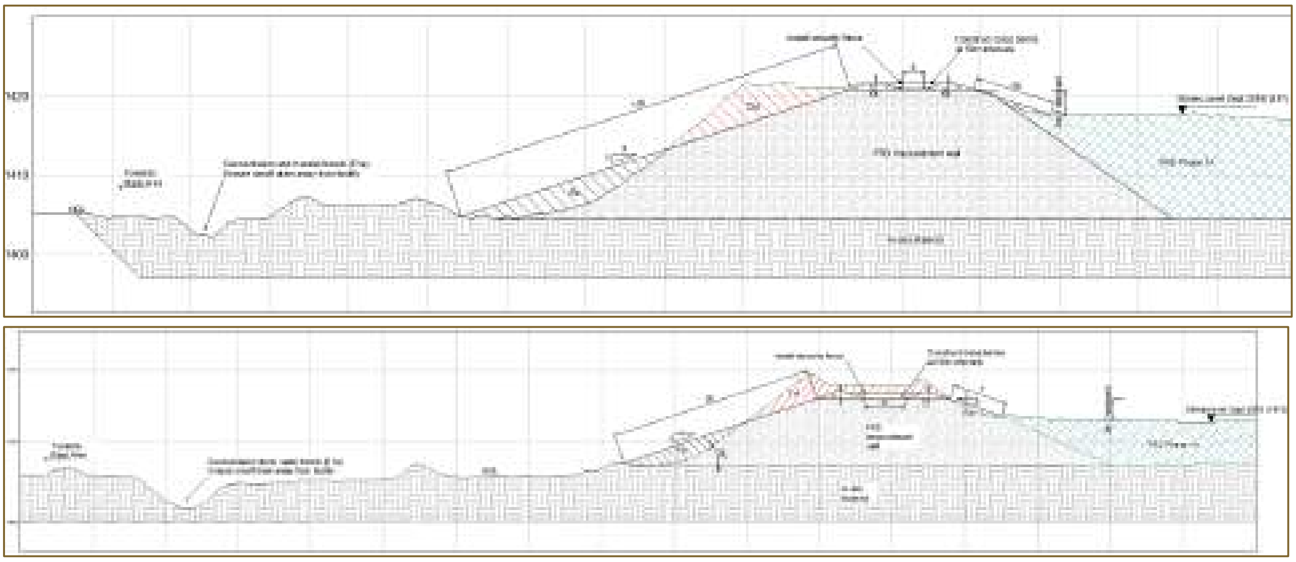


Figure 15: Typical section showing reshaping of FRD 1A

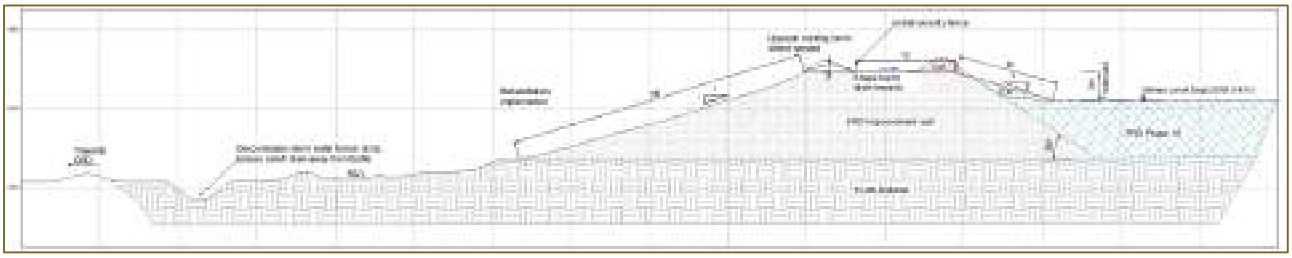


Figure 16: Typical section of already rehabilitated slope of FRD 1A

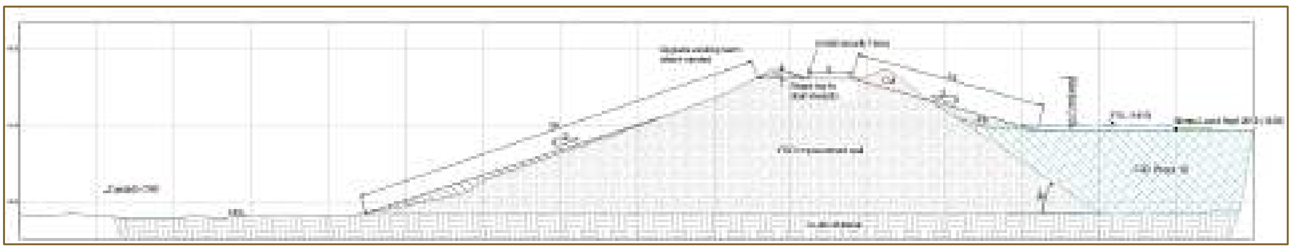


Figure 17: Typical section of upgrade required on already rehabilitated slope of FRD 1B

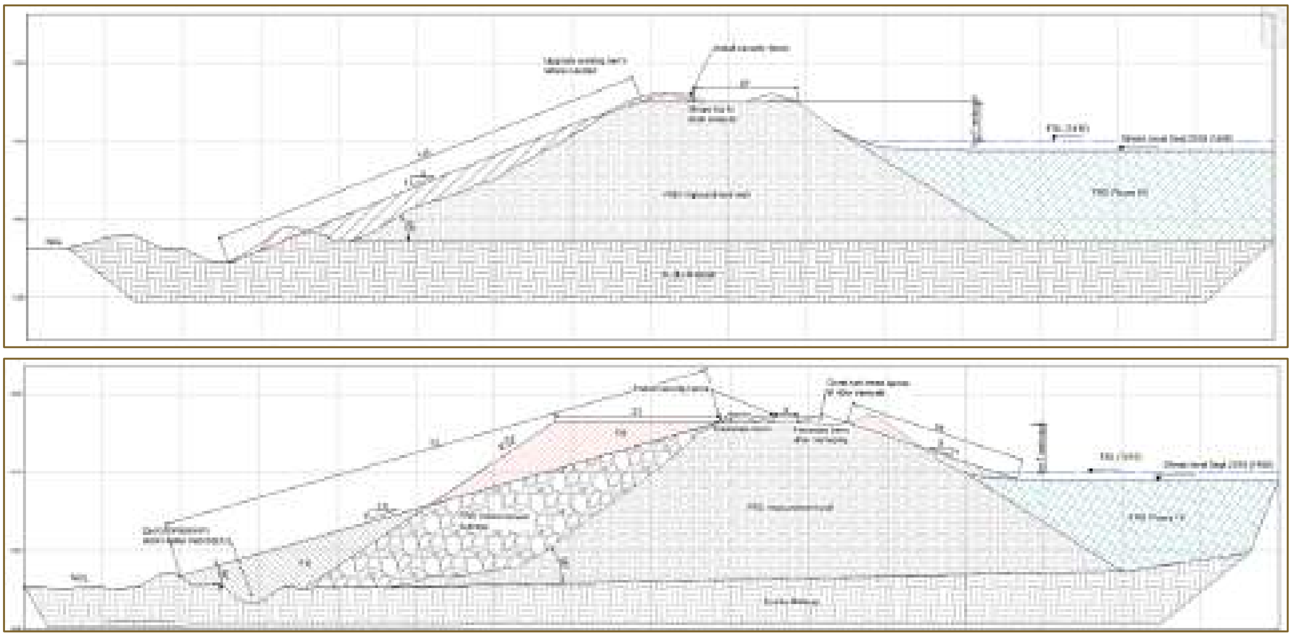


Figure 18: Typical section of buttressing and reshaping of FRD 1B

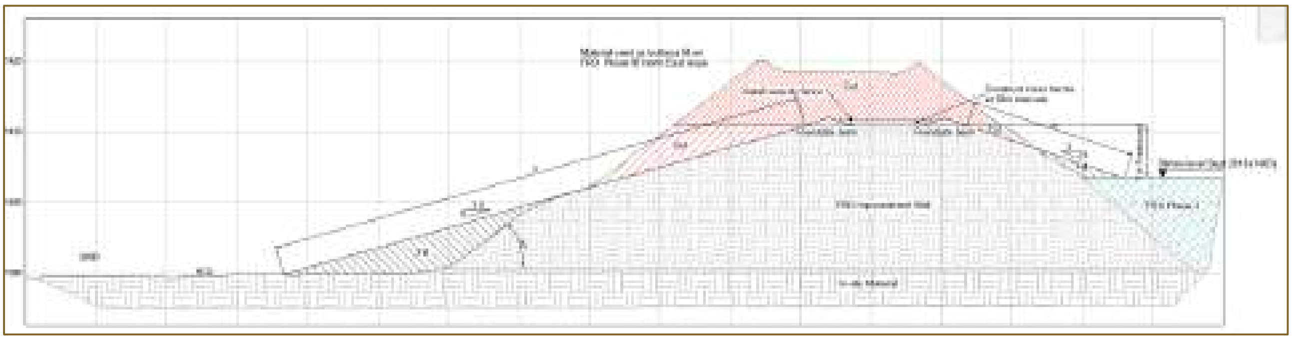


Figure 19: Typical section of reshaping of FRD Phase 2 (NE side)

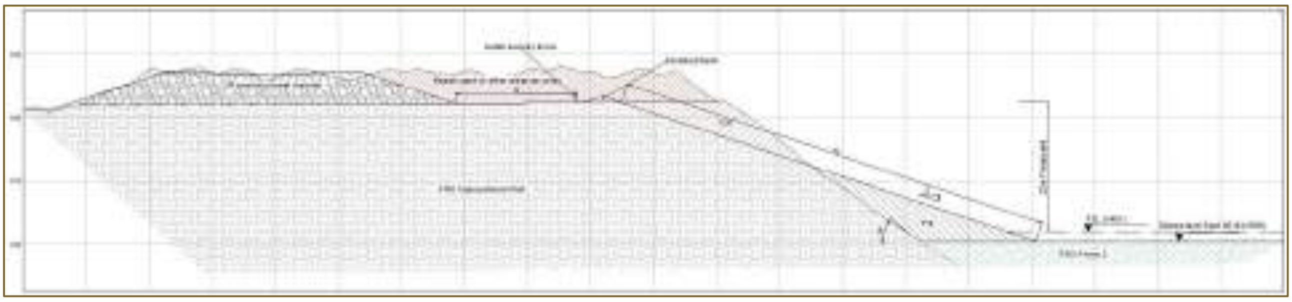


Figure 20: Typical section of reshaping of FRD Phase 2 (SE side)

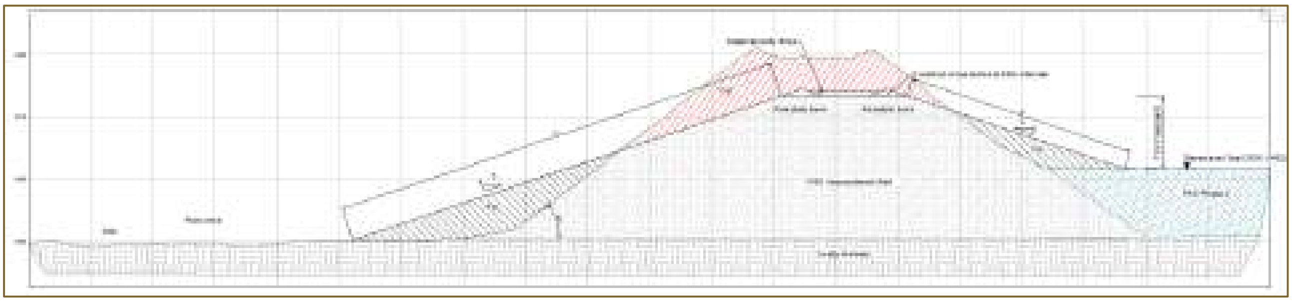


Figure 21: Typical section of reshaping of FRD 2 (SW side)

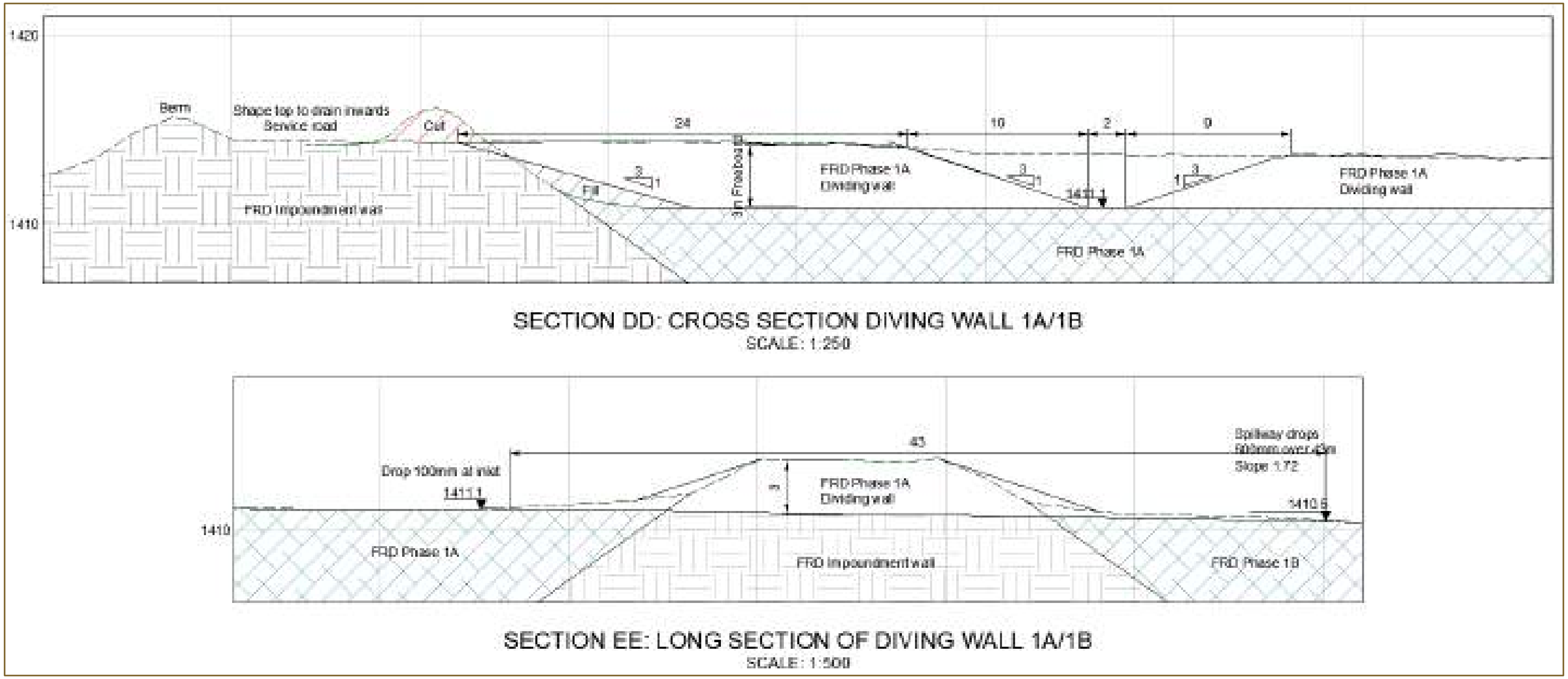


Figure 22: FRD: Typical sections of diving wall between FRD 1A & FRD 1B

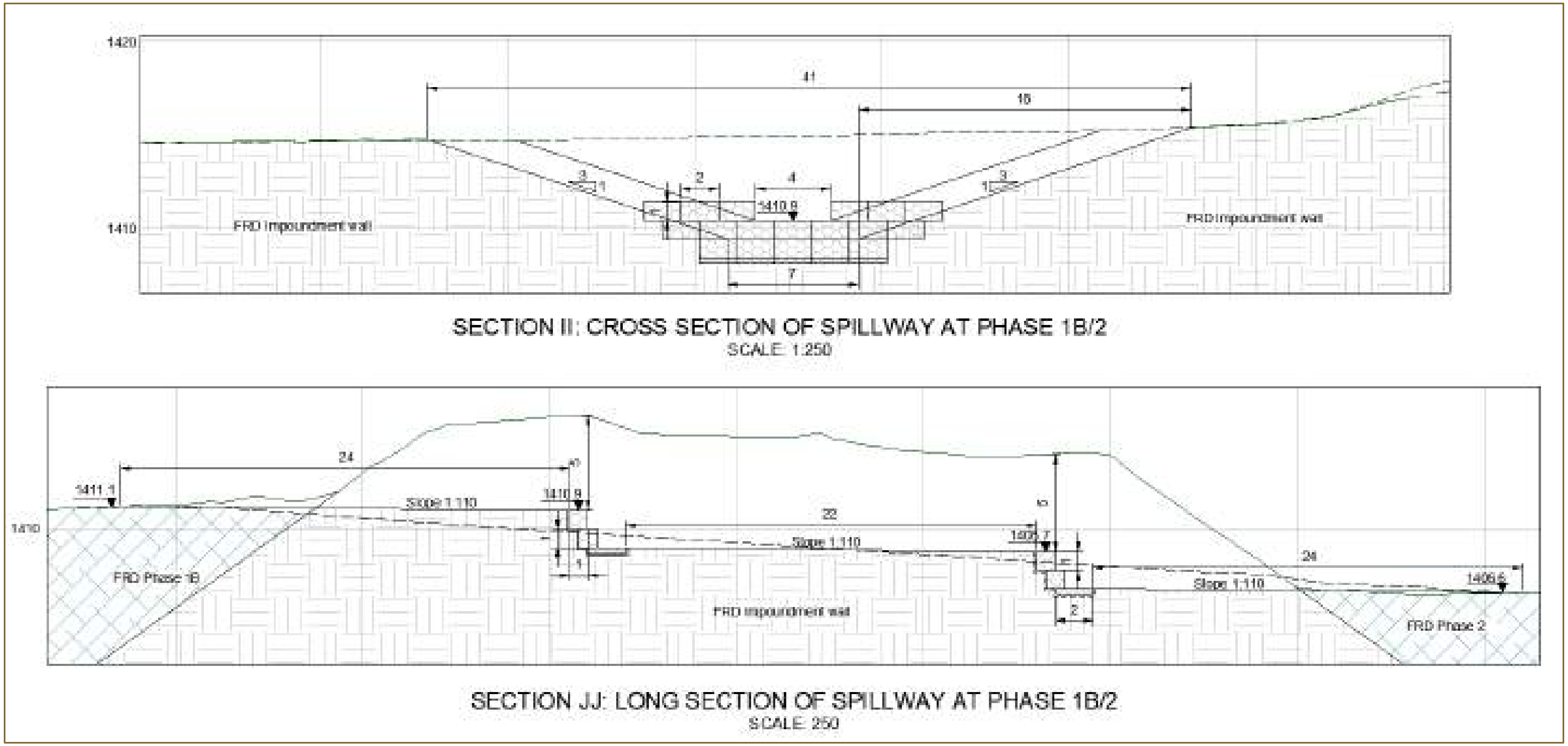


Figure 23: FRD: Typical sections of gabion spillway between FRD 1B and FRD 2

5.6.5 FRD: Gaps and Uncertainties

The following uncertainties must be addressed to improve this design and finalise the rehabilitation plan for implementation. Some of these uncertainties are addressed during implementation.

- The dry out period of the top of the facility and the safety risk will remain an uncertainty until the bearing capacity of the material can be tested;
- It remains uncertain when seepage from the facility will stop. The proposal to contain all runoff on the facility can increase the risk of continued seepage.

5.7 OPEN PIT

5.7.1 Open Pit: Current Status

The open pit has a footprint of ±74 ha and is ±240 m deep. The eastern side is solid and stable, while the western side has weathered formations with slip failures that are visible. Further failures are expected, especially on the western side until a more stable gradient has been reached. The ZOR has been provided by the client and is up to 130 m from the pit perimeter on the western side. The open pit is located close to a local watershed and runoff from surrounding areas could enter the pit mostly from the southern and south-western sides, but is diverted with storm water trenches and the waste rock dump to the southern side. Previous studies (E-Tek Consulting / Redco, June 2016) indicated that it is not feasible to backfill the pit or reshape the side slopes and the closure actions are focused on deterring access to the pit. Access to the bottom of the pit and therefore the remaining resource is not possible, because the existing ramps have already failed on the western side.

5.7.2 Open Pit: Design Constraints / Limitations

The main design constraints relate to the geotechnical stability of the open pit sidewalls. The proposed rehabilitation measures should not negatively affect the stability of the slopes or increase the rate of failure. Geotechnical specialists indicated that rainfall and runoff should not pond between the pit perimeter and the ZOR. Concentrated inflow over the pit perimeter should also be avoided as far as possible.

5.7.3 Open Pit: Closure Actions

The closure actions for the open pit are aimed at restricting access to the pit to mitigate long-term safety and security risks. The open pit is located within the larger area where access will be controlled based on the end land use, i.e. private owned land. The existing security fence around the mining area will also remain to restrict access to the area. Limited closure actions are proposed for the area between the security fence around the pit and the pit perimeter, because the land use of the area will be "Restricted".

Table 9: Closure Actions for the Open Pit

Closure Action	
Restrict Access	
Report Figure Reference:	**Figure 24 and Figure 25**
Drawing Reference No:	**DB037_07, 08A & 08E**
Access to the open pit will be restricted or deterred by implementing the following closure actions: • Construct 2 m high berms with coarse waste rock material at the remaining entrance ramps to the pit; • Erect a high-grade security fence 10 m outside the ZOR around the entire perimeter of the open pit; • Construct a trench and enviroberm on the western and northern sides of the pit in a balanced cut and fill operation, i.e. use the cut material from the trench to construct the enviroberm. The specifications for the trench and enviroberm are the following: o Berm top width / trench bottom width = 5 m; o Height / Depth = 2 m; o Side slopes = 1:5 • Connect the enviroberm to the WRD on the eastern side and to the Southern WRD on the southern side; • Remove topsoil before cutting the trench and filling the berm and spread the soil over the disturbed area after construction; • Establish natural indigenous vegetation on the trench and enviroberm as for other areas; • Align the trench and berm to divert clean storm water away from the pit towards the wetland areas;	

Closure Action	
• Reshaping of the top bench or other slopes of the open pit will not contribute to addressing the residual risks (i.e. illegal access to the open pit) and no action is proposed.	
Pit Stability	
Report Figure Reference:	**Figure 24 and Figure 25**
Drawing Reference No:	**DB037_07, 08A & 08E**
Support the pit stability or prevent any unplanned deterioration of the stability of the pit side walls by implementing the following actions: • Remove existing water control structures, e.g. trenches and berms that can cause the ponding of water by backfilling the trenches with material from the berms or other imported material. Shape the backfilled trenches and berm footprints to make the areas free draining; • Reinstate the berms on the pit perimeter where concentrated runoff is entering the pit at the moment and divert runoff away from the pit perimeter with low level contour drains if the topography allows; • Rip compacted areas to reduce runoff and allow the establishment of a good vegetation cover and deep rooted species; • Establish vegetation and deep rooted species between the new security fence and pit perimeter to enhance evapotranspiration.	
Protect Resource	
Report Figure Reference:	**Figure 24 and Figure 25**
Drawing Reference No:	**DB037_07, 08A & 08E**
There is still a resource at the bottom of the pit albeit not feasible to continue with mining at these depths. Access to the resource must be restricted to prevent unlawful mining activities. This will be achieved by the mitigation measures as described above, but also by covering the remaining resource in the bottom of the pit up to an elevation of 1200 mamsl. It is not feasible to cover the bottom of the pit with large volumes of earth and it was proposed (E-Tek Consulting / Redco, June 2016) to flood the bottom of the pit as quickly as possible. • Access to the remaining resource can be prevented by covering the bottom of the pit as soon and quickly as possible with water. The recharge to the pit from natural rainfall and runoff will start filling the pit as soon as dewatering stops. The area inside the enviroberm will generate runoff into the pit. The catchment area of the pit is ±106 ha; • The technical evaluation (Golder Associates Africa (Pty) Ltd, February 2019)of pit closure options (i.e. backfilling vs. pit lake formation) indicated that the water level will reach 1200 mamsl in less than 10 years without any additional catchment.	

Figure 24: Open Pit – General Arrangement

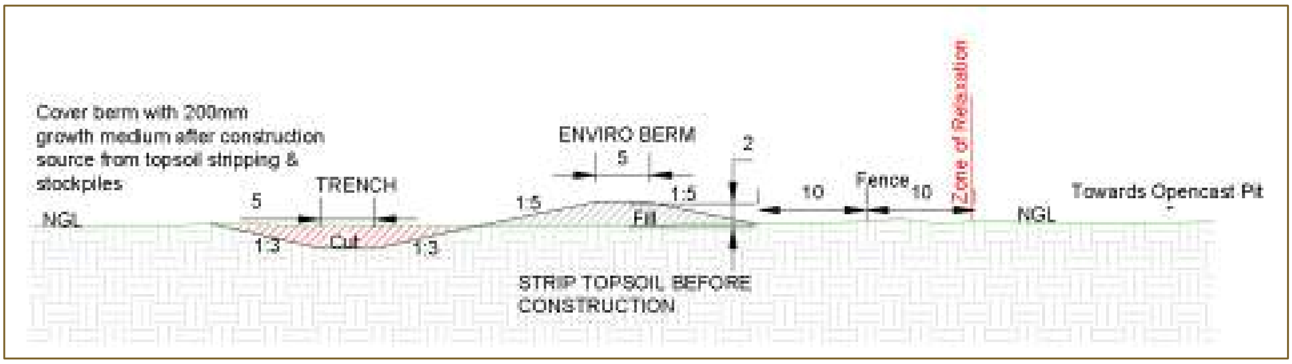


Figure 25: Open Pit: Typical section of trench and enviroberm

5.7.4 Open Pit: Gaps and Uncertainties

The following uncertainties remain for this closure scenario:

- The long term stability of the pit side walls remains uncertain and can have a residual risk if future failures affects the measures to deter access to the pit, i.e. trench, berm and security fence.

5.8 PRE-1912 TAILINGS

5.8.1 PRE-1912: Current Status

The Pre-1912 Tailings Dump is located to the east of the open pit and the current footprint is ±13 ha. The dump was deposited during initial mining before 1912 and was only recently disturbed when a portion of the facility was reprocessed. The largest portion of the dump was removed during reprocessing with portions remaining on the eastern and southern sides of the facility. The remaining portions of the dump forms separate undulating and high areas of up to 20 m and very steep remaining slopes, i.e. more than angle of repose, where material was loaded. Large trees and grass have established on the lower gradient eastern area and the southern side of the area. The slopes of the dump do not show very deep erosion gullies, although the facility was never rehabilitated or stabilised in any way. This is in contrast to many other coarse kimberlitic tailings facilities that shows extensive erosion donga formation over time. The eastern portion of the dump slumped to a low gradient during deposition and grass and trees have established through succession. Large trees (mainly *Eucalyptus spp.*) have established on the southern side of the facility.

5.8.2 PRE-1912: Design Constraints / Limitations

There are minimal rehabilitation design constraints for the Pre-1912 area. There is sufficient space around and on the disturbed footprint to reshape the remaining steep slopes. The following can be regarded as design constraints:

- Reshaping to reach the optimal design gradient of 18° will form sharp dump tops in several areas that is not practical. Two of the remaining high areas will therefore be cut off and filled into low laying areas to provide a gentle undulating area after rehabilitation;

- It will be ideal not to disturb the vegetation that has established on the eastern low gradient slopes and only selective covering with topsoil between large trees is proposed for this area. No further reshaping is required; and
- Reshaping on the southern side must be done carefully to retain the large indigenous trees that have established on this area.

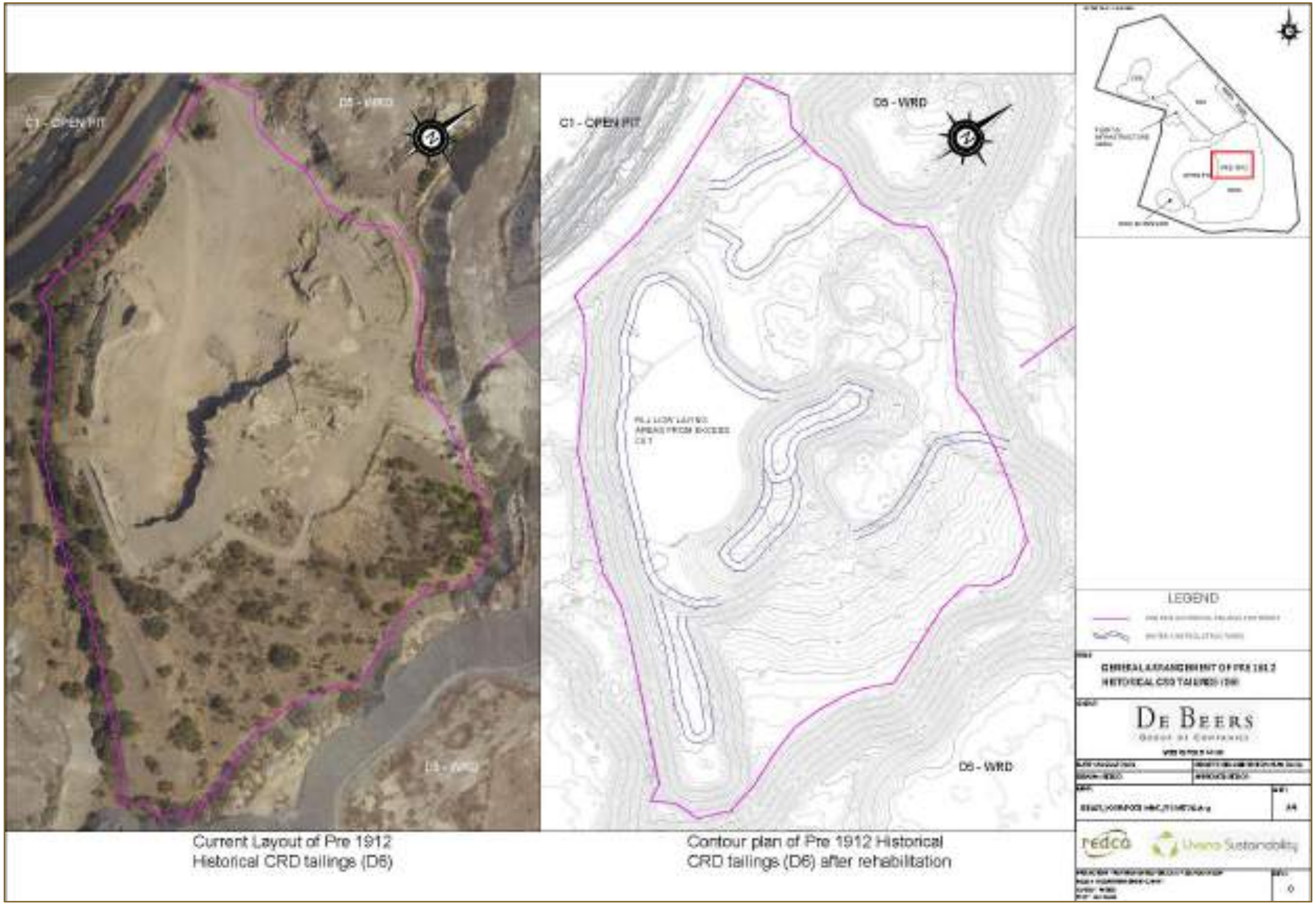


Figure 26: Pre-1912: General Arrangement

5.8.3 PRE-1912: Closure Actions

The actions to rehabilitate the Pre-1912 area are presented in Table 10 with reference to the applicable line items in the cost estimate sheets. The implementation plan and scheduling is presented later in this report.

Table 10: Closure Actions for the Pre-1912 area

Closure Action	
Reshaping	
Report Figure Reference:	**Figure 26, Figure 27**
Drawing Reference No:	**DB037_07A, 07B, 11**
Reshaping of steep slopes is required to ensure long-term ecological stability, to reach the end land use by limiting erosion, and effectively cover the area with a suitable growth medium. The following actions will be implemented: • Reshape all steep slopes from the current angle of repose (± 37°) and steeper gradients (where material was loaded) to the design gradient of 18° (1:3) to reduce the gradient and make the slope accessible for other rehabilitation actions; • Cut the top of the two high dumps up to the design elevation to avoid the construction of peaks and provide workspace during reshaping. Load and haul the material to fill the low laying area between the high dumps; • Reshape the slopes on the southern side in a balanced cut and fill operation to the design gradient; • Reshaped slopes must be even and rather concave than convex and without any windrows in any direction or deep tracks remaining up and down the slope; • Reshape all uneven surfaces (general reshaping) to even out the areas to the extent that the placing of cover material can be controlled at the average specified depth, as well as to improve the drainage pattern of the areas where needed. This action was not costed separately, because it was assumed that this material forms an even surface after reshaping and that the preparation of surfaces are also included in the rate for load, haul and place of growth medium material.	
Growth Medium Cover	
Report Figure Reference:	**Figure 26, Figure 27**
Drawing Reference No:	**DB037_07A, 07B, 11**
The disturbed and reshaped area must be covered with a suitable growth medium for the establishment of the vegetation cover to ensure the end land use. The growth medium will also support resistance against erosion to ensure long-term stability of areas susceptible to erosion. The following actions will be implemented: • Cover all reshaped slopes with a suitable growth medium up to a minimum average depth of 200 mm; • Cover all reshaped and prepared top areas with a suitable growth medium up to a minimum average depth of 100 mm; • Source suitable soil from the topsoil stockpiles as follows: o Cover the reshaped areas from topsoil stockpile TS9 (located to the south of the pit between the Main and Southern WRD); o Cover the remainder of the area from topsoil stockpile TS11 (located to the west of the pit) or TS8 (located to the east of the WRD) if TS9 does not have sufficient material; • Cover the low gradient eastern portion of the area by selectively dumping material in open areas and spreading material between trees to minimise the disturbance to large trees; • Rip the covered areas on contour (depth 300 mm, tine spacing = 1 m) to alleviate any compaction during placing of the material, mix the cover layers with each other and with the underlying material to increase coarseness and infiltration.	
Water Control	
Report Figure Reference:	**Figure 26, Figure 27**
Drawing Reference No:	**DB037_07A, 07B, 11**
The reshaping of steep slopes and covering of erodible material will reduce the erodibility of the surface layer, but a critical component is the construction of suitable water control structures to control runoff. The following actions will be implemented: • The rehabilitated slopes will drain freely to the surrounding environment; • Construct crest berms on the edge of the remaining flat top areas to contain runoff and prevent uncontrolled concentrated flow over the edges and slopes; • Construct contour berms on the indicated position on the longer slopes to reduce the slope length. The contour berms must drain freely at a gradient of 1:100 to a stable discharge position. There will be a remaining low laying area to the east of the Pre-1912 area against the western slopes of the WRD where some runoff will accumulate and pond before infiltration and evapotranspiration. This is outside the ZOR of the pit and assumed not to be a risk to future pit stability. This area cannot be made free draining without excessive amounts of earthworks.	
Fencing	
Report Figure Reference:	
Drawing Reference No:	
The mitigation measures to address the risks associated with the successful establishment of vegetation and maintenance of newly rehabilitated areas requires that the rehabilitated areas be fenced off. This will include the following actions:	

Closure Action	
• The Pre-1912 area will not be fenced off separately, but fit in with the fencing layout of the WRD; and • Construct and maintain a firebreak along the existing security fence.	
Vegetation	
Report Figure Reference:	**Figure 26, Figure 27**
Drawing Reference No:	**DB037_07A, 07B, 11**
Soil amelioration to provide a suitable growth medium and the establishment of vegetation is the same for all rehabilitated areas and are discussed in Section 5.12.	

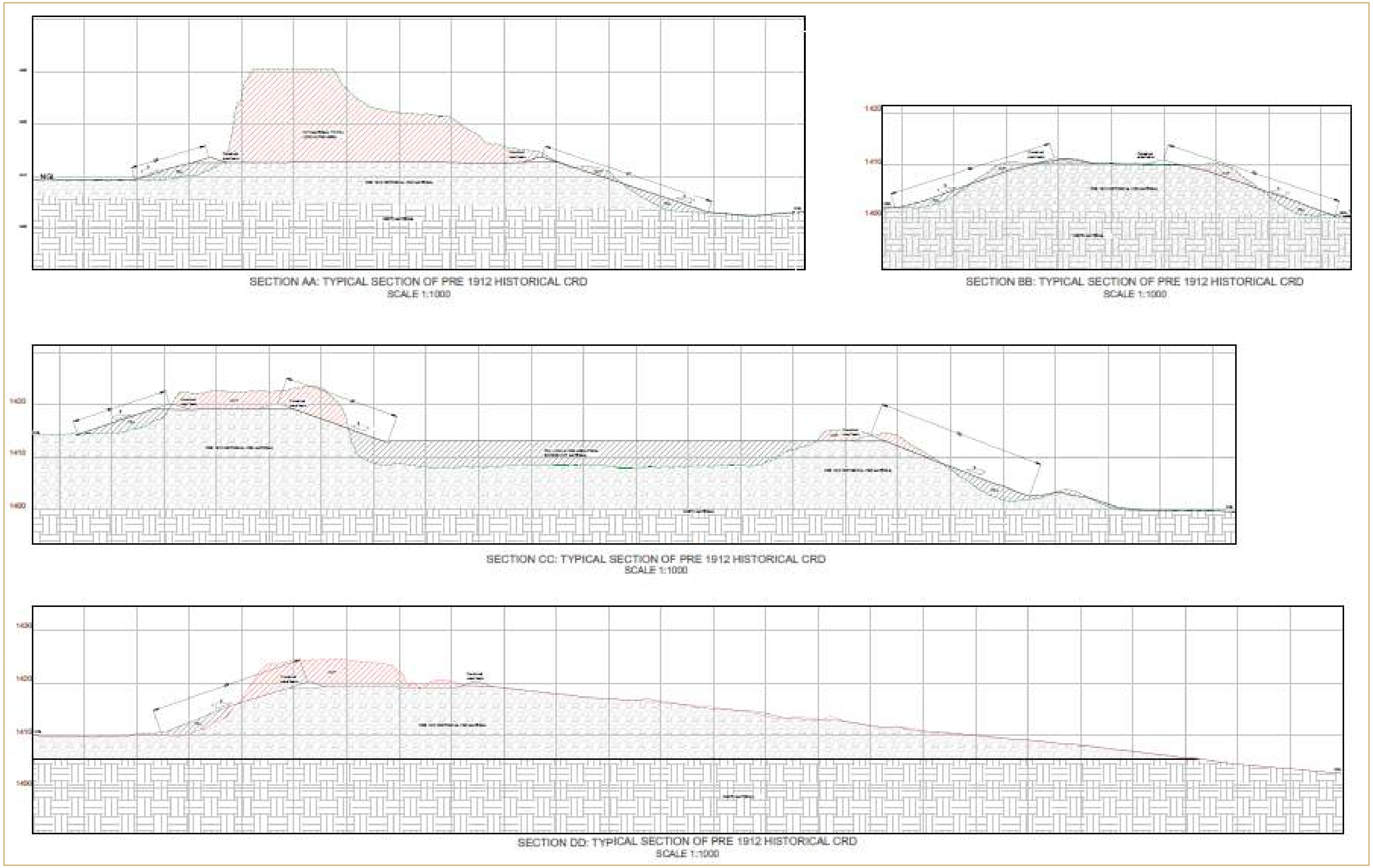


Figure 27: Typical sections for the reshaping of the remaining Pre-1912 dumps

5.8.4 PRE-1912: Gaps and Uncertainties

The following uncertainties must be addressed to improve this design and finalise the rehabilitation plan for implementation. Some of these uncertainties are addressed during implementation.

- The Pre-1912 may be considered a resource and covering may affect the quality or influence future processing.

5.9 WATER MANAGEMENT STRUCTURES

The Storm Water Control Dam (SWCD) and Return Water Dam (RWD) are located to the northeast of the FRD next to the mine boundary. The RWD is lined with a HDPE liner and the SWCD has only a coarse riprap layer in the basin. Seepage and storm water drain to the RWD through a sediment trap with earth trenches around the northern side of the FRD. Penstock water is also routed to the RWD with the seepage trenches. The RWD spill into the SWCD during flood events. The SWCD is also used as raw water buffer dam. The SWCD are excavated into the ground to a depth of ±8 m. The embankments are maximum 3 m high on the downstream side. The RWD is ±6m deep. The SWCD has a capacity of 275,000 m^3 and the RWD a capacity of 75,000 m^3. The dams cannot be made free draining without the infilling of large quantities of material. The facilities will be rehabilitated in the following manner (see Figure 28):

- Dewater the facilities during construction of works and use the water for dust suppression if the water quality allows, otherwise pump the water to the open pit to enhance the formation of the pit lake;
- Remove the HDPE liner from the RWD and dispose at a licensed waste facility;
- Cover the floor of the dam basins with a coarse basalt rock layer (100 – 300 mm size) up to an average thickness of 300 mm to act as sink for direct rainfall and form a solid bottom layer to reduce the risk of free standing water and muddy conditions;
- Reshape the embankments down to the surrounding ground level and to a gradient of 1:5 to the inside of the dam;
- Cover the reshaped embankment slopes and surrounding disturbed areas with 200mm soil;
- Construct a storm water diversion berm on the upstream side of the area to divert storm water around the facility; and
- Ameliorate and vegetate the backfilled dam basins and surrounding areas.

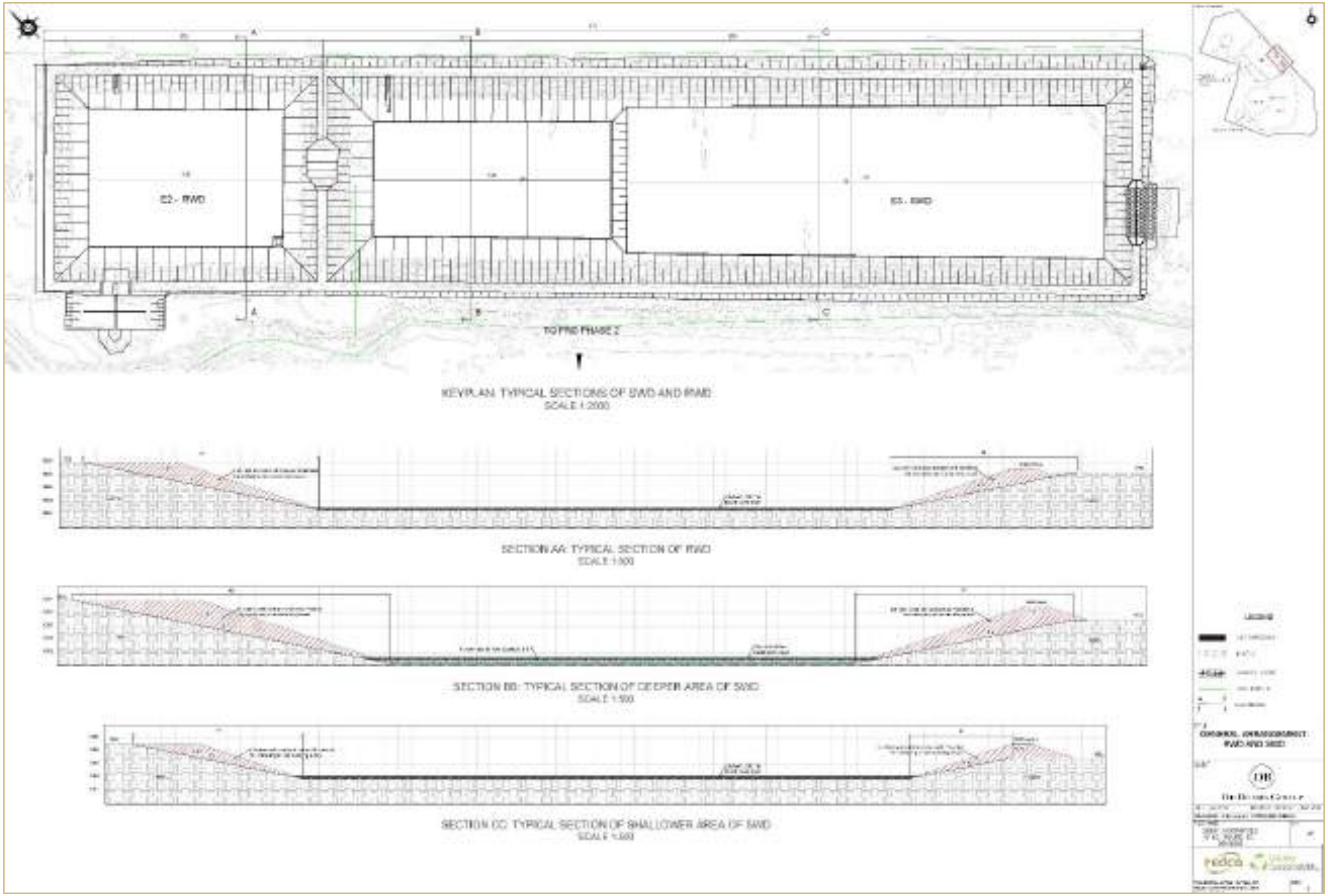


Figure 28: SWD & RWD: Typical section illustrating infilling and reshaping of embankments

5.10 SOIL STOCKPILES

Voorspoed Mine has diligently stripped topsoil before constructing infrastructure and residue facilities. There are 11 topsoil stockpiles around the mine area (see Figure 29). The average height of the stockpiles is all below 1.4 m, except for TS9 that is just below 5 m high. There is a surplus of topsoil (see Section 5.11) on the stockpiles and there is no need for borrow pits. The topsoil stockpiles have some vegetation cover, but it is not comparable to the natural environment and contributing only partially to the end land use. Weeds have also established on the stockpiles. The remaining topsoil stockpiles will be rehabilitated as follows:

- Reshape the stockpiles to form a free draining area that integrates with the surrounding drainage pattern;
- Allow several discharge positions from the top of the dumps to the surrounding ground level to reduce concentration of runoff and erosion;
- Shape and drain the dumps to the upstream side of the surrounding terrain to avoid runoff over the crest of the dumps;
- Keep the reshaped dumps undulating to retain some runoff and improve the vegetation cover;
- Ameliorate the soil and establish grass and tree species as specified.

The footprints of the stockpiles that were used to cover other rehabilitation areas will be rehabilitated as follows:

- General reshaping of the footprint during loading of material to leave a fairly even terrain;
- Rip the footprint on contour to a depth of 300mm to alleviate compaction;
- Ameliorate the soil and establish grass and tree species as specified.

Figure 29: Topsoil stockpiles at Voorspoed Mine

5.11 MATERIAL BALANCE

5.11.1 Topsoil

The topsoil stockpiles are depicted in Figure 29 and the quantities as well as allocation to the different rehabilitation areas are summarised in Table 11. There is a surplus of topsoil available and some of the stockpiles or portions will be rehabilitated in situ.

Table 11: Topsoil Material Balance for Voorspoed Mine

Topsoil Stockpile Quantities 2019					Allocation to Rehabilitation Areas					
	Volume (m^3)	Area (m^2)	Ave depth (m)	Qty of stockpile used	CRD	FRD1	FRD2	Plant	Buildings	WRD
TS1	26,498	37,709	0.70	26,498	26,498					
TS2	97,023	158,957	0.61	51,405		32,000		19,405		
TS3	68,597	48,827	1.40	35,000	35,000					
TS4	21,606	17,475	1.24	21,606	21,606					
TS5	4,987	9,854	0.51	0						
TS6				0						
TS7				0						
TS8	249,502	210,933	1.18	99,801			49,900			49,900
TS9	251,750	52,140	4.83	151,050						151,050
TS9a				0						
TS10	97,042	78,782	1.23	0						
TS11	115,143	112,927	1.02	115,143				66,783	48,360	
Total	**932,147**	**727,604**		**Allocated:**	83,104	32,000	49,900	86,187	48,360	200,950
				Required:	79,837	29,318	48,042	84,900	47,000	195,208
				Balance:	3,267	2,682	1,858	1,287	1,360	5,742

The following can be noted:

- TS5 will not be used, because the material is mixed with less suitable soil;
- TS6 were not considered, because it is a small dump and overgrown with grass;
- TS7 were not considered, because the material seems predominantly whitish weathered shale material;
- TS9a has since been used and the footprint covered by the southern WRD;
- TS9 will not be used in total and the remainder will be rehabilitated in situ;
- TS10 will not be used at all.

5.11.2 Basalt

Basalt is needed for rehabilitation for the following actions and the total volume required is summarised in Table 12:

- Fill the remainder of the primary crusher void after disposal of inert concrete and building rubble. Fill the void to an additional 20% of capacity of the void up to at least 2 m above the surrounding ground level to allow for future consolidation and subsidence;
- Construct a coarse filter wall upstream of the Northern Pan to capture any possible sediment from a portion of the newly rehabilitated plant footprint area;
- Rocks for the filling of gabions and reno mattresses for water control structures.

Table 12: Basalt Required for Rehabilitation at Voorspoed Mine

	Required	Qty (m^3)	Unit
1	Primary Crusher Void	0	m^3
2	CRD slopes	85,500	m^3
3	FRD1B	21,329	m^3
4	FRD2	32,064	m^3
5	Gabions	320	m^3
	TOTAL	139,213	m^3
	Total Stockpile Available	541,388	Tonnes
	SG	1.9	
	Total Stockpile Volume	284,941	m^3
	Assume 50 % Suitable	142,471	m^3
	Remaining	3,258	m^3

5.12 SOIL AMELIORATION & SEEDING

Establishing a good indigenous vegetation cover is a key component of the closure actions to achieve the end land use, address environmental impacts and support the long-term sustainability of the rehabilitated area. It is normally not sufficient to allow for natural re-vegetation on highly disturbed areas, because of the quality of the growth medium and the fact that stripped soil cannot always be used directly. Establishing vegetation is a relatively small cost in relation to the other closure actions, but supports the other rehabilitation actions and is indicative of the success of the overall rehabilitation. Quality topsoil is not always readily available whether stockpiled or in the natural environment and the available material for growth medium must be ameliorated and fertilised to establish and support vegetation growth. The following closure actions apply:

- Ameliorate, fertilise and cultivate the area with products as specified based on a soil analysis of the growth medium at the time of rehabilitation; and
- Seed the area with the recommended mixture of indigenous vegetation species occurring in the area and adapted to the specific conditions

The most recent soil analysis of soil used on the WRD rehabilitation indicated the following requirements:

- The soil pH is satisfactory and no lime application is recommended;
- Broadcast 20 ton/ha compost three weeks before planting and work in 10-15 cm;
  - NOTE: Only 10 ton/ha was allowed for in the cost estimate, because the results from concurrent rehabilitation showed good results without the higher application;
- Broadcast 300 kg/ha 1:1:0(32) immediately before planting and work in 5 cm;
- Topdress with 150 kg/ha LAN six weeks after planting, but only after successful germination and establishment of grass and after the first rain event.

The following must be kept in mind when developing the final amelioration programme:

- The final mixture of growth medium must be analysed after reshaping and before procurement of ameliorants to confirm the amelioration recommendations;

Amelioration & vegetation will be done in the following manner:

- Soil preparation: Supply and spread ameliorants as per recommendation evenly over the required area. Spread mechanically or by hand, depending on the gradient of the slopes;
- Supply & deliver the organic material (compost) to the site: Spread the organic material evenly over the required area. Spread mechanically or by hand, depending on the gradient of the slopes;
- Cultivation of ameliorated areas: All the areas that received ameliorants have to be cultivated, mechanically (tiller or ripper) or by hand (pick) to a minimum depth of 50 mm. Cultivation on any slope, regardless of the steepness of the slope, will be done on contour to minimise the forming of erosion furrows;
- Establishment of vegetation: Seeding will be done by hand on areas indicated. A seed mixture as per recommendation will be supplied and sown at the recommended rate (kg/ha). The seed will be divided in smaller quantities (e.g. 5 kg) and areas to be seeded clearly marked to ensure an even spreading of the seed;
- Covering of seed: All seeded areas will be brushed (swept) with branches or raked to cover the seed (especially species with woolly seeds) with a thin layer of soil. A light agricultural roller or similar equipment can be used on the top area of the dump to fix seed. The need for covering of the seed can be tested during concurrent rehabilitation and omitted if germination is satisfactory.

The costing for establishing vegetation is based on a mixture of indigenous grass species that are adapted and occur naturally in the area. The species mixture used for the closure liability estimate is specified in the BoE section in the Final Closure Plan (Redco / Uvuna Sustainability, June 2019). The final species composition will depend on the availability of seeds of which some may not be readily available at the time of implementation. The grass species that are currently available and should be considered to increase diversity and resilience of the system are listed in Table 13:

Table 13: Grass species suitable for Voorspoed Mine

	Species
1	*Cenchrus ciliaris (Malopo)*
2	*Digitaria eriantha*
3	*Heteropogon contortus*
4	*Enneapogon cenchroides*
5	*Cynodon dactylon*
6	*Antephora pubescens*
7	*Schmidtia kalhariensis*
8	*Stipagrostis uniplumis*
9	*Eragrostis tef*
10	*Urochloa panicoides*

Trees and shrubs will be established, because this will enhance biodiversity, improve long term stability and create more diverse habitats for different grass species. Deep rooted vegetation, i.e. trees must be established on the benches of reshaped slopes to enhance infiltration and evapotranspiration and maintain the capacity of the benches. It can also serve to reduce the visual impact of straight lines on the rehabilitated dump. Tree and shrub species provide shade and shelter for different grass species, as well as a more favourable habitat to survive in the harsh conditions of the area. The following is relevant and can be considered:

- Trees and shrubs can be established either from treated seed or from saplings. Establishing trees from seeds takes longer to achieve the desired stand, but is less expensive. Not all tree species propagate successfully from seeds. Establishing trees as saplings ensures the required stand, but takes more aftercare and is more expensive;

- Grass around trees must be controlled until the trees have the ability to outcompete the grass species. Young trees should be watered to ensure survival;
- A project to establish trees can be a small community based project, including the harvesting of seeds, propagating trees in a nursery, planting trees and the required aftercare; and
- Tree seeds must be treated to overcome dormancy before being spread. The seeds can also be mixed with woodchips during the composting process and spread together with the compost;

All soil stockpiles must be actively ameliorated and seeded according to the above guidelines to improve the soil quality and create a seed bank.

6 FINAL REHABILITATION

6.1 Rehabilitation Implemented

The following rehabilitation works have been implemented (see Figure 30):

- WRD: The southern and eastern slopes of Lift 1 have been rehabilitated about 4 years ago. The areas have a good grass cover and an ecological assessment done in 2017 indicated that the area is comparable with the surrounding areas and can support the end land use. The northern portions of the eastern slope were rehabilitated a year later than the southern slopes, but also show a good grass cover. The slope lengths are about 55 – 60 m long. The slopes show good stability at this stage, despite minor erosion gullies that are visible. It was assumed for this assessment that the area will stabilise and no additional corrective actions were proposed or costed;
- WRD: The southern and eastern slopes of Lift 2 have been rehabilitated less than a year ago. Vegetation has germinated, but the area is still very sensitive. It was assumed for this assessment that the area will improve and stabilise and no additional corrective actions were proposed or costed;
- WRD: The bench between Lift 1 and 2 has edge berm walls, but these are the original temporary berms for water control and safety during construction. The crest walls must be trimmed or enlarged where needed and cross berm walls must be constructed on the bench. This aspect was included in the cost assessment;
- FRD: The north-western slope of FRD 1A and 1B was reshaped, covered and seeded. Vegetation has established, but the cover is not yet satisfactory and erosion is visible on the bottom portion of the slope of FRD 1B. The cost to cover this portion and re-seed it was included in the cost assessment;
- CRD: The northern portion of the eastern slope of Leg 1 was reshaped in one single slope to 18° and covered with 300mm soil just more than a year ago. Erosion gullies formed in the first rain season and the area was repaired subsequently. Contour berms were constructed on a portion of the area. The rehabilitated works are not according to the original design and the area must be monitored for stability. The cost to reshape the slope to have two benches and covering it again was included in the cost assessment.

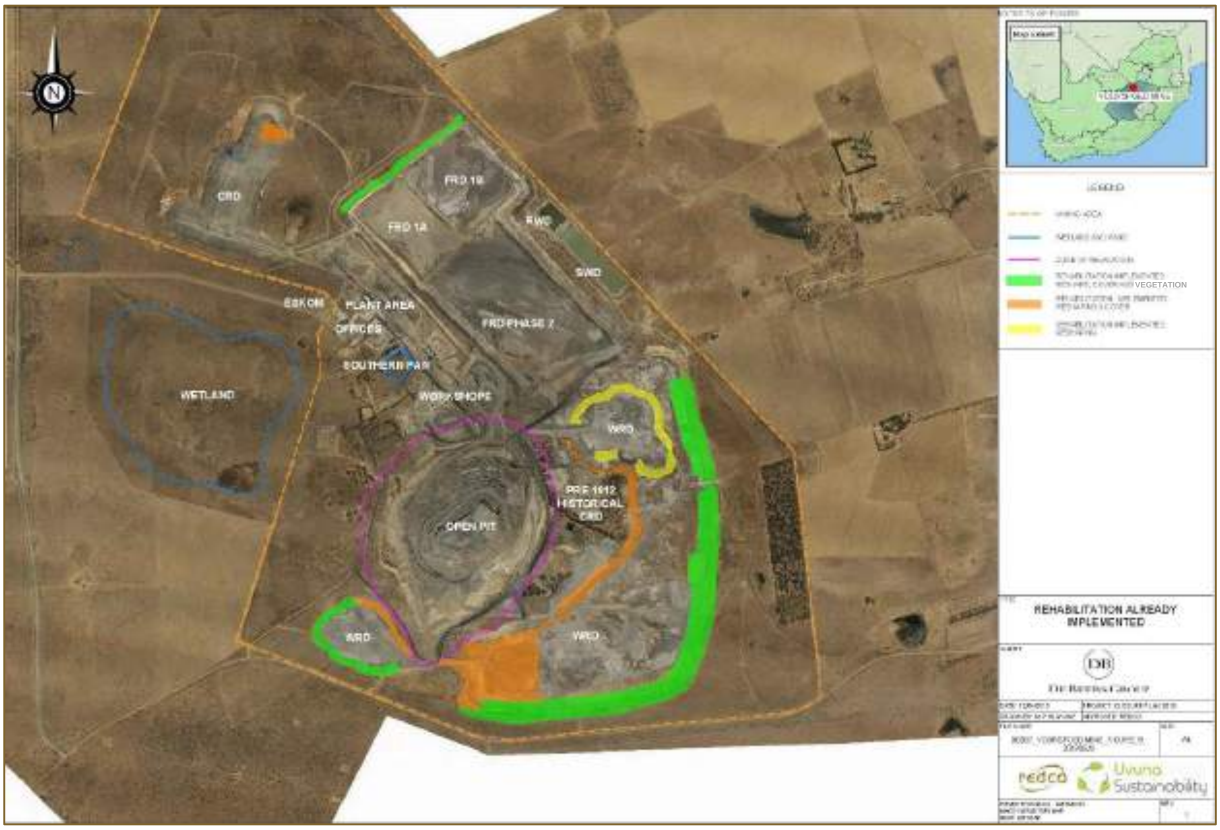


Figure 30: Areas where rehabilitation was implemented

6.2 Implementation Plan

A first draft of the implementation plan was developed for all outstanding rehabilitation work to serve as basis for further detailed planning and support the liability forecast. The implementation plan consists of a set of spreadsheets for different closure domains that details the actions, quantities, expected production rate, duration and resources (attached in ANNEXURE B), a set of accompanying drawings (attached in ANNEXURE A) as well as an implementation schedule (attached in ANNEXURE C). A proposed implementation schedule is illustrated in Figure 31. The implementation plan is based on the following assumptions:

- The work will be implemented by an external contractor that will provide the needed fulltime resources;
- Working time is 5 days per week and 7 hours (effective) per day; this is to account for inefficiencies, health and safety procedures, machine availability, unforeseen standing time etc.; working longer hours will require more operators to do double shifts and a possible increase in unit rates;
- The following earthworks equipment is required as a minimum:
    - o 2x D10 bulldozers for bulk reshaping of slopes, final general reshaping of large areas and ripping of compacted areas;
    - o Load and haul team consisting of 3.6 m^3 wheel loader, 3 to 4x 40 ton ADT's, 1x D8 for spreading soil; grader and water truck that maintain haul roads;
    - o Some of the load and haul actions will require an additional 1x D6 bulldozer to assist with the spreading of soil (e.g. soil covering on the CRD);

  - 1x D6 bulldozer to construct berms with in situ material;
- The demolition contractor will establish the needed equipment to demolish structures and handle the demolition waste;
- The spreading of compost, fertilisers and seeds will all be done by hand to provide job opportunities; about 40 people is required to implement the works in the indicated time;
- The construction of gabion structures will require a team of at least 20 people;

The following can be noted from the implementation schedule:

- The critical path on the schedule is the reshaping of slopes with bulldozers;
- There are short periods when the load and haul team is not active, although there is some overlapping of the load and haul team that must still be optimised;
- Work is scheduled to start on the WRD, because the area is almost ready for complete rehabilitation and presents a large footprint area; this will allow the longest vegetation phase to be implemented as soon as possible;
- Demolition of the conveyors must start as soon as possible on the CRD, because the other rehabilitation work on this facility has a long duration;
- The construction of the buttress at FRD 1B is a large work component and additional resources or an alternative design can bring forward the final completion date, because the FRD rehabilitation work is the last work to be done;
- The top area of FRD 2 has just 18 months to dry out, which will most probably not be sufficient to allow heavy equipment traffic; increasing the resources on other areas will therefore not shorten the overall project if the drying out of the FRD top areas is a constraint;
- Conversely the project duration can be shortened if no work needs to be done on top of the FRD and an additional load and haul team and bulldozers can be established;
- The establishment of vegetation must still be optimised, because some of the completion dates are not at the optimal time, i.e. early in the rain season;

It is clear that there are several other options available to optimise the implementation schedule and this should be done in close consultation with the client in follow up improvements of the rehabilitation plan. This can only be done once a decision has been made on the implementation model, i.e. the use of internal or external resources.

ID		Area and Activity	Task Name	Start	Finish
1			CLOSURE	Tue 19/12/31	Tue 19/12/31
2			Mine closure plan	Mon 19/05/20	Fri 30/03/15
3		D5	WRD	Wed 19/05/22	Wed 20/05/06
18		D1	CRD	Tue 19/12/17	Thu 22/02/03
43			FRD	Mon 20/03/02	Fri 21/07/16
85		D7	Basalt Stock pile	Tue 21/09/21	Fri 21/11/26
91			Topsoil stockpiles	Mon 20/03/02	Fri 24/07/19
124		C1	Open Pit	Thu 19/12/05	Tue 20/04/21
134			Buildings and Structures	Mon 20/03/02	Mon 21/10/18
166		D6	Pre 1912	Tue 20/02/18	Mon 20/05/11
172		E1	Stormwater trench	Thu 21/09/09	Mon 21/11/15
176		E2	Return water dam	Wed 24/01/31	Wed 24/03/13
182		E3	Storm water dam	Thu 24/03/14	Wed 24/07/17
186		F8	Mine footprint invader control	Mon 19/05/20	Fri 19/06/28
188		J1.1	Maintenance	Thu 19/12/05	Wed 24/07/10
197		H1.1	Monitoring	Tue 20/03/24	Fri 30/03/15

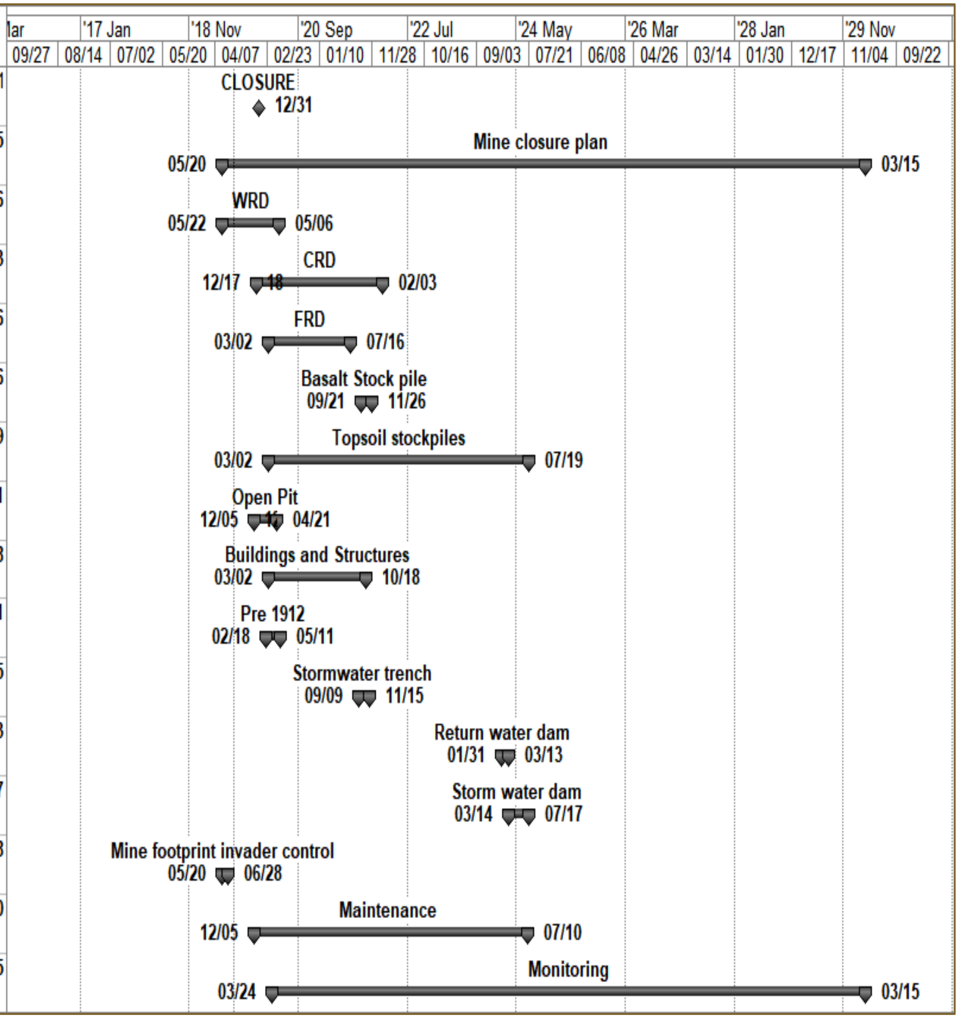


Figure 31: Typical Implementation Schedule (WRD)

7 Bibliography

E-Tek Consulting / Redco, June 2016. *Voorspoed Mine: Pit Closure Study,* s.l.: s.n.

Golder Associates Africa (Pty) Ltd, February 2019. *Technical Evaluation of the Risks, Impacts and Management Requirements into Pit Backfilling Versus Current Mine Plan (Pit Lake), Report 1792363-318923-1_Rev1.* s.l.:s.n.

Redco / E-Tek Consulting, August 2014. *DeBeers Group of Companies, Voorspoed Mine, Improved Preliminary Closure Plan.* s.l.:s.n.

Redco / Uvuna Sustainability, June 2019. *DeBeers Group, Voorspoed Mine, Updated Final Closure Plan 2019,* s.l.: s.n.

ANNEXURE A Drawings & Plans Illustrating Rehabilitation Proposals & Planning

(Attached)

Drawing Register:

DRAWING NO	DESCRIPTION
DB037_1	General Arrangement: FRD Facility
DB037_2	Details & Sections: FRD Facility
DB037_3	Set of Sections: FRD Facility
DB037_4	General Arrangement: CRD Facility
DB037_5	Details & Sections: CRD Facility
DB037_6	Set of Sections: CRD Facility
DB037_7	Details & Sections: WRD, SWCD, Enviro Berm & Crusher Void
DB037_8	Reference drawings

ANNEXURE B Implementation Plan Spreadsheets

(Attached)

ANNEXURE C Implementation Schedule

(Attached)

APPENDIX E

Voorspoed Mine End Land Use Plan, NEKA Sustainability Solutions, 2017

REPORT

Proposed End Land Use Plan for Voorspoed Diamond Mine

Prepared by:
Dr M. E. Aken
NEKA Sustainability Solutions

Submitted to:
Mr Hans Kgasago
Manager Mine Closure:
De Beers Voorspoed Mine
Enquiry No: VS-E-047-16

EXECUTIVE SUMMARY

This report presents a proposed End Land Use Plan (ELUP) for the De Beers' Voorspoed Diamond Mine, which is located approximately 35 km north of the town of Kroonstad in the Free State Province, South Africa. The mine has commenced closure-planning work ahead of anticipated mine closure in 2021, and this ELUP forms an integral part of the closure planning for the mine.

NEKA Sustainability Solutions was contracted to prepare an ELUP that is aligned with the mine's other closure planning initiatives, including the mine's Preliminary Mine Closure Plan, Final Rehabilitation Plan, and Social Closure Plan, and is aligned with the Fezile Dabi district municipality's Integrated Development Plan (IDP).

The client's brief in preparing this ELUP was to:

- Conduct a soil survey over the De Beers-owned Voorspoed properties to determine the land capability and possible productive end land use potential of the farms;
- Conduct a vegetation assessment over the Voorspoed properties to determine veld condition and carrying capacity for livestock farming;
- Develop a comprehensive list of potential end land uses for evaluation at a key stakeholder meeting to determine which of the options had the highest likelihood of succeeding beyond closure; and
- Evaluate the business case (financial viability) for the selected end land use (ELU) options.

Amongst the wide variety of potential ELU options proposed, the agricultural use of the Voorspoed properties post-closure was deemed to be the most appropriate in the regional context, and the most likely to be sustainable in the long term. The agricultural ELU options that were selected for economic evaluation included the production of selected crops (maize and sunflower), domestic livestock farming (cattle and sheep), and also game farming, and combinations of these.

One of the objectives of the economic evaluation was to determine if any of the proposed ELU options could generate sufficient profit to support the required monitoring, maintenance and remediation work anticipated during the post mining closure monitoring phase, and beyond.

The land capability assessment indicated that the Voorspoed properties could be utilised for extensive sheep, cattle and game farming, with limited cropping on existing cultivated lands. The general shortage of surface and groundwater in the area mitigated against the selection of intensive agriculture in the form of large-scale centre pivot irrigation of maize and vegetables, and the greenhouse cultivation of vegetables and cut flowers. The high cost of importing/pumping irrigation water from remote water sources, if this water use could be licenced, would render the irrigation enterprises marginal to unprofitable.

Some of the potential end land use options that were considered, but not evaluated further, were those that required environmental authorisation under the NEMA EIA regulations (for example cattle feed lots, commercial piggeries, or large chicken farms). These ELU options would be more difficult to implement because of the protracted timeline for permitting and the likely strong opposition from neighbouring stakeholders because of nuisance odours. In addition, the limited surface and groundwater resources on Voorspoed would likely be insufficient to water the high densities of livestock kept, with a further compounding factor being that these intensive farming enterprises would have a far greater pollution impact on the existing surface and groundwater resources in the area.

In total, eight different farming scenarios were evaluated for their profitability over a 10-year period.

The first four scenarios evaluated included all of the Voorspoed properties, and required the purchase of the appropriate feedstock of cattle, or sheep, or game (or a combination of these). These four scenarios also included the purchase of agricultural equipment to maintain cropping activities on the existing cultivated lands on Belmont and Welvaart for the production of maize and sunflower seeds, respectively.

The first four mixed ELU options evaluated for all farms were:

- **Scenario 1.1**: Crops + cattle +sheep
- **Scenario 1.2**: Crops + cattle only
- **Scenario 1.3**: Crops+ sheep only
- **Scenario 1.4**: Crops + game only

None of the above scenarios met the arbitrarily set business case "success metrics", which were that the enterprise should have a positive cash flow within 3 years, that the enterprise should generate a minimum annual cash flow of R2.5 million, and that all debt should be paid back within 10 years. Many assumptions were made in the financial modelling and these are described in the report. Most importantly it was assumed that the properties and existing buildings were already owned by De Beers and would therefore not need to be purchased, but that all other farming equipment, livestock and game, as well as fencing, would need to be purchased or installed.

All options above had a negative NPV. While farming with domestic livestock produced a positive cash flow from Y1, the annual cash flow for these scenarios was only ~ R1.2 million. None of these enterprises had reduced their debt significantly by Y10. The annual cash flow for game farming was, however, significantly higher (growing from R5 million in Y3 to R8 million in Y10), however the bank overdraft had only been halved by Y10. The main constraint for the above scenarios was the high cost of capital (bank loans and interest on loans) needed to fund the purchase of stock and equipment, and the relatively low margins made on crops and stock or game sold.

In an attempt to secure capital to support business start-up purchases, a second set of scenarios was evaluated where the farms Belmont and Welvaart were sold off, with the remaining properties being used for livestock or game farming. With the loss of cultivated land on the sold properties, no cropping was included in these scenarios.

The second set of ELU options evaluated for the remaining farms were:

- **Scenario 2.1**: Cattle + sheep
- **Scenario 2.2**: Cattle only
- **Scenario 2.3**: Sheep only
- **Scenario 2.4**: Game only

Counter intuitively, the enterprises in this second set of scenarios also did not meet all of the business success metrics, although farming with game came close. While all enterprises had a positive NPV (as a result of the interest earned from capital invested from the sale of the two farms), this capital grew slowly over the 10 years, and the annual cash flow was low to negative for all domestic livestock farming scenarios. Only game farming on the reduced property area produced an annual cash flow of R3 million in Y3, growing to R5 million in Y10, and provided sufficient income to settle the bank loan in Y9.

The results of the preliminary findings of the economic assessments for the eight ELU scenarios presented above were reviewed by De Beers' senior manager, ecology and DBCM properties, who provided constructive input to the game farming scenarios. His main concern was that the sale prices used in the models for game farming were too high. The proliferating game farming industry in South Africa over the past 10 years has created a surplus of game, resulting in lower game prices being realised than used in the economic models above. The game models were rerun with sale prices reduced by 20%. The results indicated that all game farming ELU options were marginal to non-profitable.

In summary, none of the ELU options evaluated presented a positive business case for Voorspoed to take forward as an option that would provide a "cash neutral" or profitable enterprise to fund all monitoring and maintenance work required during the post-closure monitoring period. The main impediment for each of the options evaluated was the high cost of capital for monies loaned from the bank for the purchase of stock and equipment, and the relatively low margins made on crops and stock or game sold.

The land capability and pasture assessments of the Voorspoed properties, including rehabilitated areas on the mining rights, indicated that these areas are suitable for agricultural production and can be sold off for a profit that can be invested to fund post-closure monitoring and maintenance.

The sale of the Voorspoed properties, excluding Welvaart (which would be retained because it is in the zone of influence of the FRDs), would optimistically raise R16 322 900 (2 040 ha @ R8 000/ha). If this capital were invested at an interest rate of 6% pa with a drawdown of R200 000 per month (i.e. R2.4 million pa) then the capital would last for approx. 8 years.

In terms of next land use, the Voorspoed properties can be used for profitable gain if integrated into existing and established farming enterprises in close proximity to the mine, and particularly where any start-up capital needed is kept as low as possible.

Contents

LIST OF ABBREVIATIONS

ARC – ISCW	Agricultural Research Council, -Institute for Soil, Climate and Water
CEC	Cation Exchange Capacity
COM	Chamber of Mines
CRD	Coarse Residue Deposit
CSI	Corporate Social Investment
EIA	Environmental Impact Assessment
ELU	End Land Use
ELUP	End Land Use Plan
EMP	Environmental Management Plan
FRD	Fine Residue Deposit
IDP	Integrated Development Plan
MPRDA	Minerals and Petroleum Resource Development Act (Act 28 of 2002)
MRA	Mining Rights Area
NEM:BA	National Environmental Management: Biodiversity Act (Act 10 of 2004)
NEMA	National Environmental Management Act (Act 107 of 1998)
NPV	Net Present Value
NSDP	National Spatial Development Perspective
NWA	National Water Act (Act 36 of 1998)
NWU	North-West University, Potchefstroom
SLP	Social Labour Plan
SoW	Scope of Work
WRD	Waste Rock Dump

1. INTRODUCTION

The De Beers' Voorspoed Diamond Mine (Voorspoed) is located approximately 35 km north of the town of Kroonstad in the Free State Province, South Africa, and is situated on De Beers-owned properties including the farms Voorspoed 401, Voorspoed 2480, Geldenhuys 1477 and Morgenster 772. These farms comprise a total area of 1 947.02 ha, of which 994.66 ha comprises the Voorspoed Mining Rights Area (MRA). De Beers also owns two properties to the east of the MRA, namely Welvaart 1011 (471.09 ha) and Belmont 2390 (378.58 ha), both of which are leased out to the neighbouring farmer (and previous landowner). The total area of the De Beers' properties, including the Voorspoed mining rights area and remainder of Voorspoed 401, as well as the Welvaart, Belmont and Morgenster farms, is 2 796.69 hectares.

Voorspoed Mine is nearing the end of its economic life of mine, which is currently estimated to be 2021. This provides a five-year window within which the mine will detail it's closure planning to ensure that it not only complies with current legislation and company policies and standards for mine closure, but also to ensure that current and final closure rehabilitation activities are conducted to support the proposed end land use (ELU) options.

The end land use plan (ELUP) presented in this report is intended to inform, in part, the final mine closure plan for Voorspoed.

NEKA Sustainability Solutions (NEKA) was contracted by Voorspoed to develop an ELUP for the De Beers' properties associated with the mine. An important requirement from De Beers was that the ELUP developed should generate income that would make the mine at least cash neutral, if not profitable, during the post-closure monitoring period, and beyond.

1.1 Client's Brief

The scope of work provided by Voorspoed to develop the ELUP included the following:

- Determine the land capability of the De Beers-owned properties associated with the Voorspoed Mine;
- Undertake a veld condition assessment on the same properties, and determine their stock carrying capacity;
- Review an existing list of potential end land use options for the mine and surrounding properties, and evaluate all feasible additional end land uses and their suitability for implementation;
- Review critical success criteria in considering potential end land use options;
- Identify at least three most feasible post-mining end land use options for Voorspoed Mine properties;
- Ensure that the ELUP is aligned with the detailed rehabilitation and closure plan, the socio-economic impact assessment, and the open pit closure plans; and
- Present a feasibility study that sets out a business case for the preferred ELU options for a period of at least five years post closure, bearing in mind Voorspoed's key objective of striving for a situation where the mine is cash neutral at closure, specifically during the post-closure monitoring period.

1.2 Battery limits for the study

The battery limits for the study were described in the scope of work and include all Voorspoed properties (2 796.69 ha) as shown in Figure 1 below. Table 1 provides a detailed breakdown of the component areas of the Voorspoed farms, the mining areas, and the MRA.

1.3 Current land use on the De Beers Voorspoed properties

The current land uses on the De Beers-owned properties at Voorspoed are shown in Table 1 below. The farms Welvaart, Belmont and Morgenster, as well as areas on the farm Voorspoed 401 that lie outside of the MRA, are leased to the neighbouring farmer for stock grazing, primarily cattle grazing, but also for raising sheep. Deeper soils on Welvaart and Belmont farms are cultivated for maize or sunflower seed production, and are occasionally planted to high value pasture species such as *Eragrostis tef*, which is baled for sale.

A total area of 2 503.18 ha on the Voorspoed properties is available for post mining land use, with approximately 285.22ha being unavailable as a result of mining disturbance. The waste rock dump (WRD) is being rehabilitated to grazing potential and was included in the area available for ELU planning.

The large wetland (pan) to the west of the MRA has been treated as a “no go” area during mining, and has been excluded from the areas currently leased to the farmer for livestock grazing. The wetland and buffer zone (~178.59 ha) were, however, included in the financial modelling when evaluating the profitability of different ELU options for Voorspoed.

Wetlands have special conservation status as sensitive landscape feature in terms of the NEM:BA, so this pan wetland will require careful management in any future land use scenario. Controlled grazing (by cattle, sheep or game) of the wetland in future will be important to maintain vigour in the vegetation assemblages in and around the pan. The pan will also provide additional grazing, with associated benefits to farming income.

It is interesting to note that historically (since 1912), significant portions of the properties currently owned by Voorspoed were used for dryland cropping of maize, sunflower, wheat, and sorghum where soils were sufficiently deep, while the remaining areas were used for livestock grazing. Many old 1:50,000 topo-cadastral maps of the Voorspoed farms show the areas that were cultivated in the past, and are now recognised as old lands used for grazing.

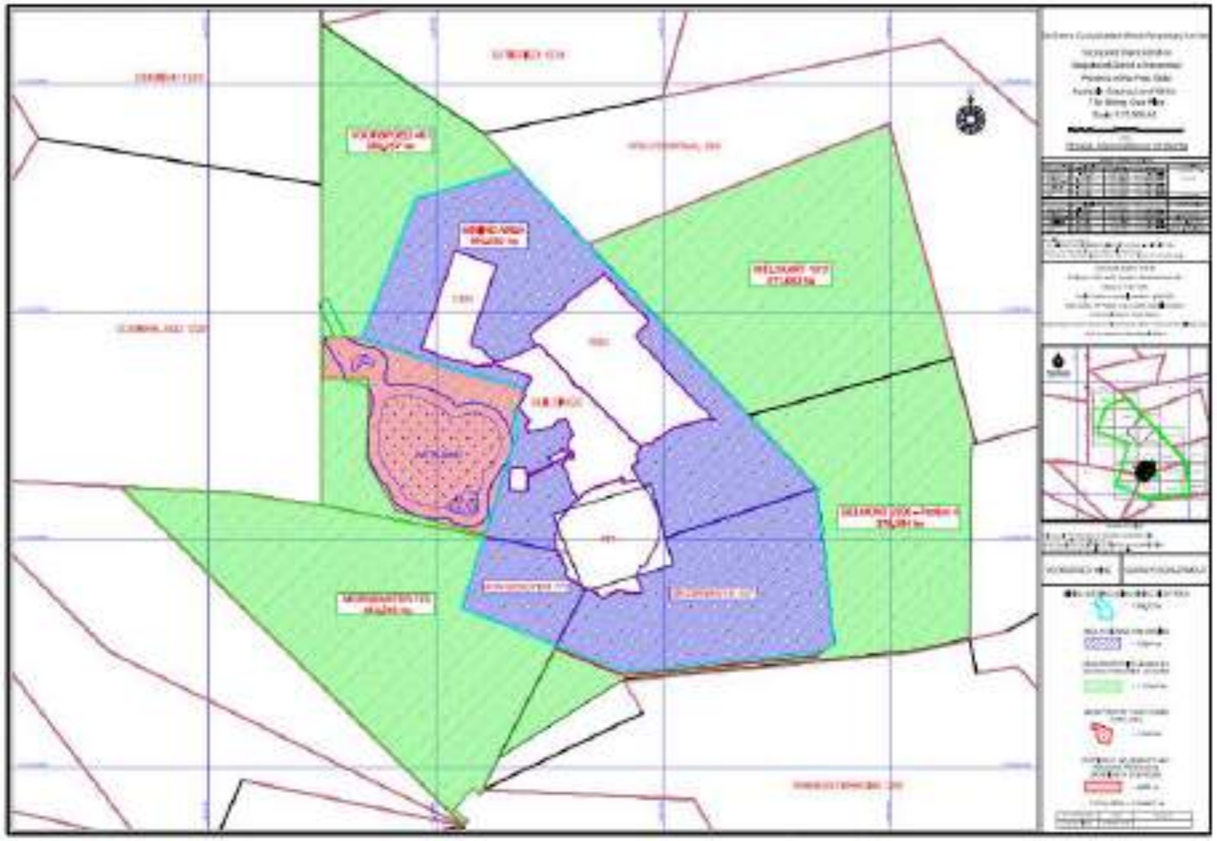


Figure 1: Map showing De Beers farms to be included in the Voorspoed ELUP. Areas in green are currently leased, while the wetland in pink, and the area in blue, within the MRA, will be available for grazing use at closure.

Table 1: Current land uses on De Beers-owned land at Voorspoed (all numbers are in hectares).

Property/Area	Current Land Use				De Beers-owned land	Land leased by Mr Leonard	Area sterilised by mining	Area of land available for ELU
	Cropland	Grazing	Wetland (no-go area)	Mining altered / unavailable				
Voospoed (unmined)		282.26			282.26	282.26		282.26
Morgenster (unmined)		483.22			483.22	483.22		483.22
Belmont	172.00	206.58			378.58	378.58		378.58
Welvaart	181.00	290.09			471.09	471.09		471.09
Mining right area (MRA)					994.66			
MRA - available for grazing		709.44						709.44
MRA - unavailable for grazing				285.22			285.22	
Road servitude				8.29	8.29		8.29	
Wetland			178.59		178.59			178.59
Column Totals	**353.00**	**1 971.59**	**178.59**	**293.51**	**2 796.69**	**1 615.15**	**293.51**	**2 503.18**
TOTAL ALL AREAS				**2 796.69**				

*The right hand block of the table shows the total hectares of De Beers-owned land, the lands leased to the neighbouring farmer (Mr Leonard), areas sterilised or unavailable as a result of mining, and the area of land available for inclusion in the ELUP.

1.4 Assumptions and Limitations

The ELU options for Voorspoed were developed with input from a limited number of key stakeholders with technical expertise in soils and land capability, vegetation assessment and stock carrying capacity, as well as experts in biodiversity conservation, mine closure planning and the financial evaluation of different farming models.

While every attempt has been made to ensure that the ELUP presented in this report is aligned with current regional and local planning, the objectives of government could shift in time, and may require the plan to be updated, if not revised.

It is understood that the proposed ELU options presented in this report will be subjected to scrutiny in a wider stakeholder forum as part of the mine closure public participation process. This process may present additional ELU options for further consideration and evaluation, however, it is hoped that the work presented here will help guide discussions on alternative ELU options that have not been covered in this report, but also it is hoped that the information presented will help moderate unrealistic expectations on ELU options that the Voorspoed properties could support on a sustainable basis. The different ELU options presented in this report for economic evaluation were not intended to be detailed farm plans ready for implementation, but rather to provide sufficient detail in terms of the different farming approaches to allow an economic comparison of the different farming options (scenarios) to be done with a reasonably robust level of confidence. If any one of the farming options proposed in this ELUP were to be considered for implementation, it should be presented for detailed farm planning and refined financial evaluation, primarily to improve confidence in the quantum of investment capital required and to determine cash flow and profitability into the future.

The high level pit water balance planned was not completed, in part because insufficient information was available to develop a stage storage curve, but also because a detailed hydrological and geohydrological study is currently being conducted to address the impacts of mining wastes and mineral residues on the environment, including surface and ground water resources, and also to provide a detailed pit water balance.

2. LEGISLATION – POST MINING LAND USE

Mining and environmental legislation in South Africa has advanced to a point where comprehensive mine closure planning, including end land use planning, are now strongly legislated.

Closure planning for sustainable post mining land use is regulated by the Minerals and Petroleum Resource Development Act (MPRDA) Regulations (GNR 527: 2004) , the National Environmental Management Act (NEMA) EIA Regulations (GNR 982; 2014), and the most recently gazetted NEMA Financial Provisioning Regulations (GNR 1147; 2015).

The following regulations are pertinent to the development of an end land use plan: and in developing its mine closure plan, including a sustainable end land use plan,

- MPRDA Reg. 61: Closure objectives: this regulation requires the mine to "provide broad future land use objective(s) for the site";
- MPRDA Reg. 62: Contents of closure plan: this regulation requires that the closure plan "must include a sketch plan drawn on an appropriate scale describing the final and future land use proposal and arrangements for the site";
- NEMA Reg. GNR 982: Appendix 5 outlines the requirements for the Content of closure plan, stating that it must include "measures to rehabilitate the environment affected by the undertaking of any listed activity or specified activity and associated closure to its natural or predetermined state or to a land use which conforms to the generally accepted principle of sustainable development, including a handover report"; and
- NEMA Reg. 1147: which requires that "The final rehabilitation, decommissioning and mine closure plan must ~ include a proposed final post-mining land use which is appropriate, feasible and possible of implementation, including:
    - 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; and
    - a map of the proposed final post-mining land use.

3. CONTEXT FOR ELU PLANNING FOR VOORSPOED MINE

The section below summarises the key biophysical, social and spatial planning context relevant to developing an ELUP for Voorspoed. Biophysical information has been largely drawn from the Voorspoed 2010 EMP.

3.1 Bio-physical environment

3.1.1 Location of the Voorspoed Mine

Voorspoed Mine is situated about 35km north of Kroonstad in the Free State Province of South Africa and 190km southwest from Johannesburg. The mine is located on De Beers-owned property and includes the farms Voorspoed 401, Voorspoed 2480, Geldenhuys 1477 and Morgenster 772. Collectively these farms have a total area of 1 947.02 ha.

Voorspoed Mine lies on a flat to slightly undulating landscape that slopes gently to the north. A small granite koppie, called Renosterkop, lies to the south-west of the mine and rises approximately 100 m above the surrounding topography. This koppie provides a diversity of habitats, which support a wide diversity of plant species. In terms of the ELUP the increased diversity of shrubs and trees on Renosterkop would provide good habitat for browsers.

3.1.2 Brief description of the mine

Voorspoed Diamond Mining Company commenced mining at Voorspoed in 1906, when the kimberlite deposit was first discovered. The mine was bought by De Beers in 1912 after which it was closed.

De Beers recommenced mining of the Voorspoed deposit in 2006, and it is expected to continue operations until 2021.

The mine comprises the following key facilities:

- The open pit (which will remain at closure will be approximately 400 m deep and 1.2 km in diameter);
- The waste rock dump (WRD) having a final footprint area of approximately 220 ha that will be rehabilitated to grazing potential;
- The course residue deposit (CRD) covering an area of approximately 37 ha (which may be reprocessed in future);
- The fine residue deposit (FRD) comprising several dams that cover an area of approximately 102 ha, with associated water management facilities including a return water dam (RWD) approximately 9.3 ha; and
- Processing plant, stockpiles, magazine, workshops and office facilities covering a combined area of approximately 50 ha.

The primary source of make-up water for the processing plant at Voorspoed comes from the Renoster River weir approximately 18 km north of mine. The Renoster River is supplied from the Koppies dam. Potable water is supplied by boreholes on site.

3.1.3 Soils

Although soils will be discussed in more detail later, it can be noted here that the parent material of the dominant soils on the Voorspoed properties are mainly derived from underlying sandstone and shale from the Volksrust Formation, Ecca Group. The less dominant soils on site are derived from andesite parent material of the Hekpoort Formation, and from dolerite intrusions.

3.1.4 Climate

Voorspoed falls within the Highveld Climate Zone and has a long-term average rainfall of 560 mm, 80% of which falls during the wet season between October and March. With the recent drought, rainfall has been substantially lower than this long-term average. The average monthly maximum and minimum temperatures are 29.8^{o} C and 15.8^{o} C for the month of January dropping to 18.7^{o} C and -0.3^{o} C for July, respectively.

The average 24-hour rainfall depth for the 1:100 year storm event in the area is 125 mm, though one extreme rainfall event recorded at the Welvaart weather station in January 1923 produced 291.4 mm of rain over 24 hours.

Evaporation far exceeds precipitation, with the net deficit being close to 1 000 mm per year.

3.1.5 Vegetation

Voorspoed Mine is situated in the Grassland Biome of Southern Africa, and falls within four vegetation types, namely Vaal-Vet Sandy Grassland, Central Free State Grassland, Vredefort Dome Granite Grassland, and Highveld Salt Pans. The Vaal-Vet Sandy Grassland type dominates the Voorspoed property, which is generally flat to undulating with the exception of a small hill, Renosterkop, to the southwest of the mine.

Low and Rebelo (1996) classify the vegetation on the Voorspoed site as Veld Type 39 – Moist Cool Highveld Grassland (*Cymbopogon-Themeda* veld), Veld Type 36 - Dry Clay Highveld Grassland, and Veld Type 36 - Dry Sandy Highveld Grassland (also *Cymbopogon-Themeda* veld).

The grasslands on Voorspoed are dominated by *Themeda triandra* (Red grass), which thrives in the soil derived from the belt of dolerite intrusions located in the region.

Baseline studies done as part of the 2006 EIA for Voorspoed identified overgrazing to be an issue on the farms. This was seen in trampling effects on vegetation, including the vegetation in and around the large wetland pan, but also in the number of Increaser II species identified on the farms, including the prevalence of *Seriphium plumosum* (bankrotbos), which is an indicator of overgrazed land.

No red data plant species have been recorded on the Voorspoed properties.

3.1.6 Animal life

Voorspoed has a relatively rich diversity of animal species which will lend itself as an area of biodiversity/conservation interest after mining.

The following mammal species have been recorded on site: Blesbok, Common Duiker; Steenbok, Yellow Mongoose, and Ground Squirrel. There is also evidence of the presence of Aardvark, Porcupine and Springhare.

The red data species below may occur on site, but have yet to be confirmed. Their status is recorded as Critically Endangered (CR), Endangered (EN), Vulnerable (VU) or Near Threatened (NT) as well as Data Deficient (DD). The following red data mammals are listed as potentially present: White-tailed Rat (EN), Brown Hyaena (NT), South African Hedgehog (NT), Schreibers' Long-fingered Bat (NT), Welwitsch's Hairy Bat (NT), Geoffroy's Horseshoe Bat (NT), Highveld Golden Mole (NT), Least Dwarf Shrew (DD), and the Lesser Dwarf Shrew (DD).

A literature search indicated that thirty reptile species could occur on site: one species of tortoise, 14 species of lizard and 15 species of snake.

The seasonally inundated wetland and pans at Voorspoed also provide suitable habitat for several amphibians, including the Giant Bullfrog which is a threatened species, but has not yet been seen.

Over 82 species of bird have been recorded on the Voorspoed properties (2010 EMP), with a total of 19 red data species listed as being present or possibly present on site. Six of the red data species are listed as Vulnerable (VU) and 13 as Near Threatened (NT). The red data species listed are: Black Stork (NT), Marabou Stork (NT), Yellow-billed Stork (NT), Secretary bird (NT), Cape Vulture (VU), Martial Eagle (VU), African Marsh Harrier (NT), Pallid Harrier (NT), Peregrine Falcon (NT), Lanner Falcon (NT), Lesser Kestrel (VU), Blue Crane (VU), Blue Korhaan (NT), Greater Painted Snipe (NT), Chestnut-banded Plover (NT), Black-winged Pratincole (NT), African Grass Owl (VU), and the Melodious Lark (NT).

3.2 Socio economic context

3.2.1 Integrated Development Plans (IDP)

Voorspoed Mine falls within the Fezile Dabi district municipality that forms part of the greater Mangaung metropolitan municipality. The Fezile Dabi district municipality, which was formerly known as the Northern Free State district municipality, consists of four local municipalities:

- Moqhaka;
- Metsimaholo;

- Ngwathe; and
- Mafube.

The Voorspoed mine properties straddle two of these local municipalities with Morgenster farm in the west falling within the Moqhaka local municipality, and the remaining farms Voorspoed, Welvaart and Belmont falling into the Ngwathe local municipality. These two municipalities are the areas of immediate relevance to the operation and its zone of influence. The town of Kroonstad (in the Moqhaka local municipality) is the nearest major urban centre and a significant source of labour and support services to the mine. The mine sources its water from the Koppies Dam, in the Ngwathe municipality, which brings close ties to that region as well.

The Fezile Dabi district is characterized by its strategic agricultural contribution to the Free State's share of agricultural produce, leading to the area being labelled as the breadbasket of South Africa. The district's contribution comes mainly from the production of maize, wheat, sorghum, and sunflower, and stock farming, including the production of cattle, sheep and game. Today these commodities also have a spin-off in the form of a variety of agro-processing industries in the region. In the 19th century the area, comprising more or less the present Heilbron, Frankfort, Petrus Steyn, Lindley and Reitz, was known as the Riemland, named after the countless game herds that roamed the fertile grasslands, which are today used for stock farming, primarily cattle and sheep.

The area has a rainfall of 350 mm to 500 mm and evaporation of 1 600 mm to 2 100 mm per annum.

The grazing capacity ranges from 5 to 15 large stock units (LSU) per hectare. Game farming is on the increase and is well integrated with the growing tourism in the area. During summer this area produces a significant percentage of the country's maize and sunflower crop.

The economic sectors in the district are: trade (22%), community services (20%), manufacturing (13%), households (13%), agriculture (12%), finance (7%), construction (6%) and transport (5%).

In a recent survey the average unemployment rate within Fezile Dabi district municipality was 33.6%, in comparison with the 41.3% of the Free State Province.

MOQHAKA LOCAL MUNICIPALITY

The Moqhaka local municipality is a Category B municipality situated within the southern part of the Fezile Dabi district in the Free State province. It is the largest of the four municipalities in the district, making up over a third of the geographical area.

The Vaal River borders the western boundary of the area and the Vals and Renoster Rivers drain through the area towards the Vaal River. The rivers play a significant role in providing the raw water supply to Kroonstad, Steynsrus and Viljoenskroon. The topography of the area is particularly homogeneous with no prominent features, and the area is characterized by extremely moderate slopes. The western areas, in the vicinity of Viljoenskroon, are known for various shallow and non-perennial pans.

Apart from the dominant role agriculture plays in the region, no other significant economic activity exists. This area, like the rest of the Fezile Dabi district, is not considered as a primary tourist destination, although the area is increasingly becoming a favourite weekend destination. The hunting and guesthouse industries have grown rapidly in the past few years.

NGWATHE LOCAL MUNICIPALITY

The Ngwathe local municipality is also a Category B municipality situated within the northern part of the Fezile Dabi district in the Free State province. The Vaal River forms the northern boundary of the area, which also serves as the boundary between the Free State, Gauteng and North West Provinces. The Renoster River also drains through the region and is dammed up in the vicinity of Koppies in a series of dams, namely the Weltevrede, Rooipoort and Koppies Dams. The rivers, together with the respective dams, are prominent water sources for agricultural purposes in this region, including Voorspoed mine.

Parys has a well-developed airfield that supports commercial and tourism development in the area. It has a strong commercial component and provides a wide range of services regarding health, education and professional services to the district. The unique natural and environmental assets in the area, such as the Vaal River, which has several islands in the vicinity of Parys, and the Vredefort Dome, present opportunities for tourism in the district.

The former Heilbron district is predominantly an agricultural area, although major manufacturing industries contribute largely to the Gross Geographic Product of the district.

Koppies is located in an area of agricultural significance and mainly provides services in this regard to the surrounding rural areas. The three well-established and developed irrigation schemes enhance the agricultural character of the area. The strategic location of Koppies between the larger centres of Kroonstad and Sasolburg influence growth and development within the community. The bentonite exploitation near Koppies and the initiative for coal mining in the vicinity of the town provide significant growth potential. Koppies is becoming known for its tourist attractions. Specific reference is made to the R82 Battlefield Route, which consists of several historical battlefields. These are envisaged to be further developed along the Koppies Dam Nature Reserve.

Edenville is also located in an area of agricultural significance. The main road linking Kroonstad and Heilbron runs adjacent to the area.

The proposal in this report to return the Voorspoed properties to agricultural use is in keeping with the IDPs of the local municipalities.

4. METHODS AND APPROACHES TAKEN IN DEVELOPING THE PROPOSED ELUP FOR VOORSPOED MINE

This section presents the methodology and approaches used to derive and evaluate potential ELU options for Voorspoed Mine. The sections below reflect the requirements as per the client's brief, and covers the methods used for the soil survey and land capability assessments, the approach used to determine veld condition and carrying capacity, as well as the methods used to develop a wider selection of potential ELU options, how these were ranked by a key stakeholder group, and the methods used to evaluate the economic viability of the preferred (most feasible) ELU options.

4.1 Soil survey and land capability assessment

In 2004 a soil survey was conducted on some of the Voorspoed properties as part of the baseline work required as part of the EIA process for environmental approval. This original soil survey was done by the Agricultural Research Council, Institute for Soil, Climate and Water (ARC – ISCW).

The original survey covered the farms Voorspoed 401 and Geldenhuys 1477, and most of Morgenster 772. The Mining Rights Area (MRA) covered all of Geldenhuys 1477, most of Voorspoed 401, and a small portion of Morgenster 772.

In addition to these farms, De Beers also owns the two adjacent farms immediately east of the MRA, namely Belmont 2390 and Welvaart 1011. The aim of the current soil survey was to extend the coverage of the original survey to include the farms Belmont and Welvaart, and also to complete areas of Morgenster that were not surveyed in 2004.

A primary reason for undertaking the additional soil survey work was to determine the land capability of the surrounding farms to assess whether they could be put to more productive use on a sustainable basis, and to evaluate if the existing farming practices on the Voorspoed properties represented the best long-term use of the land.

The ARC – ISCW was contracted by NEKA Sustainability Solutions to do the extended soils survey, because of the synergies and efficiencies that could be leverage from them having compiled the original baseline survey. The soil survey was done using a hand auger to drill holes on a 150 x 150 m grid over all new areas. Holes were drilled to a depth of 1.2 m, or until refusal. Soils were then classified and mapped, and all new data were combined with data from the original survey to provide a single soil types map for the Voorspoed farms. Similarly the soil types were then used to generate a land capability map using the four-class land capability types recommended in the Chamber of Mines (COM) Guidelines[1].

Soil samples were taken from representative soil types over the properties, with A and B1 horizon samples being sent for chemical analysis. A total of 20 soil samples were analysed for pH, texture, major cations, fertility, cation exchange capacity (CEC), and organic carbon.

The soil survey report compiled by the ARC - ISCW is presented in Appendix A, the results of which are discussed later.

4.2 Vegetation assessment, veld condition and carrying capacity

Dr PC Zietsman, Omni Eko, was contracted to conduct a vegetation assessment on the Voorspoed farms to record species composition, veld condition, carrying capacity, and also to do an economic assessment of several proposed ELU options.

It is important to note that the vegetation assessment was conducted at the end of one of the severest droughts in living memory. According to the South African Weather Service, South Africa received the lowest rainfall between January and December 2015 since the recording of rainfall began in 1904. By February 2016 five provinces had been declared drought disaster areas, including Mpumalanga, Limpopo, KwaZulu-Natal, North West and the Free State, in which Voorspoed is located.

[1]Guidelines for the rehabilitation of land disturbed by surface coal mining in South Africa, 1981. Chamber of Mines of South Africa, Johannesburg.

4.2.1 Species composition

The species composition of the herbaceous layer of the veld was determined, based on the frequency of occurrence of species according to the nearest plant. A minimum of 100 observation points were assessed on walked transects (1 m interval along a 100 m transect) on representative portions of all farms. Plants belonging to the family Poaceae (grasses) were identified as far as possible to species level (though challenging in the drought conditions) and non-grasses (forbs and karoo shrubs) were grouped together. The nearest herbaceous plant to each transect point was recorded.

4.2.2 Veld condition assessment

A veld condition assessment was conducted for each vegetation unit according to the Ecological Index Method of Vorster (1982), as revised by Tainton *et al*. (undated) and described by Heard *et al*. (1986). This method not only assessed the current condition of the veld, but can also serve as a reference from which subsequent assessments could be compared to determine trends in relation to specific environmental conditions and management interventions.

For the purpose of the veld condition assessment, the different herbaceous species (grasses and forbs) recorded in the experimental plots were divided into ecological groups, namely Decreasers, Increaser Ia, Increaser IIa, IIb and IIc species (Tainton *et al*., 1980). These categories of species are described more fully in the Vegetation Assessment report attached as Appendix B.

4.2.3 Carrying capacity

From the herbaceous dry mass per hectare assessments an estimate of the grazing capacity of each vegetation unit was calculated according to the formula proposed by Moore *et al*. (1985), and again described by Moore and Odendaal (1987) and Moore (1989).

The utilization factor, expressed as a decimal value, represents that part of the available herbaceous material that can be consumed. Actual consumption is limited by grazing preferences of the animals, losses due to trampling, and environmental factors. The percentage of available dry matter that the animals will actually consume is determined by factors such as palatability of the plant material and the species of animal (bulk feeder or concentrate feeder). However, even when the animals are able to consume a high percentage of the available dry matter, overgrazing should be avoided by limiting their intake to a pre-determined level.

The utilization factor represents that part of the available leaf and shoot material that can be consumed. Actual consumption is limited by browsing preferences of the animals. Limited scientific information currently exists on which to base the utilization factor (f), but indications are that it is very low. In the case of Black Rhinoceros it can be as low as 8% (f = 0.08), and up to about 20% or more (f = 0.20) for other browsers. The estimated percentage leaf presence (p = phenology) for the various plant groups can theoretically vary from 100% (p = 1.0) in the case of evergreens to 0% (p = 0.0) during winter for the early deciduous group. However, there are indications that browsers may utilize the tips of shoots and twigs, even if no leaves are present. This implies that the value of p will always be above 0 (Smit 1996b).

4.3 Reviewing and expanding Voorspoed's list of potential ELU options

As part of its closure planning, Voorspoed had identified a number of potentially viable end land uses as listed below:

- Extensive cattle farming;
- Cattle feedlot and cattle feed production;
- Maize under centre pivot irrigation (utilising pit lake water);
- Maize and other crops produced under extensive dryland;
- Sunflower, soya bean and other alternative oil producing crops (for bio-fuel);
- Vegetable production under centre pivot irrigation (utilising pit lake water);
- Vegetables production in green houses;
- Chicken production (broilers for meat and layers for eggs);
- Piggery; and
- Extensive and intensive sheep farming.

Part of the scope of work of the current project was to add other potentially viable ELU options to this list. This was done as part of the key stakeholder engagement workshop held to evaluate the potential of different ELU options to be taken forward for economic evaluation. The expanded list is presented later.

4.4 Conducting a key stakeholder engagement workshop to assess the feasibility of different ELU options

A key stakeholder workshop was held at Voorspoed mine on 25 August, 2016 to review all ELU options identified, and to rank these subjectively as described below for perceived economic viability and perceived ease of implementation (tempered by social acceptability, capital cost and legal requirements). The aim was to capture a high level and intuitive response (thin slicing[2]) from workshop participants, all experienced in their respective disciplines and/or professions.

The workshop was attended by Anglo American's lead manager for mine closure, De Beers' biodiversity manager, Voorspoed mine's management team and mine closure champion, as well as representatives from Free State Nature Conservation and neighbouring and local farmers, including a representative from the Kroonstad/Free State farmer's association. The list of workshop attendees is presented in Appendix C.

4.4.1 Method for scoring the feasibility of different ELU options

For each of the Voorspoed farms, and for the MRA, workshop delegates were asked to rate each potential ELU option along two intersecting axes, these being:

- Perceived ease of implementation (as mentioned above – influenced by social acceptability, capital cost and legal requirements); and
- Perceived economic viability.

Each axis ran from 0 to 10, with the higher number of each axis representing highest profitability or greatest ease of implementation, respectively.

The consensus scores for each ELU option for each mine property/geographic area were captured in a spreadsheet as shown in Table 2 below.

[2] **Thin-Slicing** is a term used to mean taking quick decisions on the basis of limited information. Generally it is one's education, experience, and beliefs that help in thin-slicing a situation to gain a quick understanding.

Table 2: Example of spreadsheet table used to capture input from workshop attendees on each ELU option (table below is for Morgenster)

End Land Use Option	Perceived ease of implementation	Perceived economic viability
Extensive cattle farming	8	6
Extensive sheep farming	6	7
Intensive cattle farming (feedlot)	2	4
Intensive sheep farming	5	7
Commercial piggery	3	4
Chicken farming (broilers& layers)	4	7
Dryland sunflower	4	7
Dryland maize	4	6
Sunflower & soya – supply to bio-fuel plant	1	1
Maize under centre pivot irrigation	2	5
Vegetable production - centre pivot irrigation	2	6
Vegetable production in greenhouses	2	5
Cut flower production	2	5
Conservation - wetlands/biodiversity	4	5
Game farming - high value species	6	7
Game farming	8	6
Aggregate production - WRD	1	1
Brick making CRD	1	1
Brick making FRD	1	1
Solar farm	2	5
Mining tourism	4	3
Pecan nut plantation	4	2

In making their input, workshop attendees were asked to consider, as a minimum, the following critical success factors for the different ELU options:

- That the ELU options proposed must be sustainable (economically and environmentally);

- That the ELU options must be aligned with mine's Social and Labour Plan (SLP) and regional Integrated Development Plan (IDP); and
- That the preferred ELUP must be aligned with Voorspoed's Rehabilitation and Closure Plans.

In addition participants were asked to consider the opportunities and challenges for different ELU options presented by the geographic location of the mine, and mine specific opportunities and constraints, namely that:

- "The Greater Kroonstad is the centre of a large agriculture community that plays an important role in the economy of the region.";
- The mine properties have mixed landscape units – and that the proposed ELU options may reflect this in mixed post-mining land uses;
- Some sensitive areas on the mine properties need to be conserved (wetlands/pans)
- The long term average rainfall for the area is low (approx. 550mm/y), with water scarcity being an impediment to ELU options with significant water demand;
- The long term veld carrying capacity is relatively low (6 – 10 ha /LSU);
- Groundwater yields are low at between 0.2 – 2.0 l/s, which would be insufficient to support large scale irrigation;
- Renoster weir pipeline could supply irrigation water, but that the profits would need to carry the cost of ongoing licencing, and pipeline and pump maintenance, and the electrical or diesel cost for pumping;
- Some potential ELU options would require an EIA and EMP for authorisation; and
- Pit water quality and volumes may not be suitable for stock watering and irrigation;
- etc.

4.4.2 Method used for ranking ELU options

As the information was captured, as described above, the results were plotted on an Excel graph that visually reflected the workshop outputs for all ELU options on each farm. Figure 2 below shows and example of the biplot output representing the consensus input from delegates. The position of the plotted dots allowed the ELU options to be ranked as Best options, Possible options, Improbable options and Unlikely options.

The data for all farms were combined into a summary table shown later (Table 13), where the options were rank from 1 to 4, representing Best to Unlikely options.

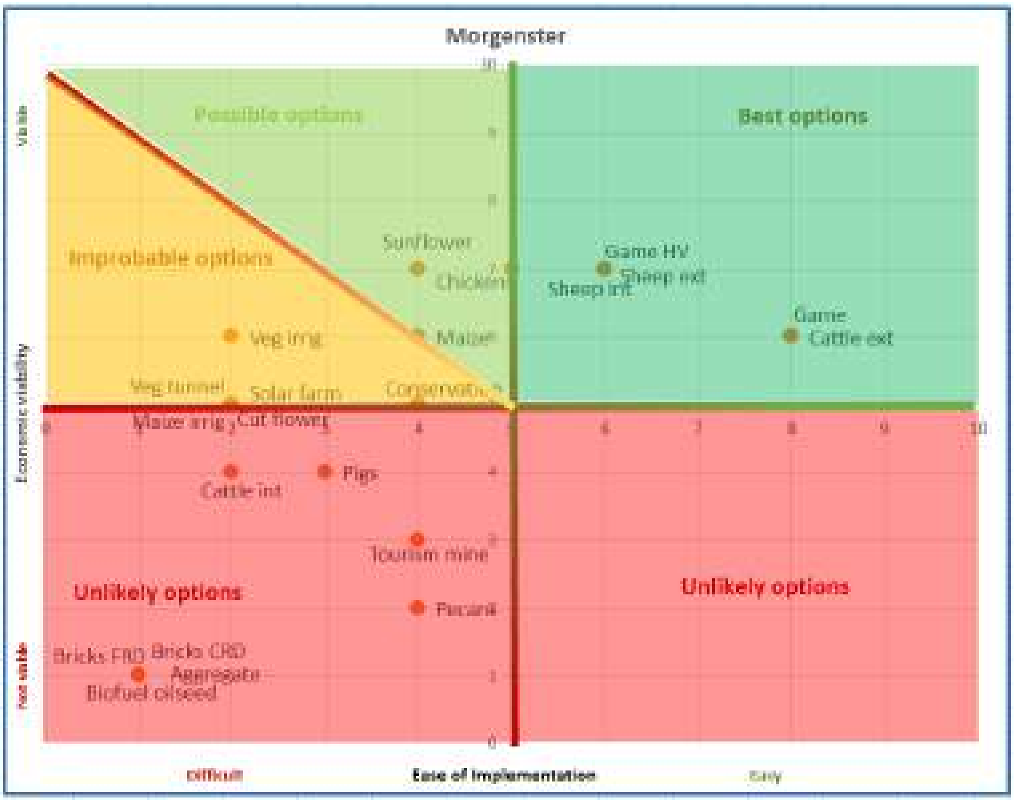


Figure 2: This figure shows the biplot output for Morgenster

The intention of the workshop was to identify the three most feasible ELU options to take forward for economic evaluation, and to assess the business case for each. As it turned out, selecting just three ELU options (scenarios) for evaluation was difficult, largely because any ELUP conceived would likely comprise a number of different ELU options because of the heterogeneity of the Voorspoed farms with regard to topography, vegetation assemblages, soil types, etc.

4.5 Evaluating the economic viability of different proposed ELU options

Following an assessment of the current land uses, land capability, veld condition, and carrying capacity of the Voorspoed properties Omni Eko and NEKA Sustainability Solutions developed a number of potential ELU options that involved mixed farming for economic evaluation.

The ELU agricultural options that were evaluated in this study were developed as a result of outcomes of the key stakeholder engagement workshop, and were guided by an assessment of sustainable land use practices in the area surrounding Voorspoed, and in alignment with mine's closure plan, and the regional IDP.

Is important to note that the end land use options proposed in the present study do not preclude the development of any other post mining land use options, provided that these are environmentally and socially acceptable, and sustainable in the long-term.

4.5.1 Economic success criteria

The economic success criteria used to evaluate the financial viability of the various ELU options (scenarios), have been selected somewhat subjectively, and are presented below. One key driver for success was the challenge to find an enterprise that could start generating capital early to satisfy the mine's requirement of being cash neutral (or profitable) in the post-closure monitoring phase. The enterprise would be considered successful/viable if it:

- Had a positive NPV
- Generated a positive net cash flow commencing in Year 3;
- Generated a net cash flow in excess of R2.5 million annually from Year 3; and
- Settled all debt from loans by Year 10.

4.5.2 Scenarios including all farms

To provide some "base case" from which to work, the first option evaluated was to determine the economic viability of running the Voorspoed properties in much the same way as the neighbouring farmer, who has been running the farms Welvaart and Belmont for many years. In the first set of scenarios described below all of the Voorspoed farms were included in the economic evaluation (see Figure 1Figure 3). The first set of scenarios evaluated were:

- **Scenario 1.1: Crops, Cattle and Sheep**. This scenario was intended to represent as close as possible the "base case", which included the production of crops (maize and sunflower seed) and livestock (cattle and sheep), as is currently practised on the two adjacent farms Belmont and Welvaart.

  In this scenario, and in other scenarios below that include cropping, the cultivated lands on Welvaart (comprising 181 ha) were used for the production of maize, while the cultivated lands on Belmont (comprising 172 ha) were used for the production of sunflower seed.

  Table 1Table 3 below show the areas of land allocated to grazing and cropping on the different farms.

  The remaining uncultivated areas of the farms Belmont and Welvaart were combined with all other available grazing land on the farms Voorspoed, Morgenster and Geldenhuys, which in the case of Scenario 1.1 was split 50-50 between sheep and cattle (on a hectare basis).

Table 3 Area of land on different farms allocated grazing and cropping

	Grazing (ha)	Cropland (ha)	Total (ha)
Belmont	207	172	**379**
Welvaart	290	181	**471**
Voorspoed	282	0	**282**
Morgenster	483	0	**483**
Wetland	179	0	**179**
MRA	709	0	**709**
Total	**2150**	**353**	**2503**

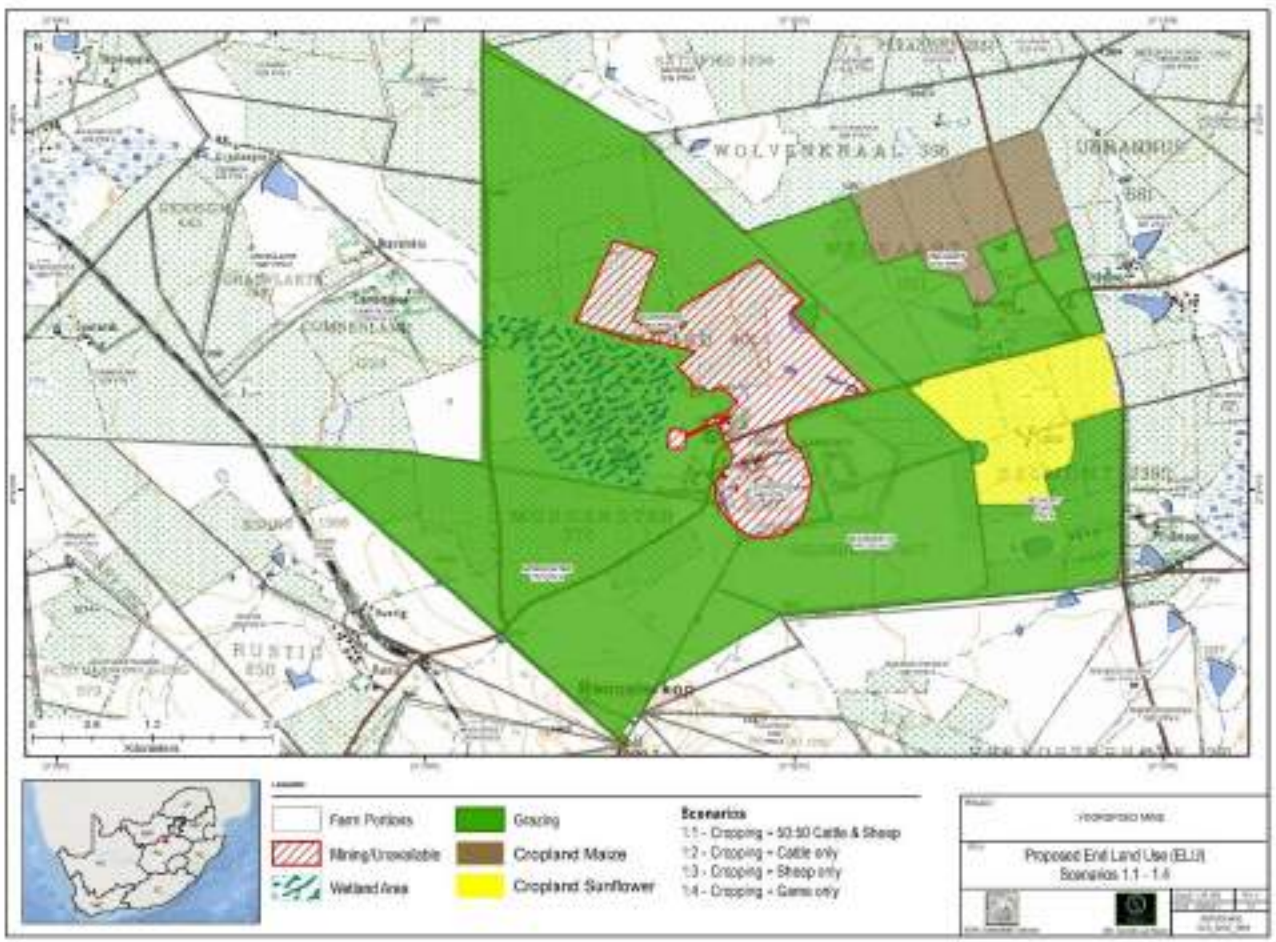


Figure 3: Map showing potential grazing and cropping areas on the Voorspoed farms. The white area hatched in red is excluded as “unavailable – permanently disturbed by mining. This map applies to Scenarios 1.1 – 1.4.

In assessing the economic viability of this scenario, a total of 544 sheep (including 18 rams) and 106 cattle (including 3 bulls) were "purchased" to stock the properties, with stock costs being as follows: R4 000/ram, R3 500/ewe, R20 000/bull and R12 000/cow. In terms of labour for the whole farm the model included one manager and six general workers.

Is important to note that for the purposes of the economic evaluation the large wetland on Voorspoed 401 was included in the area available for grazing, but will need careful management to prevent over-utilisation during the dry season.

- **Scenario 1.2: Crops and Cattle.** This scenario is essentially identical to Scenario 1.1 above, except that all available grazing was put to cattle production. In this scenario a total of 213 cattle (including 7 bulls) were "purchased".
- **Scenario 1.3: Crops and Sheep.** Identical to Scenario 1.2 above except that all available grazing was put to sheep production, where a total of 1 088 sheep (including 35 rams) were "purchased"; and
- **Scenario 1.4: Crops and Game.** Identical to Scenarios 1.2 and 1.3 above, but with all available grazing being used for game farming. The model caters for the purchase of 25 animals (23 Female and 2 Male) of each of the species presented in Table 6 below, with current commercial prices shown. This number of animals may seem low for the 2 150 ha of land available grazing, but the stocking rate was chosen to allow adequate grazing for the expected offspring.

4.5.3 Assumptions made in the financial model for the different scenarios

Certain assumptions needed to be made regarding the proposed ELU practices in order to do the financial calculations. The assumptions made included, but were not limited to, the following:

- Grazing capacity: 6 ha/LSU;
- Cropland productivity: Maize 4.5 ton/ha and Sunflowers 1.5 ton/ha. Assumed prices (SAFEX May 2017) were R2 500/ton for maize and R5 800/ton for sunflower seed;
- Labour requirements were estimated as follows:
  - General Manager: R40 000/month (R480 000/annum) in all scenarios;
  - General Workers R4 000/month (R48 000/annum) per worker where the number of workers depended on the scenario and combination of farming practices. The following number of workers were assumed for each farming practice:
    - Crops (Maize and Sunflowers): 4
    - Cattle, sheep or cattle and sheep: 2
    - Game: 4
- The only loan facility considered was a bank overdraft;
- Interest rates on the bank account were 11% for a negative balance and 4% for a positive balance;
- Income Tax was calculated at 30%; and
- All analyses were done at "constant prices" and there were thus no inflationary increase in the prices or costs over the years.

In all the scenarios where crop farming was modelled, the 181 ha of cultivated land on Welvaart was used for maize production, while the 172 ha on Belmont was used for sunflower seed production. It was assumed that if De Beers/Voorspoed were to continue cropping practices on these farms that tractors and implements would need to be purchased. The types of equipment required (for cultivation on a 0.9m row spacing), with current prices, are presented in Table 4 below. The assumption was made that contract harvesting would take place and therefore no capital outlay for a harvester was made.

Table 4: Implements required for crop production

Tractor/Implement	Description	Price (excl. vat)
MF 7624 Tractor	162 kw	R1 800 000
MF 6711 Tractor	82 kw	R800 000
Optima HD Planter	6 Row	R754 000
Kverneland CLG	13 Chisel with rollers	R350 000
Kverneland iX Track Sprayer	24m Boom 2800/ Tank	R950 000
	Total	**R4 654 000**

In terms of fixed assets, the assumption was made that all fixed assets, including housing, sheds, fences (for cattle and sheep), water provisioning for the animals, as well as a kraal to work with the animals, were already available on the land. For the game farming options, additional fencing would be required and was specified and costed as a 2.1 m high fence with 17 electrified lines, according to legal requirements. The estimated 26.5 km of electrified fence would be installed at a cost of R110/m, costing a total of R2.9 million.

Assumptions made regarding the weight and price of domestic livestock used in the modelling, including weaning percentage and female replacement percentage are given in Table 5 below.

Table 5: Assumptions regarding domestic livestock enterprises.

Variable	Sheep	Cattle
Weight of ewes / cows (kg)	60	500
Weight of lambs / calves sold (kg)	30	230
Weight of rams / bulls (kg)	70	550
Price for lambs / calves (R/kg live)	R30.00	R21.18
Price for culled ewes / cows (R/kg live)	R22.38	R17.00
Weaning percentage	90%	80%
Female replacement percentage	20%	15%

The assumptions made for the price of different game species for both browsers and grazers is shown in Table 6.

Table 6: Commercial prices for required game *(GU = grazer unit & BU = browser unit)*

Species	Grazer and Browser Units	No.	Total GU and BU they represent	Price/Animal	Price/Group
Buffalo M	3.8 GU	2	7.6	R100 000	R200 000
Buffalo F	3.8 GU	23	87.4	R240 000	R5 520 000
Sable M	1.3 GU	2	2.6	R75 000	R150 000
Sable F	1.3 GU	23	29.9	R135 000	R3 105 000
Roan M	1.5 GU	2	3.0	R90 000	R180 0000
Roan F	1.5 GU	23	34.5	R220 000	R5 060 000
Tsessebe M	0.7 GU	2	1.1	R20 000	R40 000
Tsessebe F	0.7 GU	23	16.1	R40 000	R920 000
Eland M	0.7GU & 2.2BU	2	1.4GU & 4.4BU	R20 000	R40 000
Eland F	0.7GU & 2.2BU	23	16.1GU & 50.6BU	R6 500	R149 500
Impala M	0.2GU & 0.1BU	2	0.4GU & 0.2BU	R2 500	R5 000
Impala F	0.2GU & 0.1BU	23	4.6GU & 2.3BU	R2 000	R46 000
Total		**150**	**204.7GU & 57.5BU***		**R15 415 500**

The number of game animals purchased may seem very low for the 2 150 ha of available grazing, however this is not the case as there should be grazing available for the offspring. Table 7 below indicates the grazing hectares needed by the different species.

The assumptions made regarding the selling of the animals, were that all male animals would be kept and hunted once they are matured, while female animals would be sold off on auction when they were two years of age. The age at which different game species matured enough to be hunted for trophies differs for different species and under different conditions.

Dr Flippie Cloete (NWU) suggested the following ages for the culling of the male animals per species:

- Buffalo – 8 years
- Roan – 6 years
- Eland – 8 years
- Sable – 5 years
- Tsessebe – 5 years
- Impala – 4 years

The selling / hunting prices for game species is shown in

Table 8 below. Significant revenue accrues from selling and or hunting in the game farming ELU options.

Further assumptions made for the financial modelling are covered in Appendix B.

Table 7: Grazing needed for different game species

			Business Start-up		Full Capacity	
Species	**LSU/ Animal**	**Grazing Capacity (ha/LSU)**	**No. of animals**	**Grazing required (ha)**	**No. of animals**	**Grazing required (ha)**
Buffalo M	1.2	6	2	14	58	418
Buffalo F	1.3	6	23	179	25	195
Sable M	0.7	6	2	8	31	130
Sable F	0.7	6	23	97	25	105
Roan M	0.8	6	2	10	40	192
Roan F	0.8	6	23	110	25	120
Tsessebe M	0.325	6	2	4	31	60
Tsessebe F	0.325	6	23	45	25	49
Eland M	1.3	6	2	16	58	452
Eland F	1.2	6	23	166	25	180
Impala M	0.16	6	2	2	22	21
Impala F	0.18	6	23	25	25	27
Total			**150**	**676**	**390**	**1949**

Table 8 Prices for the hunting / selling of game

	Species	Price (R/animal)
Hunting	Buffalo M	R122 525
	Sable M	R75 400
	Roan M	R75 400
	Tsessebe M	R26 390
	Eland M	R24 505.00
	Impala M	R5 184
Sales	Buffalo F	R240 000
	Sable F	R135 000
	Roan F	R220 000
	Tsessebe F	R40 000
	Eland F	R6 500
	Impala F	R2 000

4.5.4 Scenarios excluding Belmont and Welvaart

When the first set of scenarios evaluated did not meet the economic success criteria mentioned in section 4.5.1, a second set of scenarios was evaluated where the neighbouring farms Belmont and Welvaart were sold to raise capital to offset the start-up capital required to run equivalent farming enterprises on the remaining Voorspoed farms (see Figure 4: Map showing potential grazing areas in green, with the purple farms Welvaart and Belmont having been "sold" off to raise capital for farming enterprises on the green areas. The white area hatched in red is excluded as "unavailable – permanently disturbed by mining. This map applies to Scenarios 2.1 – 2.4.Figure 4).

The second set of scenarios evaluated are presented below:

- **Scenario 2.1: Cattle and Sheep**. This scenario did not include the production of crops because the available cultivated lands were on the disposed farms Belmont and Welvaart. Although significant areas of the Voorspoed and Morgenster farms have arable land capability, it was decided not to include cropping of these areas (which would require additional capital for tractors and farming implements), but rather to use all available grazing for the production of cattle and sheep. For modelling purposes the available grazing was split with 50% of the land being allocated to sheep farming and 50% being dedicated to cattle production;
- **Scenario 2.2: Cattle only.** The scenario is essentially identical to the one above, but where all available grazing was put to cattle production ;
- **Scenario 2.3: Sheep only.** Identical to Scenario 2.2 above except that all available grazing was put to sheep production; and
- **Scenario 2.4: Game only.** Identical to Scenarios 2.2 and 2.3 above, but with all available grazing being used for game farming.

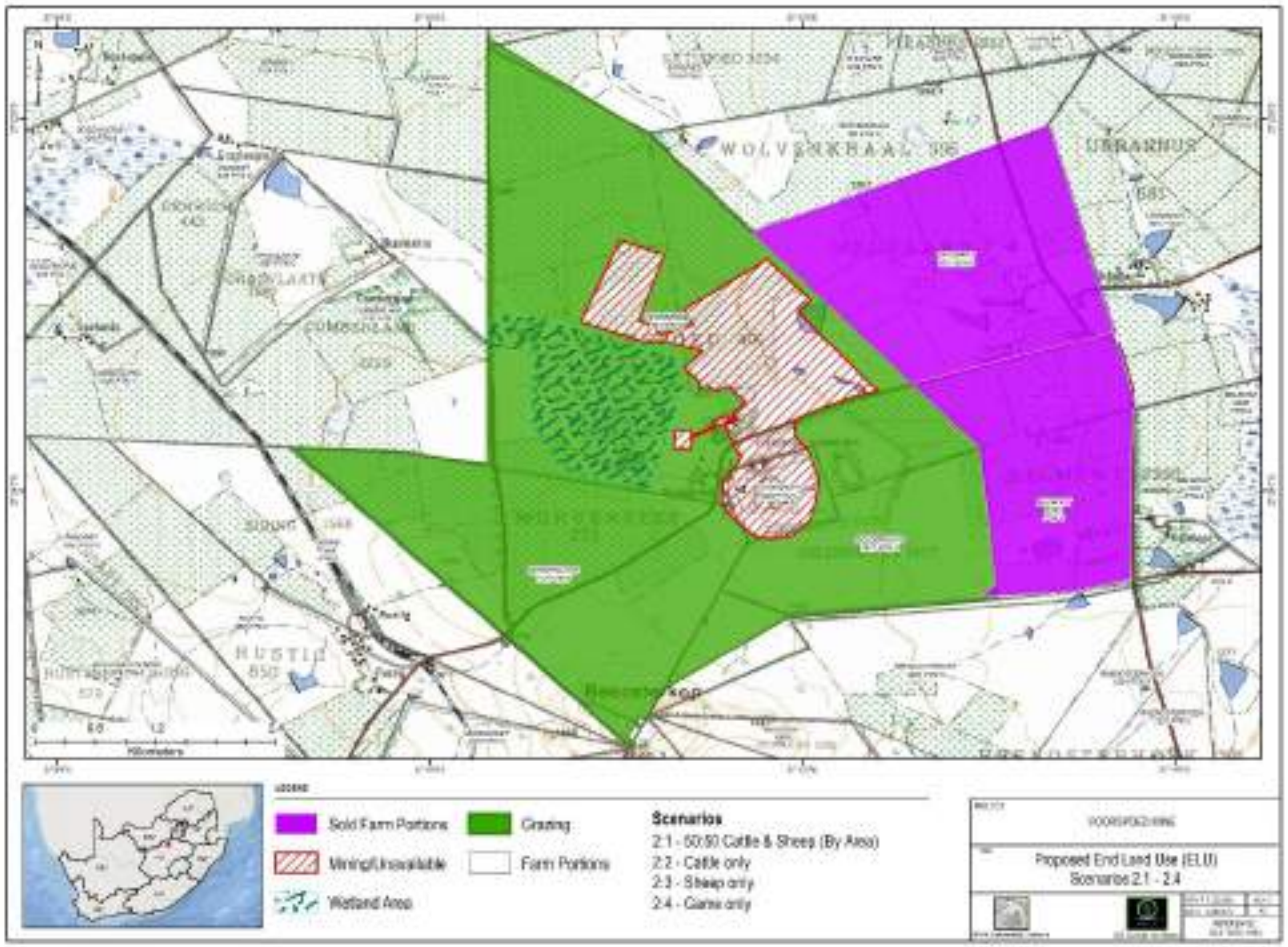


Figure 4: Map showing potential grazing areas in green, with the purple farms Welvaart and Belmont having been "sold" off to raise capital for farming enterprises on the green areas. The white area hatched in red is excluded as "unavailable – permanently disturbed by mining. This map applies to Scenarios 2.1 – 2.4.

5. OUTCOMES OF THE ELUP STUDY COMPONENTS

5.1 Soil Survey and Land Capability Assessment

The soil survey conducted as part of the current study was completed by the ARC – ISCW on the remaining sections of Morgenster 772 and the farms Welvaart 1011 and Belmont 2390, which had not been previously surveyed.

The results of the two surveys (2004 & 2016) were combined in a report compiled by the ARC - ISCW (attached as Appendix A). The position and extent of different soil types recorded on the Voorspoed properties are shown in Figure 5. Table 9 describes the dominant soil forms on site, their textural characteristics, effective depth, extent, and agricultural potential. The text below summarises the more detailed description given of the Voorspoed soils in the ARC report.

5.1.1 Soil types on Voorspoed farms

The Voorspoed farm, which has largely been disturbed by mining, is dominated by moderately deep soils of the Avalon (Av) form, which comprise brown, apedal to weakly structured sandy loam to sandy clay loam topsoils underlain by brown to yellow-brown, apedal sandy clay loam sub-soils over a grey-brown, mottled, soft plinthite layer. The south-western and south-eastern sections of the farm contain Westleigh (We) soils that characteristically have soft plinthite occurring directly under the topsoil. Soils in and around vleis, dams and streams, typically have dark brown, loam to clay loam topsoil underlain by grey-brown, mottled sandy clay to clay subsoil with signs of wetness. The dominant soil form in these areas is Katspruit (Ka/W map unit). The dominant soil form adjacent to wetland areas on Voorspoed farm are Sepane (Se) soils that have a dark brown, loam to clay loam topsoil horizon underlain by a brown to black, moderately to strongly structured, blocky clay loam subsoil, usually calcareous. Lighter grey, calcareous, unconsolidated material with signs of wetness often occurs deeper in the profile. The farm Morgenster contains a variety of soil forms, but is dominated by deep to moderately deep red apedal Hutton (Hu) soils and yellow-brown Avalon (Av) soils, along with smaller patches of structured Sterkspruit (Ss) soils, and with gleyed structured Sepane (Se) soils described above. In the south west corner of the farm, rock and shallow soils of the Mispah (Ms) form occur, surrounded by moderately deep to deep soils with a red and yellow-brown apedal to weakly structured sandy clay loam topsoil, underlain by red and yellow-brown apedal sandy clay loam subsoils. The dominant soil forms are Hutton (Hu) and Clovelly (Cv). These soils have a moderately high agricultural potential although they may be shallow in places. Westleigh (We) soils dominate along the northern boundary of the farm adjacent to the large wetland comprises Westleigh soils, with the characteristics described above.

On Welvaart farm the northern area comprises predominantly Avalon (Av) soils that are moderately deep to deep, comprising brown, apedal to weakly structured sandy loam to sandy clay loam topsoils underlain by brown to yellow-brown, apedal sandy clay loam sub-soils over a grey-brown, mottled, soft plinthite layer. In some areas a soft plinthite layer occurs directly under the topsoil to classify these soils as Westleigh (We) soils. The low lying drainage line running west to east through Welvaart comprises wetland soils, with the dominant soil form being Katspruit (Ka), with a small patch of Kroonstad (Kd) soils. The Sepane (Se) soil form is common on the lower slopes along the drainage line and adjacent to the wetland, and is typified by having a dark brown, loam to clay loam topsoil horizon underlain by a brown to

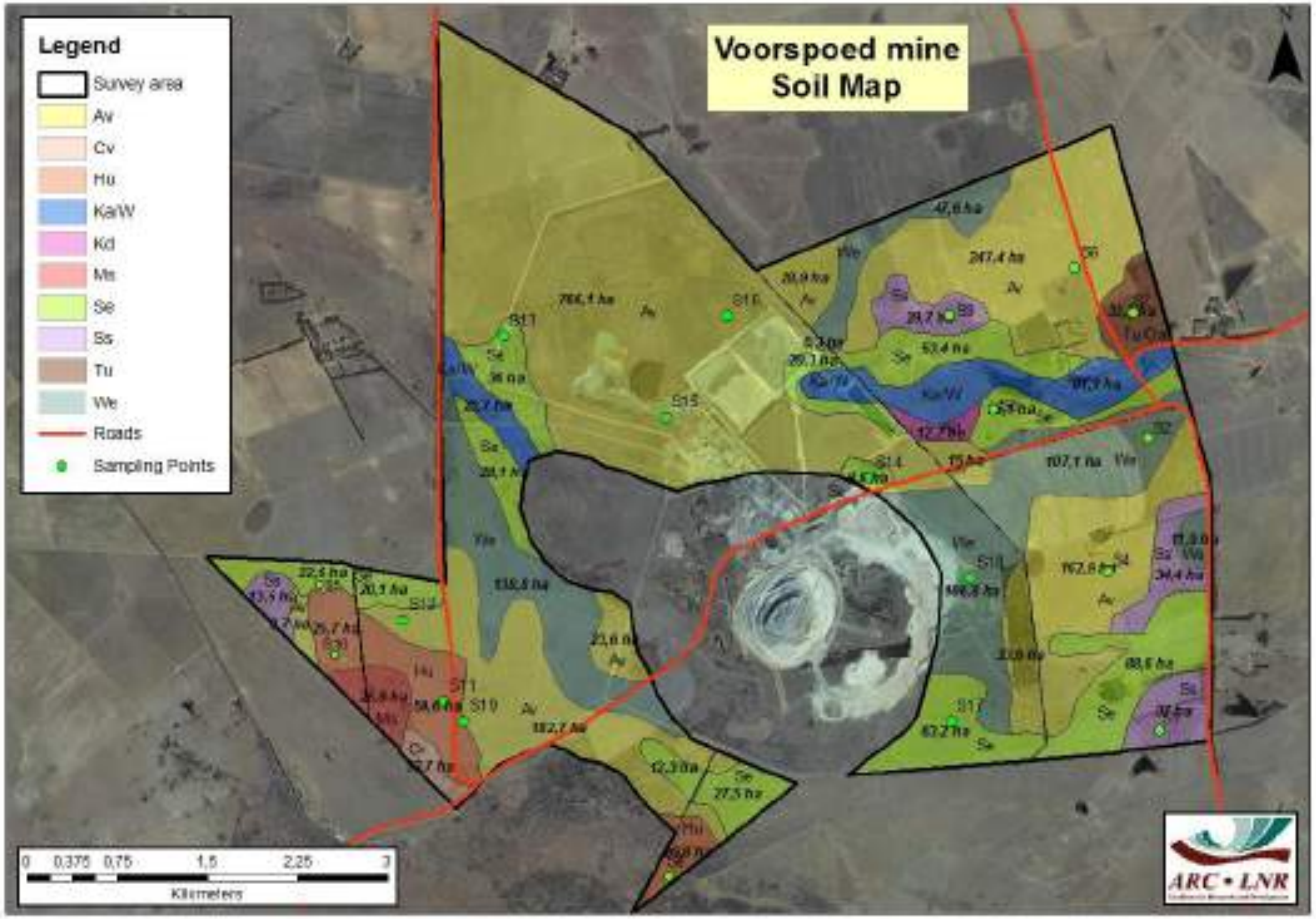


Figure 5: The position and areal extent of different soil types on the Voorspoed properties

Table 9: Soil mapping units recorded on the Voorspoed Mine properties

MAP UNIT	DOMINANT SOIL FORM/ FAMILY	SUBDOMINANT SOIL FORM/ FAMILY	EFFECTIVE DEPTH (mm)	DESCRIPTION OF MAPPING UNIT	LAND CAPABILITY	AREA (ha)
Av	Av3100/3200	We2000, Pn3100	500 - 1000+	Brown to yellow-brown, apedal to weakly structured, sandy loam to sandy clay loam topsoil on yellow-brown, apedal to weakly structured, sandy clay loam subsoil on grey, mottled soft plinthite, often grading into a wet, clay layer.	Arable, moderate	1 466.2
We	We2000/1000	Av3100/3200, Pn3100	300 - 500	Dark brown to brown, apedal to weakly structured, sandy loam to sandy clay loam topsoil horizon on grey, weakly structured, sandy clay loam to clay loam, mottled soft plinthite subsoil.	Arable, low	415.0
Se	Se2220/2210	Va2122/2121, Ar1100	250 - 400	Dark brown, sandy loam to sandy clay loam, weakly structured topsoil horizon, on dark brown, moderately to strongly structured blocky clay loam subsoil, usually calcareous. Lighter grey, mottled clay material with signs of wetness is often found deeper in the profile.	Grazing	411.0
Hu	Hu3100	Bv3100, Cv3100	600 - 1200+	Reddish-brown to red, apedal to weakly structured, sandy loam to sandy clay loam topsoil on red, apedal to weakly structured, sandy clay loam subsoil, on weathering rock or (occasionally) soft plinthite.	Arable, moderate	109.1
Cv	Cv3100	Oa2120, Tu2110, Hu3100	600 - 1200+	Brown, apedal to weakly structured, sandy loam to sandy clay loam topsoil on brown to yellow-brown, apedal to weakly structured, sandy clay loam subsoil on weathering rock.	Arable, moderate	13.7
Ka/W	Ka1000	Kd1000	300-750	Dark brown greyish-brown, weakly structured, sandy clay loam topsoil on grey to grey-brown, gleyed sandy clay to clay subsoil. Surface water may occur.	Wetland	123.0
Kd	Kd1000	Ka1000	300-750	Dark brown to greyish-brown, weakly structured, sandy clay loam topsoil on grey, apedal, sandy loam to sandy clay loam subsoil on gleyed, structured, sandy clay to clay subsoil.	Grazing	12.2
Ss	Ss1200	Se2210	300-650	Dark brown to reddish-brown, weakly structured, sandy loam to sandy clay loam topsoil abruptly overlying brown, strongly structured, sandy clay to clay subsoil with dark brown clay cutans.	Grazing	115.4
Tu/Oa	Tu1110	Oa1110	600-950	Brown, weakly structured, sandy loam to clay loam topsoil horizon on yellow-brown to brown, weakly structured, sandy clay loam to clay loam subsoil, usually calcareous. Lighter grey, calcareous, unconsolidated material with signs of wetness often occurs deeper in the profile	Arable, low	33.3
Ms	Ms2100	R	0 - 250	Brown, apedal loamy topsoil directly overlying hard rock. Rock outcrops also occur in this unit.	Grazing	34.0
					Total	2 732.9

Note: The area quoted for Avalon does not cater for the loss of this soil type under the FRD, CRD and office/plant infrastructure black, moderately to strongly structured, blocky clay loam subsoil, which is usually calcareous. Along the eastern boundary of Welvaart is an area of brown, loam to clay loam topsoil horizon underlain by a yellow- brown to brown, weakly structured, clay loam subsoil, where the dominant soil form is Tukulu (Tu), with the Oakleaf (Oa) soil form being subdominant. Close to the middle of the farm is a patch of Sterkspruit (Ss) soils characterised by having a dark reddish-brown, apedal, sandy clay loam topsoil underlain by a strongly structured horizon with dark brown clay cutans.

On the farm Belmont, lying just south of Welvaart, the northern areas are dominated Westleigh (We) soils that characteristically have plinthic material lying directly under the topsoil. Most of the central part of the farm consists of Avalon (Av) soils. In the south-east, the farm also has a small area of Sterkspruit (Se) soils with the same characteristics described for the same soil form on Welvaart. The remainder of the farm is occupied by the Sepane (Se) soil form.

5.1.2 Soil chemistry results

The soil analytical results for representative soil samples collected for different soil forms over the Voorspoed properties are detailed in the soil survey report (Appendix A). Soil sampling points are shown in Figure 5 above.

The soils were analysed for a range of parameters as described earlier. Clear textural differences were evident between the apedal soils (Hutton, Avalon, and Clovelly) and more structured soils (Sepane, Valsrivier, Sterkspruit).

Topsoil textures are generally in the sandy loam to sandy clay loam range (10-20% clay), and the soils are not strongly leached, with subsoil values of between 20 and 30 when the sum of cations is divided by the clay percentage. Values over 15 are considered eutrophic (lightly leached), as confirmed by the presence of calcium in the subsoil, which has not been leached out as would be the case in a higher rainfall environment.

The phosphorus (P) levels in the soils are variable, generally reflecting cultivation practices, where topsoils on cultivated land have higher levels of P.

The organic carbon levels also often reflect the effects of cultivation, with values generally below 1%, and often significantly so.

Apedal soils are neutral to acidic, while clay soils are often slightly alkaline. The soils did not have any major cation imbalances that would affect agricultural potential of the soils.

5.1.3 Land capability

The soil type and soil depth information gleaned from the soil survey were used to develop the Voorspoed land capability plan (Figure 6Figure 6), which uses the land capability classes described in the Chamber of Mines Guidelines. **Error! Reference source not found.**The area of different land capability classes across the Voorspoed properties is also given in Figure 6.

Land capability defines the agricultural potential of the land for different agricultural land uses, and reflects the ability of the soil to sustainably perform certain functions in order to produce crops under cultivation. Important factors determining the agricultural potential of the soil include the effective (rooting) depth, soil texture, structure and natural drainage. Where any one of these is restrictive, the agricultural potential of the land will be reduced.

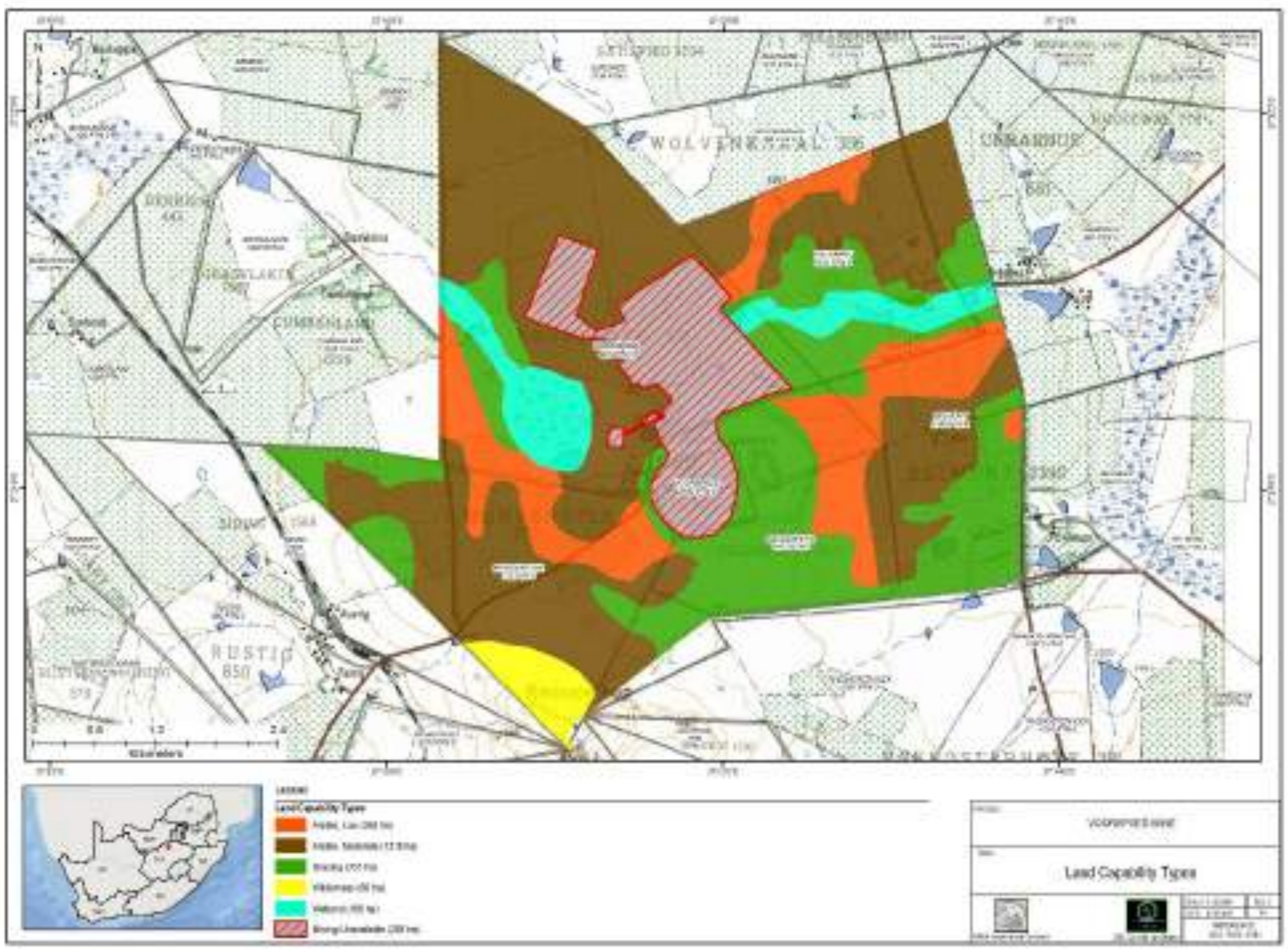


Figure 6: Land capability classes on the Voorspoed Mine (extrapolated with input from ARC-ISCW).

In addition, the climate (e.g. rainfall, evaporation and temperature) significantly affects the agricultural potential of the land. In the case of Voorspoed, where the long-term annual average rainfall is 560 mm or less, the dryland (rain-fed) agricultural potential is not high. Within most growing seasons, and very often from year to year, there will be significant variation in rainfall, with annual, seasonal and intra-seasonal drought periods and occasionally times of excess. Under these circumstances, sustainable crop production may be problematic especially on marginal soils.

The farmer leasing the Welvaart and Belmont farms has many years of farming experience in the area and confirmed that the Avalon soils, which cover much of the area are only suitable for reliable crop production if they are deeper than 900 mm and if the rainfall is normal or above the long-term average. On shallower soils, with otherwise arable land capability, the shallower rooting depth of crops puts them at risk of drought stress if rainfall is not consistent over the growing season, and especially at times when sufficiency of water is critical, for example at tasselling and cob formation stages

The ARC consulted with a local experts (Mr P.J. Botha, Agricultural Consultant, Kroonstad: personal communication) who suggested that in normal to good rainfall years, the deeper soils will perform well, but the shallower soils (such as shallow Avalon or Westleigh soils with an effective depth of 600 mm or less) will be affected by excessive wetness in the profile. In drier years, the shallower soils will at least provide a yield, while the deeper soils will dry out. Other sources (Ludick and Joubert, 1986) confirm that expected yields on the Avalon soils, under normal conditions, will be 3.6 t/ha/y or more, while the yields on the shallower soils fall to around 2.6 t/ha/y.

As mentioned previously, confirmed long-term rainfall in the Voorspoed areas is around 550 mm per annum, which is just feasible for dryland cultivation, but does not make allowance for the expected variability between years and within any season. If cropping of the soils classified as having arable land capability is considered, on marginal soils, one would probably need to look at scenarios and agricultural risk profiles.

If the soils cannot be sustainably cultivated, the best option (especially for the structured soils) is to place them under pasture for grazing of livestock. The grazing capacity of this area is reasonably good, between 7 and 10 ha/LSU (ARC-ISCW, 2004). The 1:50 000 topo cadastral maps for the Voorspoed Mine area (272AC) indicate that historically approximately 50% of the surface areas of the farms Voorspoed 401 and Morgenster 772 were cropped.

Comments from farmers attending a key stakeholder workshop held on the mine looking at potential post mining land use options, indicated that increasingly unreliable and reducing rainfall in the area, resulted in more frequent failed crops. This led farmers to abandon croplands on shallower arable soils and to plant improved pasture species for cattle and sheep grazing.

5.2 Veld condition and carrying capacity assessment

The vegetation work conducted by Omni Eko is presented in Appendix B and is summarised below. As mentioned earlier the primary objectives of vegetation assessment were to develop an understanding of species composition, veld condition and the carrying capacity of the land to inform the suitability of the Voorspoed farms for any potential future agriculture that would involve grazing for livestock or game, and to provide the basis for the financial modelling to evaluate the viability of different land use options.

5.2.1 *Species composition and veld condition on each of the farms*

The vegetation assessments conducted between October 2016 and March 2017 allowed Omni Eko to visit the MRA and all of the surrounding Voorspoed farms. Table 10 below summarises the dominant species present on each of the farms.

Table 10: Percentage species composition for each farm

Voorspoed 1		**Welvaart**	
Aristida congesta	2.0	*Aristida congesta*	2.3
Cynodon dactylon	11.5	*Cynodon dactylon*	17.3
Digitaria eriantha	61.0	*Eragrostis lehmanniana*	34.5
Eragrostis curvula	6.5	*Setaria incrassata*	2.7
Eragrostis lehmanniana	6.5	*Themeda triandra*	32.7
Setaria incrassata	1.0	*Urochloa panicoides*	10.0
Themeda triandra	0.5	*Seriphium plumosum*	0.5
Seriphium plumosum	11.0		
Morgenster (Renosterkop)		**Morgenster M01-M02**	
Aristida congesta	2.0	*Aristida congesta*	3.3
Cynodon dactylon	5.0	*Cynodon dactylon*	16.2
Cymbopogon pospischilii	10.5	*Digitaria eriantha*	53.8
Digitaria eriantha	14.5	*Eragrostis chloromelas*	7.1
Eragrostis chloromelas	10.0	*Eragrostis lehmanniana*	14.8
Eragrostis lehmanniana	1.0	*Eragrostis superba*	1.4
Eragrostis superba	1.5	*Setaria incrassata*	0.5
Eragrostis echinochloidea	3.5	*Themeda triandra*	0.5
Panicum maximum	33.0	*Seriphium plumosum*	2.4
Setaria incrassata	8.0		
Themeda triandra	11.0		
Pan Wetland		**Belmont**	
Cynodon dactylon	3.0	*Cynodon dactylon*	12.7
Digitaria eriantha	19.0	*Digitaria eriantha*	48.6
Setaria incrassata	58.0	*Eragrostis chloromelas*	17.3
Themeda triandra	4.0	*Themeda triandra*	4.5
Unknown A	2.0	*Seriphium plumosum*	2.3
Unknown D	3.0	*Urochloa panicoides*	14.5
Bare soil	11.0		

Green cells: composition > 20%; orange cells = invader species; yellow = bare soil

In those instances where the percentage composition of any plant species exceeded 15 - 20% (e.g. *Digitaria eriantha* at Voorspoed 1) it could be assumed that the area used to be cultivated and has been rehabilitated by planting high quality grazing.

Of concern was the high percentage (11%) of *Seriphium plumosum* (slangbos, bankrotbos) at Voorspoed 1. It is an aggressive invader and degrader of grazing. Although the percentage at Morgenster M01-M02 was much lower (2.4%), both farms must be cleared of this species which will detrimentally reduce carrying capacity with further invasion.

The only area where "bare soil" (11%) was noted, was in the Pan Wetland. It is clear that the grass in this specific area was moribund due to the absence of grazers. A very good rule of thumb is that no grazing is just as bad as over-grazing.

5.2.2 Veld condition assessments and carrying capacity

The veld condition can be determined from the species composition that shifts over time if grasslands are under or overgrazed. The prevalence of Decreaser species (desirable grazing species) indicates that the veld is in good condition and provides optimal grazing, and with good management will have a higher carrying capacity than poorly managed grasslands with a higher abundance of less desirable species Increaser 2.

Table 11 below indicates the estimated dry matter available for grazing on the different farms, split between Decreaser (desirable) and Increaser 2 species. It is clear that the Farms Voorspoed 1, Belmont and Welvaart have a much higher biomass of less palatable Increaser 2 species, usually indicative of overgrazing. Despite this evidence of overgrazing on some farms the dry matter available for grazing species is able to support economically viable numbers of livestock.

Table 12 below is particularly interesting in that it shows the rapid recovery of the veld following good rains after several years of severe drought. During the last assessment in March 2017, the carrying capacity of the veld had recovered to a point where it was only marginally lower (6.8 ha/LSU) than the district average of 6 ha/LSU on which the financial modelling was done.

5.3 Additional ELU options

As mentioned earlier, Voorspoed Mine had developed a list of potential ELU options that needed to be considered and expanded upon. Following the key stakeholder workshop held at Voorspoed Mine on 25 August 2016, additional ELU options were added to the original list of options.

The original ELU options list provided by Voorspoed has been reorganised below:

- Extensive cattle farming;
- Extensive sheep farming;
- Intensive cattle farming (feedlot);
- Intensive sheep farming;
- Commercial piggery;
- Chicken farming (broilers and layers);
- Dryland maize and other crops (sunflower/soya);

Table 11: Dry matter (DM) production for each farm

	Voorspoed 1 (282.257 ha)			
	Utilization factor (%)	kg DM/ha	Total kg Utilizable	Total/Ton/ha
Decreaser	0.4	161.0	45432.1	45.4
Increaser 2	0.2	69.8	19712.8	19.7
Total		230.8	65144.9	65.1
	Morgenster (Renosterkop) (241.608 ha)			
	Utilization factor (%)	kg DM/ha	Total kg Utilizable	Total/Ton/ha
Decreaser	0.4	185.3	44765.1	44.8
Increaser 2	0.2	12.2	2957.3	3.0
Total		197.5	47722.4	47.7
	Morgenster M01-M02 (241.608 ha)			
	Utilization factor (%)	kg DM/ha	Total kg Utilizable	Total/Ton/ha
Decreaser	0.4	158.2	38232.0	38.2
Increaser 2	0.2	24.1	5817.9	5.8
Total		182.3	44050.0	44.0
	Wetland (178.59 ha)			
	Utilization factor (%)	kg DM/ha	Total kg Utilizable	Total/Ton/ha
Decreaser	0.4	861.8	153901.7	153.9
Increaser 2	0.2	0.0	0.0	0.0
Total		861.8	153901.7	153.9
	Belmont (378.584 ha)			
	Utilization factor (%)	kg DM/ha	Total kg Utilizable	Total/Ton/ha
Decreaser	0.4	137.9	52214.3	52.2
Increaser 2	0.2	84.5	31982.8	32.0
Total		222.4	84197.1	84.2
	Welvaart (471.093 ha)			
	Utilization	kg DM/ha	Total kg	Total/Ton/ha
Decreaser	0.4	85.9	40476.3	40.5
Increaser 2	0.2	28.6	13454.4	13.5
Total		114.5	53930.7	53.9

Table 12: Grazing / carrying capacity of all the farms at Voorspoed Mine

	Grazing capacity ha/LSU		
	Measured production at the beginning of growing season	Estimated production end of December	Estimated production end of growing season
Voorspoed 1	15.8	7.9	5.3
Morgenster	18.5	9.2	6.2
Morgenster M01	20.0	10.0	6.7
Wetland	*4.2*	*2.1*	*1.4*
Belmont	16.4	8.2	5.5
Welvaart	31.9	15.9	10.6
Average	**17.8**	**8.9**	**5.9**
Average - excluding the wetland	**20.5**	**10.3**	**6.8**

- Sunflower and soya – supply to bio-fuel plant;
- Maize under centre pivot irrigation;
- Vegetable production under centre pivot irrigation (pit lake); and
- Vegetable production in greenhouses.

The following additional potential ELU options were added to the list prior to and during the stakeholder workshop:

- Cut flower production;
- Conservation - wetlands/biodiversity;
- Game farming - high value species;
- Game farming;
- *Aggregate production – WRD;*
- *Brick making CRD;*
- *Brick making FRD;*
- Solar farm;
- Mining tourism; and
- Pecan nut plantation

The options in italics were captured, but were deemed unsuitable for post-closure activities as they would work against finalising rehabilitation of these facilities. Process of waste rock could be practiced, but this would best be done during the remaining life of mine.

5.4 Ranking of ELU options – workshop outcomes

The summary results of the workshop are presented in Table 13 below, and show how different ELU options ranked on different farms, and in general. It is important to say that this screening process was used to float out those ELU options deemed by the workshop attendees to be most feasible and sustainable in the long term.

The consensus views captured and summarised in Table 13 indicate that extensive sheep and cattle farming, and intensive sheep farming, would be feasible and sustainable ELU options for the Voorspoed properties, perhaps with the exception and mining disturbed areas and newly rehabilitated areas of the MRA.

Game farming too, was considered to be a highly feasible ELU for all farms, including the breeding of high value game species.

Dryland maize and sunflower seed cropping on the farms Welvaart and Belmont were considered to be feasible and sustainable post mining ELU practices, primarily because the agricultural land is currently cultivated. The old lands on Voorspoed and Morgenster, which had been cropped many years ago, have been over seeded and would require significant effort to reinstate, which is why they did not rank as highly as the former two farms, despite the fact that the deep Hutton soils and adjacent Avalon soils on Morgenster could produce good crop yields. At the time of the workshop maize production was deemed to be only marginally profitable because of low rainfall and high input costs, even on Welvaart and Belmont, both of which are established farms run by experienced farmers. The apparent contradiction that maize farming was not profitable, but that it was still presented as a feasible and sustainable ELU on areas with arable land capability, was debated. The general consensus was that cropping would be profitable again when the recent long drought, caused by the Pacific Ocean El Nino phenomenon, broke and rainfall patterns returned to normal. In 2015, the Free State and country as a whole had been in one of the lowest rainfall periods (droughts) since the Weather Bureau started recording rainfall in 1904.

Intensive cattle farming (feedlot farming) was not considered feasible because of the perceived pollution impacts on the surface and ground water resources and also because of the anticipated nuisance smells resulting from the high concentration of animals. The limited availability of fresh water would also be a restriction. Profitable feedlots generally stock between 3 000 and 4 000 head of cattle at any time, translating to a water requirement of at least 160 kl/d (~40 l/LSU/d). This excludes any requirement for irrigation water (~35 kl/ha/d) if this were needed to increase biomass production on surrounding pastures to supplement cattle feed. The concentration of this number of head of cattle would require at least a basic assessment in terms of the NEMA EIA regulations (2014), and a water use licence in terms of the NWA (1998).

The consideration of a commercial piggery as a potential ELU met with similar challenges facing the proposed cattle feedlot option both in respect of potential pollution of the environment, nuisance smells, and also the requirement for environmental authorisation that would reduce the scoring in respective “ease of implementation”.

Table 13: Ranking of potential ELU options results following inputs at the stakeholder workshop (1 = most viable vs 4 = least viable)

End Land Use Option	Welvaart	Belmont	Morgenster	Voorspoed	MRA
Extensive cattle farming	1	1	1	1	3
Extensive sheep farming	1	1	1	1	2
Intensive cattle farming (feedlot)	4	4	4	4	4
Intensive sheep farming	1	1	1	1	2
Commercial piggery	4	4	4	4	4
Chicken farming (broilers& layers)	2	2	2	2	1
Dryland sunflower	1	1	2	2	4
Dryland maize	1	1	2	2	4
Sunflower & soya – supply to bio-fuel plant	4	4	4	4	4
Maize under centre pivot irrigation	3	3	3	3	4
Vegetable production under centre pivot irrigation	3	3	3	3	4
Vegetable production in greenhouses	3	3	3	3	3
Cut flower production	3	3	3	3	3
Conservation - wetlands/biodiversity	4	4	3	3	4
Game farming - high value species	1	1	1	1	1
Game farming	1	1	1	1	1
Aggregate production - WRD	4	4	4	4	3
Brick making CRD	4	4	4	4	4
Brick making FRD	4	4	4	4	4
Solar farm	3	3	3	3	2
Mining tourism	4	4	4	4	3
Pecan nut plantation	4	4	4	4	4

All potential ELU options requiring irrigation, namely the production of maize and vegetables under centre pivot irrigation, and the production of vegetables and/or cut flowers in greenhouses with a high water requirement were deemed less feasible than those agricultural enterprises relying primarily on rainfall and minor supplementary watering for livestock or game.

The proposed activities of producing aggregate from the waste rock dump (WRD), and making bricks from the CRD and FRD mineral wastes were deemed to be activities that should be conducted during the operational life of the mine with the objective of reducing mining waste or mineral waste footprints before final closure. At closure these facilities would be rehabilitated and monitored during the post mining monitoring period (5 to 10 years), to demonstrate that they are stable features of the landscape that can be left after site relinquishment and issuance of a closure certificate.

While the idea of a solar farm was appealing, the workshop attendees felt that covering otherwise valuable agricultural land with solar panels would work both against the regional agricultural objectives of the IDP, and would also diminish the sense of place of Voorspoed in its rural setting. The scoring for solar panels on the mining rights area indicated that this was slightly more acceptable in that the panels could be erected on previously disturbed ground and may also be positioned amongst existing relief of the rehabilitated waste rock dumps so that they would not be as visually intrusive. The one negative aspect working against the construction of solar panels in the MRA is that the footprint is relatively small and may not provide sufficient for the number of panels that may be required to make the enterprise financially viable.

Mining tourism was not considered to be a realistic or feasible ELU for the Voorspoed properties because of the relatively small size of the mine. It is unlikely that Voorspoed in itself would act as a magnet to draw visitors or tourists who would be interested in historical mining sites. The relative proximity of the more well-known Kimberley diamond mines would likely make them a preferred destination for mining tourists. The Kimberley diamond mines have huge historical interest and through the sheer size and accessibility of the remaining pits would provide a far better site for mining tourism, especially in the context of history and legacy of diamond mining in the country. This is not to say that limited mining tourism could not be integrated into what will be the final end land use plan, especially if that included game farming with the opportunity to see some of South Africa’s more valued antelope game species, and if the game farming developed with suitable accommodation though interest would likely be limited and this aspect of closure should not be of capitalised.

Pecan nuts can be a lucrative crop in many parts of the country. They have a number of requirements not fully met on any of the Voorspoed farms, and these are that the trees require deep soils and ample water. It is unlikely that a profitable pecan nut farm could be established on the Voorspoed properties considering the requirement for irrigation and the general lack of deep well-drained soils. For this reason pecan nut farming was not scored very highly as a feasible option to be taken forward for economic assessment.

The conservation option on its own was deemed to be more relevant for Morgenster and Voorspoed each of which has conservation and biodiversity points of interest, namely the large wetland on Voorspoed that provides an essential habitat for a variety of wetland species at least on a seasonal basis, and provides a head water feed to a stream that runs to the north-west at the pan’s decant point, and also

Morgenster which includes the rocky outcrop Renosterkop that has a wide variety of habitat types and vegetation biodiversity with conservation value. The farms Welvaart and Belmont have been heavily utilised for agricultural purposes and as such most of the land, including wetland areas, has been significantly impacted and does not currently have high biodiversity conservation value. This does not mean to say that Welvaart should not be managed for recovery, but it would seem more appropriate to combine the conservation of wetlands and biodiversity with a suitable post mining land use like game farming, where these features of conservation value can be integrated into the landscape on which game is farmed.

5.5 Proposed ELU options to be taken forward for feasibility analysis

The stakeholder engagement process highlighted essentially seven (7) potential go forward options, none of which are unrelated and all of which align with the regional objectives to develop agriculture in the area. The go forward options are as follows

- Extensive cattle farming;
- Extensive sheep farming;
- Intensive sheep farming;
- Dryland maize production;
- Dryland sunflower production;
- Game farming; and
- Game farming, with high-value game species.

As discussed earlier, the Voorspoed farms have different soil types, land capability units and landscape features, so it would be expected that the optimal ELUP for the Voorspoed properties would be one with mixed land use.

All of the options above are variations on the same theme of agricultural production, which have been taken forward for economic assessment to determine which of the options or combination options would provide the most profitable enterprise for the mine properties at closure, with the stated objective of aiming for an end land use that as a minimum provides breakeven (cash neutral) scenario in covering the post-closure monitoring and maintenance programme until full and final relinquishment of the site, and the issuance of a closure certificate.

5.6 Economic evaluation of the proposed ELU options for the Voorspoed properties

This section summarises the economic evaluations done on the various farming ELU options, with the detailed assessments shown in the Omni Eko report in Appendix B.

In the first suite of scenarios (**Scenario 1.1 – 1.2**) the farming enterprises were evaluated as if implemented on all farms (Section 5.6.1 below). When none of these options met the business success criteria set, and alternative suite of scenarios was evaluated (**Scenarios 2.1 – 2.4**), where the farms Belmont and Welvaart were sold off to raise capital to fund the proposed ELU farming options on the balance of the Voorspoed properties (and including grazing on the available areas of the MRA, unmined areas of Voorspoed, and Morgenster). The pan wetland was included in the financial modelling when evaluating the profitability of different ELU options for Voorspoed. The results of the economic evaluation of the second set of scenarios is covered in Section 5.6.2.

5.6.1 Economic evaluation of ELU use options that include all Voorspoed properties

The results of the economic evaluation of **Scenarios 1.1 – 1.4**, which include different farming practices across all of the available Voorspoed properties, are summarised in Table 14 below. The detailed cash flow tables are available in Appendix B.

What the results indicate is that, while borrowing start-up capital allows the enterprises to start generating a positive cash flow in Y1 (**Scenarios 1.1 – 1.3**) and in Y3 (**Scenario 1.4**), none of the modelled enterprises pays off the bank loan over a 10 year period. Scenario 1.4, although requiring a significantly larger injection of start-up capital, has a much higher cash flow than the other scenarios (from Y3), and reduces its loan amount by 50% over 10 years.

Despite this, none of the ELUPs proposed meets all of the criteria of the business success metrics set.

Following this initial evaluation, the option to sell off Belmont and Welvaart was explored as a means to provide additional capital to reduce the amount of money that needed to be loaned on start-up.

As mentioned earlier, the main difference after selling off Belmont and Welvaart (other than a decrease in available grazing) was that cropping was removed from the ELUPs for **Scenarios 2.1 – 2.4**, discussed below.

5.6.2 Economic evaluation of ELU use options that exclude the farms Belmont and Welvaart

The results of the economic evaluation of Scenarios 2.1 – 2.4, which exclude Belmont and Welvaart, are summarised in Table 15 below. The detailed cash flow tables are also available in Appendix B.

Table 14: Summary of economic model for land use scenarios for all properties. Original model adjusted for revised area of approx. 2 503.18 ha for cropping and grazing.

End Land Use Plan Options	NPV	Start up capital needed	Capital borrowed	Capital contribution (property sales)	No. of years for positive cashflow	Annual value of first positve cashflow	Annual value of cashflow (Y10)	Bank balance (Y5)	Bank balance (Y10)	Year in which debt repaid
Scenario 1.1 Crops + cattle + sheep	R (8 018 034)	R 8 850 212	R 8 850 212	R 0	1	R 939 171	R 1 196 100	R (9 440 234)	R (8 259 499)	>10
Scenario 1.2 Crops + cattle	R (6 354 246)	R 8 191 801	R 8 191 801	R 0	1	R 998 017	R 1 258 106	R (8 358 243)	R (6 410 699)	>10
Scenario 1.3 Crops + sheep	R (9 557 720)	R 9 508 623	R 9 508 623	R 0	1	R 900 324	R 1 154 094	R (10 484 508)	R (9 963 023)	>10
Scenario 1.4 Crops + game	R (15 466 708)	R 23 685 800	R 23 685 800	R 0	3	R 5 174 151	R 8 138 785	R (30 901 020)	R (15 192 064)	>10

Table 15: Summary of economic model for land use scenarios where Belmont & Welvaart sold off. Original model adjusted for revised area of approx. 1 653.5 ha for grazing.

End Land Use Plan Options (Belmont and Welvaart sold)	NPV	Start up capital needed	Capital borrowed	Capital contribution (property sales)	No. of years for positive cashflow	Annual value of first positve cashflow	Annual value of cashflow (Y10)	Bank balance (Y5)	Bank balance (Y10)	Year in which debt repaid
Scenario 2.1 Cattle + sheep	R 5 828 255	R 3 389 944	R 0	R 8 490 000	never	R (38 871)	R (38 871)	R 5 553 657	R 6 226 307	0
Scenario 2.2 Cattle	R 6 696 092	R 2 882 108	R 0	R 8 490 000	3	R 10 776	R 10 776	R 6 219 058	R 7 181 352	0
Scenario 2.3 Sheep	R 5 103 394	R 3 894 530	R 0	R 8 490 000	never	R (65 870)	R (65 870)	R 4 956 994	R 5 437 366	0
Scenario 2.4 Game	R 3 279 354	R 14 747 300	R 0	R 8 490 000	3	R 3 043 952	R 5 415 659	R (9 331 342)	R 4 769 727	9

What the results indicate, counter intuitively, is that despite having a positive bank balance throughout the10 year period for Scenarios 2.1 – 2.3, all enterprises have a negative to small positive annual cash flow that would not support any post mining monitoring and maintenance, even after 10 years. Clearly the benefits of the capital injection from the sale of the two farms is eroded by the significantly reduced farming area (reducing from approx. 2 511 ha to 1 474 ha).

Although Scenario 1.4 (game farming), required a significantly larger injection of start-up capital, it has a much higher cash flow than the other scenarios (from Y3) with an annual cash flow of R3 million that grows to R5 million in Y10. The bank loan was settled in Y9.

This latter scenario (Scenario 2.4) is the only one to achieve all of the business success criteria.

5.6.3 Independent review of the economic evaluations for game farming enterprises

Following completion of the economic modelling, Voorspoed requested that a presentation of the results be given to Mr Piet Oosthuizen, Senior Manager: Ecology and DBCM Properties, at their Ecological Offices in Kimberley on 29 May 2017.

The following constructive input was given for the financial models, and approaches, involving game farming, which changed the preliminary findings:

- That the available area of grazing for game on Voorspoed was unlikely to be adequate for a sustainable game farming enterprise (where a minimum of 10 000 ha is desirable);
- That the gestation period for buffalo be pushed out from 12 to 15 months;
- That the sale prices of the game used in the economic model were probably higher than would be fetched on the open market; and
- That animal rights groups were increasing opposed to hunting, which was seen to be a growing reputational risk for De Beers, where game farming income models were based on trophy hunting.

The financial models involving game farming were rerun with the gestation period for buffalo pushed out to 15 months, and with a 20% reduction in the sale price of game (both live weight for females and hunting prices for trophy males). The model was rerun for both game scenarios, namely:

- Scenario 1.4: where game was farmed on all farms, and integrated with existing cropping on Belmont and Welvaart, and
- Scenario 2.4: where the farms Belmont and Welvaart we sold off to raise capital, with game being farmed exclusively on the remaining farms.

Not unexpectedly, the reduced selling prices of game resulted in neither game farming scenario being profitable.

Mr Oosthuizen further recommended that the Voorspoed farms would probably best be sold, and the capital invested to fund post-closure monitoring and maintenance, rather than the mine trying farm the properties for profit to support the post-closure costs.

Voorspoed management have stated their intention to retain Welvaart farm, which is in the “zone of influence” of the mineral residue deposits that will be left on the mining disturbed area, and could present a safety risk to people on the farm in the unlikely event of failure.

6. CONCLUSION: THE PROPOSED ELUP FOR THE VOORSPOED MINE PROPERTIES

Amongst the wide variety of potential ELU options proposed, the agricultural use of the Voorspoed properties post-closure was deemed to be the most appropriate in the regional context, and the most likely to be sustainable in the long term. The agricultural ELU options that were selected for economic evaluation included the production of selected crops (maize and sunflower), domestic livestock farming (cattle and sheep), and also game farming, and combinations of these.

The general shortage of surface and groundwater in the area mitigated against the selection of intensive agriculture in the form of large-scale centre pivot irrigation of maize and vegetables, and the greenhouse cultivation of vegetables and cut flowers. The high cost of importing/pumping irrigation water from remote water sources, if this water use could be licenced, would render the irrigation enterprises marginal to unprofitable.

One of the objectives of the economic evaluation was to determine if any of the proposed ELU options could generate sufficient profit to support the required monitoring, maintenance and remediation work anticipated during the post mining closure monitoring phase, and beyond.

Unfortunately, the results of the financial modelling done for the different preferred ELU options indicated that none of these presented a positive business case for Voorspoed to take forward as an option that would provide a “cash neutral” or profitable enterprise to fund all monitoring and maintenance work required during the post-closure monitoring period. The main impediment for each of the options evaluated was the high cost of capital for monies loaned from the bank for the purchase of stock and equipment, and the relatively low margins made on crops and stock, or game, sold. The latter largely reflects the low crop yields on relatively shallow soils and the low carrying capacity of the grasslands under low rainfall conditions in the region.

The land capability and pasture assessments made on the Voorspoed properties (including rehabilitated areas on the MRA), however, indicated that these areas are all suitable for agricultural production. In terms of next land use, the Voorspoed properties can be used for profitable gain if integrated into existing and established farming enterprises in close proximity to the mine, particularly if bank loans for start-up purchases can be kept as low as possible.

Figure 7 presents a proposed ELUP reflecting which areas of the Voorspoed properties are suitable for cropping and livestock grazing, and which would likely be the most sustainable end land uses in the long term. This would not preclude the opening up of old lands for cultivation in areas shown as having arable land capability in Figure 6. However, if extending existing cultivated lands is considered, this should be done judiciously because the large capital investment needed to prepare new cultivated lands and the relatively shallow soils on the Voorspoed properties, compounded by the low and variable rainfall, would make the expanded cropping scenario a more risky enterprise.

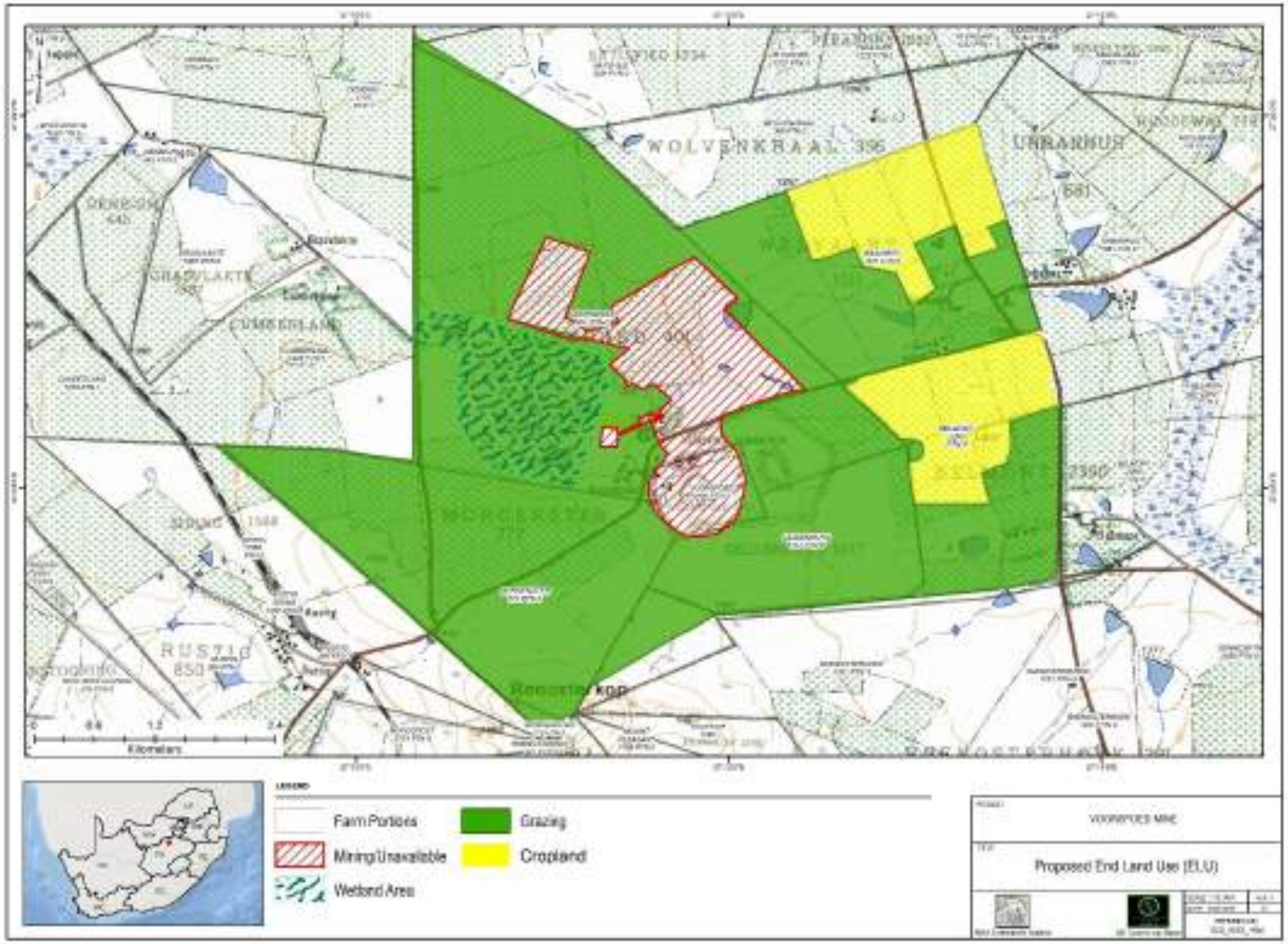


Figure 7: Proposed end land use plan for the Voorspoed properties.

Since none of the modelled farming enterprises proved to be profitable, Voorspoed may consider selling off the properties and investing the capital to fund post-closure monitoring and maintenance.

The sale of the Voorspoed properties, excluding Welvaart (which would be retained because it is in the zone of influence of the FRDs), would optimistically raise R16 322 900 (2 040 ha @ R8 000/ha). If this capital were invested at an interest rate of 6% pa with a drawdown of R200 000 per month (i.e. R2.4 million pa) then the capital could provide for post-closure monitoring and maintenance work for approx. 8 years. If closure were not obtained during this period, De Beers would need to provide funds from the corporate centre to support this work.

The author is mindful that the proposed ELU options taken through for economic/feasibility evaluation in this report are not labour intensive, and that Voorspoed is committed to leave a positive legacy at closure. It is argued that the CSI spend during the LoM provides the most important vehicle to "do good" in uplifting local communities. Indeed, Voorspoed has, through employing staff and through its CSI spend to date, made a significant contribution benefitting local communities.

Mining by its very nature is a temporary land use, with benefits accruing primarily during the operational phase. Once the resource has been depleted, finding a sustainable post-closure land use that can match the benefits delivered during the operational phase is always difficult.

The full suite of potential ELU options covered in this report will need to be presented to the mine's wider stakeholder group during the mine closure public consultation process. The work done to date provides Voorspoed management with a high level assessment of the pros and cons of the different proposed ELU options to help guide the discussions that will be needed with a wider stakeholder group, and also to proactively consider responses to stakeholders questions, and to temper expectations on what mine closure can realistically deliver.

7. DOCUMENTATION REVIEWED

The following documentation was provided by Voorspoed for review in developing the proposed ELU options presented in this report:

- Preliminary rehabilitation and closure plans
- Environmental Management Plans (EMP)
- Open pit closure plan
- Baseline Biodiversity Assessment & Management Plan
- Floristic Biodiversity Assessment
- Faunal Biodiversity Assessment
- Vegetation of Rehabilitated areas Report
- Soil Survey Report
- Soil Management Procedure
- Alien Invasive Management Procedure
- Social Impact Assessment
- Water balance, water quality data & hydrological / geohydrological reports
- Site Drawings
- Locality Plans.

Mark E. Aken (PhD) (*Pr. Sci. Nat*. – Env. - 400001/92)

NEKA Sustainability Solutions

M: 083 389 3331

E: aken.mark@gmail.com

APPENDIX A

ARC – ISCW: Soil Survey Report 2016

APPENDIX B

Omni-Eko Vegetation Report: veld carrying capacity, veld condition & economic assessment of different ELU options

APPENDIX F

Technical Evaluation of the Risks, Impacts and Management Requirements into Pit Backfilling Versus Current Mine Plan (Pitlake), Golder and Associates, 2019

REPORT

Technical Evaluation of the Risks, Impacts and Management Requirements into Pit Backfilling Versus Current Mine Plan (Pit Lake)

Voorspoed Diamond Mine

Submitted to:

Mr Hans Kgasago
De Beers Consolidated Mines
Voorspoed Mine
Farm Voorspoed,
S156

Submitted by:

Golder Associates Africa (Pty) Ltd.
P.O. Box 6001 Halfway House, 1685 Building 1, Maxwell Office Park
Magwa Crescent West Waterfall City Midrand, 1685 South Africa

+27 11 254 4800

1792363-318923-1_Rev1

February 2019

Distribution List

1 Copy - DBCM

1 eCopy - ProjectReports@golder.co.za

Executive Summary

The final closure of the Voorspoed Mine (~307 m deep ×~900 m excavation) is addressed in three different scenarios. Two of these scenarios deals with the development of a pit lake (i.e. Scenario 1 and 2). In the case of Scenario 1 (also referenced as the “Mine Plan”), the pit will be left to fill/rewater by direct rainfall recharge and local runoff from the pit footprint area. Scenario 2 addresses a larger “engineered” local catchment that will enhance the runoff to the pit and subsequently the rewatering progress. It is a fact that evaporation in the Voorspoed region is much higher than the total rainfall and groundwater ingress into the pit, the pit lake water level elevation is predicted to remain as a local piezometric sink i.e. the final water level elevation will settle several metres below the surrounding natural groundwater level elevation.

Due to closure plans for the Voorspoed Mine, it is required that the rewatering of the pit occurs over a relatively short period – this is a high-rated management requirement. Due to the high surface elevation of the mine, i.e. situated close the runoff-water divides of three quaternary catchments, the local runoff is directed away from the pit area; thus, any contribution from local runoff to enhance the development of a deep pit lake, is limited. The only physical contribution to the rewatering process is from (i) direct rainfall recharge, and (ii) local groundwater ingress. The numerical modelling, however, confirms the impact of the high evaporation rate and the low groundwater ingress observed during LoM and that the rewatering rate in terms of Scenarios 1 and 2 will be retarded [under the current climate conditions, 200 years after close the water table could be in the order of 94 m below ground surface]. In the case of Scenario 2, where a “local catchment” feeding local runoff into the pit excavation is engineered, the simulated rewatering water level elevation over a 200-year period will be ~75 m below ground surface. The gain is in the order of 19 m.

Rewatering of the back filled pit excavation (viz. Scenario 3) will be driven by recharge from local rainfall infiltration and groundwater ingress and could reach the pre-mining water level elevation in ~32 years – this is mainly due to the absence of the evaporation component. This scenario puts a risk on migration of poorer quality groundwater from the filled excavation to the local groundwater resources due to leaching of dissolved substances from the waste rock filling – now a semi-consolidated mass. A long-term responsibility for observations/monitoring on the mine site and surrounding land is required, followed by mitigation procedures, for example designing a special pollution plume borehole capturing system and subsequent storage/treatment procedures. In the latter case several water resources and environmental regulations will comply.

The water quality characteristics [modelling] in the cases of Scenario 1 and 2 for the Pit Lake water body shows that the initial TDS concentration is generally below the water quality limits for life stock water quality limits. Other important hydrochemical constituents such as Sodium, Sulphate and Calcium for Scenario’s 1 and 2, however, indicates a long-term increase due to the evaporation impact. This water quality characteristic is based by the groundwater quality of the Pit water source, i.e. seepages in the pit floor area which can be regarded as deep, crustal/Kimberlite type water. As noted above, the water level elevation will remain as a local “sink” under the current drier climate conditions regulated by a low groundwater inflow and high evaporation rate.

The effect of water quality stratification in the Pit Lake scenarios has not been addressed in this technical evaluation, however, it is foreseen that the pit lake water body could “settle” in a specific stratified pattern where the fresher water input from annual rainfall, and shallow groundwater ingress “overlies” the older, saline water generated during the initial rewatering phase consisting of residual evaporated water and seepages. This phenomenon, however, does not render the Pit Lake water body fit for water use supplies as some dissolved constituents will remain elevated throughout the water body.

The socio-economic and environmental assessment favours Scenario 1 in terms of environmental and economic aspects and Scenario 2 on social aspects. Scenario 3 comes out as a poorer option regarding the environmental aspects (migration of poor water quality from a water saturated backfilled excavation to the local groundwater system), and economic responsibilities (extraordinary cost of the back-filling procedure and dealing with a large waste rock dump foot print area that will require a contaminated land assessment).

Regarding the legal consequences, there no significant differences between Scenario 1 & 2, except the amendment of Part 2 of the 2017 EIA Regulations to change the closure condition from backfilling to a pit lake scenario. In the case of Scenario 2 (specifically the “engineered catchment”), diverting part of the catchment’s clean water into the pit excavation, ensues a loss to the catchment’s water budget – this will have to part of the EIA Regulation update and notifying the Department of Water and Sanitation). Scenario 3, however, requires a new water use license for pit excavation back filling using waste rock material, as well as a Contaminated Land Assessment of the waste rock foot print. In addition, a full EIA will be required (i.e. a waste management activity in terms of the 2017 EIA regulations) and subsequently a waste management license (GN R.633, Activity 34(11)). In addition, Scenario 3 requires an additional EIA compliance in the case of polluted groundwater capturing down gradient of the backfilled pit through a set of capturing waterholes and their abstracted water. Regarding GN 704, Scenarios 1 and 2 are compliant, but with Scenario 3, exemption is required.

In closing, the best option for closure of the Voorspoed Pit excavation is Scenario 1. Considering costs and long-term environmental impacts, Scenario 1 is the best option. Considering that special mitigation in terms of security and protection of the property against illegal mining and unauthorised tress passing with potential fatal consequences, are required and should be managed and funded for a considerable time after final closure. The latter requirement also accounts for Scenario 2, which is regarded as benefitting the social aspects above Scenario 1, and to some degree the environmental aspects. Redirecting local runoff, i.e. Scenario 2, to enhance the development of the Pit Lake may not be supported by the Department of Water and Sanitation and a special motivation will be required. Scenario 3 offers the best option towards the social aspects (specifically public safety and is close to having a pre-mining environment established), however, the economic and environmental significances overrides Scenario 1 and 2 benefits considerably, therefore, Scenario 3 is not regarded as an economic-environmental executable option.

Table of Contents

TABLES

FIGURES

APPENDICES

1.0 BACKGROUND

The Voorspoed Diamond Mine in the eastern Free State is approaching final closure phase. According to the mine closure plan, the excavation, which is circular feature measuring ~900 m in diameter with a depth of ~310 m, will be left to rewater over time. The terrain surrounding the pit excavation will be prepared according to mine's closure rehabilitation plan.

The Environmental Management Program (EMPr, 2010), high-lights that "all excavations will be back filled" using the material that has been removed from the pit during the Life of Mining. This material is currently stored in the Course and Fine Residual Dumps and the Waste Rock Dump (WRD). In this technical evaluation, only waste rock from the WRD will be used back filling of the pit excavation to ground level.

This technical evaluation addresses the closure of the pit excavation. Two options (divided into 3 scenarios) have been considered, namely;

(a) The Pit Lake Option (Current Mine Plan), i.e. allowing the open pit to recharge with groundwater, direct rainfall input, and local surface water runoff. This option is further subdivided into two scenarios;
   (i) Scenario 1: The development of a pit lake under current conditions i.e. direct rainfall to the pit footprint area, groundwater ingress and evaporation. Runoff from the pit catchment area will be diverted from the pit perimeter area, including, runoff from other impacted areas. This development will be supported by the final surface water management plan (2019 study), or
   (ii) Scenario 2: In addition to Scenario 1 above, the development of a pit lake with a specifically engineered local runoff catchment area to enhance runoff to the pit mainly to enhance development of a deeper pit lake during the initial rewatering period.

(b) Excavation Backfill Scenario (Scenario 3) using the current waste rock dump as main source of fill material and back filling the pit excavation to current ground elevation level.

This technical evaluation aims to evaluate both options in terms of hydrogeology, hydrology, geochemistry and legal aspects to guide a risk-based assessment in selecting the most appropriate closure strategy for the pit lake development. The scenarios described above are illustrated in Figure 1.

It is, however, expected that the re-watering Scenario's 1 and 2 under "natural conditions" will be a long-term process. Since evaporation from the open pit excavation is higher than the actual groundwater recharge, the pit lake scenarios will result in a permanent pit water level "sink[1]", however, salinification of the pit-lake water body in time could develop. It is, however, expected that stratification of the pit water body could develop over time; thus, a fresher component of the water body would develop at the pit lake surface. The intention is that this water body will not be available for any future water use due to abstraction limitations.

In considering the positive/negative risk impacts and management requirements of all the above-mentioned scenarios, there are several important aspects and they are

(i) Legislative requirements for Scenarios 1, 2 and 3;

(ii) Geochemical source term of the pit structure (i.e. rock faces incl. side walls);

(iii) Geochemical source term of the backfilling material (i.e. mainly the waste rock dump);

(iv) Water level elevation and water quality signatures of Pit Lake waterbody and rate of rewatering;

(v) Risk of polluting the surrounding aquifer system(s) based on the final hydraulic nature/relief of the rehabilitated site, and

[1] Water level is significantly lower than the surrounding water level – surrounding water will flow towards this point.

(vi) The socio-economic (potential costing) and environmental aspects related to the three scenarios.

(vii) Address post closure risks and management requirements related to the pit excavation as exposed in the three scenario assessments.

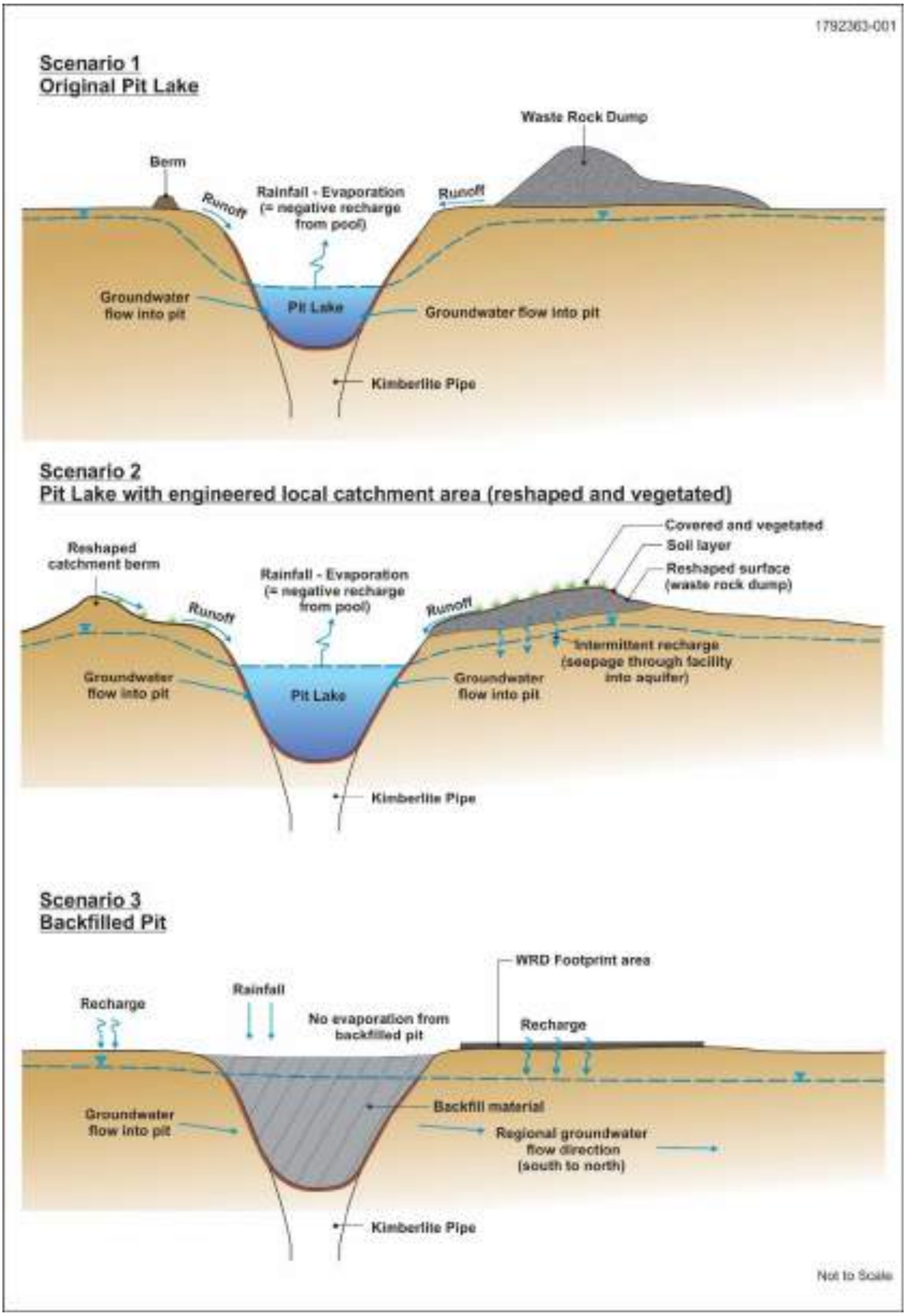


Figure 1: Proposed Voorspoed Mine Pit Excavation scenarios

2.0 OBJECTIVES OF THE TECHNICAL EVALUATION

The principal objective is to undertake a technical evaluation based on the Geohydrological Concept[2], Risks, Impacts and Management Requirements in terms of Pit Backfilling versus the Current Mine Plan (herein the Pit Lake).

In terms of the Geohydrological concept, two key components must be considered in evaluating the risks associated with the three potential scenarios, namely; (i) the resulting groundwater level and (ii) the resulting water quality within the pit excavation. The potential risks associated with these factors are outlined below for consideration in ensuing sections;

- Resulting pit water level elevation
  - Final water level in the pit results in a local groundwater sink – groundwater inflows to the pit are significantly reduced by evaporation and an indefinite suppressed water table sink develops in the vicinity of the excavation (under Scenario 1 & 2).

    Risk: This may result in an indefinite reduction in groundwater contribution to surface streams or surface pans, where applicable. This reduction in groundwater contribution is insignificant in terms of the total quaternary catchment area.

    Risk: Water levels may stabilise at a considerable depth from surface and consequently the pit lake area needs to be secured (i.e. fenced) permanently to ensure safety.
- Resulting water quality
  - The high local evaporation rate overrides sequential refreshing by direct rainwater recharge and subsequently the pit lake water quality will gradually worsen over time (under Scenario 1 & 2).

    Risk: Water will not be safe for consumption or other uses. The intention is, however, it that this water will not be available for domestic or other agricultural water supplies due to (i) the poorer quality and (ii) depth to water table.

    Risk: Surface water bodies could become contaminated due to decant of poor-quality water; however, it is highly unlikely that this will happen under the current climate conditions as it is expected that the pit will indefinitely act as a local water table sink.
  - Water level in backfilled excavation area becomes a groundwater mound and subsurface flow of potentially poor-quality water to the surrounding aquifer occurs (Scenario 3)

    Risk: In this case it is possible that the aquifer and potential groundwater users could be impacted by poor groundwater quality seepage from a 100% rewatered pit, however, due to the very low hydraulic characteristics of the host rock in the area, this expected retarded down-gradient migration of poor water quality will be refreshed (flushed) by local rainwater recharge.

In the light of the above-mentioned potential risks, it is necessary to understand the pit excavation's rewatering progress and the expected water quality signatures of a Pit Lake (under Scenarios 1 & 2) and the back-filled excavation (under Scenario 3). It is important to note that these risks are manipulated by: (i) the geochemistry of the pit sidewall rock formation and the hydrochemistry characteristics of the local groundwater [in the case of Scenario 1 & 2], (ii) the runoff water quality and volumes from the proposed local

[2] Collective grouping for the groundwater, surface water and geochemistry components of the water cycle in the site area.

engineered catchment [Scenario 2] and (iii) the geochemistry of the back-fill source material and the resulting water quality signature of the saturated portion of the filled excavation [Scenario 3].

The Technical Evaluation will therefore need to consider several important risks pertinent to the current geo-environmental conditions, associated impacts on the water quality and what mitigation measures need to be implemented. The important components are:

- Scenario 1: Original Pit Lake development (as per current design and deposition plan) –
  - Address the legal aspects of a pit lake development.
  - Review the re-watering timeline of the [post mining] opencast pit from (i) groundwater ingress, (ii) direct rainfall recharge and, (iii) the geochemical balance related to different water/soil/rock interactions (i.e. pit side walls and rim[3] area).
  - Develop a pit lake water quality mixing [time series] model based on the above-mentioned inputs. This will be based on the [updated] stochastic modelling.
- Scenario 2: Enhanced Pit Lake development (Scenario I plus a reshaped, engineered local catchment) –
  - In addition to the objectives in the above-mentioned scenario, this scenario will include the water quality status of the larger surface water runoff area; and
  - The enhanced rewatering progress of the water table elevation of the Pit Lake in order to secure the remaining ore body from illegal mining activities.
- Scenario 3: Backfilling of the pit excavation (with material from the current waste rock dump) –
  - Address the legal aspects of backfilling opencast pits (e.g. in terms of GN 704 and Section 19 of the NWA, and permission from the DMR to sterilise possible future resource).
  - Geochemical source term of the waste rock dump material is required in support of a waste assessment and contaminated land assessment of the waste rock site footprint (after backfill material has been removed).
  - Final groundwater elevation and water quality status of a 100% back-filled pit excavation.
  - Risk assessment and mitigation/rehabilitation requirements related to above-mentioned scenarios; and
  - Finally, the stochastic model (supported by the groundwater numerical modelling) needs to be amended and adapted for "on-site" and post-closure management of the backfilling process.

Finally, an environmental assessment and Socio-economic risk evaluation considering all scenarios will be conducted consisting of (i) a Risk Assessment, (ii) a Sustainability Option Analysis, (iii) Quantitative Scenario Cost, using the GoldSET framework tool for (ii) and (iii).

3.0 SCOPE OF WORK

The following important characteristics of the above-mentioned scenarios have been cited and need to be assessed:

- Assessment of physical features: After detailed sampling and analyses of the pit water, pit sidewalls and waster rock dump;
- Pit Lake: Rates of water ingress/recharge/losses (i.e. water table elevation rises over time); and
- Pit Lake: Hydrochemical signatures under "natural" and "enhanced" pit lake [re-watering] scenarios.
- Backfilling: Volume / mass balance and potential porosity and material setting;

[3] Area surrounding the pit perimeter where small, local runoff will report to the Pit Lake water body during rainfall events.

- Backfilling: Waste rock geochemistry signature(s) when altered to “activated” source term characteristics and resulting saturated hydrochemical characteristics of saturated back-filled body;
- Backfilling: Hydraulic dynamics of a backfilled opencast pit, i.e. a groundwater mound condition;
- Scenarios 1-3: Environmental and socio-economic risks and impacts; and
- Scenarios 1-3: Legal Consequences.

4.0 TECHNICAL EVALUATION COMPONENTS

The technical evaluation will follow the sequence of tasks as agreed in the original proposal for this investigation. Please note that Task 1 (Golder Voorspoed H&S arrangement) are related to Health & Safety and Preliminary Project Arrangements which have no relevance to the Technical Evaluation (see April 2018 Progress Reports for reference).

4.1 GEOCHEMISTRY ASSESSMENT

4.1.1 Approach

Our approach towards the geochemistry assessment of the technical elevation will cover (i) Acid rock drainage risk, (ii) Sampling and Laboratory Program, (iii) Geochemical Test Results, (iv) Acid Base Accounting, (v) Drainage Chemistry Analyses and (v) Waste Assessment and Classification. The objective of the geochemical component is the assessment of the Pit Lake water quality and (ground)water-logged back filled excavation.

4.1.1.1 Acid Rock Drainage Risk Assessment

The screening criteria that was used to assess the acid generation potential of the waste rock and pit wall rock materials was based on guidelines from Price et al. (1997) in conjunction with Soregaroli and Lawrence (1997); Morin and Hutt (2007) and MEND (2009); Usher et al. (2003); and INAP (2010)- see Table 1.

Table 1: Acid Generation Potential Assessment Criteria

Guidelines from Price et al. (1997) and Soregaroli and Lawrence (1997).			
Sulphide sulphur	**NPR (Bulk NP /AP)**	**Potential for ARD**	**Comments**
<0.3%	----	None	No further ARD testing required provided there are no other metal leaching concerns. *Exceptions:* host rock with no basic minerals, sulphide minerals that are weakly acid soluble.
>0.3%	<1	Likely	Likely to be ARD generating.
	1-2	Possibly	Possibly ARD generating if NP is insufficiently reactive or is depleted at a rate faster than that of sulphides.
	2-4	Low	Not potentially ARD generating unless significant preferential exposure of sulphides occur along fractures or extremely reactive sulphides are present together with insufficiently reactive NP.
	>4	None	No further ARD testing required unless materials are to be used as a source of alkalinity.

Guidelines from Morin and Hutt (2007) and MEND (2009)			
Paste pH	**NPR**	**Potential for ARD**	**Comments**
<6	<1	Acid generating (AG)	Net acid generating, and already acidic.
>6		Potentially acid generating (PAG)	Potentially acid generating unless sulphide minerals are non-reactive. Thus, samples are net acid generating, but not yet acidic.
<6 and >6	1 ≤ NPR ≤ 2	Uncertain	Possibly acid generating if NP is insufficiently reactive or is depleted at a rate faster than sulphides.
>6	>2	Not potentially acid generating (Non-PAG)	Not expected to generate acidity i.e. samples are net acid neutralizing.
<6		Theoretically not possible	

Nett Neutralisation Potential	**Potential for ARD**
< -20 kg $CaCO_3$ eqv.tonne^{-1}	Potentially acid generating (PAG)
> -20 kg and < +20 $CaCO_3$ eqv.tonne^{-1}	Uncertain
> +20 kg $CaCO_3$ eqv.tonne^{-1}	Not potentially acid generating (Non-PAG)

Guidelines based on Net Acid Generation (NAG) Tests (INAP 2010)			
NAG pH	**NPR**	**Potential for ARD**	**Comments**
<4.5	<1	Potentially acid forming	-
<4.5	>1	Uncertain	Conflicting ABA and NAG results. Further tests (kinetic tests) may be required to ascertain the ARD generation risk
>4.5	<1	Uncertain	
>4.5	>1	Non-Acid forming	-

4.1.1.2 Waste Classification (SANS10234 and GN R. 634 of 2013)

According to section 4(2) of GN R.634 of 2013, all waste generators must ensure that their waste is classified in accordance with SANS 10234 within 180 days of generation, except if it is listed in Annexure 1 of the GN R.634. Furthermore, waste must be re-classified every 5 years.

Waste classification according to SANS 10234 (based on the Global Harmonised System) is required by the Waste Classification and Management Regulations (GN R. 634 of 23 August 2013). Waste classification indicates physical, health and environmental hazards. The SANS 10234 covers the harmonised criteria for classification of potentially hazardous substances and mixtures, including wastes, in terms of its intrinsic properties/hazards.

The chemical test results as well as intrinsic properties of the waste streams were used for the SANS 10234 classification. Constituents present in concentrations exceeding 1% are used for classification in terms of health hazards, except when the constituent is known to be toxic at lower concentrations (carcinogens etc.) where a cut-off value of 0.1% is applied (Table 2).

Environmental hazard is based on toxicity to the aquatic ecosystem and distinguish between acute and chronic toxicity, bioaccumulation and biodegradation.

Environmental hazard is based on toxicity to the aquatic ecosystem and distinguish between acute and chronic toxicity, bioaccumulation and biodegradation.

Table 2: Cut-off values/concentration limits for hazard classes

Hazard class	Cut-off value (concentration limit) %
Acute toxicity	> 1.0
Skin corrosion	> 1.0
Skin irritation	> 1.0
Serious damage to eyes	> 1.0
Eye irritation	> 1.0
Respiratory sensitisation	> 1.0
Skin sensitisation	> 1.0
Mutagenicity: Category 1 Category 2	> 0.1 > 1.0
Carcinogenicity	> 0.1
Reproductive toxicity	> 0.1
Target organ systemic toxicity	> 1.0
Hazardous to the aquatic environment	> 1.0

4.1.1.3 Waste Assessment

In terms of the National Environmental Management Laws Amendment Act 25 of 2014 – Government Notice 448 in Government Gazette 37713, dated 2 June 2014 (commencement date: 2 September 2014) mine residue stockpiles and deposits (MRSD) are regulated as a waste by the National Environmental Management: Waste Act, 2008 (Act 59 of 2008) and are included in the definition of Waste as listed in Schedule 3 of NEMWAA.

According to the Regulations Regarding the Planning and Management of Residue Stockpiles and Residue Deposits from prospecting, mining, exploration or production operation (GN R. 632 of 24 July 2015), MRSD need to be assessed according to:

- Waste Assessment as per the National Norms and Standards for the Assessment of Waste for Landfill Disposal (GN R.635 of 23 August 2013) (WCMR); and
- Identification of the barrier design as per the National Norms and Standards for Disposal of Waste to Landfill (GN R.636 of 23 August 2013).

In terms of Regulation 8 of the WCMR, waste must be assessed in accordance with the Norms and Standards for Assessment of Waste for Landfill Disposal prior to the disposal of waste to disposal facilities or landfill (GN R.635 promulgated on 23 August 2013). In terms of these Norms and Standards, the appropriate landfill and/or barrier requirements for waste storage/disposal can be determined by following the prescribed and appropriate leach test protocols. The results must be assessed against the four levels of thresholds for leachable and total concentrations, which in combination, determines the waste type and associated barrier design / liner requirements. The terminology is as follows:

- LC means the leachable concentration of a particular contaminant in a waste, expressed as mg/l;
- TC means the total concentration of a particular contaminant in a waste, expressed as mg/kg;
- LCT means the leachable concentration thresholds for particular contaminants in a waste (LCT0, LCT1, LCT2, LCT3); and
- TCT means the total concentration thresholds for particular contaminants in a waste (TCT0, TCT1, and TCT2).

Figure 2 shows the flow diagram of the process to be followed to determine the waste type for disposal

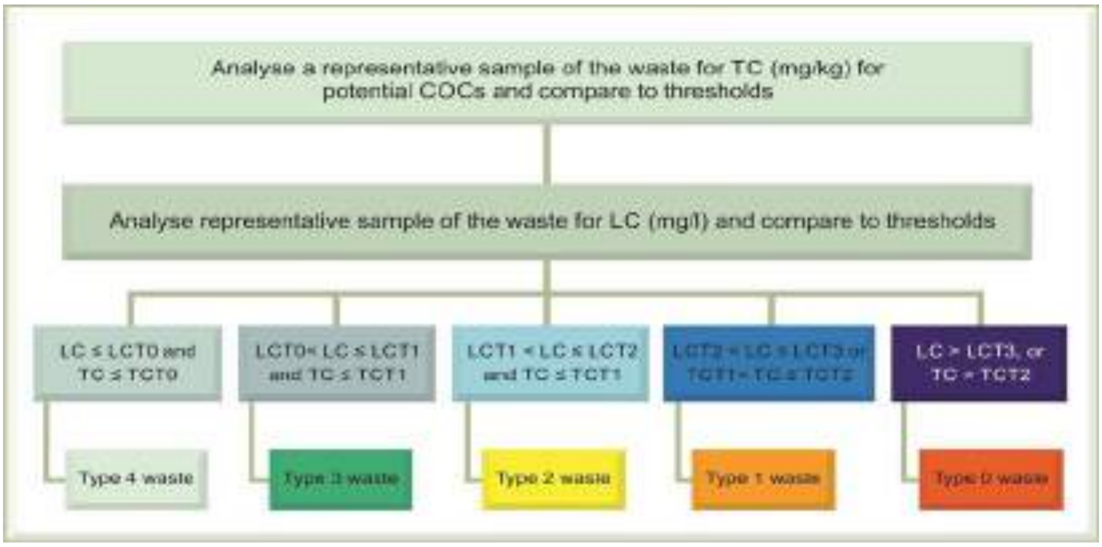


Figure 2: Flow diagram for waste classification according to the GN R. 635

4.1.1.4 GN R. 636 Barrier Design Requirements

Waste assessed in terms of the Standard for Assessment of Waste for Landfill Disposal (GN R.635 of 2013) set in terms of the WCMR must be disposed to a licensed landfill with liner or barrier design requirements as provided in Table 3.

Table 3: Landfill Disposal Requirements detailed in GN R. 636.

Waste Type	Landfill Disposal Requirements
Type 0	Disposal to landfill is not allowed. The waste must be treated first and then re-assessed to determine Waste Risk Profile for disposal.
Type 1	Disposal only allowed at a Class A landfill (Figure 3) in terms of these draft regulations, or at a HH / Hh landfill as specified in the Minimum Requirements Waste Disposal by Landfill (2nd Ed., DWAF, 1998).
Type 2	Disposal only allowed at a Class B landfill (Figure 4) in terms of these draft regulations, or a GLB+ landfill as specified in the Minimum Requirements Waste Disposal by Landfill (2nd Ed., DWAF, 1998).
Type 3	Disposal only allowed at a Class C landfill (Figure 5) in terms of these draft regulations, or a GLB+ landfill as specified in the Minimum Requirements Waste Disposal by Landfill (2nd Ed., DWAF, 1998).
Type 4	Disposal allowed at a Class D landfill (Figure 6) in terms of these draft regulations, or a at a GSB- landfill as specified in the Minimum Requirements Waste Disposal by Landfill (2nd Ed., DWAF, 1998).

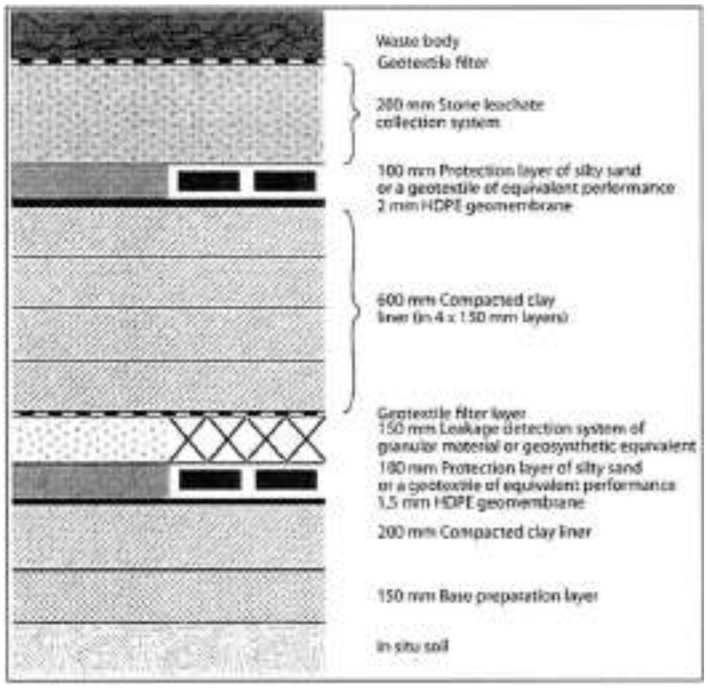


Figure 3: Example of Class A barrier design

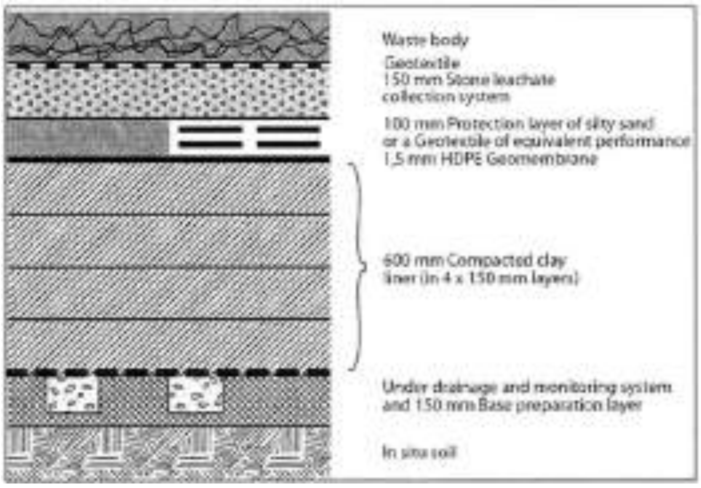


Figure 4: Example of Class B barrier design

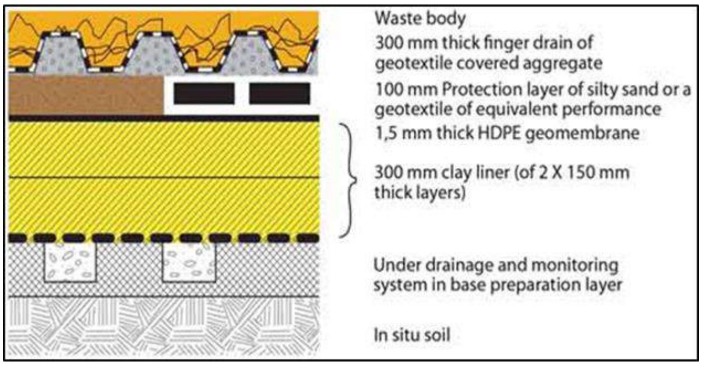


Figure 5: Example of Class C barrier design

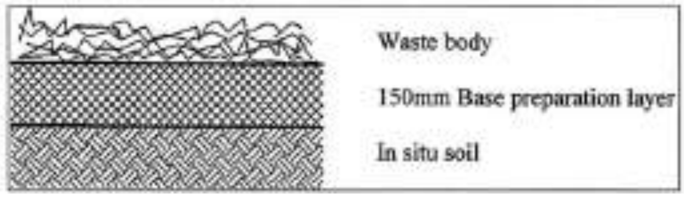


Figure 6: Example of Class D barrier design

4.1.2 Sampling Programme

Geochemical sampling of waste rock and a water sample was carried out on 15th and 16th February 2018 by a Golder geochemist with assistance from Voorspoed personnel. Discrete grab samples of different lithological units were collected from accessible and safe positions inside the pit, and from positions that were spatially distributed on an area that was not previously sampled on the waste rock dump (WRD) with the aim of collecting recent (fresh) materials (Figure 7). No samples were collected below surface to assess the variation of waste rock with depth as this requires drilling into the dump.

Some of the discrete samples of same rock type were mixed in the field resulting in a total of nine composite samples (Table 4). It should be emphasized that compositing limits assessment of spatial variability in characteristics of materials on the dumps and on the pit wall. However, the samples were considered sufficient to provide indicative ARD risk and metal leaching characteristics of pit wall rock and backfilled waste materials.

4.1.3 Laboratory Programme

The composite mine waste samples and the water sample were submitted to UIS Analytical Services (Pty) Ltd, a SANAS accredited laboratory in Pretoria for chemical analyses. The extent of the laboratory programme at UIS was driven by best practice guidelines for water resource protection in the South African Mining Industry and the requirements of the National Norms and Standards for the Assessment of Waste for Landfill Disposal (GN R. 635 of 23 August 2013), and requirements of GN R. 632 of 2015:

- Mineralogical determination by X-ray diffraction;
- Acid base accounting;
- Whole rock analyses to determine total concentrations of inorganic potential constituents of concern (PCOCs); and
- Australian Standard Leach Procedure (ASLP) with the appropriate extractions required for the specific disposal options, followed by ICP scan to determine leachable concentrations of inorganic PCOCs, including determination of cation and anion concentrations, total dissolved solids and pH.
- Net acid generation leach tests followed by ICP scan to determine leachable concentrations of inorganic PCOCs after complete oxidation, including determination of cation and anion concentrations, total dissolved solids and pH.

4.1.4 Geochemical Test Results

The analytical results for waste rock samples collected during the 2018 sampling event are summarised in this section.

4.1.4.1 Environmental Mineralogy

The mineralogical analysis was aimed at identifying minerals that have a potential of generating acidity (sulphides and sulphates) and neutralisation potential (including carbonate and silicate minerals). The mineralogical results of waste rock samples are summarised in Figure 8.

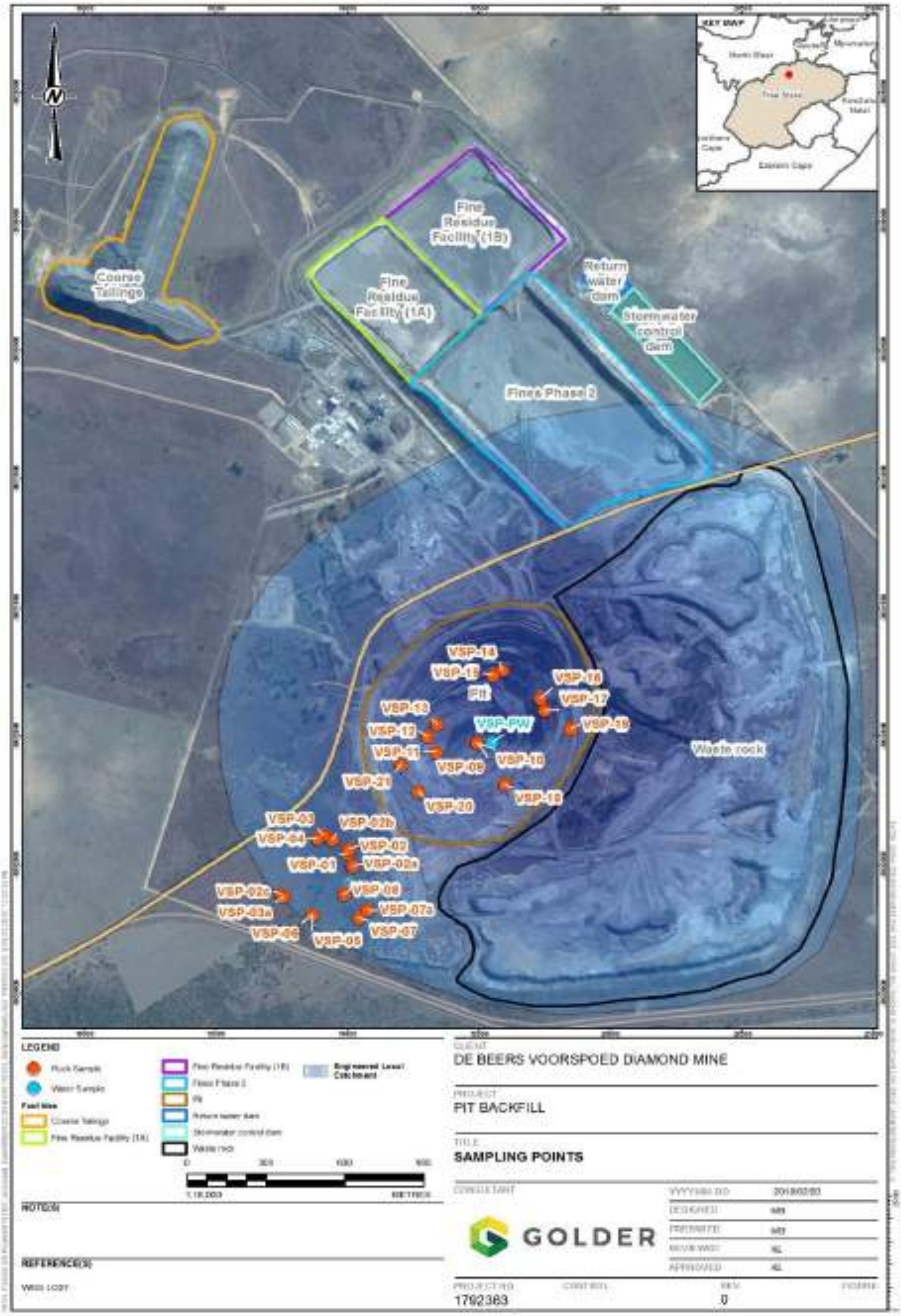


Figure 7: Location of rock samples and mine water sample

Table 4: List of samples

Discrete Sample ID	Latitude	Longitude	Rock Type	Source	Composite ID
VSP-01	27°24.264'	027°11.527'	Shale	Waste Rock Dump	VSP-03/VSP-01
VSP-03	27°24.226'	027°11.471'	Shale, carbonaceous	Waste Rock Dump	
	27°24.355'	027°11.380'	Shale	Waste Rock Dump	
VSP-04	27°24.233'	027°11.458'	Mudrock	Waste Rock Dump	none
VSP-02	27°24.254'	027°11.531'	Basalt	Waste Rock Dump	VSP-02/VSP-06/VSP-07
	27°24.290'	027°11.554'	Basalt	Waste Rock Dump	
	27°24.235'	027°11.492'	Basalt	Waste Rock Dump	
	27°24.350'	027°11.375'	Basalt	Waste Rock Dump	
VSP-06	27°24.394'	027°11.446'	Basalt	Waste Rock Dump	
VSP-07	27°24.399'	027°11.554'	Basalt	Waste Rock Dump	
	27°24.383'	027°11.574'	Basalt	Waste Rock Dump	
VSP-05	27°24.394'	027°11.446'	Dolerite	Waste Rock Dump	VSP-05/VSP-08
VSP-08	27°24.349'	027°11.519'	Dolerite	Waste Rock Dump	
VSP-11	27°24.050'	027°11.731'	Shale	Pit	VSP-15/VSP-11/VSP-13/VSP-21
VSP-13	27°23.991'	027°11.733'	Shale	Pit	
VSP-15	27°23.888'	027°11.862'	Carbonaceous shale	Pit	
VSP-21	27°24.077'	027°11.650'	Shale and conglomerate. Pyrite observed in conglomerate.	Pit	
VSP-10	27°24.031'	027°11.825'	Dolerite	Pit	VSP-10/VSP-12/VSP-14/VSP-20
VSP-12	27°24.017'	027°11.711'	Dolerite	Pit	
VSP-14	27°23.879'	027°11.884'	Dolerite	Pit	
VSP-20	27°24.133'	027°11.691'	Dolerite	Pit	
VSP-16	27°23.937'	027°11.972'	Mudstone	Pit	VSP-16/VSP-19
VSP-19	27°24.001'	027°12.042'	Weathered mudrock	Pit	
VSP-17	27°23.963'	027°11.981'	Basalt	Pit	VSP-17/VSP-18
VSP-18	27°24.118'	027°11.890'	Basalt	Pit	
VSP-22			Kimberlite	Pit	VSP-22/VSP-23
VSP-23			Kimberlite	Pit	
VSP-PW	27°24.029'	027°11.861'	Pit water from sump	Pit	Not applicable

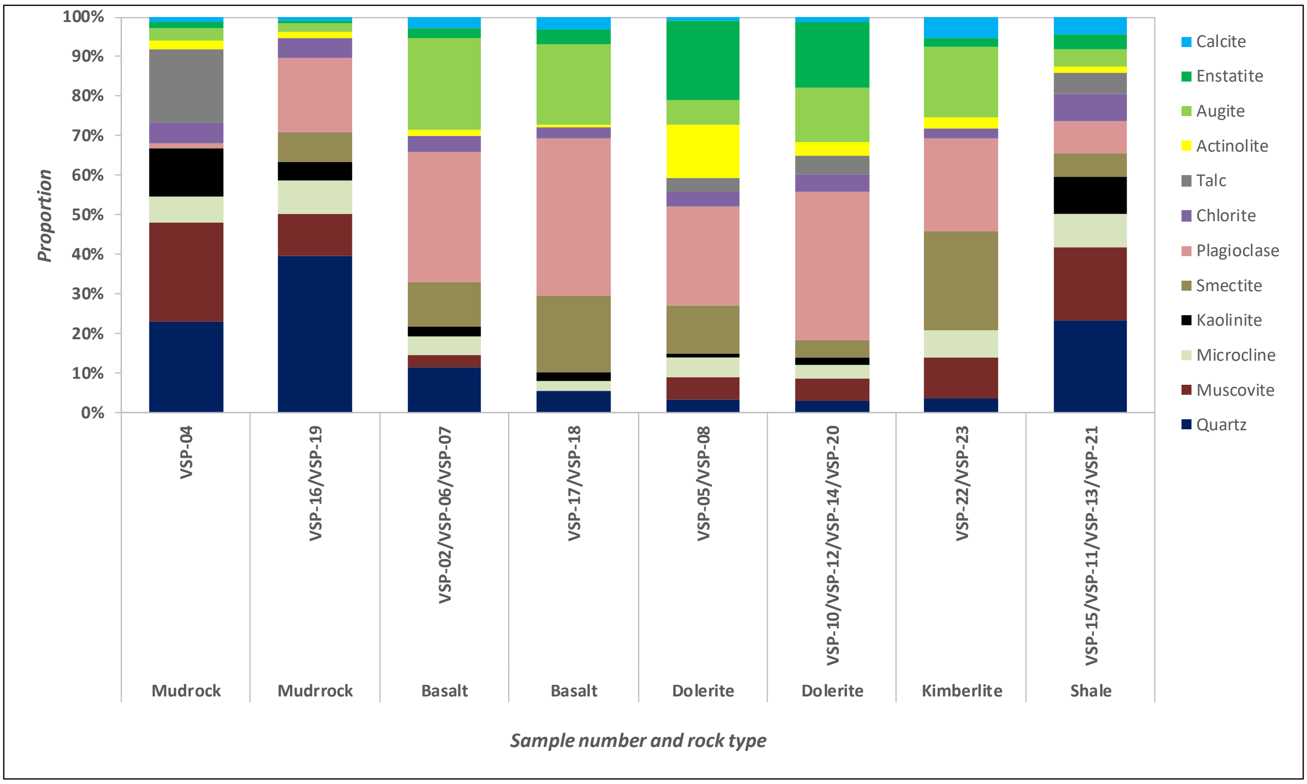


Figure 8: Mineralogical composition of waste rock samples

None of the acid forming minerals were detected in the analysed samples. Calcite, a carbonate mineral, was detected in all waste rock samples as a rare[4] to minor phase (0.89%-5.4%). Alumina-silicate minerals were rare to major phases.

Neutralisation capacity in the pit wall rock and waste rock dump materials is expected to be provided by calcite, which is a fast-reacting (dissolving) buffering mineral. The alumino-silicate minerals are likely to provide additional buffering capacity at variable rates as these are intermediate weathering (ultramafic and mafic) to very slow weathering (felsic) minerals.

4.1.4.2 Elemental composition

The extent of elemental enrichment in the CRD, FRD and WRD samples was assessed using the geochemical abundance index (GAI). GAI compares the measured concentration of an element with the estimated median crustal abundance after Fortescue (1992) and Price (1997), using the equation:

$$GAI = log_2[Cn/1.5 \times Bn]$$

where Cn is the concentration of the element in the sample and Bn is the crustal abundance of that element.

The GAI is expressed in integer increments from 0 through to 6, where a GAI of 0 indicates the element is present at a concentration similar to or less than the crustal abundances; GAI of 3 corresponds to a 12-fold; and so forth, up to a GAI of 6, which indicates a 96-fold or greater enrichment above the median crustal abundances.

[4] Semi-quantitative classification of mineral phases: dominant (>40% of the mineral fraction), major (10-40%), minor (2-10%), accessory (1-2%) and rare (<1%)

The elements that were found to be enriched in the waste rock samples from the waste rock dump and pit are provided in Table 5 and waste rock elements concentrations over average crustal abundance values are summarised in Figure 9.

Table 5: Geochemical Abundance Index for waste rock samples

Rock Type	Source	Elements with GAI > 0 (Elements with GAI > 3 are highlighted in bold)
Mudrock	Waste Rock Dump	As, **Au**, Ba, **Bi, C**,Hf, La, Ni, Pt, S, Se, **Te.**
Mudrock	Pit	As, Au, B, **Bi**, **C**, Li, **Pt**, S, Sb.
Basalt	Waste Rock Dump	As, Au, **B**, **Bi**, C, Hf, Li, **Pt**, **Sb**, Sn, U, W, Zr.
Basalt	Pit	Au, B, **Bi**, **C**, **Pt**, **Sb**, Se, V, W.
Dolerite	Waste Rock Dump	Au, **C**, **Cr**, Mg, Mn, **Pt**, Sb, Se.
Dolerite	Pit	As, Au, Bi,C, Cr, Mg, Ni, **Pt**, Sb, Se.
Shale	Pit	As, Au, Ba, **Bi**, **C**, **Pt**, S, Sb, Se.
Shale	Waste Rock Dump	As, Au, B, **Bi**, **C**, Hf, Li, **Pt**, Sb, Se, U, W.
Kimberlite	ROM Stockpile	Bi, C, Cr, Pt.

The waste rock materials from the waste rock and pit walls at Voorspoed are enriched (in decreasing order) in carbon, bismuth, antimony, boron, chromium, arsenic, sulphur, tungsten, lithium, selenium, nickel, magnesium and uranium (Figure 9). Selenium, arsenic, antimony, nickel, uranium, magnesium, chromium, boron and sulphur are environmentally-significant as they are associated with sulphides, carbonates and mafic silicate minerals, which are fast weathering minerals. Thus, these elements are potential constituents of concern (PCOCs) from waste rock dump seepage and pit water at Voorspoed. The other enriched elements, e.g. tungsten, are mainly insoluble and therefore not environmentally significant.

4.1.5 Acid Base Accounting

The acid base accounting results of waste rock samples are presented in Table 6. The total sulphur (0.01%-0.18%) and sulphide (0.003%-0.084%) content of all rock samples was very low.

Bulk neutralization potential (Bulk NP) was variable (4.0-83 kg $CaCO_3$ eqv t^{-1}), with low values being recorded in mudrock samples and one shale sample, and the highest NP being recorded in the kimberlite sample (Table 6). This agrees with mineralogical results, which indicated that Kimberlite had a relatively high proportion of calcite, and mudrock had low proportion of calcite and reactive alumina-silicate minerals (Figure 8). The alkaline paste pH (7.9-10.8) indicates sufficient reactive NP in all mine residue materials to buffer acidity generated by the initial oxidation of sulphides during the testing procedure. There is excess buffering capacity in the wall rock and waste rock dump materials, with Bulk NP exceeding acid potential (TAP and SAP) in all samples (Table 6).

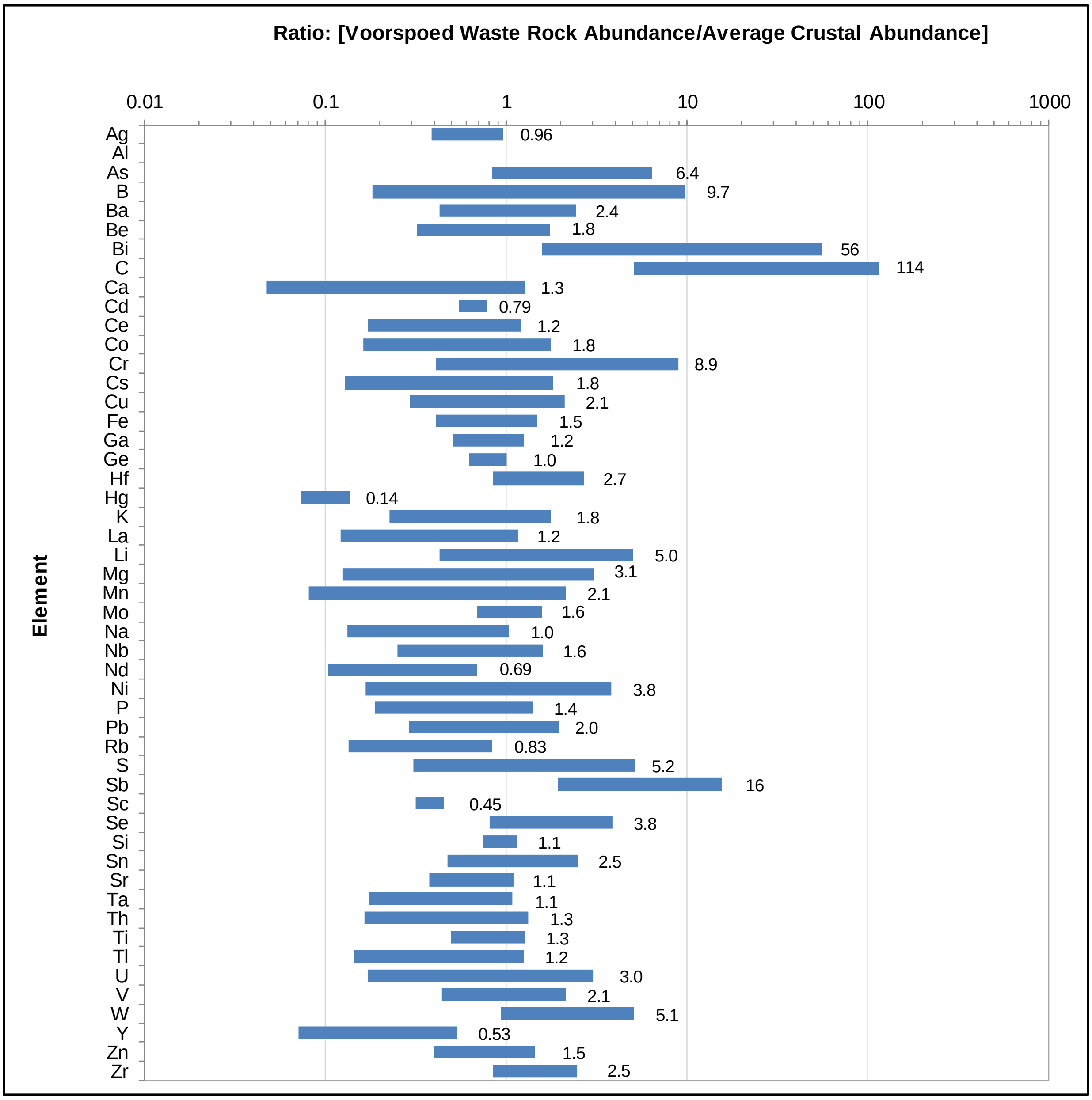


Figure 9: Ratios of Voorspoed mine waste rock elemental concentrations against average crustal concentration

Table 6: Waste rock and wall rock samples Acid Base Accounting Results

Source	Rock Type	Paste pH	Total Sulphur	Sulphide Sulphur	Sulphate Sulphur	Other Sulphur	Total Carbomn	Bulk NP[1]	SAP[2]	TAP[2]	SNNP[3]	TNNP[3]	SNPR[4]	TNPR[4]	ARD Risk Classification based on TNPR
		s.u	%					Kg $CaCO_3$ eqv/t					No units		
WRD	Mudrock	7.9	0.082	0.068	0.0090	0.005	0.62	4.0	2.1	2.6	1.9	1.5	1.9	1.6	Uncertain
Pit	Mudrock	8.2	0.036	0.026	0.0070	0.003	0.20	12	0.81	1.1	12	11	15	11	Non-PAG
Waste rock dump	Basalt	9.6	0.024	0.0030	0.0080	0.013	0.19	26	0.094	0.76	26	26	281	35	Non-PAG
Pit	Basalt	9.5	0.010	0.0040	0.0060	0.000	0.27	41	0.13	0.33	41	41	327	126	Non-PAG
Waste rock dump	Dolerite	9.9	0.052	0.024	0.019	0.009	0.11	30	0.75	1.6	29	29	40	19	Non-PAG
Pit	Dolerite	9.9	0.038	0.014	0.024	0.00	0.12	28	0.44	1.2	28	27	65	24	Non-PAG
ROM stockpile	Kimberlite	10.8	0.022	0.011	0.010	0.00	0.09	83	0.34	0.7	83	82	242	120	Non-PAG
Pit	Shale	9.0	0.070	0.044	0.012	0.01	1.2	48	1.4	2.2	47	46	35	22	Non-PAG

Source	Rock Type	Paste pH	Total Sulphur	Sulphide Sulphur	Sulphate Sulphur	Other Sulphur	Total Carbomn	Bulk NP[1]	SAP[2]	TAP[2]	SNNP[3]	TNNP[3]	SNPR[4]	TNPR[4]	ARD Risk Classification based on TNPR
		s.u	%					Kg $CaCO_3$ eqv/t					No units		
Waste rock dump	Shale	8.6	0.18	0.084	0.0070	0.09	2.1	14	2.6	5.5	11	9	5	3	Non-PAG
Waste rock dump	Mudrock	7.9	0.082	0.068	0.0090	0.005	0.62	4.0	2.1	2.6	1.9	1.5	1.9	1.6	Non-PAG

[1]Bulk NP is NP measured by Sobek titration.

[2]SAP - acid potential based on sulphide sulphur; TAP - acid potential based on the total sulphur content

[3]SNNP - the difference between bulk NP and SAP; TNNP - the difference between bulk NP and TAP

[4]SNPR - Ratio of SAP and bulk NP; TNPR - Ratio of TAP and bulk NP

[5]PAG – Potentially acid generating; Non-PAG – not potentially acid generating

All rock samples from the waste rock dump and pit are not potentially acid generating (Non-PAG) apart from one sample of mudrock from the waste rock dump, which classified as having an uncertain ARD generation potential as per the guidelines of Morin and Hutt (2007) and MEND (2009). Samples with Uncertain acid rock drainage (ARD) generation risk indicate that the ABA test work was unable to determine whether acidic drainage will occur in future. Figure 10 shows the uncertain area in grey between the PAG and NAG areas. Such samples are essentially marginal - with nett neutralisation potential close to zero. This can be resolved by subjecting the samples to kinetic test work [which takes several weeks to complete, i.e. outside the Scope of Work)].

Classification using the guidelines of Price et al. (1997) and Soregaroli and Lawrence show that all the samples have no potential of generating acidity due to a low sulphur content (Figure 11).

Either sulphide sulphur or total sulphur content can be used to estimate AP and classify ARD potential. The overall classification of samples' AP was based on total sulphur content, since this is considered to be conservative.

The net acid generation pH shows that mudrock, one shale sample and composite samples from the WRD collected in 2017 are Non-PAG (pH > 4.5), and the other rock samples (one shale, dolerite, basalt and kimberlite) have an Uncertain acid generation potential (Figure 12).

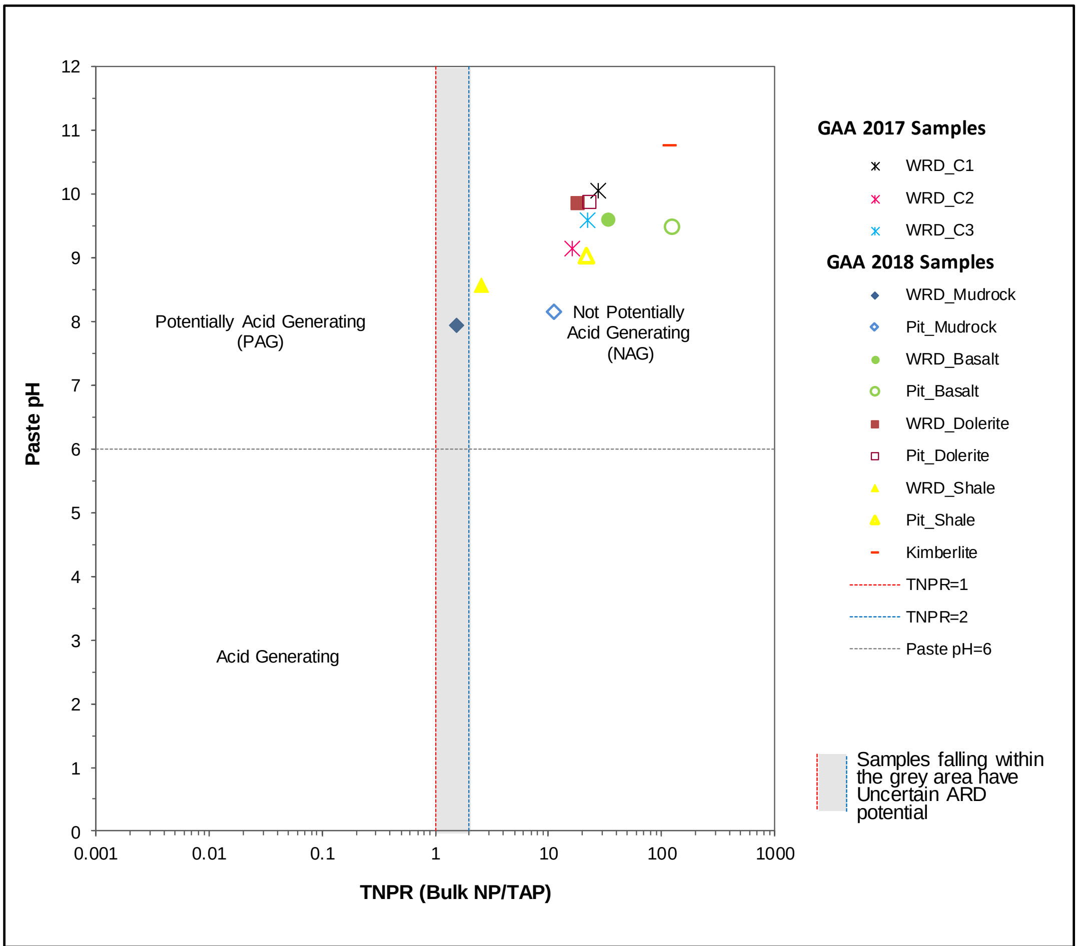


Figure 10: Plot of paste pH versus net potential ratio (TNPR) for samples collected for the current (Golder, 2018) and previous (Golder, 2017) geochemical studies

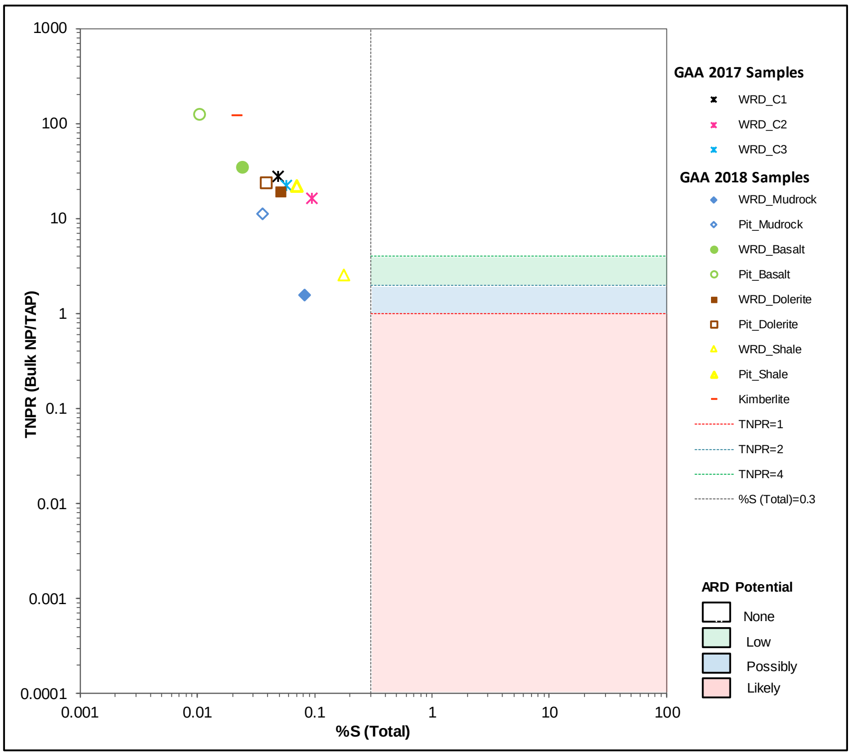


Figure 11: Plot of net potential ratio (TNPR) versus total sulphur content (%S) for samples collected for the current (Golder, 2018) and previous (Golder, 2017) geochemical studies

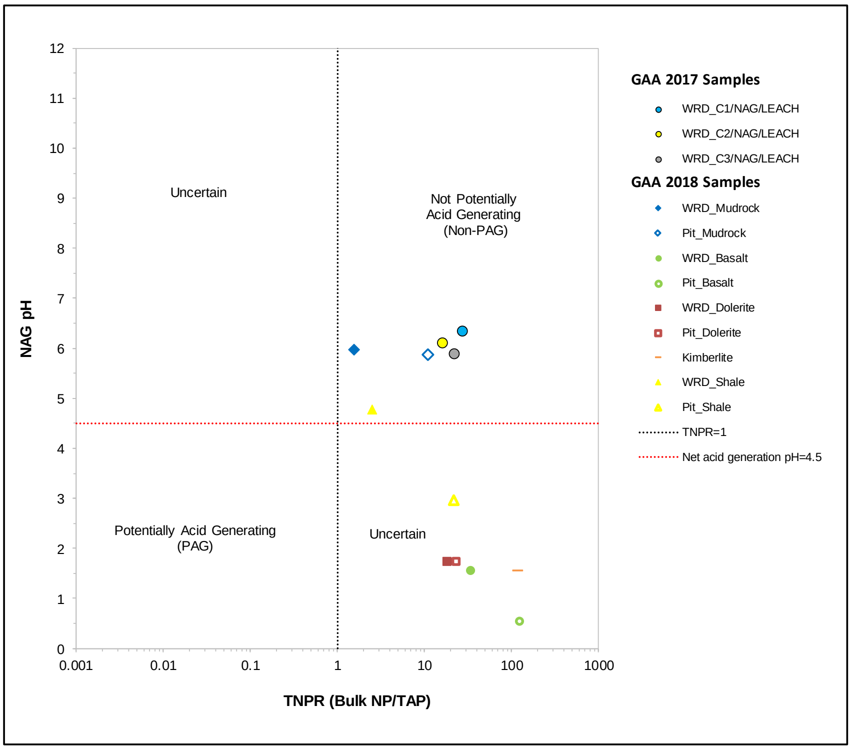


Figure 12: Plot of net potential ratio (TNPR) versus NAG pH for samples collected for the current (Golder, 2018) and previous (Golder, 2017) geochemical studies

4.1.6 Drainage Chemistry Analyses

Australian standard leaching procedure (ASLP) and net acid generation (NAG) leach tests were carried out on waste rock samples, in order to obtain indications of the potential drainage quality and PCOCs from the pit and waste rock dump at Voorspoed. These short-term leach tests measure readily soluble components of geological materials but do not predict long term water quality. Water-rock interactions often develop over periods of time that are much greater than can be represented in an 18 to 24-hour extraction test (INAP, 2010).

Leachate generated by net acid generation (NAG) leach tests represents complete and instantaneous oxidation and leaching of all reactive minerals. These tests were done to assess the maximum (worst case) quality of drainage from the coarse residue dump, fine residue dump and waste rock dumps. Under field conditions, sulphide oxidation and release of elements will occur gradually and concentrations in mine drainage are expected to be lower than NAG leachate chemistry at any given time.

The results of leach tests samples are summarized and compared with DWAF (1996) water quality guidelines in Table 7 and Table 8 where exceedances of guidelines are highlighted. The results were also compared to DWS (2016) water quality planning limits (WQPL) for the management units in the Renosterspruit catchment. The WQPL replaced the resource water quality objectives (RWQO). It should however be noted that WQPL are set only for pH, EC, turbidity and ammonia for catchment C70H, in which the Voorspoed mine is located. The leach and water samples results are also illustrated in Figure 13 and Figure 14.

The waste rock and wall rock materials are likely to produce predominantly near-neutral, low-metal drainage upon exposure to rainfall (Figure 13 and Figure 14). The following constituents that exceeded water quality guidelines (some marginally) in leachate samples are likely to be elevated in pit water and seepage from the waste rock dump:

- The pH (alkaline) is likely to exceed DWAF (1996) domestic and irrigation water quality guidelines as well as the WQPL for Renosterspruit water management units (Table 7);
- Aluminium is likely to exceed domestic, livestock and irrigation water quality guidelines;
- Iron, manganese and arsenic are likely to exceed domestic and irrigation water quality guidelines;
- Molybdenum is likely to exceed livestock and irrigation water quality guideline; and
- Sodium absorption ratio (SAR) is likely to exceed irrigation water quality guidelines.

The NAG leachate results indicate that the waste rock materials are likely to generate neutral mine to acid rock drainage with low to high metal concentrations (Figure 13 and Figure 14). The pit water and drainage from the waste rock dump is likely to exceed water guidelines for the following constituents as per Table 8:

- The pH (acidic) is likely to exceed the DWAF (1996) domestic and irrigation water quality guidelines as well as the WQPL for Renosterspruit water management units;
- Electrical conductivity, molybdenum, sodium, SAR and zinc are likely to exceed irrigation water quality guidelines;
- Aluminium, arsenic, calcium and iron are likely to exceed domestic use quality guidelines;
- Manganese is likely to exceed domestic use and irrigation water quality guidelines; and
- Mercury is likely to exceed domestic and livestock water quality guidelines.

It should be noted that these are ‘likely’ exceedances since under field conditions concentrations are influenced by solid (waste rock/wall rock) to liquid (groundwater inflows and rainfall) ratio, and equilibrium reactions among other factors.

Table 7: Summary of ASLP leach testing results compared to water quality standards

PCOC	Units	ASLP Leachate (1:20 solid: Liquid ratio)												South African DWAF (1996) drinking water quality guidelines			WQPL for Renoster (C70D, C70E, C70F, C70G, C70H)
		Basalt	Basalt	Shale	Shale	Mudrock	Mudrock	Dolerite	Dolerite	Kimberlite	Golder 2017 composite samples						
		WRD	Pit	WRD	Pit	WRD	Pit	WRD	Pit	Pit	WRD						
		VSP-02/VSP-06/VSP-07	VSP-17/VSP-18	VSP-03/VSP-01	VSP-15/VSP-11/VSP-13/VSP-21	VSP-04	VSP-16/VSP-19	VSP-05/VSP-08	VSP-10/VSP-12/VSP-14/VSP-20	VSP-22/VSP-23	WRD_C1	WRD_C2	WRD_C3	Domestic (Class 0)	Livestock	Irrigation	
pH	s.u	***9.9***	***10.0***	***9.7***	***9.7***	8.2	***9.3***	***8.6***	***9.8***	***10.6***	***9.9***	***9.4***	***9.6***	6-9	ng	6.5-8.4	***7.4-8.6***
TDS	mg/l	102	144	128	93	30	72	100	74	142	196	158	164	450	1000	ng	ng
EC	mS/m	14	21	16	14	3.3	10	15	11	25	26	23	22	ng	ng	40	***70***
P Alkalinity	mg/l $CaCO_3$	20	31	17	16	<0.6	6	1	17	64	24	8	11	ng	ng	ng	ng
M Alkalinity	mg/l $CaCO_3$	88	118	102	89	17	53	33	68	144	88	68	39	ng	ng	ng	ng
Cl^-	mg/l	0.4	1.0	0.2	0.2	0.3	0.3	1.7	0.4	<0.25	2.1	1.7	1.3	100	1500	ng	ng
F^-	mg/l	<0.1	<0.1	0.20	0.13	0.21	0.10	0.47	<0.1	0.13	<0.1	0.22	0.24	1	2	2	ng
NO_3^-	mg/l	1.2	2.2	<0.3	<0.3	<0.3	1.1	4.3	<0.3	2.1	7.0	7.9	8.2	ng	100	ng	ng
NO_3^- as N	mg/l	0.3	0.5	<0.1	<0.1	<0.1	0.2	1.0	<0.1	0.5	1.6	1.8	1.9	6	ng	ng	ng
NO_2^-	mg/l	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.2	<0.2	<0.2	6	ng	ng	ng
SO_4^{2-}	mg/l	7	8	12	8	6	14	49	3	9	26	35	30	200	1000	ng	ng

PCOC	Units	ASLP Leachate (1:20 solid: Liquid ratio)												South African DWAF (1996) drinking water quality guidelines			WQPL for Renoster (C70D, C70E, C70F, C70G, C70H)
		Basalt	Basalt	Shale	Shale	Mudrock	Mudrock	Dolerite	Dolerite	Kimberlite	Golder 2017 composite samples						
		WRD	Pit	WRD	Pit	WRD	Pit	WRD	Pit	Pit	WRD						
		VSP-02/VSP-06/VSP-07	VSP-17/VSP-18	VSP-03/VSP-01	VSP-15/VSP-11/VSP-13/VSP-21	VSP-04	VSP-16/VSP-19	VSP-05/VSP-08	VSP-10/VSP-12/VSP-14/VSP-20	VSP-22/VSP-23	WRD_C1	WRD_C2	WRD_C3	Domestic (Class 0)	Livestock	Irrigation	
Al	mg/l	2.2	1.5	0.6	1.2	0.3	0.4	0.1	0.8	1.1	11	6.3	6.6	0.15	5	5	ng
As	mg/l	0.009	0.011	0.026	0.051	0.011	0.033	0.002	0.010	0.303	0.011	0.007	0.012	0.01	1	0.1	ng
B	mg/l	0.03	0.05	0.15	0.09	0.09	0.08	0.09	0.03	0.05	0.13	0.16	0.13	ng	5	0.5	ng
Be	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	ng	0.1	ng	ng
Ca	mg/l	1.7	1.1	1.3	1.2	0.4	1.6	19.9	1.5	1.3	5.1	5.0	4.0	32	1000	ng	ng
Cd	mg/l	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	5	10	10	ng
Co	mg/l	0.002	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.003	0.001	<0.001	ng	1	0.05	ng
Cu	mg/l	0.006	0.008	0.002	<0.001	0.002	0.002	<0.001	0.001	0.002	0.026	0.007	0.007	1	0.5	0.2	ng
Fe	mg/l	1.4	1.3	0.2	0.2	0.2	0.1	0.1	0.5	0.8	8.3	3.6	3.6	0.1	10	5	ng
Hg	mg/l	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	0.001	0.001	ng	ng
K	mg/l	1.1	0.7	1.5	1.7	0.6	1.8	0.5	2.4	2.0	4.5	3.7	4.2	50	ng	ng	ng
Li	mg/l	0.006	0.007	0.006	0.005	0.001	0.004	0.001	0.005	0.001	0.004	0.004	0.004	ng	ng	2.5	ng
Mg	mg/l	0.5	0.5	0.1	0.1	0.0	0.4	3.4	0.5	0.7	4.7	1.9	1.9	30	500	ng	ng

PCOC	Units	ASLP Leachate (1:20 solid: Liquid ratio)												South African DWAF (1996) drinking water quality guidelines			WQPL for Renoster (C70D, C70E, C70F, C70G, C70H)
		Basalt	Basalt	Shale	Shale	Mudrock	Mudrock	Dolerite	Dolerite	Kimberlite	Golder 2017 composite samples						
		WRD	Pit	WRD	Pit	WRD	Pit	WRD	Pit	Pit	WRD						
		VSP-02/VSP-06/VSP-07	VSP-17/VSP-18	VSP-03/VSP-01	VSP-15/VSP-11/VSP-13/VSP-21	VSP-04	VSP-16/VSP-19	VSP-05/VSP-08	VSP-10/VSP-12/VSP-14/VSP-20	VSP-22/VSP-23	WRD_C1	WRD_C2	WRD_C3	Domestic (Class 0)	Livestock	Irrigation	
Mn	mg/l	0.07	0.024	0.018	0.005	0.003	0.001	0.004	0.011	0.023	0.054	0.018	0.027	0.05	10	0.02	ng
Mo	mg/l	0.001	0.001	0.03	0.02	0.004	0.014	0.002	0.001	0.002	0.004	0.005	0.007	ng	0.01	0.01	ng
Na	mg/l	31	44	37	29	9	19	4	23	44	35	35	37	100	2000	70	ng
SAR	mmol/L^ 0.5	5.3	8.7	8.1	6.7	4.0	3.6	0.2	4.2	7.6	2.7	3.4	3.8	ng	ng	1.5	ng
Ni	mg/l	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	0.003	0.009	0.004	0.003	ng	1	0.2	ng
Pb	mg/l	<0.001	0.004	0.003	0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.003	0.002	0.002	0.01	0.1	0.2	ng
Se	mg/l	0.009	0.014	0.023	0.010	0.006	0.010	0.016	0.005	0.004	0.003	0.007	0.005	0.02	50	0.02	ng
U	mg/l	0.0004	0.0002	0.0001	0.0001	<0.0001	0.0001	<0.0001	0.0001	0.0001	0.0006	0.0020	0.0008	ng	ng	0.01	ng
V	mg/l	0.043	0.089	0.017	0.018	0.004	0.010	0.001	0.018	0.028	0.023	0.010	0.016	0.1	1	0.1	ng
Zn	mg/l	0.029	0.098	0.025	0.021	0.024	0.000	0.071	0.023	0.022	0.028	0.022	0.018	3	20	1	ng

ng = no guideline

Values highlighted in blue indicate that the measured value exceeds the DWAF domestic water use guidelines, brown values that the measured value exceeds the livestock, bold italics exceed WQPL limit

Table 8: Summary of NAG leach testing results compared to water quality standards

PCOC	Units	NAG Leachate (1:100 solid: Liquid ratio)												South African DWAF (1996) drinking water quality guidelines			WQPL for Renoster (C70D, C70E, C70F, C70G, C70H)
		Basalt	Basalt	Shale	Shale	Mudrock	Mudrock	Dolerite	Dolerite	Kimberlite	Golder 2017 composite samples						
		WRD	Pit	WRD	Pit	WRD	Pit	WRD	Pit	Pit	WRD						
		VSP-02/VSP-06/VSP-07	VSP-17/VSP-18	VSP-03/VSP-01	VSP-15/VSP-11/VSP-13/VSP-21	VSP-04	VSP-16/VSP-19	VSP-05/VSP-08	VSP-10/VSP-12/VSP-14/VSP-20	VSP-22/VSP-23	WRD_C1	WRD_C2	WRD_C3	Domestic (Class 0)	Livestock	Irrigation	
pH	s.u	6.9	6.8	5.4	6.1	4.4	4.6	7.5	7.0	6.4	6.3	6.1	5.9	6-9	ng	6.5-8.4	***7.4-8.6***
TDS	mg/l	254	312	316	310	226	280	290	282	340	338	354	322	450	1000	ng	ng
EC	mS/m	32	39	40	41	26	30	37	38	45	45	44	44	ng	ng	40	***70***
P Alk.	mg/l $CaCO_3$	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	ng	ng	ng	ng
M Alk.	mg/l $CaCO_3$	66	73	33	57	<3.5	4	66	65	74	67	57	52	ng	ng	ng	ng
Cl^-	mg/l	2	2	2	<0.25	<0.25	6	1	3	<0.25	<0.25	6.9	<0.25	100	1500	ng	ng
F^-	mg/l	0.25	0.27	0.22	0.20	0.12	<0.1	0.19	0.19	0.11	0.23	0.17	0.16	1	2	2	ng
NO_3^-	mg/l	<0.3	0.3	7.0	<0.3	<0.3	<0.3	13.6	<0.3	<0.3	<0.3	<0.3	1.28	ng	100	ng	ng
NO_3^- as N	mg/l	<0.1	<0.1	1.58	<0.1	<0.1	<0.1	3.07	<0.1	<0.1	<0.1	<0.1	0.29	6	ng	ng	ng
SO_4^{2-}	mg/l	13	10	38	26	14	24	16	18	27	13	29	19	200	1000	ng	ng

PCOC	Units	NAG Leachate (1:100 solid: Liquid ratio)												South African DWAF (1996) drinking water quality guidelines			WQPL for Renoster (C70D, C70E, C70F, C70G, C70H)
		Basalt	Basalt	Shale	Shale	Mudrock	Mudrock	Dolerite	Dolerite	Kimberlite	Golder 2017 composite samples						
		WRD	Pit	WRD	Pit	WRD	Pit	WRD	Pit	Pit	WRD						
		VSP-02/VSP-06/VSP-07	VSP-17/VSP-18	VSP-03/VSP-01	VSP-15/VSP-11/VSP-13/VSP-21	VSP-04	VSP-16/VSP-19	VSP-05/VSP-08	VSP-10/VSP-12/VSP-14/VSP-20	VSP-22/VSP-23	WRD_C1	WRD_C2	WRD_C3	Domestic (Class 0)	Livestock	Irrigation	
Al	mg/l	0.64	0.48	2.88	0.69	2.22	2.27	0.34	0.29	0.21	0.44	1.1	0.56	0.15	5	5	ng
As	mg/l	0.006	0.001	0.017	0.073	0.017	0.011	0.020	0.008	0.004	0.008	0.013	0.014	0.01	1	0.1	ng
B	mg/l	0.024	0.073	0.492	0.147	0.267	0.446	0.020	0.078	0.148	0.049	0.058	0.063	ng	5	0.5	ng
Ba	mg/l	0.056	0.396	0.461	0.204	0.313	0.477	0.059	0.089	0.254	0.172	0.155	0.153	ng	ng	ng	ng
Ca	mg/l	20	21	20	32	5	13	11	11	30	34	39	35	32	1000	ng	ng
Cd	mg/l	<0.0001	<0.0001	0.0005	0.0001	<0.0001	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	0.0001	5	10	10	ng
Co	mg/l	0.012	0.002	0.042	0.051	0.016	0.015	0.002	0.016	0.007	0.001	0.006	0.004	ng	1	0.05	ng
Cu	mg/l	0.001	0.004	0.061	0.018	0.010	0.012	0.005	0.007	0.010	0.018	0.013	0.025	1	0.5	0.2	ng
Fe	mg/l	1.25	1.40	0.53	0.22	0.96	0.72	0.84	0.49	0.34	0.39	1.1	0.34	0.1	10	5	ng
Hg	mg/l	<0.0001	<0.0001	<0.0001	0.0001	0.0001	0.0002	<0.0001	<0.0001	<0.0001	0.11	0.0078	0.0032	0.001	0.001	ng	ng
K	mg/l	2	1	6	6	5	5	4	5	6	11	12	11	50	ng	ng	ng

PCOC	Units	NAG Leachate (1:100 solid: Liquid ratio)												South African DWAF (1996) drinking water quality guidelines			WQPL for Renoster (C70D, C70E, C70F, C70G, C70H)
		Basalt	Basalt	Shale	Shale	Mudrock	Mudrock	Dolerite	Dolerite	Kimberlite	Golder 2017 composite samples						
		WRD	Pit	WRD	Pit	WRD	Pit	WRD	Pit	Pit	WRD						
		VSP-02/VSP-06/VSP-07	VSP-17/VSP-18	VSP-03/VSP-01	VSP-15/VSP-11/VSP-13/VSP-21	VSP-04	VSP-16/VSP-19	VSP-05/VSP-08	VSP-10/VSP-12/VSP-14/VSP-20	VSP-22/VSP-23	WRD_C1	WRD_C2	WRD_C3	Domestic (Class 0)	Livestock	Irrigation	
Li	mg/l	0.044	0.008	0.048	0.024	0.044	0.031	0.017	0.016	0.004	0.012	0.015	0.012	ng	ng	2.5	ng
Mg	mg/l	3.4	4.2	3.0	2.6	1.2	3.7	9.4	7.5	5.3	6.1	6.4	5.2	30	500	ng	ng
Mn	mg/l	0.060	0.102	0.559	0.460	0.070	0.284	0.038	0.155	0.160	0.12	0.23	0.34	0.05	10	0.02	ng
Mo	mg/l	0.007	0.001	0.02	0.012	0.003	0.005	0.007	0.002	0.003	0.0058	0.0061	0.0061	ng	0.01	0.01	ng
Na	mg/l	51	59	58	51	55	52	49	50	61	72	67	68	100	2000	70	ng
SAR	mmol/L^ 0.5	2.8	3.1	3.2	2.3	5.9	3.3	2.6	2.8	2.7	3.0	2.6	2.8	ng	ng	1.5	ng
Ni	mg/l	0.002	0.001	0.094	0.122	0.041	0.015	0.011	0.035	0.011	0.015	0.047	0.037	ng	1	0.2	ng
Pb	mg/l	<0.001	<0.001	0.002	<0.001	0.002	0.002	<0.001	<0.001	<0.001	0.002	0.002	0.001	0.01	0.1	0.2	ng
Se	mg/l	0.016	0.006	0.006	0.012	0.012	0.005	0.008	0.005	0.008	0.003	0.002	0.001	0.02	50	0.02	ng
Si	mg/l	23	29	32	28	36	33	26	21	31	45	43	42	ng	ng	ng	ng
Te	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	ng	ng	ng	ng

PCOC	Units	NAG Leachate (1:100 solid: Liquid ratio)												South African DWAF (1996) drinking water quality guidelines			WQPL for Renoster (C70D, C70E, C70F, C70G, C70H)
		Basalt	Basalt	Shale	Shale	Mudrock	Mudrock	Dolerite	Dolerite	Kimberlite	Golder 2017 composite samples						
		WRD	Pit	WRD	Pit	WRD	Pit	WRD	Pit	Pit	WRD						
		VSP-02/VSP-06/VSP-07	VSP-17/VSP-18	VSP-03/VSP-01	VSP-15/VSP-11/VSP-13/VSP-21	VSP-04	VSP-16/VSP-19	VSP-05/VSP-08	VSP-10/VSP-12/VSP-14/VSP-20	VSP-22/VSP-23	WRD_C1	WRD_C2	WRD_C3	Domestic (Class 0)	Livestock	Irrigation	
Tl	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	ng	ng	ng	ng
U	mg/l	0.0002	<0.0001	0.0007	0.0010	0.0013	0.0013	<0.0001	0.0001	0.0003	0.0010	0.0009	0.0012	ng	ng	0.01	ng
V	mg/l	0.050	0.084	0.036	0.027	0.026	0.015	0.061	0.044	0.025	0.053	0.048	0.045	0.1	1	0.1	ng
W	mg/l	0.001	<0.001	0.001	0.001	0.001	0.022	0.001	0.001	0.001	0.001	0.001	0.000	ng	ng	ng	ng
Zn	mg/l	0.04	2.12	1.04	0.21	0.35	0.52	0.10	0.08	0.14	0.13	0.14	0.14	3	20	1	ng

ng = no guideline

Values highlighted in blue indicate that the measured value exceeds the DWAF domestic water use guidelines, brown values that the measured value exceeds the livestock bold italics exceed WQPL limit

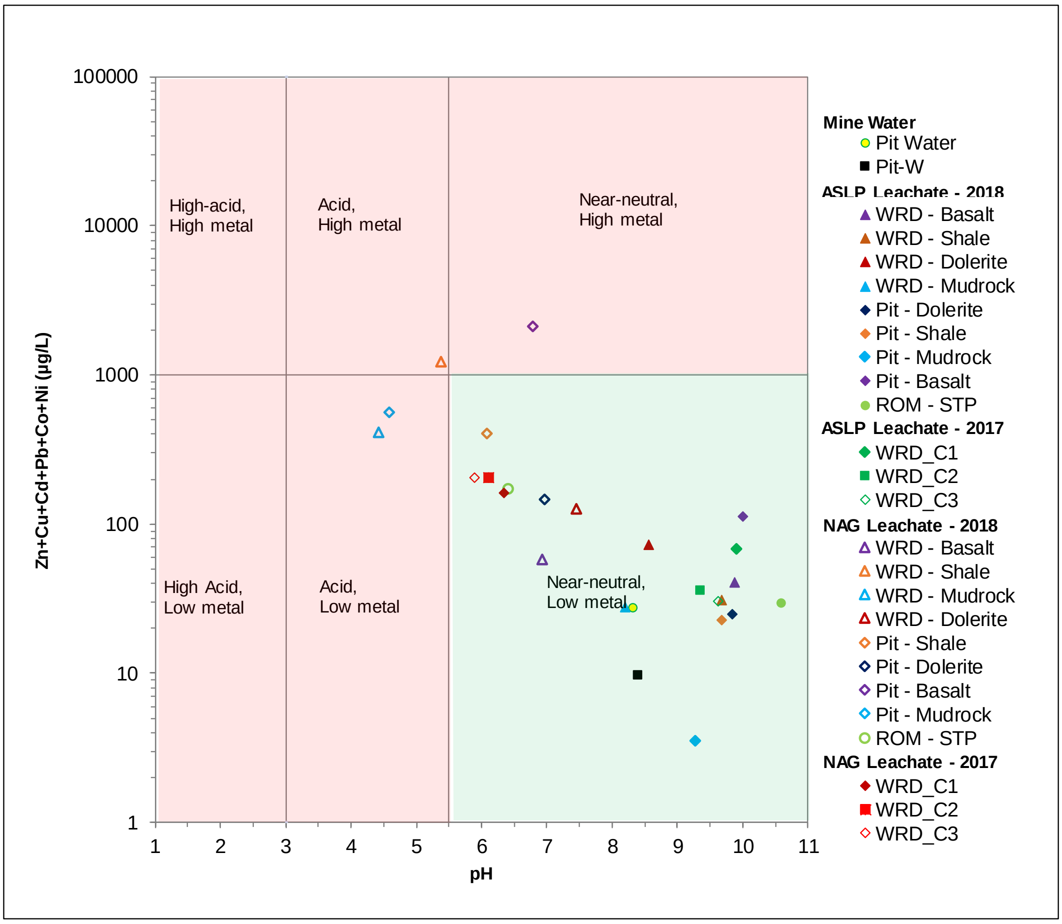


Figure 13: Ficklin diagram showing composition of leachate and pit water samples from Voorspoed

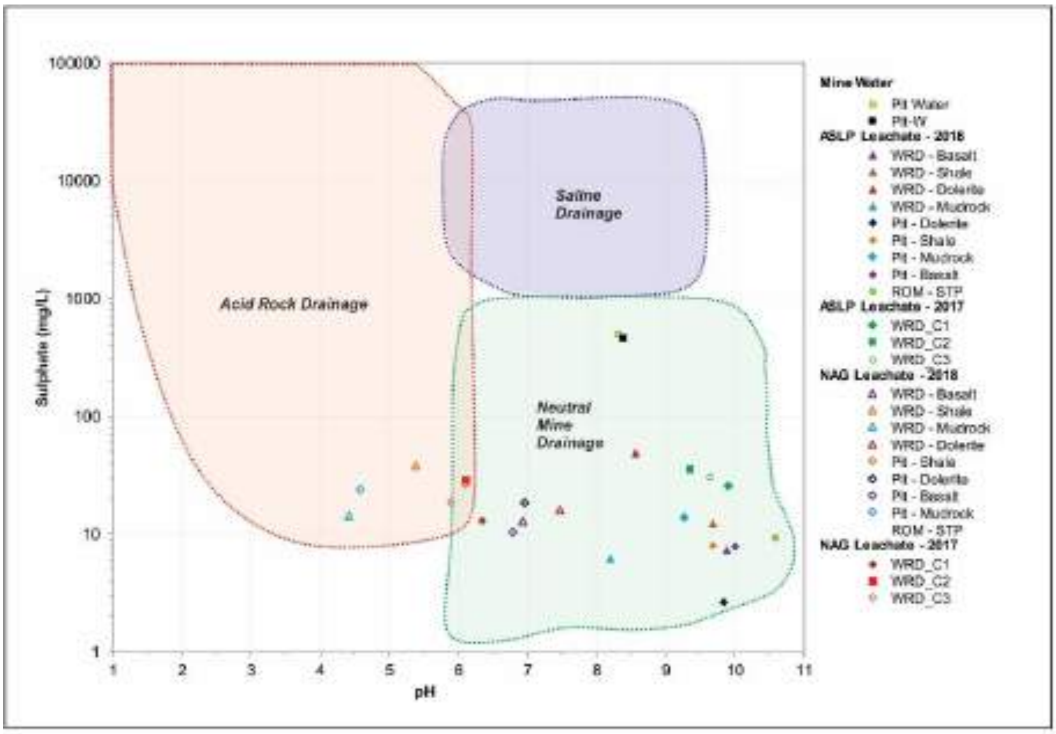


Figure 14: Classification of leachate and pit water samples from Voorspoed (modified after INAP, 2010)

4.1.6.1 Pit Water

The open pit mine water samples collected in May 2017 and February 2018 were characterised by alkaline pH (Table 9). The water samples exceeded the following water quality guidelines:

- The total dissolved solids and nitrate exceeded the domestic and livestock water quality guidelines;
- Sodium and selenium exceeded domestic and irrigation water quality guidelines:
- Electrical conductivity and SAR exceeded irrigation water quality guidelines;
- Sulphate and fluoride exceeded domestic water use guidelines; and molybdenum exceeded irrigation and livestock guidelines.

The elevated nitrate levels could be due to explosives residue.

Table 9: Results of pit water samples collected in 2017 and 2018 compared against water quality guidelines

Constituent of Concern	Units	May-17 sample	Feb-18 sample	Pit baseline (2004)	Groundwater background (Apr-2017)	South African DWAF (1996) drinking water quality guidelines			WQPL for Renoster (C70D, C70E, C70F, C70G, C70H)
		Pit-W	VSP-PW	Pit 1	BH30	Domestic (Class 0)	Livestock	Irrigation	
pH	s.u	8.4	8.3	7.1	7.9	6-9	ng	6.5-8.4	*7.4-8.6*
Total Dissolved Solids	mg/l	1212	1152	1934	615	450	1000	ng	ng
Total Suspended Solids	mg/l	44	NA	NA	NA	ng	ng	50	ng
Electrical Conductivity	mS/cm	*167*	*155*	***294***	***102***	ng	ng	40	***70***
Sulphate	mg/l	456	492	44	27	200	1000	ng	ng
Chloride	mg/l	42	56	242	33	100	1500	ng	ng
Nitrate	mg/l	218	222	NA	NA	ng	100	ng	ng
Nitrate as N	mg/l	49	50	0.1	0.25	6	ng	ng	ng
Nitrite as N	mg/l	0.23	22	NA	NA	6	ng	ng	ng
Fluoride	mg/l	1.3	0.6	1.1	<0.3	1	2	2	ng
Ammonia	mg/l	***0.11***	NA	NA	***1.6***	ng	ng	ng	***0.072***
Ammoniacal Nitrogen as N	mg/l	0.09	NA	NA*	NA	1	ng	ng	ng
Total Alkalinity as $CaCO_3$	mg/l	104	84.7	1403	480	ng	ng	ng	ng
Aluminium	mg/l	<0.020	0.020	18.2	NA	0.15	5	5	ng
Antimony	mg/l	0.003	0.007	NA	NA	ng	ng	ng	ng

Constituent of Concern	Units	May-17 sample	Feb-18 sample	Pit baseline (2004)	Groundwater background (Apr-2017)	South African DWAF (1996) drinking water quality guidelines			WQPL for Renoster (C70D, C70E, C70F, C70G, C70H)
		Pit-W	VSP-PW	Pit 1	BH30	Domestic (Class 0)	Livestock	Irrigation	
Arsenic	mg/l	0.0133	0.024		<0.0025	0.01	1	0.1	ng
Barium	mg/l	0.026	0.037	NA	NA	ng	ng	ng	ng
Boron	mg/l	0.243	0.407	NA	0.047	ng	5	0.5	ng
Cadmium	mg/l	<0.0005	0.0005	NA	<0.0005	5	10	10	ng
Calcium	mg/l	20	43	95	53	32	1000	ng	ng
Chromium	mg/l	<0.0015	<0.001	0.08	<0.0015	ng	ng	ng	ng
Cobalt	mg/l	<0.002	0.0008	NA	NA	ng	1	0.05	ng
Copper	mg/l	<0.007	0.017	0.09	<0.007	1	0.5	0.2	ng
Iron	mg/l	<0.02	0.018	23	0.54	0.1	10	5	ng
Lead	mg/l	<0.005	<0.001	0.38	<0.005	0.01	0.1	0.2	ng
Magnesium	mg/l	1.2	2.0	49	49	30	500	ng	ng
Manganese	mg/l	0.003	0.014	1.9	NA	0.05	10	0.02	ng
Mercury	mg/l	<0.001	0.0001	NA	<0.001	0.001	0.001	ng	ng
Molybdenum	mg/l	0.20	0.19	NA	NA	ng	0.01	0.01	ng
Nickel	mg/l	<0.002	0.003	NA	<0.002	ng	1	0.2	ng
Potassium	mg/l	4	6.1	58.6	2.8	50	ng	ng	ng
Selenium	mg/l	0.047	0.065	NA	<0.003	0.02	50	0.02	ng
Silicon	mg/l	7.201	0.939	NA	NA	ng	ng	ng	ng
Sodium	mg/l	360	286	432	53	100	2000	70	ng
Uranium	mg/l	<0.005	0.001	NA	NA	ng	ng	0.01	ng
Zinc	mg/l	<0.003	0.006	0.25	<0.003	3	20	1	ng

The results of a pit water sample collected by Southern Africa Geoconsultants (PTY) LTD as part of the groundwater baseline study, and results of water sample collected by Golder (2017) from borehole BH30, which is located upgradient of the open pit, considered to represent the local background groundwater quality signature, were compared to recent (2017-29018) pit water quality data (Table 9). The results showed that:

- The baseline and background water also exceeded water quality guidelines for TDS, EC, calcium and sodium (baseline pit water). The ammonia concentration in background groundwater also exceeded the WQPL for Renosterspruit catchments. This shows that the current mining activities at Voorspoed are not the only source of these constituents.
- The baseline pit water exceeded water quality guidelines for chloride, aluminium, iron, magnesium, manganese and potassium, which were below the limits in recent pit water.
- Levels of sulphate, nitrite and nitrate, which exceeded water quality guidelines in recent pit water samples, were below the guidelines in the baseline water sample. This shows influence of mining activities on levels of these constituents in pit water. The nitrate is possibly from blasting residue and sulphate from oxidation of sulphide minerals exposed by mining activities in the pit.
- Molybdenum and selenium levels, which exceeded levels in recent samples, were not determined in the 2004 sample.

4.1.7 Waste Assessment and classification

Analysis results for the waste assessment are summarised in Table 10 and Table 11.

Waste Assessment

The total concentrations of arsenic, barium, copper, cobalt, fluoride, manganese, nickel and vanadium exceeded the TCT0 levels in at least one of the waste rock and wall rock samples. The leachable concentrations of all analytes were less than LCT0 in all the samples apart from selenium in one sample each shale and dolerite (Table 11). However, the overall geochemical profile of the waste rock materials has no exceedances of LCT0 (Table 11).

Thus, whilst the waste rock is not Type 4, it does not meet the full definition of Type 3 waste due to low risk from leachable concentrations – see Figure 2.

Barrier Requirement

Although waste rock material might be considered as Type 3 waste for the purpose of barrier or cover design (in terms of GN R. 635 Regulation 7(6)), the environmental risk associated with drainage from the waste rock dump is similar to that of a Type 4 waste due to low concentrations of leachable constituents. Thus, motivation can be made for a Class D barrier, rather than the Class C barrier required for Type 3 waste given the fact that the geochemical profile the waste rock does not exceed LCT0 for any parameter.

Waste Classification

- Physical hazards: The waste rock material from the WRD is not flammable; do not enhance combustion of other substances; is not oxidising; and is not corrosive. Therefore, is classified as non-hazardous in terms of physical hazards.
- Health hazards: The total concentration of aluminium, calcium, iron, magnesium, potassium and silicon and sodium exceeded 1% in the waste rock samples. However, none of these parameters exceed 1% in leachate and therefore do not constitute a health risk.
- Certain trace elements such as Cd, Ni, As and Cr (VI) have been recognized as human or animal carcinogens by International Agency for Research on Cancer (IARC). The carcinogenic properties of these metals depend mainly on factors such as oxidation states and chemical structures. The total and leachable concentrations of carcinogenic trace metals were <0.1% in the samples from the WRD. Therefore, none of these elements constitute a health risk.

  The waste rock materials from the WRD is not a health hazard.

Environmental hazard: The total concentration of aluminium, calcium, iron, magnesium, potassium, sodium and silicon exceeds 1% in the waste rock samples. However, the leachable concentrations of these elements do not exceed the threshold for environmental hazard (at 1:20 dilution factor, 1% is 500 mg/L) as are leachable concentrations of all the other analytes. Therefore, the waste rock material from the WRD is [considered to be] non-hazardous to the environment due to low solubility of elements.

4.1.8 Conclusion drawn

The acid rock drainage risk of waste rock materials is low due to low sulphur content and high neutralisation capacity. The pH (alkaline), aluminium, iron, manganese, arsenic and sodium absorption ratio, zinc and calcium are PCoC in drainage from the waste rock materials as they exceeded at least one water quality guideline in ASLP and NAG leachate. Constituents of concern in pit water are total dissolved solids, electrical conductivity, sulphate, fluoride, SAR, nitrate, sodium, selenium and molybdenum.

The waste rock materials do not constitute a physical hazard, are not a health hazard, and are not hazardous to the environment. Although the waste rock material might be considered as Type 3 waste for the purpose of barrier or cover design (in terms of GN R. 635 Regulation 7(6)), the environmental risk associated with drainage from the waste rock dump is similar to that of a Type 4 waste due to low concentrations of leachable constituents. Thus, motivation can be made for a Class D barrier, rather than the Class C barrier required for Type 3 waste given the fact that the geochemical profile the waste rock does not exceed LCT0 for any parameter.

Table 10: Classification of waste rock samples based on total concentrations (whole rock chemistry data

Potential Constituent of Concern	Units	GN R.635 levels of thresholds for total concentrations			Golder 2017 Waste Rock Samples			Golder 2018 Waste Rock Samples									
		TCT0	TCT1	TCT2	Composite samples			Basalt		Shale		Dolerite		Mudrock			Kimberlite
					WRD_C1	WRD_C2	WRD_C3	VSP-02/VSP-06/VSP-07	VSP-17/VSP-18	VSP-03/VSP-01	VSP-15/VSP-11/VSP-13/VSP-21	VSP-05/VSP-08	VSP-10/VSP-12/VSP-14/VSP-20	VSP-04	VSP-16/VSP-19	Waste rock overall geochemical profile	VSP-22/VSP-23
Al	mg/kg	ng	ng	ng	69861	75683	74095	119717	87326	92725	59964	52242	67215	73566	92831	81886	71555
As	mg/kg	5.8	500	2000	4.9	7.7	7.0	2.2	1.5	5.8	11.6	5.7	2.0	5.9	6.3	4.8	4.5
B	mg/kg	150	15000	60000	17.4	27.9	30.3	19.3	1.6	43.9	44.0	4.2	4.4	87.7	24.8	27	5.8
Ba	mg/kg	62.5	6250	25000	718	504	504	334	213	690	529	167	311	443	703	408	946
Ca	mg/kg	ng	ng	ng	46288	39470	33106	38701	57075	6254	19597	51022	56525	2187	5596	31593	58948
Cd	mg/kg	7.5	260	1040	0.12	0.12	0.13	0.10	0.10	0.12	0.13	0.12	0.09	0.09	0.09	0.11	0.11
Co	mg/kg	50	5000	20000	40	39	30	24	28	8	16	51	39	10	5	23	30
Cr	mg/kg	46000	800000	N/A	284	361	208	159	141	112	227	1021	752	142	47	326	310
Cu	mg/kg	16	19500	78000	97	54	57	104	126	30	48	142	105	29	20	80	114
F^-	mg/kg	100	10000	40000	436	491	472	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Potential Constituent of Concern	Units	GN R.635 levels of thresholds for total concentrations			Golder 2017 Waste Rock Samples			Golder 2018 Waste Rock Samples										
		TCT0	TCT1	TCT2	Composite samples			Basalt		Shale		Dolerite		Mudrock		Waste rock overall geochemical profile	Kimberlite
					WRD_C1	WRD_C2	WRD_C3	VSP-02/VSP-06/VSP-07	VSP-17/VSP-18	VSP-03/VSP-01	VSP-15/VSP-11/VSP-13/VSP-21	VSP-05/VSP-08	VSP-10/VSP-12/VSP-14/VSP-20	VSP-04	VSP-16/VSP-19		VSP-22/VSP-23
Fe	mg/kg	ng	ng	ng	67483	61538	56224	79231	84926	46049	50531	92727	85455	50224	25559	66287	77343
Hg	mg/kg	0.93	160	640	0.020	0.023	0.033	<0.01	0.01	0.01	0.01	0.01	0.01	0.01	<0.01	0.010	0.01
K	mg/kg	ng	ng	ng	15275	16935	18927	16620	7388	29960	32641	4151	7729	29429	30624	18885	28997
Mg	mg/kg	ng	ng	ng	35881	30996	23699	22626	31665	9775	14666	85088	64042	3449	11826	31253	48581
Mn	mg/kg	1000	25000	100000	1398	1128	1234	1121	1811	458	518	2255	1438	98	294	1055	1423
Mo	mg/kg	40	1000	4000	0.92	0.79	0.84	1.89	0.91	1.41	1.45	1.41	1.73	0.82	0.82	1.3	1.23
Na	mg/kg	ng	ng	ng	16395	12018	12983	18376	23558	12790	7619	14340	14837	2982	16536	14429	19993
Ni	mg/kg	91	10600	42400	90	117	74	43	30	24	105	377	162	36	17	99	157
Pb	mg/kg	20	1900	7600	13	18	19	21	4	17	25	9	6	25	16	15	10
Sb	mg/kg	10	75	300	0.41	0.76	0.69	3.11	0.47	0.60	0.95	1.05	0.38	1.97	0.69	1.2	0.55
Se	mg/kg	10	50	200	0.17	0.17	0.39	0.12	0.17	0.04	0.15	0.15	0.07	0.07	0.07	0.11	0.19

Potential Constituent of Concern	Units	GN R.635 levels of thresholds for total concentrations			Golder 2017 Waste Rock Samples			Golder 2018 Waste Rock Samples										
		TCT0	TCT1	TCT2	Composite samples			Basalt		Shale		Dolerite		Mudrock			Kimberlite
					WRD_C1	WRD_C2	WRD_C3	VSP-02/VSP-06/VSP-07	VSP-17/VSP-18	VSP-03/VSP-01	VSP-15/VSP-11/VSP-13/VSP-21	VSP-05/VSP-08	VSP-10/VSP-12/VSP-14/VSP-20	VSP-04	VSP-16/VSP-19	Waste rock overall geochemical profile	VSP-22/VSP-23
Si	mg/kg	ng	ng	ng	273917	286070	296821	245214	203381	270088	258164	226569	231563	274758	310903	249871	211453
V	mg/kg	150	2680	10720	211	167	162	264	286	91	130	214	244	159	59	189	251
Zn	mg/kg	240	160000	640000	79	69	72	83	92	97	69	110	83	30	67	80	97

Table 11: Classification of waste rock samples based on leachable concentrations (ASLP data)

Potential Constituent of Concern	Unit	GN R.635 levels of thresholds for leachable concentrations				Golder 2017 Waste Rock Samples			Golder 2018 Waste Rock Samples									
		LCT0	LCT1	LCT2	LCT3	Composite samples			Basalt		Shale		Dolerite		Mudrock		Waste Rock overall geochemical profile	Kimberlite
						WRD_C1	WRD_C2	WRD_C3	VSP-02/VSP-06/VSP-07	VSP-17/VSP-18	VSP-03/VSP-01	VSP-15/VSP-11/VSP-	VSP-05/VSP-08	VSP-10/VSP-12/VSP-14/VSP-20	VSP-04	VSP-16/VSP-19		VSP-22/VSP-23
Al	mg/l	ng	ng	ng	ng	11	6.3	6.6	2.2	1.5	0.6	1.2	0.1	0.8	0.3	0.4	0.93	1.1
As	mg/l	0.01	0.5	1	4	0.011	0.0066	0.012	0.01	0.01	0.03	0.05	0.00	0.01	0.01	0.03	0.02	0.30
B	mg/l	0.5	25	50	200	0.13	0.16	0.13	0.0	0.05	0.15	0.09	0.09	0.03	0.09	0.08	0.07	0.05
Ba	mg/l	0.7	35	70	280	0.23	0.15	0.13	0.04	0.03	0.05	0.03	0.23	0.04	0.01	0.06	0.06	0.08
Ca	mg/l	ng	ng	ng	ng	5.1	5.0	4.0	1.7	1.1	1.3	1.2	20	1.5	0.4	1.6	3.6	1.3
Cd	mg/l	0.003	0.15	0.3	1.2	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.001	<0.0001
Co	mg/l	0.5	25	50	200	0.0026	0.0005	<0.001	0.002	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0012	0.001
Cr	mg/l	0.1	5	10	40	0.029	0.020	0.015	0.001	0.001	0.003	0.002	0.001	0.001	0.000	<0.001	0.0011	0.002
Cu	mg/l	2	100	200	800	0.026	0.0073	0.0067	0.006	0.008	0.002	<0.001	<0.001	0.001	0.002	0.002	0.00	0.002
Fe	mg/l	ng	ng	ng	ng	8.3	3.6	3.6	1.39	1.29	0.23	0.22	0.06	0.47	0.16	0.11	0.55	0.76
Hg	mg/l	0.006	0.3	0.6	2.4	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.001	<0.0001

Potential Constituent of Concern	Unit	GN R.635 levels of thresholds for leachable concentrations				Golder 2017 Waste Rock Samples			Golder 2018 Waste Rock Samples									
		LCT0	LCT1	LCT2	LCT3	Composite samples			Basalt		Shale		Dolerite		Mudrock		Waste Rock overall geochemical profile	Kimberlite
						WRD_C1	WRD_C2	WRD_C3	VSP-02/VSP-06/VSP-07	VSP-17/VSP-18	VSP-03/VSP-01	VSP-15/VSP-11/VSP-	VSP-05/VSP-08	VSP-10/VSP-12/VSP-14/VSP-20	VSP-04	VSP-16/VSP-19		VSP-22/VSP-23
K	mg/l	ng	ng	ng	ng	4.5	3.7	4.2	1.06	0.67	1.53	1.67	0.51	2.38	0.55	1.84	1.25	1.98
Mg	mg/l	ng	ng	ng	ng	4.7	1.9	1.9	0.52	0.48	0.13	0.12	3.39	0.47	0.04	0.41	0.71	0.72
Mn	mg/l	0.5	25	50	200	0.054	0.018	0.027	0.068	0.024	0.018	0.005	0.004	0.011	0.003	0.001	0.02	0.023
Mo	mg/l	0.07	3.5	7	28	0.0037	0.0055	0.0070	0.001	0.001	0.028	0.018	0.002	0.001	0.004	0.014	0.01	0.002
Na	mg/l	ng	ng	ng	ng	35	35	37	30.7	43.7	36.5	28.5	3.9	22.7	9.3	19.4	25.05	43.9
Ni	mg/l	0.07	3.5	7	28	0.0091	0.0039	0.0026	0.0035	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0033
Pb	mg/l	0.01	0.5	1	4	0.0031	0.0020	0.0022	<0.001	0.0038	0.0034	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0
Sb	mg/l	0.02	1	2	8	<0.001	0.0006	0.0008	0.002	<0.001	0.002	0.001	<0.001	0.001	0.002	0.002	0.0014	0.010
Se	mg/l	0.01	0.5	1	4	0.0032	0.0066	0.0050	0.009	0.01	0.02	0.01	0.02	0.005	0.006	0.01	0.01	0.004
Si	mg/l	ng	ng	ng	ng	13	16	19	1.13	1.40	0.11	0.87	1.52	1.92	0.66	0.46	1.05	1.00
Ti	mg/l	ng	ng	ng	ng	0.4257	0.2576	0.3108	0.034	0.038	0.010	0.015	0.003	0.012	0.002	0.012	0.017	0.047
V	mg/l	0.2	10	20	80	0.023	0.010	0.016	0.0	0.089	0.017	0.018	0.001	0.018	0.004	0.010	0.03	0.028

Potential Constituent of Concern	Unit	GN R.635 levels of thresholds for leachable concentrations				Golder 2017 Waste Rock Samples			Golder 2018 Waste Rock Samples									
		LCT0	LCT1	LCT2	LCT3	Composite samples			Basalt		Shale		Dolerite		Mudrock		Waste Rock overall geochemical profile	Kimberlite
						WRD_C1	WRD_C2	WRD_C3	VSP-02/VSP-06/VSP-07	VSP-17/VSP-18	VSP-03/VSP-01	VSP-15/VSP-11/VSP-	VSP-05/VSP-08	VSP-10/VSP-12/VSP-	VSP-04	VSP-16/VSP-19		VSP-22/VSP-23
Zn	mg/l	5	250	500	2000	0.028	0.022	0.018	0.029	0.098	0.025	0.021	0.071	0.023	0.024	0.000	0.04	0.022
pH	s.u	ng	ng	ng	ng	9.9	9.4	9.6	9.9	10.0	9.7	9.7	8.6	9.8	8.2	9.3	9.4	10.6
TDS	mg/l	1000	12500	25000	100000	196	158	164	102.0	144.0	128.0	93.0	100.0	74.0	30.0	72.0	95	142.0
F^-	mg/l	1.5	75	150	600	<0.1	0.22	0.24	<0.1	<0.1	0.2	0.1	0.5	<0.1	0.2	0.1	0.15	0.1
Cl^-	mg/l	300	15,000	30,000	120,000	2.1	1.7	1.3	0.4	1.0	0.2	0.2	1.7	0.4	0.3	0.3	0.59	<0.25
NO_3 as N	mg/l	11	550	1100	4400	1.6	1.8	1.9	0.3	0.5	<0.1	<0.1	1.0	<0.1	<0.1	0.2	0.29	0.5
SO_4^{2-}	mg/l	250	12,500	25,000	100,000	26	35	30	7.3	7.9	12.3	7.9	48.8	2.6	6.2	13.9	13.24	9.2

4.2 CONCEPTUAL MODELLING

Two pit excavation closure options are possible. These options were outlined as three Scenarios in preceding sections and illustrated in Figure 1. The limitations and assumptions for the three scenarios are detailed below:

- Scenario 1: Pit Lake Conditions (as per Mine Plan) –
  - The average S-Class Pan evaporation is 1551 mm/year measured at C6E001 station. The mean monthly S-Class Pan evaporation has been considered in the modelling.
  - It is assumed that mean water quality characteristics of groundwater, contaminated surface runoff & pit perimeter and side wall runoff are valid throughout post closure.
  - Rainwater chemistry is unknown and has been assumed.
- Scenario 2: Pit Lake with enhanced [engineered] runoff-area directed to the open pit –
  - The engineered local catchment area is a reshaped area using the waste rock material where possible;
  - The local catchment area will be covered with soil and vegetation to stabilise the soils;
  - The engineered catchment is assumed to have a soil conservation service (SCS) runoff curve number of 72.
  - The additional runoff generated from the reshaped “local catchment’ area is directed to the pit. This scenario will enhance the re-watering of the pit and progressing the Pit Lake development.
  - Evaporation from the pit was added as per Scenario 1; and
  - Water quality consideration as per Scenario 1.
- Scenario 3: Backfilled Pit
  - The waste rock dump is removed to fill the pit;
  - It was assumed that the pit will be filled completely (based on the assumption that the WRD is 30 m high); and
  - No evaporation occurs from the pit when the water level stays below the surface level of the backfilled material.
  - No additional runoff occurs to the pit.
  - Although the pit will be filled to the top, the fill material is assumed to have a porosity of 30% i.e. the void volume in the pit is reduced by 70% relative to Scenario 1 and 2 which evaluate the open pit.
  - Water chemistry considerations are similar for Scenarios 1 and 2; and
  - The waste rock material geochemical signatures will impact on the water quality of the back filled pit excavation.

The Voorspoed Conceptual Model presented here is based on the known hydrogeological conditions of the site area and follows the same assumptions as modelled by Golder (2017).

4.2.1 Geology

The strata proximal to the Voorspoed site comprise of shales and mudstones of the Volksrust Formation (VRM) which are part of the Ecca Group of the Karoo Supergroup. The Volksrust Formation is underlain by coarser grained; conglomerates, shales and sandstones of the Vryheid Formation (VRSSC). Shale (VRVS) is found to occur at depth. The sedimentary package dips at approximatly15^0 towards the north-north-west.

The strata have been intruded by dolerite dykes and sills. Three major sills were identified to intersect the pit, namely;

- Dolerite Sill (#14) (the number assigned in the GEMCOM model) - a sill with a thickness ranging from 1 to 25 m, but more commonly ranging from 3 to 8 m thick in the immediate mine area. The upper contact zone of the sill is relatively permeable based on packer test data.
- Dolerite Sill (#13) - a thicker sill with a thickness ranging from 20 to 180 m, more commonly ranging from 80 to 120 m in the mine area.
- Dolerite Sill (#12) - a sill in the shale discovered by De Beers in exploration boreholes. The thickness of this lower sill ranges from 10 to 65 m, most commonly being between 30 and 55 m

The Kimberlite pipe on the farm Voorspoed 401 is an irregular, approximately oval shaped body. The initial dimensions of the pipe were in the order of 490 m x 350 m – current excavation diameter is ~9 00 m. An essentially vertical body of Stormberg-age basalt intruded into the southern part of the Kimberlite pipe. The bottom of the basalt has been intersected at a depth 430 m below ground surface.

4.2.2 Voorspoed Mine Pit

Golder was provided with the pit shell representative of life of mine (December 2019 shown in **Figure 15**). The tabulated stage storage curve of the pit was calculated and presented by Golder (2017). The final depth of the pit is proposed to be at an elevation of 1103 mamsl. The total void volume at LoM is 56 Mm^3 and the pit will measure ~300 m in depth.

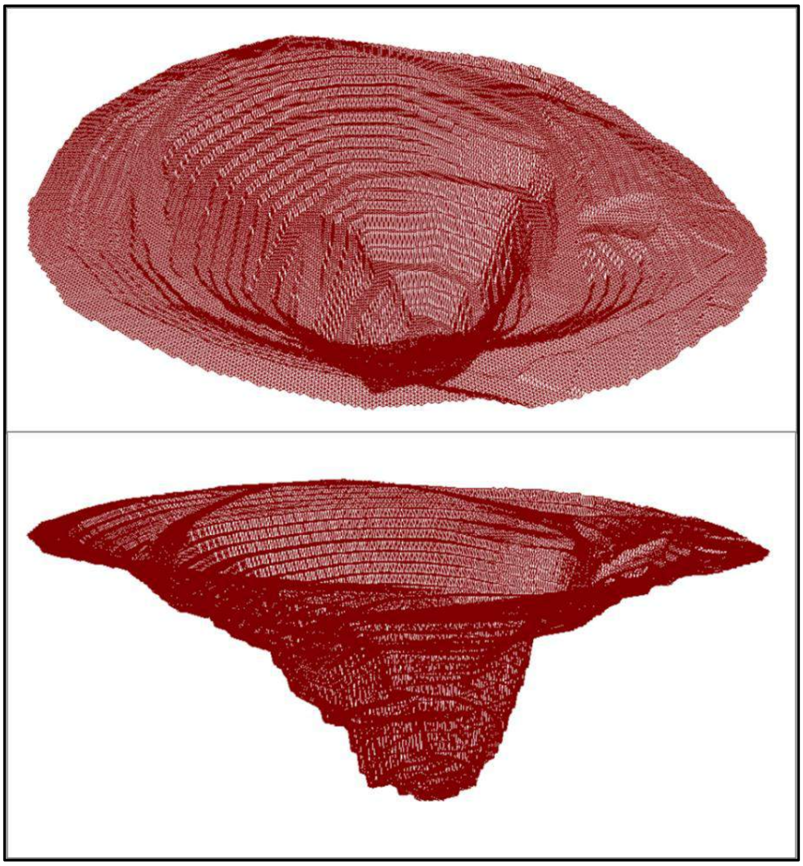


Figure 15: Voorspoed mine pit shell (December 2019)

4.2.3 Groundwater Catchment and Aquifer characteristics

The catchments boundaries are delineated to coincide with physical geographical features such as water divides, rivers and water bodies.

- The Heuningspruit, 8 km north east of the mine, was taken to represent the northern extent of the groundwater catchment. While the Renosterspruit was taken to represent the southern boundary.

  The above-mentioned boundaries are considered groundwater discharge boundaries along which groundwater contributes to baseflow of the river systems.

- The western and eastern boundaries were delineated along local surface water divides, which were assumed to behave as groundwater divides. As these boundaries are located 8 – 9 km from the mine, the assumption is deemed valid as abstraction from the pit is unlikely to reach the boundary condition and hence change the behaviour of the boundary.
- In addition to the external boundaries describing the catchments, surface water bodies and pans represent possible points of groundwater discharge.

The groundwater catchment considered has an aerial extent of 267 km^2 and encompasses much of quaternary catchment C70H.

The aquifer types identified in previous studies are outlined below;

- The shallow aquifer zone (< 100 m below surface) comprising the weathered and fractured, layered Ecca Group strata represents a low permeability (minor aquifer).
- Geological structures (faults and dykes) were identified to behave as preferential flow paths for groundwater flow.
- A localised deep aquifer (100 - 400 mbgl) associated with the brecciated and fractured rocks which followed the emplacement of the Kimberlite pipe and the dolerite sills and dykes.
- Alluvial aquifers associated with rivers and water bodies, common within the catchment.

The presence of the dolerite sill overlying the sandstone and mudrock at depth and the fractured nature of the country rock gives rise to confined to semi confined aquifer conditions.

4.2.4 Hydro Stratigraphy and Aquifer Parameters

The hydro stratigraphy was determined based on borehole logs drilled and cross sections produced in Itasca (2014) and HCI (2004). The major hydro stratigraphic units of the study area characterised below;

- Upper Mudstone: 20 – 30 m thick and found only in area surrounding the pit;
- Upper Dolerite: 5 – 16 m thick surrounding the pit. This upper dolerite was also observed in boreholes:
  - VD-BH1 50 m thick;
  - VD-BH2 79 m thick;
  - VD-BH4 84 m thick; and
  - Not observed in boreholes VD-BH3 and VD-BH5;
- Lower Mudstone: approximately 40 m thick to the north and west of the pit and thinner - approximately 20 m thick - to the east of the pit, however, it might be as thin as 1 m in the case of VD-BH5;
- Upper Sandstone: varying from 5 m to 142 m in thickness. This layer appears to be thicker from the pit eastward and thinner to the west;

- Base layers: Most boreholes did not reach this depth. It was assumed that these layers extend to the entire model domain. The base layers found in the pit cross section (Itasca Denver, 2014) are:
  - Central Dolerite: 58 to 153 m thick;
  - Lower Sandstone: absent to 117 m thick;
  - Upper Shale: absent to 229 m thick;
  - Lower Dolerite: 16 to 69 m thick; and
  - Lower Shale: 8 to 217 m thick.

Hydraulic conductivity

According to the descriptions presented in the HCI (2004) report, KML undertook packer testing of the strata proximal to the mine in 2003. The outcomes of the packer testing are outlined in Table 12. Typical of fractured rock aquifers, the estimated conductivity values obtained through packer testing are highly variable and, in some cases vary over several orders of magnitude. The following observations are drawn from the packer testing results;

- Dolerite sills exhibit low permeability. During testing this stratum was described to have "no water take" and thus can be characterised as aquitards which vertical discretise the fractured Karoo aquifer.
- Similarly, the shale units are inferred to be of lower permeability than the overlying mudstones.
- The VRS sandstones are significantly more conductive than the other units evaluated.

In addition to the packer testing results presented above, Geocon (2004) drilled and tested four boreholes. The boreholes were drilled to depths of 40 to 100 m and thus represent the upper weathered and fractured aquifer. The drilling was based on a geophysical survey utilised to identify potentially water bearing structures and thus the testing results possibly display a bias to more permeable values.

Nevertheless, alike to the discussion above, the conductivities of the four tests indicated significant variability in the hydraulic characteristics of the aquifer, with conductivities ranging between 0.06 m/d to 0.18 m/d.

The range of conductivity values indicates the country rocks, devoid of fault zones and reflective of a minor aquifer. As such limited flow and pollutant migration is expected in the aquifers surrounding the mine.

Table 12: Aquifer parameters

Rock Unit	Packer Testing (KML, 2003)	
	Minimum Hydraulic Conductivity (m/d)	Maximum Hydraulic conductivity(m/d)
Mudstone (VRM)	1.00E-06	2.00E-01
Conglomerate, Shales, Sandstone (VRSSC)	1.00E-06	1.00E-02
Sandstone (VRS)	2.00E-04	2.00E-02
Shale (VRVC)	1.00E-06	1.00E-04
Dolerite	1.00E-06	6.00E-03
Kimberlite	1.00E-06	8.00E-02

Storativity

To date no attempt has been made to quantify the aquifer storativity based on field measurements. The most recent modelling undertaken by Itasca (2014) assumed storativity values ranging between 5E-03 to 5E-04. No mention of the storativity values utilised in the Geocon (2004) study were made.

4.2.5 Groundwater Levels and Flow Directions

Golder (2017) described the baseline conditions of pre-mining site as follows:

- The geometric mean of pre-mining water levels was 8 mbgl, with water levels ranging between 3 and 45 mbgl. The latter reflects to an exploration borehole located near the pit.
- Based on the 2004 survey, static water levels are shown to correlate with surface topography, and it is thus inferred that groundwater flow mimics surface water flow directions.
- The nearest potential receptor borehole pre-mining was located 1.6 km east of the pit area.

Water level monitoring has been undertaken at selected boreholes since August 2007. The data from these monitoring stations has been evaluated. The water level trends on site were shown and described by Golder (2017). A summary follows, and a map of the boreholes and water levels is shown in Figure 16.

- Until March 2016, VDBH01 was the primary water supply borehole on site. Thus, while the water level trends reflect the general fluctuations observed on the CRD, the saw tooth trend observed is a reflection of abstraction from this borehole. Following cessation of pumping, this borehole has recovered to a water level 10 m higher than the pre-mining water level of 2004. This is contradictory to the expected water level trend based on the CRD and what is observed at other boreholes. The rise in water level is possibly a result of seepage from the TSF Phase 2 area.
- VDBH04 is located 400 m from the foot of the coarse waste rock dump. Based on measured water levels and inferences from topography, groundwater is expected to flow from the waste rock dump toward this borehole. The water level trend at this site closely represents the CRD trend.
- Leonard 2: water level is constant from September 2013 to July 2015;
- MBH01 - MBH05 are located on adjacent properties north and north east of the mine. With the exception of MBH01 and MBH 05, the remaining monitoring boreholes have sporadically been monitored and consequently data interpretation is limited. MBH01 and MBH 05 both closely correlate with the CRD trend
- MBH10 and MBH 19, showed sharp rise in water level (> 15 m) that were seemingly associated with significant recharge events. These types of fluctuations are common in low permeability aquifers.

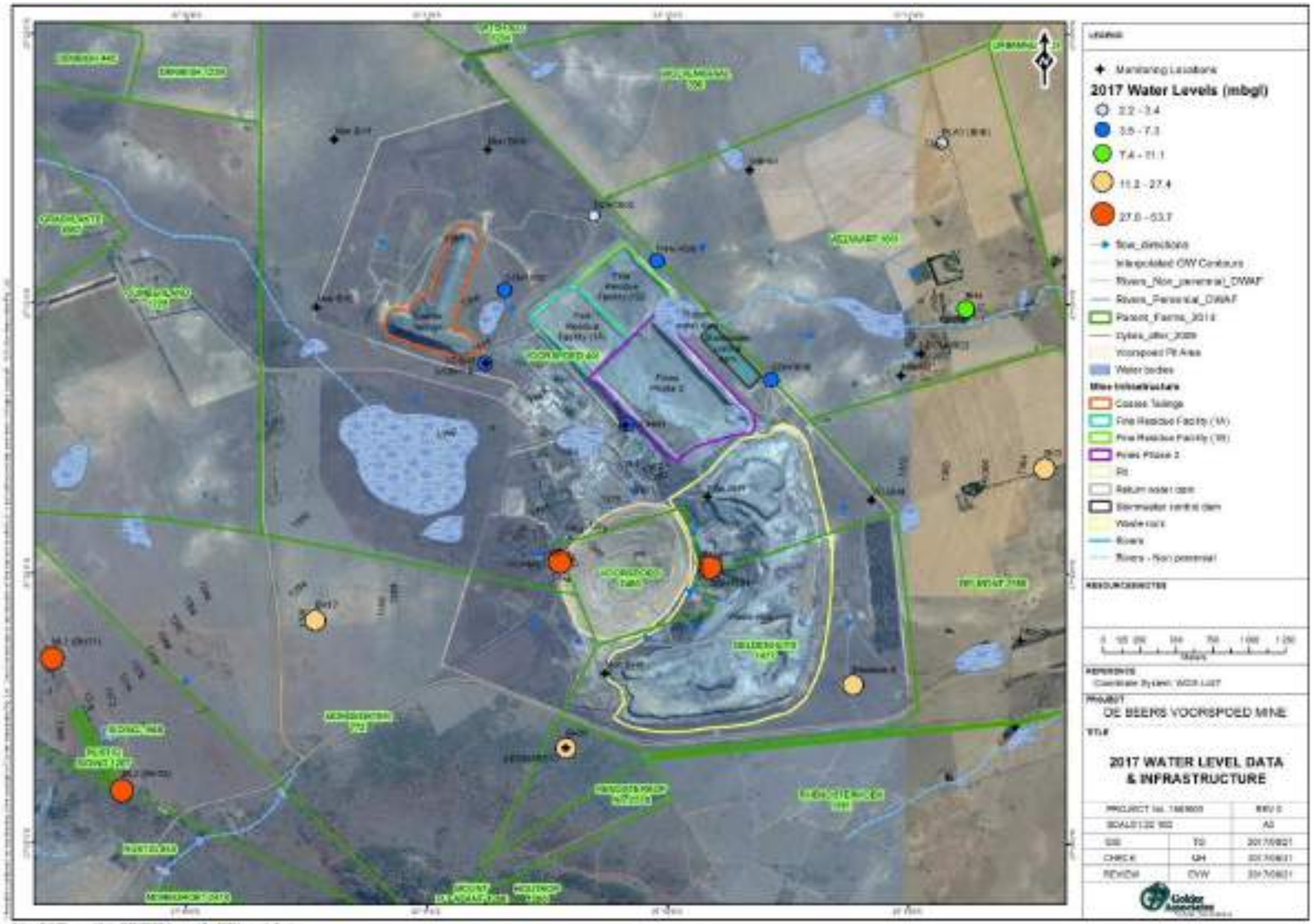


Figure 16 :Voorspoed Mine – 2017 borehole and water level information

4.2.6 Basic Voorspoed Mine Concept

The original conceptual hydrogeological model for post closure (Golder, 2017) is shown in Figure 17. Sulphide values for the different rock dumps and surface water storage facilities are for illustration only.

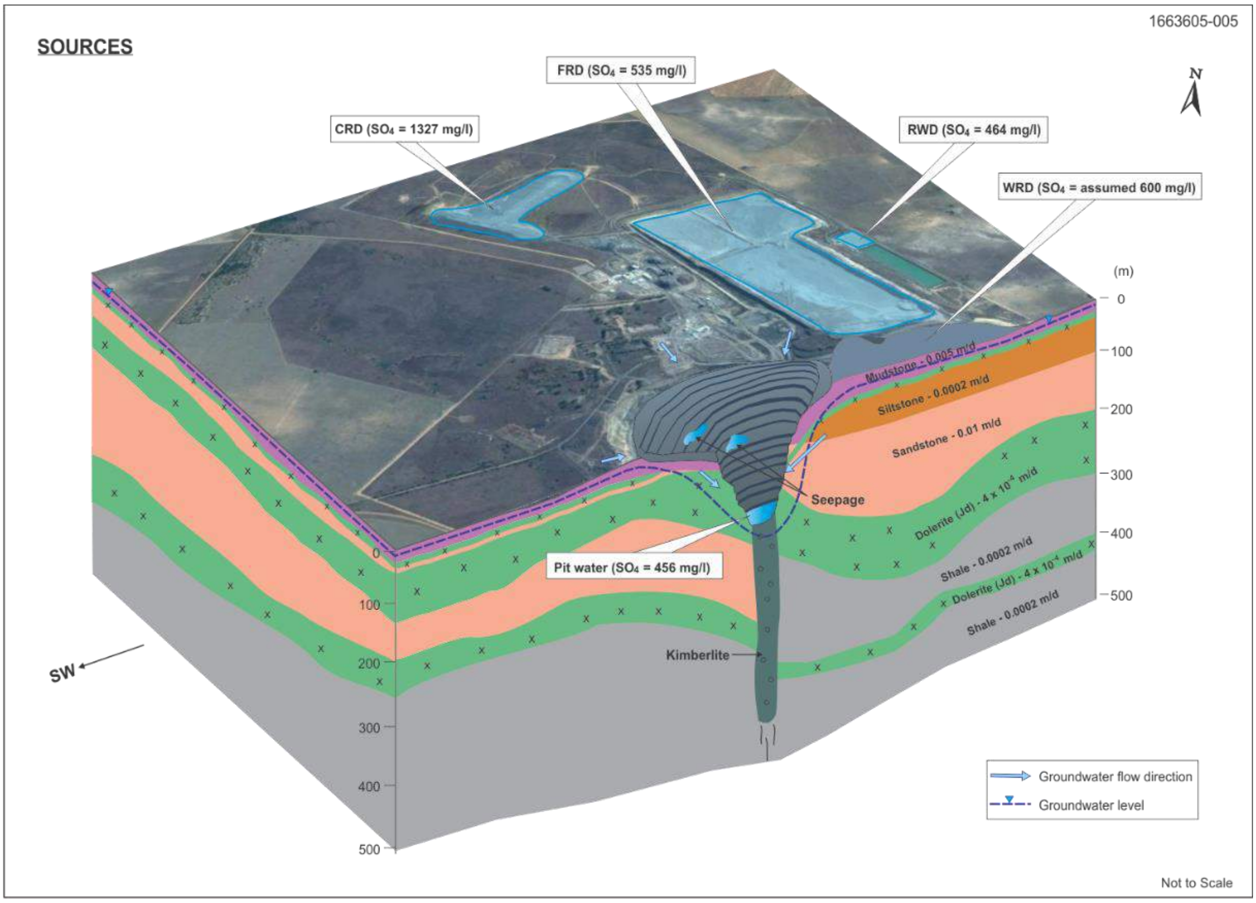


Figure 17: Voorspoed Mine – Conceptual 3D block model for post closure

4.2.7 Discussion

As outlined above there are several assumptions required to evaluate the hydrogeology, hydrology and geochemistry of the three potential scenarios. The assumptions, where valid, are kept consistent in all three scenarios to allow for direct comparison of the outcomes.

Observations coming from the groundwater monitoring dataset indicates that there is a water table drawdown cone present around the pit excavation. It has been reported that only during exceptional rainfall events, seepages appear on the sidewalls of the excavation – their magnitude varies according to the rainfall depths but does not result into extraordinary ingress into the pit excavation. Apart from dealing with direct rainfall recharge in the pit excavation catchment, groundwater ingress from the surrounding sidewalls is limited and taken up by evaporation. The overall classification of the pit excavation in terms of groundwater influx is that it operates as a dry system caused by high evaporation rates and low permeability of the host rock formations.

4.3 NUMERICAL MODELLING

Golder (2017) reported on the background and basis of the three model scenarios described in this memorandum. Although the model was simplified by combining layers with the same properties, the calibration did not change, and the steady state calibration gave the same results as presented by Golder (2017).

4.3.1 Model Input Parameters

The model parameters that stayed the same for all scenarios are hydraulic conductivity and storativity. These calibrated model parameters are presented in Table 13 for the regional model and in Table 14 for the pit. Recharge was varied for the three scenarios as listed in Table 15.

Table 13: Calibrated model parameters (based on Golder, 2017 values)

		Upper & Lower Mudstone	Dolerite	Upper Sandstone	Lower Sandstone	Shale	Structures (faults & Dykes)
Layer 1	Kx (m/d)	0.04					
	Kx:Ky:Kz	Kx=Ky=10Kz					
	Ss (1/m)	2.00E-05					
Layer 2	Kx (m/d)	0.008					
	Kx:Ky:Kz	Kx=Ky=Kz					
	Ss (1/m)	2.00E-05					
Layer 3	Kx (m/d)		4.00E-05				
	Kx:Ky:Kz		Kx=Ky=Kz				
	Ss (1/m)		5.00E-05				
Layers 4 &5	Kx (m/d)					0.0002	
	Kx:Ky:Kz					Kx=Ky=10Kz	
	Ss (1/m)					3.33E-05	
Layers 6 & 7	Kx (m/d)			0.01			
	Kx:Ky:Kz			Kx=Ky=10Kz			
	Ss (1/m)			3.33E-05			
Layers 8- 10	Kx (m/d)				0.001		
	Kx:Ky:Kz				Kx=Ky=10Kz		
	Ss (1/m)				3.33E-05		
Layers 11-16	Kx (m/d)		4.00E-05				
	Kx:Ky:Kz		Kx=Ky=Kz				
	Ss (1/m)		5.00E-05				Same for all layers

		Upper & Lower Mudstone	Dolerite	Upper Sandstone	Lower Sandstone	Shale	Structures (faults & Dykes)
Layers 17-22	Kx (m/d)				0.001		
	Kx:Ky:Kz				Kx=Ky=10Kz		
	Ss (1/m)				3.33E-05		
Layers 23-24	Kx (m/d)					0.0002	
	Kx:Ky:Kz					Kx=Ky=10Kz	
	Ss (1/m)					3.33E-05	
Layer 25	Kx (m/d)		4.00E-05				
	Kx:Ky:Kz		Kx=Ky=Kz				
	Ss (1/m)		5.00E-05				
Dykes and Faults	Kx (m/d)						0.05 to 0.7
	Kx:Ky:Kz						Kx=Ky=Kz
	Ss (1/m)						2.00E-05

Table 14: Parameters used for the pit (all layers)

Parameter	Pit Scenario 1	Pit Scenario 2	Pit Scenario 3
Description	**Open pit**	**Open pit with additional runoff**	**Backfilled pit**
Kx (m/d)	10	10	1
Kx:Ky:Kz	Kx=Ky=Kz	Kx=Ky=Kz	Kx=Ky=Kz
Storativity (1)	1	1	0.3

Table 15: Recharge applied per model scenario

Scenario	Regional	Dumps	Pit
Scenario 1 Open pit	1.4% of MAP	2% of MAP	100% recharge and 100% evaporation when water level is above bench elevation. No additional runoff from the wider catchment area.
Scenario 2 Open pit with additional runoff	1.4% of MAP	2% of MAP	100% recharge + runoff generated from catchment and 100% evaporation when water level is above bench elevation. Additional runoff from the wider catchment area.

Scenario	Regional	Dumps	Pit
Scenario 3 Backfilled pit	1.4% of MAP	2% of MAP	100% recharge on backfilled pit. No additional runoff from the wider catchment area. No evaporation while water level remains below the surface of the backfilled material.

4.3.2 Numerical model results

The model results will be presented in section 4.4.3 (page 52) where it has been combined with the GoldSim model.

4.4 GOLDSIM MODELLING OF DEPOSITION PLAN SCENARIO

A dynamic systems model was setup in GoldSim to evaluate the filling and potential mass loads for the anticipated Voorspoed mine pit lake. The key components for the dynamic filling and mixing model include;

- Pit geometry
- Rainfall and Evaporation
- Groundwater inflows and potential losses
- Chemistry of sources (i.e. rainfall, runoff, groundwater inflow quality and loading from interaction with wall rock)

The components of the model are outlined below and thereafter the results are discussed in terms of the two major objectives (i) resulting pit water level and (ii) resulting pit water quality.

4.4.1 Model Inputs-Inflow and Outflow Components

Model inputs are outlined in the ensuing section;

4.4.1.1 Pit Geometry

At completion of mining the Voorspoed pit will have a final depth of 307 m and maximum diameter of over 900 m. The stage storage curve and stage surface area curve generated for the open pit i.e. applicable to Scenario 1 & 2 are depicted in Figure 18 and Figure 19.

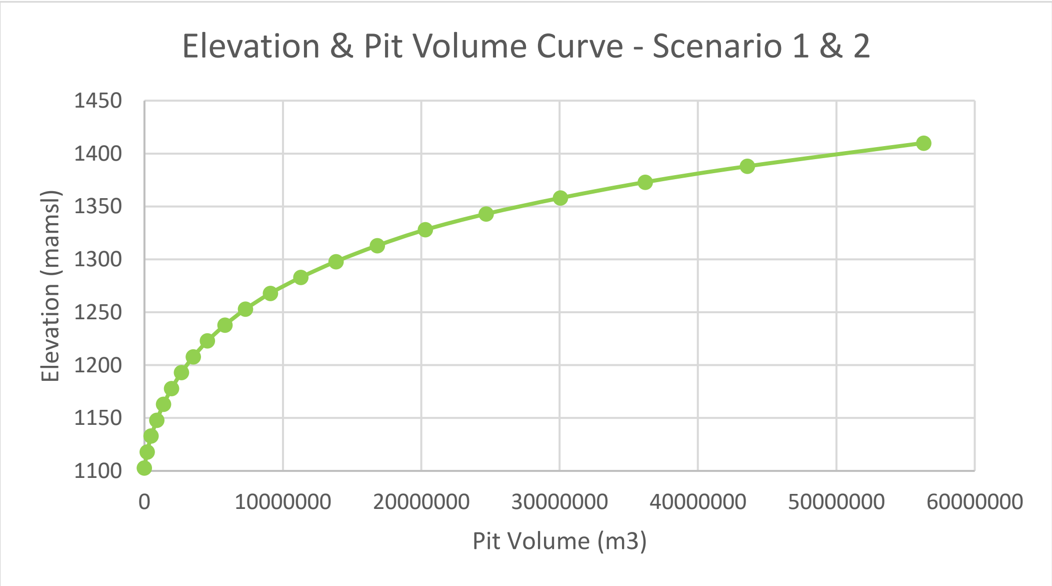


Figure 18: Elevation and pit volume curve (Scenario 1 & 2)

As mentioned above, backfilling of the pit is assumed to result in a 30% void volume relative to the original pit volume. The 30% void volume (or porosity) refers to the spaces between particles which may become saturated. The stage storage curve relevant to Scenario 3 is depicted in Figure 20.

These figures indicate that the modelled volume of the open pit will be approximately 56 Mm^3 at full capacity and the modelled [water filled] void volume of the backfilled pit (Scenario 3) will be approximately 17 Mm^3 at full capacity.

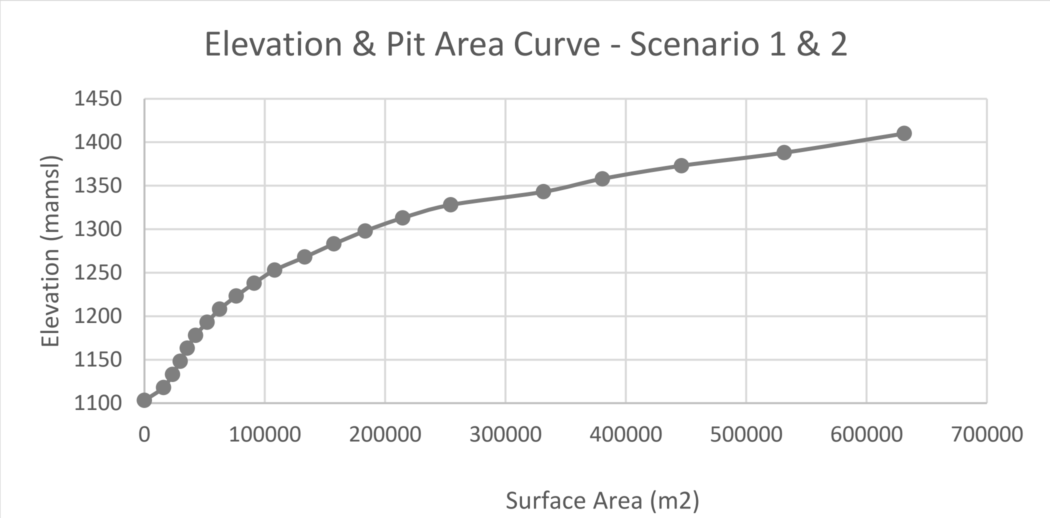


Figure 19: Elevation and Pit Area Curve (Scenario 1 & 2)

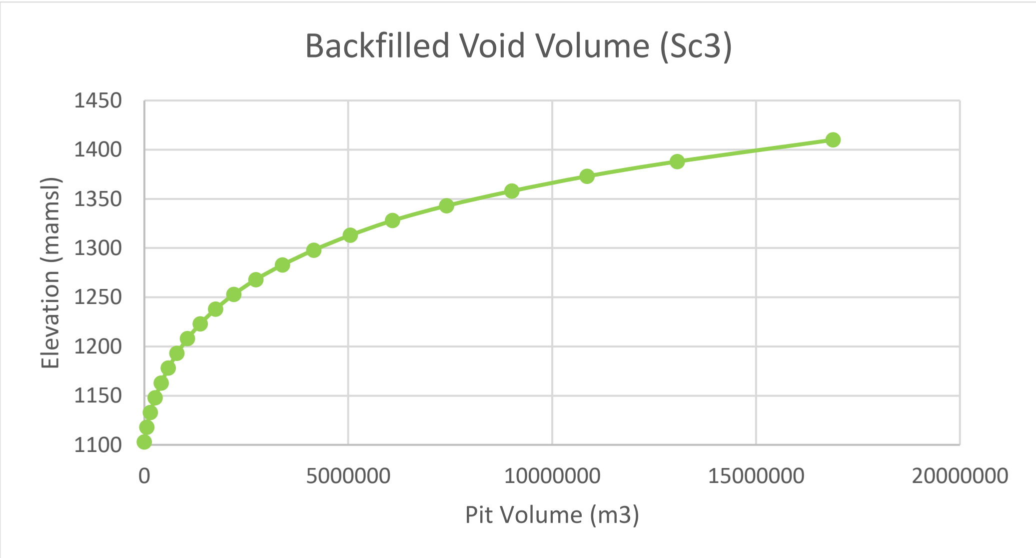


Figure 20: Elevation and pit void volume (Scenario 3)

4.4.1.2 Rainfall and evaporation

The average monthly rainfall and potential evaporation for the site are depicted in Figure 21. It is shown that potential evaporation significantly exceeds rainfall in all months. However, in early time (i.e. as the pit begins to fill) actual evaporation is limited relative to rainfall due to the extent of the evaporation surface. At a pit head elevation of approximately 1328 to 1343 mamsl, evaporation exceeds rainfall and thus be controlling force for the resulting head elevation in late time.

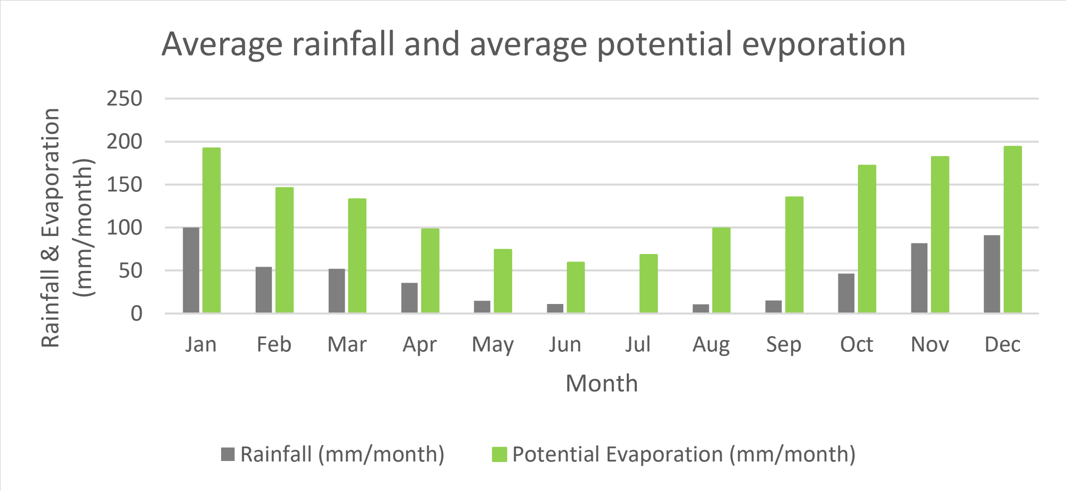


Figure 21: Average rainfall and average potential evaporation

4.4.1.3 Groundwater ingress and seepage losses

As observed during the operational phase, groundwater ingress to the Voorspoed Pit is very low. This is a consequence of the low conductivity strata which comprise the pit walls. Consequently, it is expected that during closure groundwater inflows will continue to be limited.

The three scenarios were each considered in the numerical modelling exercise described in the preceding sections. It was shown that the groundwater ingress, in all cases, initiate in the order of 6 l/s and gradually decrease to below 1 l/s. In early time groundwater and rainfall contributions are thus expected to result in relatively rapid pit flooding until evaporation balances the system in Scenarios 1 and 2.

Scenario 3 assumes backfilled conditions and consequently there is no evaporation which controls the final pit water level. Rather, the resulting head is controlled by the conductivity of the adjacent strata. The numerical model which was developed shows that the pit water levels recovers to conditions similar to pre-mining i.e. it is unlikely for decant to occur but rather it is anticipated that pre-mining water levels will re-establish, and potentially contaminated water will thereafter move away from the pit area towards the local aquifer system(s).

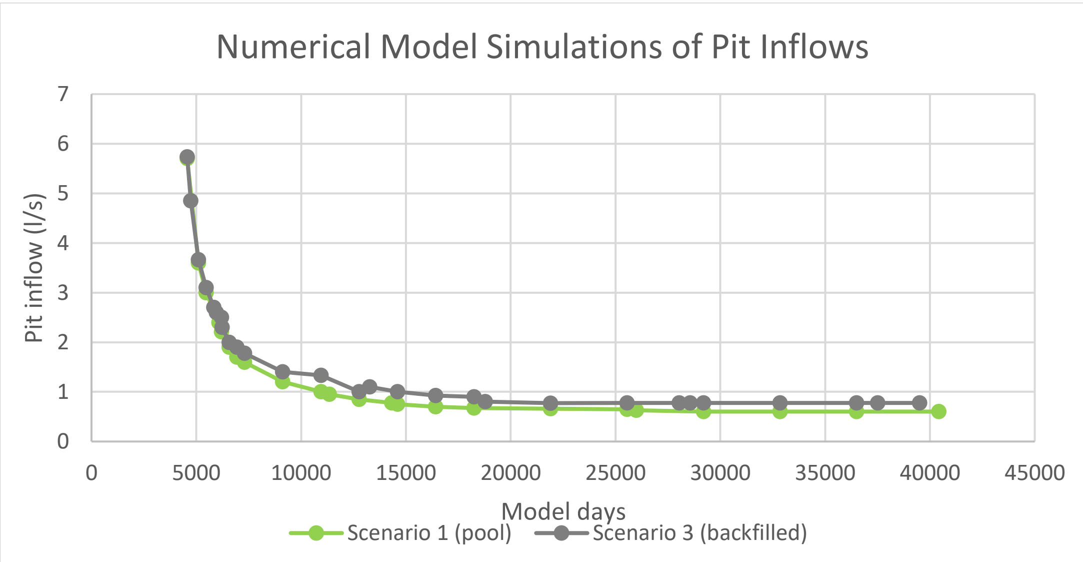


Figure 22: Numerical Model Simulation of Pit Inflows

4.4.1.4 Surface runoff

In Scenario 1 and 3 it is assumed that surface water in the wider catchment will continue to be diverted away from the pit during the post operational phase.

In Scenario 2, it is assumed that surface runoff to the pit is enhanced. In this scenario the pit is assumed to receive inflows from an engineered catchment measuring a total area of 406.2 Ha. It is assumed that the catchment will be smoothed and grassed, and accordingly surface runoff was calculated utilising the SCS method and assigning a curve number of 79. The resulting surface runoff is depicted in Figure 23.

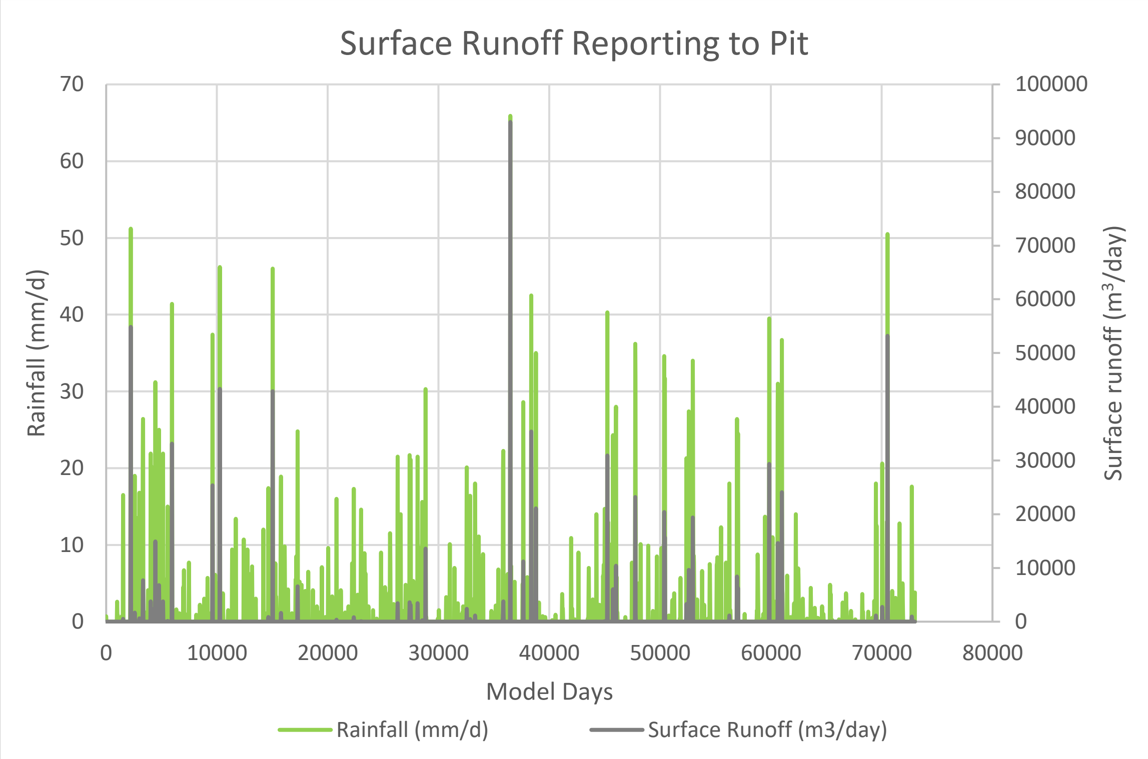


Figure 23: Surface runoff- engineered catchment

While no runoff from beyond the pit area is assumed to report to the Pit Lake in Scenario 3, there is a consideration of pit perimeter[5] and local [engineered] catchment runoff under Scenarios 1 & 2 respectively. This is particularly important to the mass loading calculation to estimate Pit Lake water quality. Rainfall that falls directly on the Pit Lake is considered to be direct precipitation, while precipitation that falls on the benches alongside the pit and the pit perimeter area is considered in-pit runoff.

4.4.2 Model Inputs - Mass Loading

The various inflow components are associated with loads which ultimately dictate the pit lake chemistry. As part of the geochemistry study it was found that potential contaminants of concern include;

- TDS;
- Calcium;
- Sodium;

[5] This regarded to be a rather small area surrounding the pit perimeter and ends at the first water control berm on the pit perimeter.

- Sulphate; and
- Selenium.

The source terms concentrations of the various inflow and outflow components for each PCOC considered in the model are summarised in Table 16.

In addition to in-pit runoff, it is considered that as the pit rises and water interacts with the fractured blast zone adjacent to the pit wall additional salts are leached. Once the wall rock is submerged, leaching of salts reduces to negligible.

For Scenario 1 and 2, a mass load, based on leach tests, was calculated and the loads for the PCOC are presented in Table 17.

Table 16: Source Concentrations

Inflow/Outflow Components	TDS (mg/l)	Ca (mg/l)	Na (mg/l)	SO4 (mg/l)	Se (mg/l)
Groundwater concentration	900	20	123	27	0.001*
Direct rainfall concentration	10*	1*	1*	1*	1.00E-05*
In-pit runoff concentration	114	3.87	27.42	17.98	0.00978
Evaporation concentration	0	0	0	0	0
Pit seepage concentration	Pit lake quality	Pit lake quality	Pit lake quality	Pit lake quality	Pit lake quality

* No data exists, and hence probable values were used.

Table 17: Mass loading associated with wall rock leaching – Scenario 1 & 2

Source Term	TDS (kg/m2)	Ca (kg/m2)	Na (kg/m2)	SO4 (kg/m2)	Se (kg/m2)
Mass load associated with wall rock leaching	20.075	0.679	4.802	3.15	0.002

In Scenario 3, it is estimated that 70% of the pit will comprise of rock material and the remaining 30% will consist of void spaces. Based on the leach tests a load was calculated as water interacts with 'fresh backfill' [backfill that is not yet submerged]. The loads associated with volume of backfill are outlined below (Table 18);

Table 18: Mass loading associated with backfill material

Source term	TDS (kg/m3)	Ca (kg/m3)	Na (kg/m3)	SO4 (kg/m3)	Se (kg/m3)
Loads associated with backfill leaching	6.48	0.198	1.56	0.93	5e-4

4.4.3 Goldsim Model Results

As described else where the potential risks to be evaluated are those associated with the final head elevation within the pit and the resulting pit water quality. The outcomes of the three scenarios were evaluated and a discussion on the risks of each outcome are outlined in the ensuing section.

4.4.3.1 Simulated Pit Water Level

The recovery of the hydraulic head for scenarios 1, 2 and 3 is depicted in Figure 24 and summarised in Table 19.

- In Scenario 1 the pit water level recovers to 1313 mamsl after 200 years. Hence the water level from surface is approximately 95 m. Hence, the water level within the pit after 200 years remains a groundwater sink.

- In Scenario 2 the pit water level rises approximately 20 m higher than the resulting head shown for Scenario 1 due to the additional surface runoff and reaches a head of between 1330 and 1335 mamsl after 200 years post operations. Hence the resulting head is greater than 70 m below surface. Similarly, to Scenario 1, it is found in Scenario 2 that the pit will remain a groundwater sink after 200 years post operations.

- For Scenario 3 it is assumed, based on modelling, that the pit water level increases and stabilises at conditions similar to the pre-mining water level in the backfilled pit i.e. at 1380 mamsl. The dynamic pit water balance model estimates that the pre-mining conditions will be achieved 32 years post closure. Hence after 32 years the pit will no longer act as a sink and potentially contaminated water will thus migrate away from the pit area and potentially impact on surrounding aquifers. This can roughly be calculated empirically using:

  - the average groundwater inflow at 4l/s (= 126 144 m^3/year);
  - the average surface water inflow at 700 mm/y over 70 ha (= 490 000 m^3/year);
  - relates to a total inflow of 616 144 m^3/year into the total void space of 17 M m^3; and
  - implies 28 years to fill.

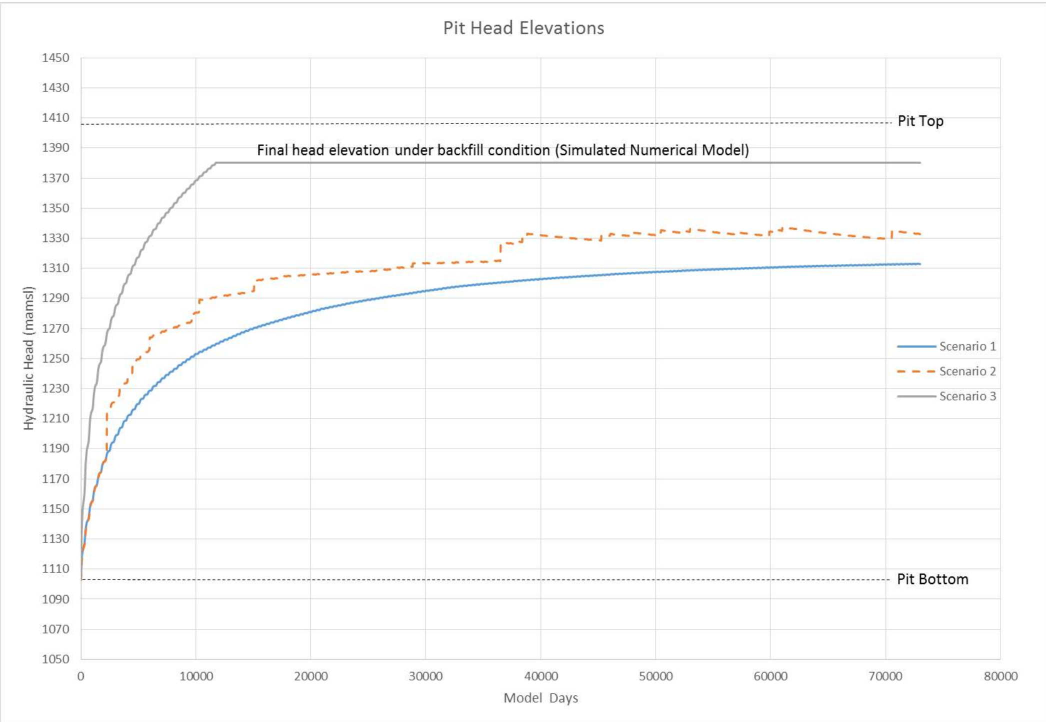


Figure 24: Simulated head in pit for three scenarios

Table 19: Water level in pit for the 3 scenarios (mamsl)

Years after mining	10	20	50	100	200
Scenario 1	1205	1237	1277	1300	1313
Scenario 2	1231	1268	1305	1315	1332
Scenario 3	1294	1344	1380	1380	1380

In the backfill scenario (Scenario 3), the pit fills up faster and reaches a higher water level because evaporation does not have an effect as in the open lake scenarios. Due to the additional runoff area directed towards the pit, the water level rises higher and quicker in Scenario 2 than in Scenario 1.

Scenario 1 and 2 pose an ongoing safety risk throughout the 200 years post operations due to the depth to water level within the open pit area. In this regard, Scenario 3 has negligible risk.

4.4.3.2 Simulated concentrations in the pit

The simulated mass loading model concentrations are schematically illustrated for TDS in Figure 25, Figure 26, and Figure 27 for scenarios 1, 2 and 3 respectively. The sources of mass considered include;

- Direct rainfall containing contaminants (as given in Table 16);
- Surface runoff (not applicable to scenarios 1 and 3);
- In pit runoff: As the rainwater moves down the sides of the pit, it collects sediment loaded with soluble matter consisting of natural salts [and where applicable potential contaminants];
- Groundwater inflow (same for all scenarios); and
- Evaporation (not applicable to Scenario 3): Removing water without contaminants, thereby concentrating the dissolved loads in the Pit Lake.

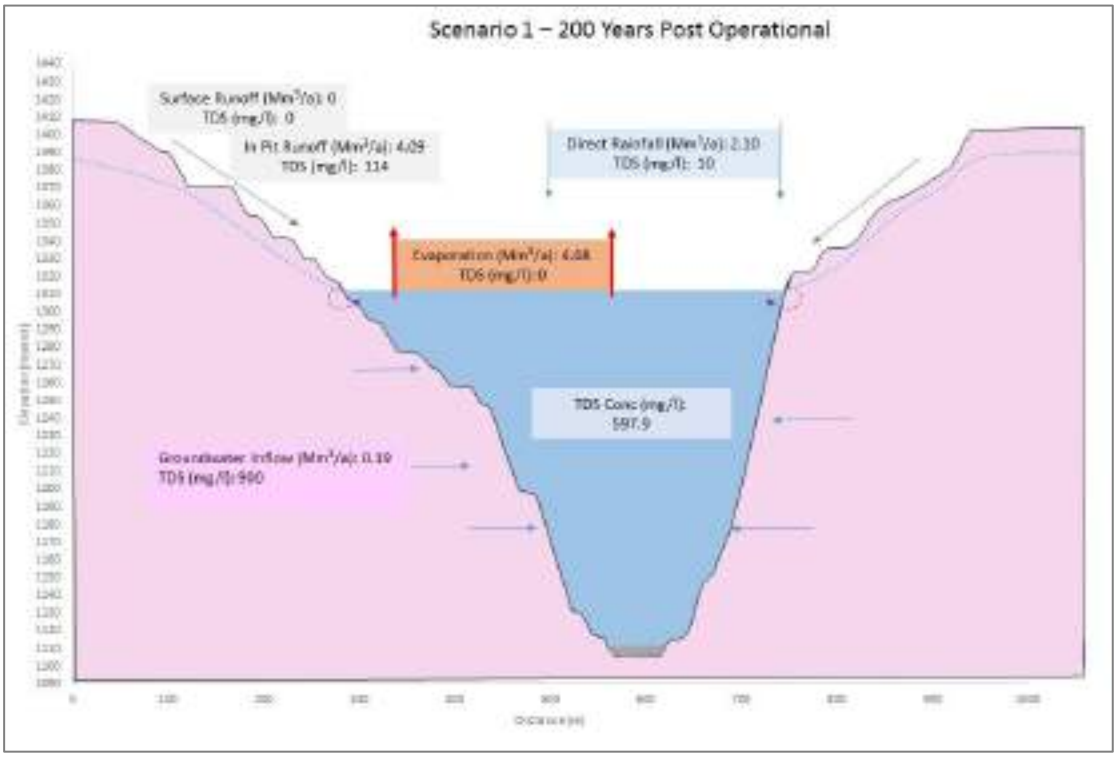


Figure 25: Simulated values used for calculating TDS load (Scenario 1 – 200 years post operational)

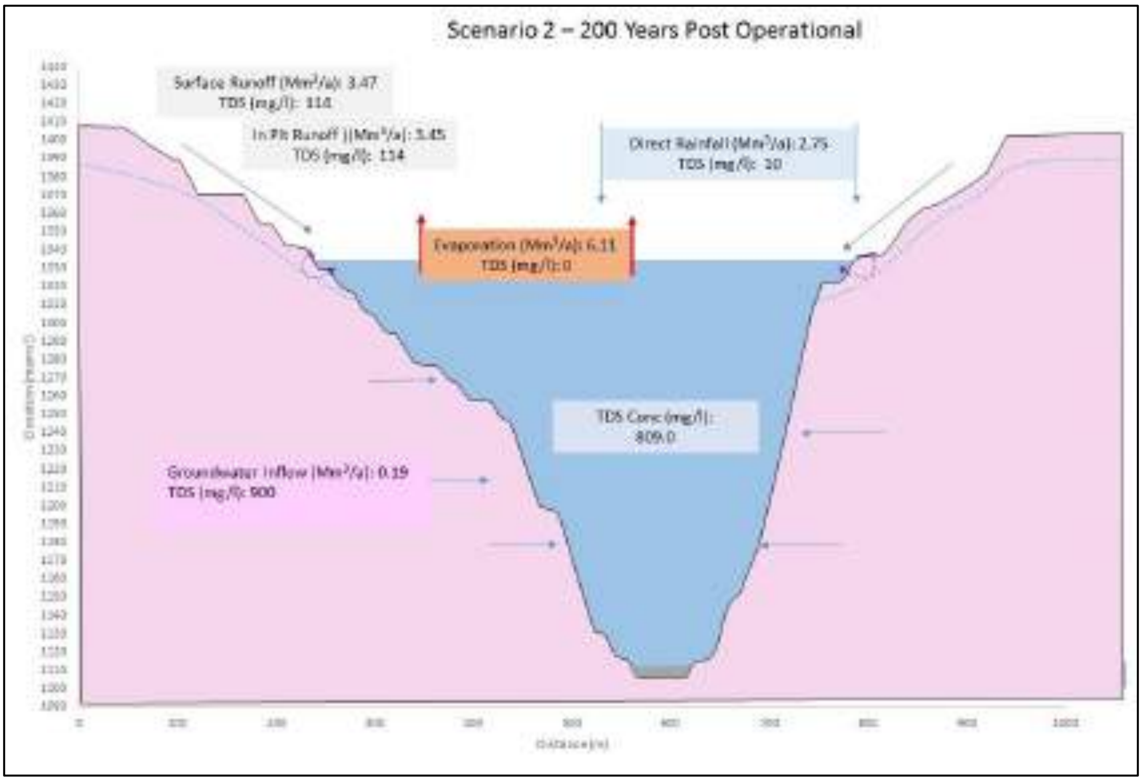


Figure 26: Simulated values used for calculating TDS load (Scenario 2 – 200 years post operational)

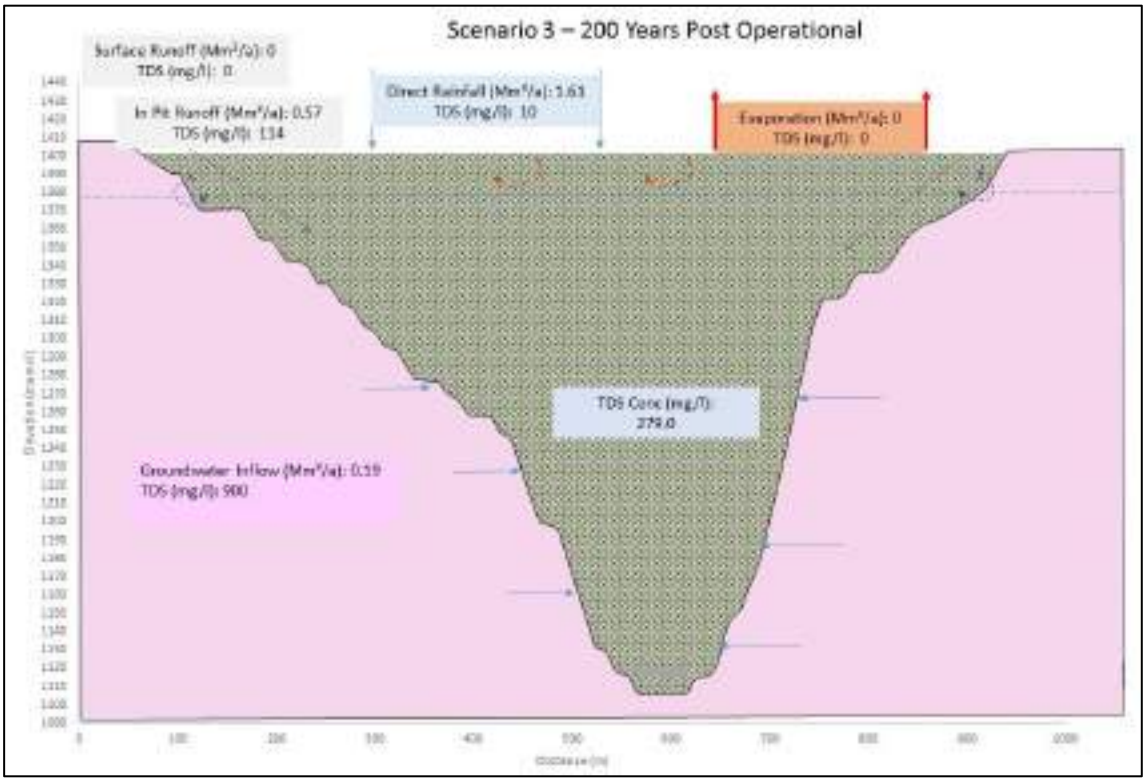


Figure 27: Simulated values used for calculating TDS load (Scenario 3 – 200 years post operational)

Discussion

The potential contaminants of concern that were modelled are TDS, Sodium, Sulphate, Calcium and Selenium. The simulated concentrations were compared to the livestock and domestic water quality limits and the following observations were made:

- For Scenarios 1 and 2 the TDS concentration is generally below the domestic water quality limit of 1000 mg/l.
- For Scenario 3 the livestock and drinking water limit are exceeded for the first 72 years and 100 years after closure respectively (Figure 28). Thereafter the contaminants are flushed out of the pit area and the concentrations decrease so that it is even lower than the concentrations for scenarios 1 and 2 after 200 years;
- Sodium concentration stays below the livestock limit for all scenarios considered. For Scenarios 1 and 2, the Sodium concentration exceeds the domestic water limit at the onset of re-watering but drops below the limit within 2 years. For Scenario 3 the Sodium concentration stays above the domestic water quality limits for more than 100 years (Figure 29);
- Sulphate concentration stays below the livestock limit in all scenarios considered. For Scenarios 1 and 2, the Sulphate concentration also stays below the domestic water quality limits, but for Scenario 3 it exceeds the drinking water limit for the first 87 years (Figure 30);
- The calcium trend is similar to the sulphate trend in that the concentration exceeding the domestic water quality limits for the first 64 years only for Scenario 3 (Figure 31); and
- Selenium exceeds both the livestock and drinking water limits for most of the time. For Scenario 1 the Selenium concentration drops below the domestic water limit but then starts to increase until it is exceeded approximately 100 years after closure. For Scenario 2 the Selenium concentration exceeds the domestic water limit and start to exceed the livestock limit after 175 years (Figure 32). For Scenario 3 the Selenium concentration eventually drops below the livestock limit after 120 years and below the domestic water limit after 165 years

In summary, the pit water concentrations for Scenario 3 is high initially and then becomes lower in time as the contaminants are flushed out of the system, but to the surrounding aquifer system. This process takes 64 to more than 100 years to reduce the concentrations to acceptable levels. For Scenarios 1 and 2 the concentrations drop rapidly, but then increases gradually, but only in the case of Selenium will the limits be exceeded after 100 to 175 years.

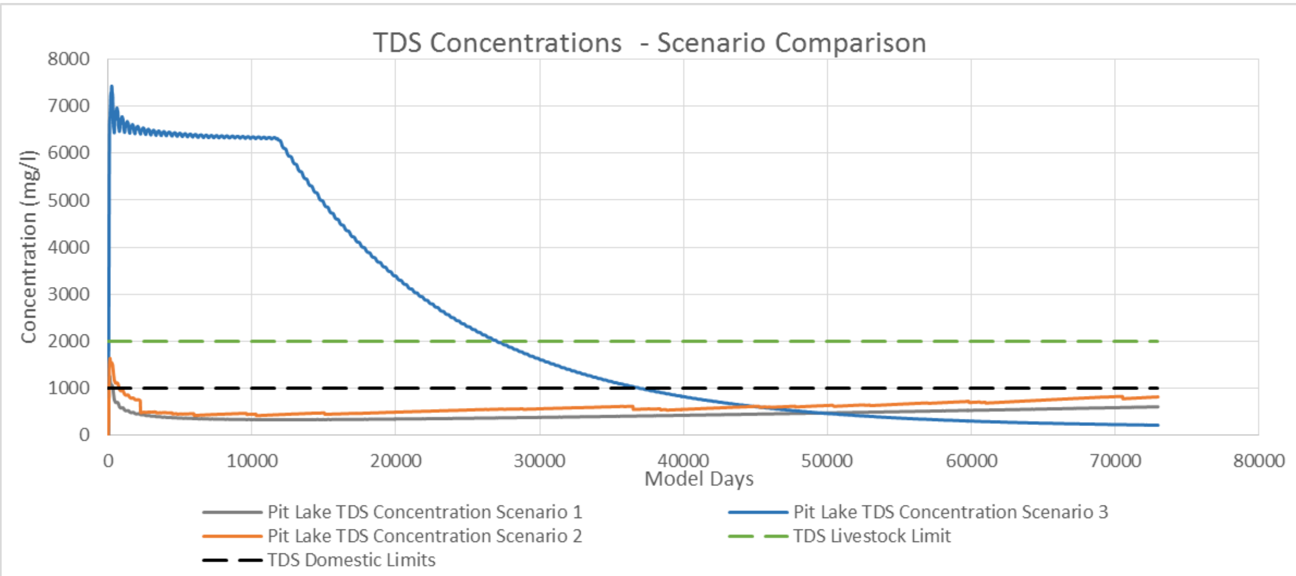


Figure 28: Simulated TDS concentration in pit

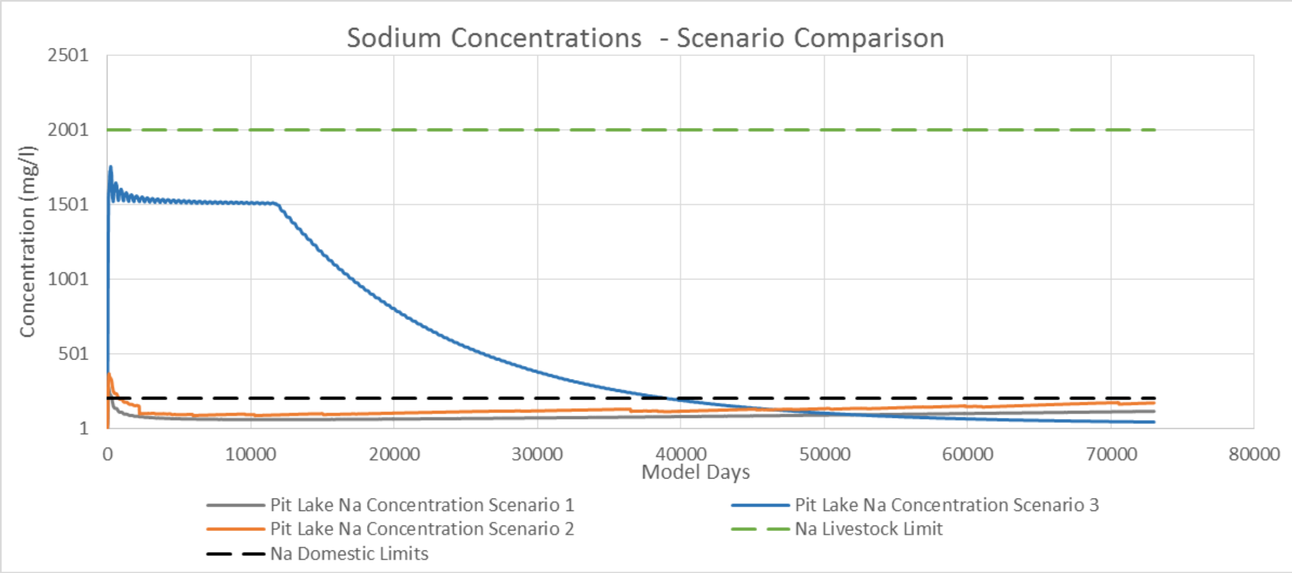


Figure 29: Simulated Sodium concentration in pit

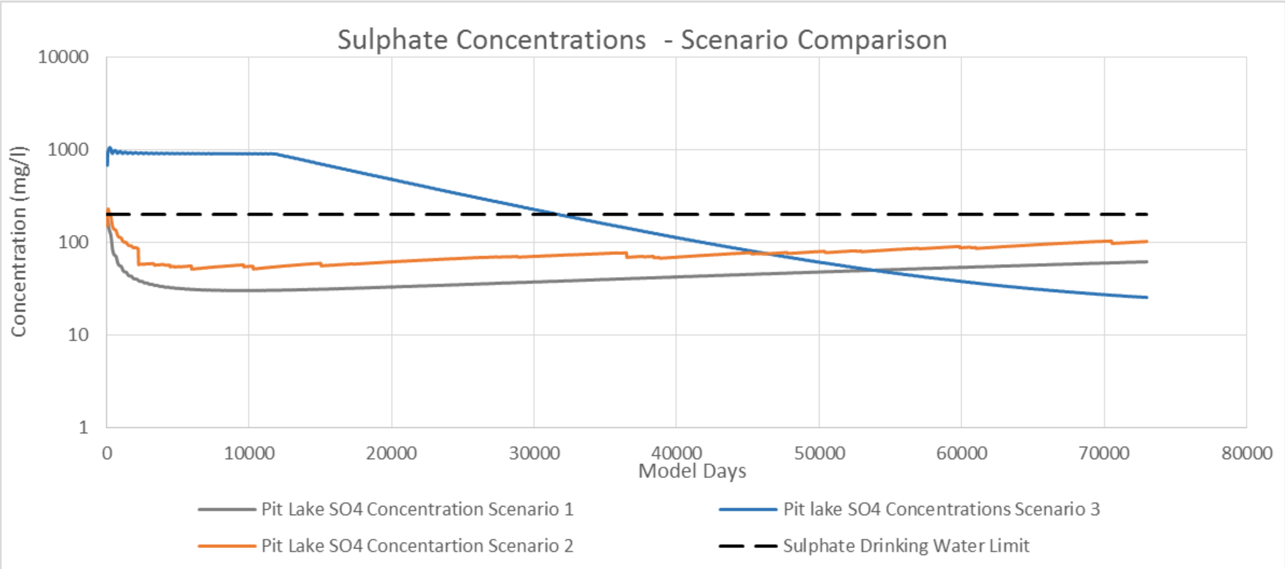


Figure 30: Simulated Sulphate concentration in pit

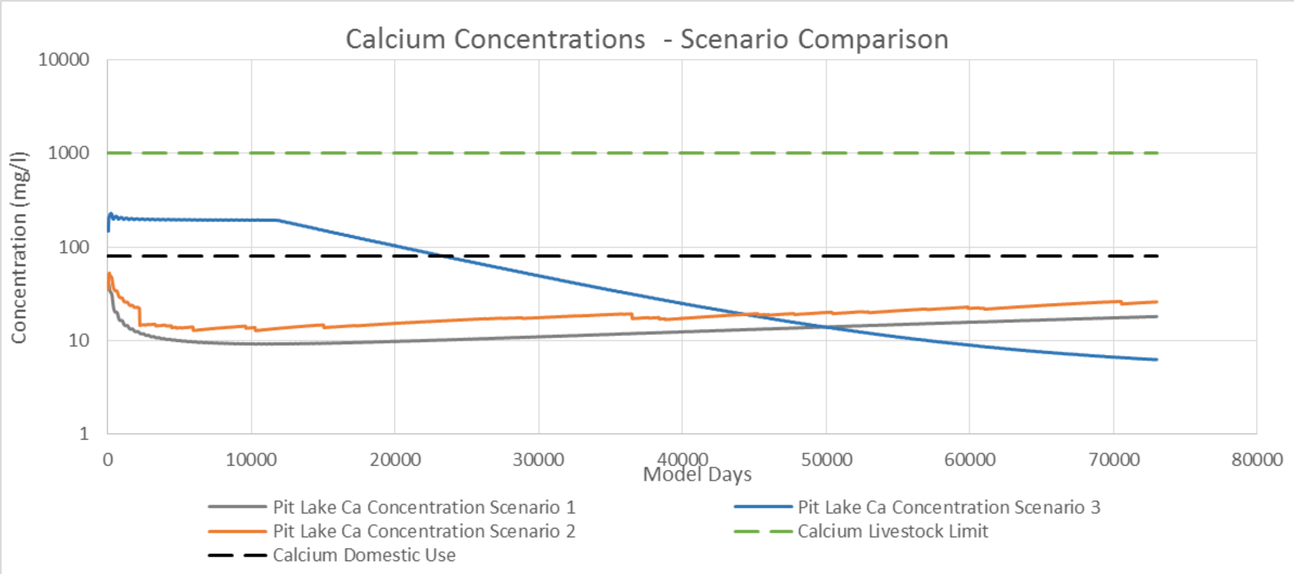


Figure 31: Simulated Calcium concentration in pit

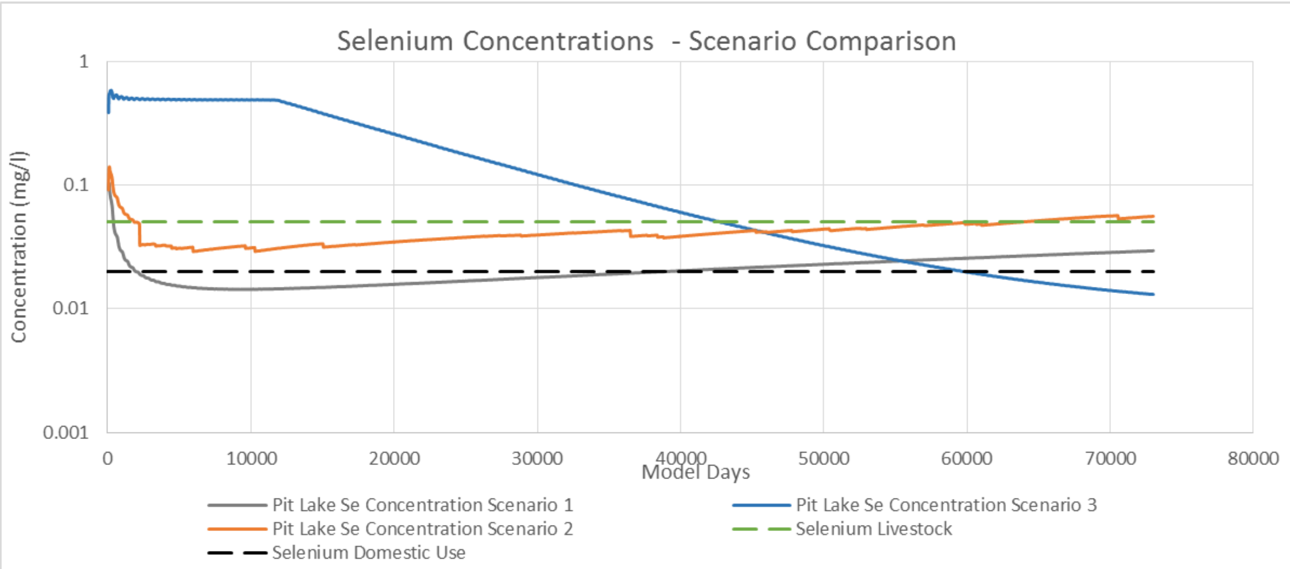


Figure 32: Simulated Selenium concentration in pit

5.0 ASSESSING ENVIRONMENTAL AND SOCIO-ECONOMIC RISKS (PHASE II)

5.1 Introduction

A risk assessment was undertaken on the three closure scenarios for the Voorspoed open pit and aimed to identify the key risks and impacts for each closure scenario. The results from the risk assessment were then used to guide the sustainability attribute option comparison which was undertaken using GoldSET. The pit closure scenarios are as follows:

- Scenario 1: The development of a pit lake under current conditions, i.e. direct rainfall to the pit footprint area, groundwater ingress and evaporation. Runoff from the pit catchment area is assumed to be diverted from the pit as per current conditions;
- Scenario 2: The development of a pit lake with a specifically engineered local runoff catchment area to enhance runoff to the pit by the reshaping of the Waste Rock Dump (WRD); and
- Scenario 3: Pit backfill scenario using the current WRD as main source of fill material.

5.2 Risk Assessment

5.2.1 Purpose

The purpose of this risk assessment was to:

- Identify all the high level environmental, social, safety and economic risks associated with each scenario;
- Identify measures required to address the identified risks;
- Utilize the risks assessed and identify measures to allow for a preliminary high-level scenario analysis; and
- Develop a scenario/option comparison model to assess the sustainability attributes using the outcomes of the risk assessment.

5.2.2 Risk Framework

The details of the framework will be discussed in the sections to follow.

5.2.2.1 Risk identification

Risks were identified in a workshop session where members of the Golder team were present. A brainstorming and discussion technique were used to identify key risks. The following advantages and disadvantages were identified and were then used as a basis to assist with the discussion and the identification of risks:

Table 20: Advantages and disadvantages of each scenario

Scenario 1: Pit lake status quo	Scenario 2: Pit lake with enhanced drainage	Scenario 3L Backfilled pit
Advantages		
• Low cost for option development • Groundwater quality largely within domestic and livestock limits, only selenium could be a problem for domestic use • Water level below natural ground level so pit will continue to act as a sink with no plume migration	• Higher cost for WRD reworking but still much less than backfilling • Groundwater quality largely within domestic and livestock limits, only selenium could be a problem for domestic and livestock use • Water level below natural ground level so pit will continue to act as a sink with no plume migration • Possible vegetation failure and soil erosion losses of the WRD will report to the pit and not to the environment	• Reuse of the post-closure WRD footprint • Increase in catchment yield • WRD will no longer pose a contamination risk, and the pit will no longer pose a safety risk
Disadvantages		
• Pit crest instability with associated break back, posing a safety risk requiring proper protection • Possibility of illegal mining taking place immediately post-closure • Continuous monitoring of WRD. Possible vegetation failure and soil erosion losses on the WRD would result in silt and other contaminants reporting to the environment	• Pit crest instability with associated break back, posing a safety risk requiring proper protection • Possibility of illegal mining taking place immediately post-closure although the period for water to fill the pit will be marginally shorter than for Scenario 1 • Reduction of catchment yield from the WRD	• WRD foot print waste classification and rehabilitation • Extreme cost to backfill and possible additional cost of abstraction and treatment of contaminated groundwater plume • Groundwater quality exceeds constituents of concern. Although the qualities within the pit improve after ±30 years the contaminants will have simply moved to the surrounds in a contaminated groundwater plume • Water level will rebound to the natural water table level and the contaminated groundwater plume will migrate down gradient to the surrounding aquifer system(s)

5.2.3 Consequence and Probability

A 5x5 consequence and probability matrix was used to rate the risks based on the following consequence criteria:

- Health and Safety;
- Environmental Impact;
- Social; and
- Economic cost.

The probability or likelihood of the risk occurring is also measured according to a 5-point scale as illustrated in Table 21.

Table 21: Likelihood matrix

Likelihood rating	Uncertainty	Definitions
5	Almost certain	90% and higher likelihood of occurring
4	Likely	Between 30% and less than 90% likelihood of occurring
3	Possible	Between 10% and less than 30% likelihood of occurring
2	Unlikely	Between 3% and less than 10% likelihood of occurring
1	Rare	Less than 3% likelihood of occurring

The combination of the risk likelihood and consequence were used to determine the risk outcome as shown in Table 22 below.

Table 22: Risk outcome

		Consequence				
		1	**2**	**3**	**4**	**5**
Likelihood	**1**	11 (Medium)	16 (Significant)	20 (Significant)	23 (High)	25 (High)
	2	7 (Medium)	12 (Medium)	17 (Significant)	21 (High)	24 (High)
	3	4 (Low)	8 (Medium)	13 (Significant)	18 (Significant)	22 (High)
	4	2 (Low)	5 (Low)	9 (Medium)	14 (Significant)	19 (Significant)
	5	1 (Low)	3 (Low)	6 (Medium)	10 (Medium)	15 (Significant)

Identified risks were categorised according to the above criteria in order to assess the consequence related to each risk. Consequences/impacts associated with each risk were identified and rated according to the risk matrix in Table 23. Consequence is rated on a 5 point scale according to the following levels:

- 1 – Insignificant;
- 2 – Minor;
- 3- Moderate;
- 4 – High; and
- 5 – Extreme.

Table 23: Consequence matrix

	CONSEQUENCE/ SEVERITY/ IMPACT				
LOSS TYPE	**1 - Insignificant**	**2 - Minor**	**3 - Moderate**	**4 - High**	**5 - Extreme**
	INSIGNIFICANT	**MINOR**	**MODERATE**	**HIGH**	**EXTREME**
Cost	Less than 1% impact on the overall closure provision	May result in overall closure provision overrun equal to or more than 1% and less than 3%	May result in overall closure provision overrun of equal to or more than 3% and less than 10%	May result in overall closure provision overrun of equal to or more than 10% and less than 30%	May result in overall closure provision overrun of 30% or more
Health and Safety	First aid case	Medical treatment case	Lost time injury	Permanent disability or single fatality	Numerous permanent disabilities or multiple fatalities
Environment	Lasting days or less; affecting small area (metres); receiving environment highly altered with no sensitive habitats and no biodiversity value	Lasting weeks; affecting limited area (hundreds of metres); receiving environment altered with little natural habitat and low biodiversity value	Lasting months; affected extended area (kilometres); receiving environment comprising largely natural habitat and moderate biodiversity value	Lasting years; affecting area on sub-basin scale; receiving environment classified as having sensitive natural habitat with high biodiversity value	Permanent impact; affecting area on a whole basin or regional scale; receiving environment classified as highly sensitive natural habitat with very high biodiversity value
Social	Minor disturbance of culture/ social structures	Some impacts on local population, mostly repairable. Single stakeholder complaint in reporting period	Ongoing social issues. Isolated complaints from community members/ stakeholders	Significant social impacts. Organized community protests threatening continuity of operations	Major widespread social impacts. Community reaction affecting business continuity. “License to operate” under jeopardy

5.2.4 Risk Assessment Findings

The risk assessment matrix can be found in Table 24 below.

Scenarios 1 and 2 both have risks associated with the low water level within the pit (90 m and 75 m below ground level, respectively). The pit wall has the possibility of being unstable and the risk of break back exists. The break back could result in the destruction of the planned access control measures (envirobund, i.e. berm and associated structures), which could cause potential loss of life for people and livestock. The risk of artisanal mining also exists due to the Kimberlite pipe and low water level soon after formal mining ceases.

A portion of the runoff from the waste rock dump will still report to the environment for Scenario 1, and in an event that contaminated runoff and erosion occurs then there is the potential for unwanted environmental impacts. Local runoff from the pit excavation perimeter will report to the Pit Lake water body. Although Scenario 2 will slightly reduce the overall catchment yield, all potentially contaminated runoff will report to the pit.

Scenario 3 was found to have both the greatest number and highest rating of risks. Key risks from Scenario 3 relate to effect of the backfilled pit on the groundwater quality and the cost of implementation. The poor water quality associated with the backfilled material in the pit is expected to migrate downslope as a contaminated groundwater plume, which could potentially affect surrounding groundwater users. In order to mitigate this environmental risk, scavenger boreholes may need to be constructed and the abstracted water treated, which poses a high capital cost along with a longer-term liability. The cost of loading and hauling the waste rock into the pit is expected to be excessive and have significant business impacts. The high cost of backfilling and water treatment can only be mitigated by stakeholder agreement in choosing either Scenarios 1 or 2.

Given the identified risks, their severity, and the required mitigation measures, the preliminary preferred scenarios in order of preference is as follows [It should be noted that the comparative GoldSET analysis will analyse the scenarios in more detail]:

1) Scenario 1: The development of a pit lake under current conditions where [contaminated] runoff from the surrounding perimeter area is channelled into the pit excavation, but runoff water from the remaining WRD is directed to the environment, i.e. the “clean water” component.

2) Scenario 2: The development of a pit lake with the WRD specifically engineered (reshaped) to direct local runoff from the WRD catchment area to the pit.

3) Scenario 3: Pit backfill scenario using the current waste rock dump as backfill material. This will create a large foot print area which will require a contaminated land classification and possible further groundwater quality consequences.

Table 24: Risk assessment

Aspect	Risk Drivers	Consequence	Consequence type	Probability	Consequence rating	Risk level (pre-mitigation)	Closure/mitigation action	Probability	Consequence rating	Risk level (post-mitigation)
. PHYSICAL CLOSURE COMPONENTS										
1.1. Pit										
Water Quality	Scenario 1: Selenium does not exceed the domestic use threshold for greater than 80 years from which time there is a marginal but progressive increase over the threshold	Pit lake water becomes unfit for domestic use over time	Environment	5	3	20 (S)	Restrict use of water for domestic use or treat water to remove selenium	2	3	9 (M)
	Scenario 2: Selenium exceeds the domestic use thresholds and continues to deteriorate over time	Pit lake water becomes unfit for domestic use from closure and also for livestock after 150 years	Environment	5	3	20 (S)	Restrict use of water for domestic and livestock use or treat water to remove selenium	2	3	9 (M)
	Scenario 3: All constituents of concern exceed the domestic threshold and in all cases the concentrations decrease over time	Pollution plume for a backfilled pit will contain significantly higher concentrations for the constituents of concern, potentially rendering the surrounding groundwater that could affect the environment	Environment	5	4	23 (H)	Construction of scavenger boreholes and abstraction of contaminated water for costly long-term water treatment	2	4	14 (S)
	Scenario 3: Backfilling of the pit results in significantly higher concentrations of salts dissolved from the waste rock which can reach the environment via a pollution plume generated by a backfilled pit	Farmers/community are no longer able to use boreholes impacted by the pollution plume	Social	4	3	17 (S)	Construction of scavenger boreholes and abstraction of contaminated water for costly long-term water treatment and provision of alternative source of clean water	2	3	9 (M)
		Mine may be required post-closure to intercept the pollution plume for costly long-term water treatment	Cost	4	4	21 (H)	On-going cost of water treatment, unless agreement is reached with stakeholders to adopt scenario 1 or 2	2	2	5 (L)
Stability	Scenario 1 and 2: Pit not backfilled and the risk of break back exists	Loss of envirobunds and associated structures due to unpredictable break back zone which causes potential loss of life and livestock due to no access control	Health & safety	3	4	18 (S)	Monitoring and maintenance. Ensure access control measures	1	4	10 (M)
	Scenario 1 and 2: Instability of the pit wall as well as the depth of the water present a safety risk	Potential loss of life and livestock	Health & safety	3	4	18 (S)	Monitoring and maintenance Ensure access control measures	1	4	10 (M)
Material balance	Scenario 3: Insufficient rock to backfill the pit, and/or settlement of the backfill during water table rebound creating a "dish" over the pit	Increased recharge creating a positive head which will accelerate the movement and extent of the pollution plume	Environment	3	4	18 (S)	In case of settlement/deficit material then source alternative borrow material to make it free draining	2	3	9 (M)
		Increased concentration of CoCs from the waste rock in the unsaturated zone rendering the affected groundwater even more unfit for use	Environment	3	4	18 (S)	In case of settlement/deficit material then source alternative borrow material to make it free draining	2	4	14 (S)
		Reducing the final land use area and options	Social	3	2	8 (M)	In case of settlement/deficit material then source alternative borrow material to make it free draining	2	2	5 (L)
Cost	Scenario 3: Cost of backfilling the pit excessive	Inadequate provision of closure costs for backfilling with significant business impact	Cost	5	5	25 (H)	Engagement with stakeholders to agree that the pit does not get backfilled, both because this is a costly exercise that was not committed to in the EMPR and because backfilling will sterilise the remaining kimberlite	2	4	14 (S)

Aspect	Risk Drivers	Consequence	Consequence type	Probability	Consequence rating	Risk level (pre-mitigation)	Closure/mitigation action	Probability	Consequence rating	Risk level (post-mitigation)
Resource sterilisation	Scenario 3: Backfilling of the pit will sterilise remaining Kimberlite material at the base	Remaining Kimberlite becomes unavailable for potential future mining	Social	5	4	23 (H)	Engagement with stakeholders to agree that the pit does not get backfilled so that the opportunity remains open for future mining enterprises where remaining kimberlite can be accessed by underground mining if feasible	2	4	14 (S)
1.2. Waste Rock Dump										
Catchment yield and quality	Scenario 1: Any contaminated runoff from the rehabilitated WRD (through loss of vegetation and soil) would enter the environments and would not be contained	Contaminated silt and runoff enter and impacts the downstream environment (soils, streams)	Environment	3	3	13 (S)	Care and maintenance programme required to maintain vegetation cover and to repair any erosion areas promptly	2	3	9 (M)
	Scenario 2: Runoff from the reshaped WRD into the pit reduces the amount of clean water runoff that would enter the environment	Reduction in catchment yield	Environment	4	2	12 (M)	Maximise catchment yield from all areas not designed to drain into the pit	2	2	5 (L)

5.3 Sustainability Option analysis (Phase II)

GoldSET is a framework tool to conduct comprehensive, transparent and defensible option analyses from a sustainability perspective. The programme supports decision-making in complex situations where trade-offs between technical and non-technical factors are inevitable.

5.3.1 Performance Objectives

A list of performance objectives was developed, which defines the attributes that would most likely result in the successful closure of the pit. The performance objectives related to the closure of the pit are listed below:

- **Physical stability:** To remove and/or stabilise surface infrastructure that is present on the mine to facilitate the implementation of the planned final land use;
- **Environmental quality:** To ensure that local environmental quality is not adversely affected by possible physical effects and chemical contamination arising from the mine site, as well as to sustain catchment yield as far as possible after closure;
- **Health and safety:** To limit the possible health and safety threats to humans and animals using the rehabilitated mine site as it becomes available;
- **Land capability / land use:** To re-instate suitable land capabilities over the various portions of the mine site to facilitate the progressive implementation of the planned final land use;
- **Aesthetic quality:** To leave behind a rehabilitated mine site that is neat and tidy, giving an acceptable overall aesthetic appearance; and
- **Social:** To ensure that the land transfers, if applicable, and measures and/or contributions made by the mine towards the long-term socio-economic benefit of the local communities are lasting and sustainable.

5.3.2 Performance Indicators and Scoring

The scenarios were analysed using indicators of performance (Table 25) which were defined in line with sustainability thinking, consisting of environmental, social and economic aspects. The indicators were selected based on the outcomes of the risk assessment as well as the performance objectives described above.

A rating scale was developed which was applicable for each indicator and a weighting applied to each indicator score. A normalization process was used to translate an indicator (either qualitative or quantitative) into a common scale out of 100% so that all indicators could be compared to one another. A weight was used to compare the relative importance of an indicator (and the issue it represents) with respect to the other indicators within the same dimension. Scores were then rolled-up typically into the three dimensions (environmental, social, and economic). For each dimension, the rolled-up score ranges from 0% to 100% — the higher the score, the better the result.

Table 25: GoldSET indicators, scoring scheme and weightings

Theme	Indicator	Description	Weighting	Scoring Scheme			
				0	33	66	100
Environmental Aspects							
Hydrological Regime	Catchment Yield	Efficacy of the option in returning the clean catchment yield of the site (WRD and pit) to pre-mining conditions.	1	No return of catchment yield expected	Some return of catchment yield expected	Significant return of catchment yield expected	Complete return of catchment yield expected
Groundwater Quality	Pit Water Quality	Efficacy of the option in not affecting the groundwater quality within the pit and plume (if applicable) during and after rehabilitation to ensure long-term availability, use and environmental sustainability.	2	Complete contamination of groundwater expected: all constituents of concern exceeded	Significant contamination of groundwater expected: constituent(s) renders water unfit for livestock use	Some contamination of groundwater expected: constituent(s) renders water unfit for domestic use	No effect on groundwater concentrations expected: no constituents of concern exceeded
Groundwater Quality	Groundwater Plume	Efficacy of the option in dealing with the migration of the contaminated groundwater plume emanating from the pit.	3	No containment of groundwater	Partial containment of the groundwater plume	Containment of the groundwater plume	Complete rehabilitation of affected groundwater expected and containment of the plume
Surface Water Quality	Runoff Water Quality	Efficacy of the option in minimizing the impact of remediation activities on the quality of surface water runoff, and associated erosion on the site, and the potential impact on the surrounding environment. This indicator measures the sustainability of the WRD.	2	Significant effect on surface water runoff expected	Moderate effect on surface water quality runoff expected	Minor effect on surface water quality runoff expected	No effect on surface water quality runoff expected
Land capability	Value of End Land Use	End-of-life potential of the property resulting from the implementation of the option	2	Property will have restricted access with limited to no development potential	Medium presence of degraded land and some end land use targets met	Low presence of degraded land and majority of end land use targets met	Absence of degraded land and land in pre-mining condition
Social Aspects							
Community Wellbeing	Access to Lands and Resources	Efficacy of the option in maximizing the beneficial use of the site and its surroundings by the public post-closure, also taking into account the FRD and CRD which will be present at closure.	1	No possible benefits from the property	Major restrictions for use	Minor restrictions for use	No restrictions for use
Water Supply	Groundwater Supply	Efficacy of the option in ensuring that water supplies are protected (potable wells, surface water or aquifers used for domestic, livestock and irrigation water supply) both during and after the rehabilitation.	3	Water supply will be / to be impacted (exceedances in parameters, restricted availability)	Water supply could be impacted by implementation of the option (exceedances in parameters, restricted availability) but will likely be rehabilitated through time	Water supply will be fully protected during and after rehabilitation	Water supply will be fully protected during and after rehabilitation and option will provide an additional water source for surrounding users
Health & Safety	Public Safety	Potential negative impacts of the option on public safety. Goal is to ensure that there is adequate access control (fencing, envirobund and water within pit to prevent artisanal mining) and a stable final land form.	3	Significant potential impact(s) on the community	Moderate potential impact(s) on the community	Minor potential impact(s) on the community	No potential impact on the community

Theme	Indicator	Description	Weighting	Scoring Scheme			
				0	33	66	100
Landscape	Aesthetic Impact	Consider impact on the landscape (aesthetic value) resulting from the implementation of the pit and WRD closure option, in the form of improving the aesthetic value	1	No improvement to the landscape	Minor improvement to landscape due to rehabilitation of dump side slopes	Improvement to landscape due to free draining and vegetated WRD along with side slope rehabilitation of remaining dumps	Gains to landscape value as consequence of active management
Economic Aspects							
Cost	Present Value of Options' Costs	Measure of the present value of the costs over the life of the project	3	A normalized score is derived based on the NPV of the options. The most expensive option gets 0 and the least gets 100, calculating the remaining scores using a linear scale			

5.4 Quantitative Scenario Cost

The indicative cost to implement each scenario was calculated to use in the economic comparison. It should be noted that these costs are high-level as they are only to be used for a comparative purpose. The explanation below summarises the costed measures and important assumptions.

It should be noted that any additional environmental liabilities have not been included in the cost and only the implementation of each scenario. No allowance has been made for monitoring or care and maintenance. It is expected that the groundwater plume, which will develop from Scenario 3, will require the abstraction and treatment of water. This intervention will likely carry a very large economic cost but has not been included in this assessment.

The cost for rehabilitation of the WRD in Scenario 1, as well as the access control measures needed for the open pit in Scenarios 1 and 2 have been sourced from the latest closure costing done by Redco and Uvuna (2018). It has been assumed that the measures within the overall cost from these sources will be sufficient.

Table 26 below shows the indicative costs calculated for each scenario (rounded to the nearest R1 000). The cost to backfill the pit is exorbitant and for all practical purposes renders this scenario economically unfeasible.

Table 26: Summary of costs

Scenario 1 cost	Scenario 2 cost	Scenario 3 cost
R 39 709 000	R 53 470 000	R 3 948 210 000

5.4.1 Scenario 1: Pit Lake Status Quo

Table 27 below shows the indicative cost which was used in the option analysis. The cost for the pit and WRD rehabilitation were provided in the Redco and Uvuna (2018) costing reports. The open pit rehabilitation consists of the construction of a fence, storm water trench and an envirobund outside the expected break back zone. The rehabilitation of the WRD consists of the reshaping the side slopes to 18 degrees and then covering the slopes with topsoil and indigenous vegetation. Water control berms and gabions will be constructed to manage runoff in a controlled manner. Lastly stock fencing will be installed around the WRD to prevent access.

Table 27: Scenario 1 cost

	Cost Component	Quantity	Unit	Unit rate	Total cost	Notes
1.0	**Open pit rehabilitation**					Cost taken from Redco and Uvuna (2018)
1.1	Access control around open pit	1	/sum	R 6 390 526	R 6 390 526	Cost includes access road blasting, water control structure, security fencing, envirobund (including topsoil and vegetation) and trench
	Sub-total for Open pit rehabilitation				**R 6 390 526**	
2.0	**Rehabilitation of WRD**					Redco and Uvuna (2018) assumed that drainage will be towards pit, assume that the same cost will apply if drainage is to environment
2.1	Rehabilitation of WRD	1	/sum	R 25 376 524	R 25 376 524	Cost includes reshaping of side slopes, shaping for drainage, parapet water control structures, toe paddock berms, gabion structures, topsoil &

	Cost Component	Quantity	Unit	Unit rate	Total cost	Notes
						revegetation of side slopes and stock fencing
	Sub-total for Rehabilitation of WRD				**R 25 376 524**	
3.0	**P&Gs, Contingencies**					As per Redco and Uvuna (2018)
3.1	Preliminaries and general	20	/sum	R 6 353 410	R 6 353 410	Assumed 20 % of Sub-total 1
3.2	Contingencies	5	/sum	R 1 588 353	R 1 588 353	Assumed 5 % of Sub-total 1
	Sub-total for P&Gs, Contingencies				**R 7 941 763**	
	Total				**R 39 708 813**	

5.4.2 Scenario 2: Pit lake with Enhanced Drainage

Table 28 below shows the indicative cost which was used in the option analysis for Scenario 2. The open pit rehabilitation measures for Scenario 1 were also assumed to be applicable for Scenario 2. The WRD will be shaped into a smooth free-draining landform which drains towards the pit. Allowance has been made to apply topsoil and revegetate the reshaped WRD with indigenous vegetation.

Table 28: Scenario 2 cost

	Cost Component	Quantity	Unit	Unit rate	Total cost	Notes
1.0	**Open pit rehabilitation**					Assume that the access control from Scenario 1 will be the same for Scenario 2. Cost taken from Redco and Uvuna (2018)
1.1	Access control around open pit	1	/sum	R 6 390 526	R 6 390 526	Cost includes access road blasting, water control structure, security fencing, envirobund (including topsoil and vegetation) and trench
	Sub-total for Open pit rehabilitation				**R 6 390 526**	
2.0	**Rehabilitation of WRD**					
2.1	Shape dump to drain towards pit	206	/ha	R 176 629.40	R 36 385 656	406 ha enhanced drainage catchment. Assume that an area equal to 206 ha will be shaped
2.2	Import and place topsoil	1015000	/m3	R 34.42	R 34 936 300	Assume topsoil available on site within 1km. 250 mm cover over footprint as this is minimum depth to achieve grazing potential
2.3	Ripping to alleviate compaction	406	/ha	R 3 266.03	R 1 326 008	
2.4	Establish vegetation	406	/ha	R 36 231.67	R 14 710 058	
	Sub-total for Rehabilitation of WRD				**R 36 385 656**	

	Cost Component	Quantity	Unit	Unit rate	Total cost	Notes
3.0	**P&Gs, Contingencies**					As per Redco and Uvuna (2018)
3.1	Preliminaries and general	20	/sum	R 8 555 236	R 8 555 236	Assumed 20 % of Sub-total 1
3.2	Contingencies	5	/sum	R 2 138 809	R 2 138 809	Assumed 5 % of Sub-total 1
	Sub-total for P&Gs, Contingencies				**R 10 694 046**	
	Total				**R 53 470 228**	

* Note that the cost is high level and for comparative options only. If Scenario 2 were to be pursued the cost would have to be refined

5.4.3 Scenario 3: Backfilled Pit

Table 29 below shows the indicative cost which was used in the option analysis for Scenario 3. The exorbitant cost is attributed to the large volume of material movement required to the fill the pit. The high-level costing has assumed that the material will be dozed down from the edge of the pit as this will be cheaper than driving the material down to the bottom of the pit. Due to the high-level estimation, it has been assumed that all material within the WRD will be used for backfilling and that it would be sufficient to fill the pit.

Table 29: Scenario 3 cost

	Cost Component	Quantity	Unit	Unit rate	Total cost	Notes
1.0	**Open pit rehabilitation**					Pit volume plus additional 15% allowed for. Load and haul of 1-2 km
1.1	Load and haul WRD material to pit	64758999	/m3	R 29	R 1 877 363 380	Assume sufficient material available in WRD to fill pit
1.2	Doze WRD material into pit	64758999	/m3	R 10	R 624 924 340	Down doze material into pit
1.4	Shape backfilled pit to be free draining	70	/ha	R 113 062	R 7 914 356	
1.5	Import and place topsoil	175000	/m3	R 34	R 5 950 000	Assume topsoil available on site within 1 km. 250 mm cover over footprint
1.6	Ripping to alleviate compaction	70	/ha	R 3 266	R 228 622	
1.7	Establish vegetation	70	/ha	R 36 232	R 2 536 217	Establish indigenous vegetation over footprint
	Sub-total for Open pit rehabilitation				**R 2 516 278 809**	
2.0	**Rehabilitation of WRD**					Assume that all material will be disposed of in dump and any contaminated soils will be excavated and disposed of into the pit
2.1	Shape dump footprint to be free draining	260	/ha	R 75 375	R 19 597 453	Shape whole footprint. Assume a 500 mm shaping sufficient
2.2	Import and place topsoil	650000	/m3	R 61	R 39 650 000	Assume topsoil available on site within 5 km. 250 mm cover over

	Cost Component	Quantity	Unit	Unit rate	Total cost	Notes
						footprint as this is minimum depth to achieve grazing potential
2.3	Ripping to alleviate compaction	260	/ha	R 3 266	R 849 168	Ripping of whole footprint
2.4	Establish vegetation	260	/ha	R 36 232	R 9 420 234	Establish indigenous vegetation over footprint
	Sub-total for Rehabilitation of WRD				**R 69 516 855**	
3.0	**P&Gs, Contingencies**					
3.1	Preliminaries and general	35	/sum	R 1 482 322 578	R 905 028 482	Assumed 35 % of Sub-total 1
3.2	Contingencies	15	/sum	R 635 281 105	R 387 869 350	Assumed 15 % of Sub-total 1
	Sub-total for P&Gs, Contingencies				**R 1 362 414 687**	
	Total				**R 3 948 210 351**	

* Note that the cost is high level and for comparative options only. If Scenario 3 were to be pursued the cost would have to be refined

5.5 GoldSET Results

The results from the GoldSET evaluation are presented in Figure 33 below. A more detailed explanation of the dimension scores are also provided below, where the strengths and weaknesses of each scenario are evaluated with reference to the indicators. The results show that Scenario 1 scores best in terms of environmental aspects and Scenario 1 and Scenario 2 score the same in social and economic aspects.

The chosen option will not always be the highest scoring in all three aspects as each aspect is in direct competition with one another. The chosen option is rather selected after a holistic consideration of the three sustainability measures, by acknowledging trade-offs, but aiming to minimise these. Given this consideration, it would be **recommended that Scenario 1 be chosen**. The scores for each indicator can be found in Figure 33.

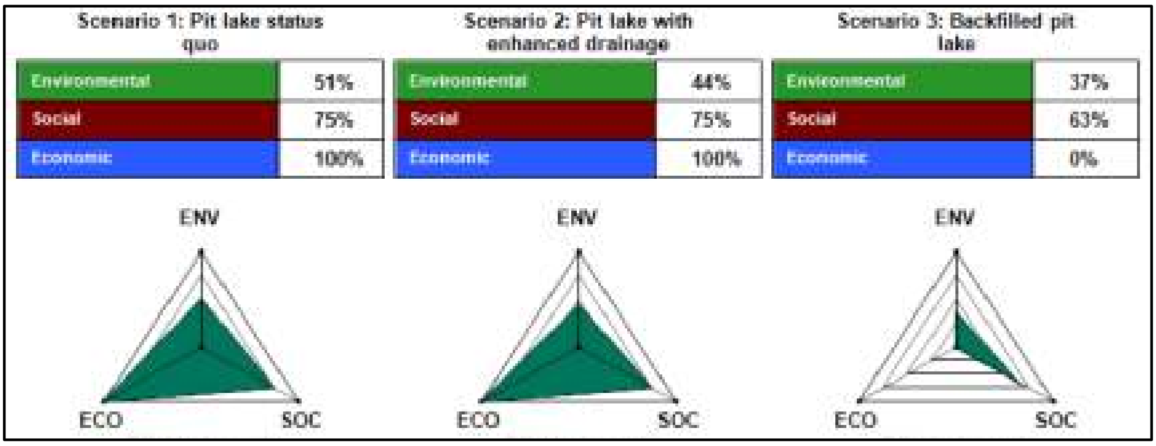


Figure 33: GoldSET results

5.5.1 Strengths and Weaknesses

The bar graphs below display the relative strengths and weaknesses per indicator for the selected options and dimensions. Weighted mean deviations are calculated to illustrate the strengths and weaknesses: a negative value portrays a weakness whereas a positive value is indicative of strength. Values close to zero illustrate a low influence on the overall performance of an option[6].

Environmental dimension

Figure 34 below illustrates the strengths and weaknesses for the environmental dimension. Scenario 3 resulted with the lowest overall environmental score at 37%. This low score is since water quality constituents will become elevated due to the chemical reactions of the backfilled material, rendering the pit water unfit for domestic, livestock or agricultural use. Furthermore, the water table will return to the pre-mining level, which will result in the movement of contaminants into the surrounding groundwater. Scenario 1 and 2 on the other hand will result in a groundwater "sink" and any potential contaminants will be contained within the pit. The water quality within the pit is expected to be better for Scenario 1 than Scenario 2, resulting in Scenario 1 ultimately scoring the overall highest environmental score of 51% (see Figure 33).

Scenario 3 does hold strength within surface water indicators by returning the largest amount of catchment yield and posing the least threat to runoff water contamination. Scenario 1 and 2 show weaker scores, with an overall reduction in the original catchment yield and a risk of contaminated runoff and erosion from the rehabilitated waste rock dump.

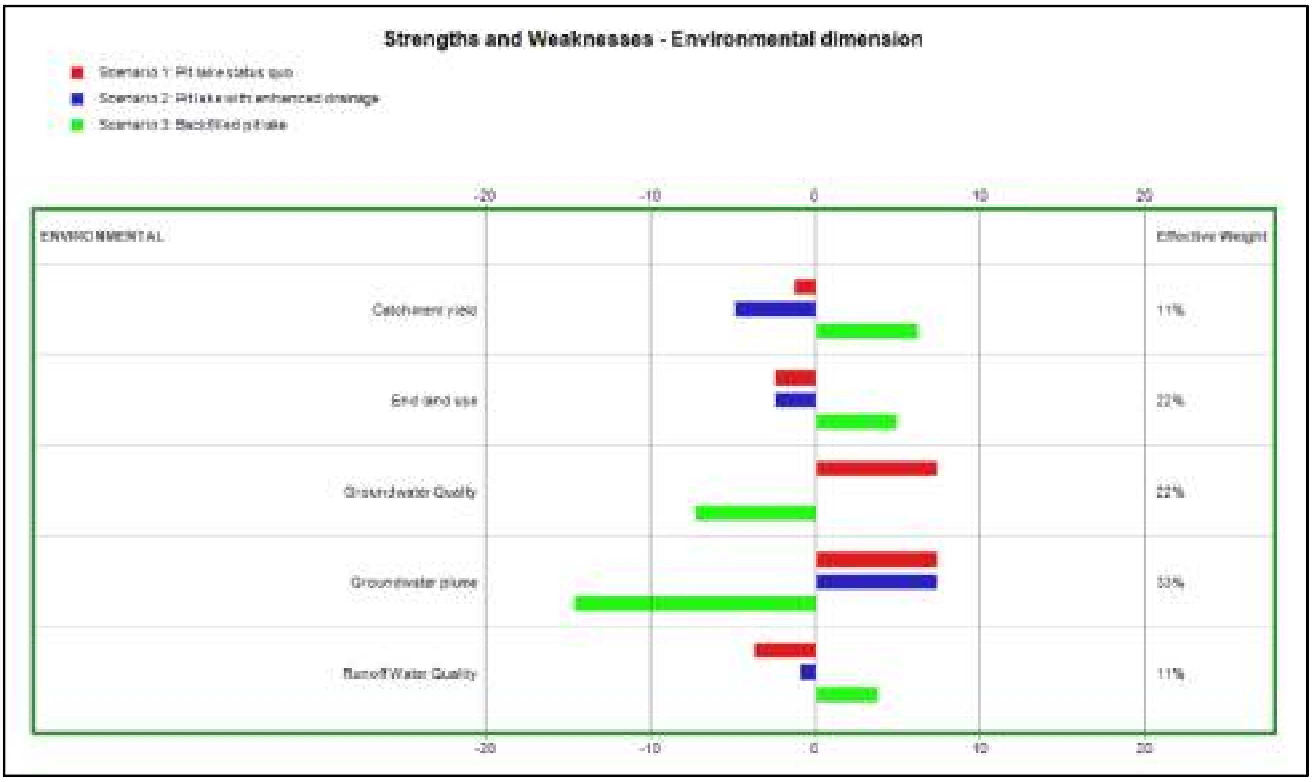


Figure 34: Strengths and weaknesses: environmental dimension (zero values not shown)

[6] Please note in Figures 34 to 36 where the calculated dimension values are "close to zero", they will not be visible on the graphical plot and appear as being absent.

Social dimension

Figure 35 below illustrates the strengths and weaknesses for the social dimension, where Scenario 1 and 2 score the highest (75%).

Scenario 1 and 2 both do not impose a threat to the groundwater supply of surrounding users as the water is contained within the pit. Scenario 3 shows the largest social weakness due to the potential of groundwater users having their resource impacted by the contaminated groundwater plume. In this case the environmental liability will be increased by the implementation of scavenger boreholes and costly water treatment.

Scenario 3 scores highest with respect to public safety with only minor surface settlement expected with the backfilled material having been well compacted. Scenario 1 and 2 pose a high risk due to the low water level which can result in a potential fatality as people or animals could fall over the side. Although access control measures will be put in place, the failure of these due to the pit wall break back could destroy them.

The availability of land for the surrounding community in the form of grazing is maximised by Scenario 3. Both Scenario 1 and Scenario 2 will not return the aesthetic value and land access to pre-mining conditions but will allow improvement due to the rehabilitation of the WRD.

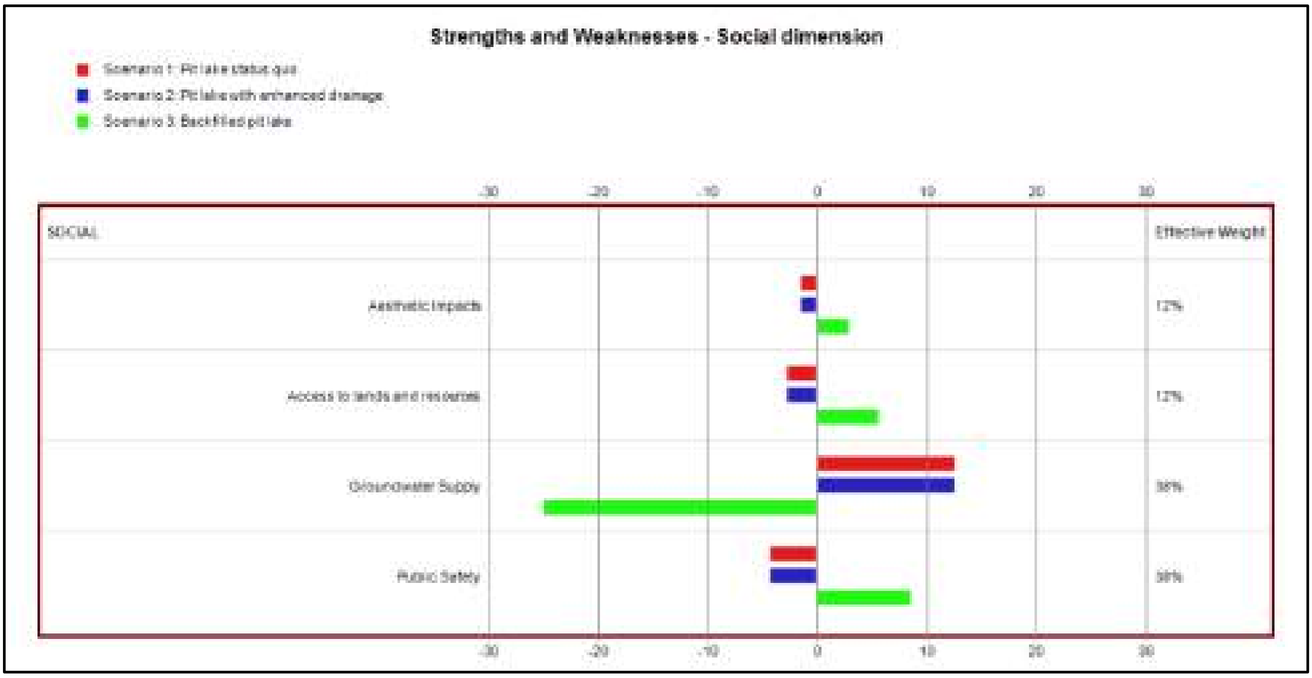


Figure 35: Strengths and weaknesses: social dimension (zero values not shown)

Economic dimension

Figure 36 below shows the strengths and weaknesses for the economic dimension in which Scenario 1 and Scenario 2 scored 100% and Scenario 3 scored the lowest score of 0%. The costs in Section 5.4 where normalised on a linear scale, the most expensive option gets 0 and the least gets 100. Scenario 2 is about R 14 million more than Scenario 1 but is scored the same (100%) as Scenario 1 as the cost for Scenario 3 is extremely large (R 3.3 billion).

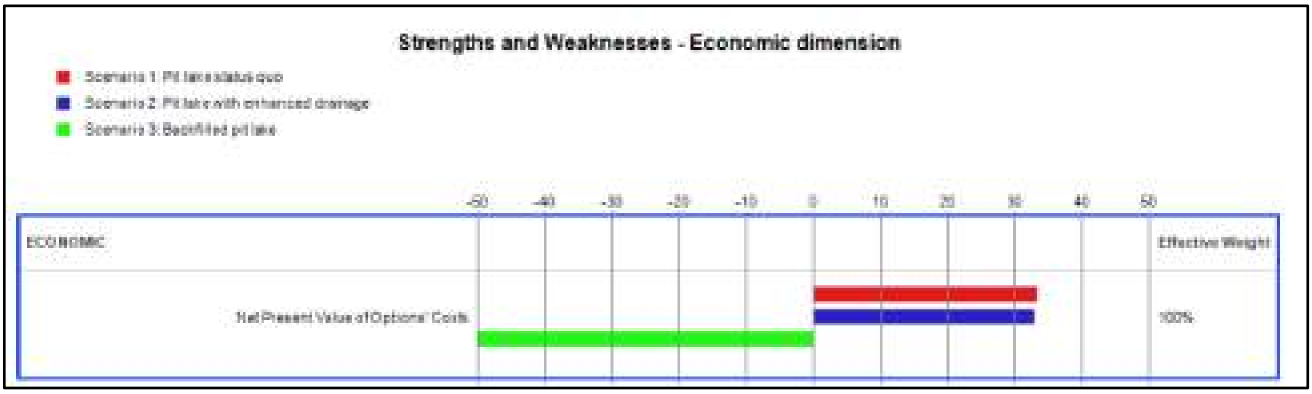


Figure 36: Strengths and weaknesses: economic dimension

6.0 LEGAL CONSEQUENCES

The assessment of the legal consequences of the implementation of Scenario 1: Original Pit Lake development and deposition plan, Scenario 2: Enhanced Pit Lake development and Scenario 3: Backfilling of pit excavation is based on the current regulatory requirements, which include the National Environmental Management Act (Act 107 of 1998) (NEMA) as amended, National Environmental Management: Waste Act (Act 59 of 2008) (NEMWA) and it regulations, National Water Act (Act 36 of 1998) and its regulations.

6.1 National Water Act, 1998 (Act 36 of 1998)

The National Water Act, 1998 (Act 36 of 1998) (NWA) regulates the management of water in South Africa. The use of water is defined in Section 21 of the NWA and in terms of section 23 of the NWA De Beers Consolidated Mines requires water use authorisation for all water uses. The mine has a water use licence (WUL) which authorises water use on the mine - WUL number 27/2/2/C870/1/1 as issued to De Beers Consolidated Mines on 20 June 2011 and it was subsequently amended on 4 February 2013.

In order to assess the legal consequences related to the three closure scenarios the relevant definitions and requirements of the NWA are outlined in this section.

6.1.1 Water Uses Associated with Closure Scenarios

Section 21 (g) of the National Water Act, 1998 (Act 36 of 1998) (NWA) defines *disposing of waste in a manner which may detrimentally impact on a water resource* as a water use.

Waste, as defined in the NWA, has a broader definition than similar definitions in the Environment Conservation Act, 1989 (Act 73 of 1989) (ECA) and the National Environmental Management: Waste Act, 2008 (Act 59 of 2008) (NEMWA).

The NWA states that waste includes any solid material or material that is suspended, dissolved or transported in water (including sediment) and which is spilled or deposited on land or into a water resource in such volume, composition or manner as to cause, or to be reasonably likely to cause, the water resource to be polluted.

This definition must be read in conjunction with the other requirements stated in the definition of section 21(g). The "disposing of waste" can be interpreted as the intention to dispose of something for which the generator has no further use for purposes of production. This does not apply to generation of leachate or the generation of acid mine drainage.

The water in the final void/pit lake does meet the NWA definition of waste, however the final void/pit lake does not meet the definition of "disposing of", provided no mine water is pumped into the final void/ Pit Lake

Scenario 1 and 2 do not entail a section 21 (g) water use, but Scenario 3 will trigger a new section 21(g) water use associated with the backfill of the pit excavation with waste rock.

The construction of storm water drains/ berms as proposed in Scenario I and 2 does not constitute a water use and does not require authorisation.

Any other water use associated with the abstraction of water from the pit or the dewatering thereof would constitute water uses and would require authorisation.

6.1.2 Water Use Authorisation

The proposed backfill of the opencast pit with mine residue, as proposed in Scenario 3 would constitute a section 21(g) water use and would require authorisation by means of a new water use licence. In order to support the authorisation for the backfill of the pit, the mine would need to prepare a technical motivation to the DWS.

The legislative regime governing mining waste changed, notably with the promulgation and subsequent application to the mining sector of the following regulations under the National Environmental Management: Waste Act (NEMWA):

- National Norms and Standards for the Assessment of Waste for Landfill Disposal (GN R.635 of 23 August 2013);
- National Norms and Standards for Disposal of Waste to Landfill (GN R.636 of 23 August 2013); and
- Regulations regarding the Planning and Management of Residue Stockpiles and Residue Deposits (GN R. 632 of 2015).

In addition to the applicability of the above regulations, the DWS requires that an appropriate liner design is the basis for separation of dirty water in a residue disposal facility from clean water in the groundwater. Any deviation from the regulation would require a risk assessment and quantitative modelling. Voorspoed Mine will have to demonstrate to the DWS that closure Scenario 3 poses less of a risk to the environment than Scenarios 1 and 2.

A special motivation and presentation will be required to obtain authorisation, as this is a deviation from the norm. The outcome of the modelling will of critical importance to support a technical motivation to the DWS for approval of a deviation from the required barrier design for the backfilling of the opencast void. This approach can include alternative mitigation options with the ultimate aim of protecting the receiving water resource. The DWS has the mandate to assess and authorise the proposed backfill of the pit excavation.

The DWS also uses a standard set of water use licence conditions for drafting water use licences. Section 21(g) water use related licences all require that the deposition or inflow and outflow be measured daily, the 0.8m freeboard be maintained, the design drawings be signed, and construction be supervised by a registered professional civil engineer. All these requirements cannot be applied to final Pit Lake scenario (i.e. Scenario 1 and 2). Golder is therefore of the opinion that a water use licence is not the appropriate legal instrument to manage a final void / pit lake as proposed in Scenario 1 and 2. Voorspoed Mine is advised not to apply for authorisation of the final void / pit lake.

6.1.3 Pollution Prevention

It is proposed that the final void as proposed in Scenarios 1 and 2 be managed in terms of section 19 of the NWA. Section 19 of the NWA requires the following:

- An owner of land, a person in control of land or a person who occupies or uses the land on which
  - any activity or process is or was performed or undertaken; or

    - any other situation exists, which causes, has caused or is likely to cause pollution of a water resource, must take all reasonable measures to prevent any such pollution from occurring, continuing or recurring.
- The measures referred to in subsection (1) may include measures to
    - cease, modify or control any act or process causing the pollution;
    - comply with any prescribed waste standard or management practice;
    - contain or prevent the movement of pollutants;
    - eliminate any source of the pollution;
    - remedy the effects of the pollution; and
    - remedy the effects of any disturbance to the bed and banks of a watercourse.

6.2 Regulations on use of water for mining and related activities aimed at the protection of water resources promulgated in Government notice 704 of 4 June 1999 (GN 704)

The Minister promulgated *Regulations on use of water for mining and related activities aimed at the protection of water resources* in terms of the NWA in Government notice 704 of 4 June 1999 (GN 704). Various schedules of the regulations are relevant to the proposed closure scenarios at Voorspoed Mine.

The Department of Water Affairs and Forestry, 2000. Operational Guideline No. M6.1. *Guideline document for the implementation of regulations on use of water for mining and related activities aimed at the protection of water resources*, Second Edition states the following:

- Should an exemption from any requirements of these regulations imply the necessity for a water use licence, the person in control of a mine or activity need only to apply for a water use licence, i.e. **a water use licence has higher authority than the regulations.** However, the following clause needs to be incorporated into the water use licence: In terms of the conditions of this licence, the Licence Holder is exempted from the clause (specific regulation) of the regulations on use of water for mining and related activities aimed at the protection of water resources (GN704).

If any closure scenario requires an Exemption from GN 704 it is proposed that the mine obtain water use authorisation as the preferred legal instrument.

6.2.1 Clean and Dirty Water Separation

Schedule 6 of GN 704 stipulates capacity requirements of clean and dirty water systems. It requires that every person in control of a mine or activity must:

(a) confine any unpolluted water to a clean water system, away from any dirty area;

(b) design, construct, maintain and operate any clean water system at the mine or activity so that it is not likely to spill into any dirty water system more than once in 50 years;

(c) collect the water arising within any dirty area, including water seeping from mining operations, outcrops or any other activity, into a dirty water system; and

(d) design, construct, maintain and operate any dirty water system at the mine or activity so that it is not likely to spill into any clean water system more than once in 50 years.

Proposed Scenario 1 will be in accordance with GN 704, although the catchment area reporting to the pit will not be minimised. <u>No exemption from GN 704 will be required</u>.

6.3 National Environmental Management Act (Act 107 of 1998) (NEMA) as amended

The National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) is South Africa's framework environmental legislation. It encompasses a set of principles that govern environmental management and against which all Environmental Management Programmes (EMPs) and actions are measured. These principles include and relate to sustainable development, protection of the natural environment, waste minimisation, public consultation, the right to an environment that is not harmful to one's health or wellbeing, and a general duty of care. The latest amendment to the NEMA, the National Environmental Management Amendment Act 2014 (Act No. 25 of 2014) was gazetted on 2 June 2014 and commenced on 2 September 2014.

6.3.1 EIA Regulations

The current EIA regulations, GN R.324, GN R.325, GN R.326 and GN R.327, promulgated in terms of Sections 24(5), 24M and 44 of the NEMA and subsequent amendments, commenced on 7 April 2017. GN R.327 lists those activities for which a Basic Assessment is required, GN R.325 lists the activities requiring a full EIA (Scoping and Impact Assessment phases) and GN R.324 lists certain activities and competent authorities in specific identified geographical areas. GN R.326 defines the EIA processes that must be undertaken to apply for environmental authorisation (EA) in respect of activities listed in GN R.327, GN R.325 and GN R.324.

Based on the closure scenarios described in section 1.0 of this Technical Evaluation, it is unlikely that any listed activities will be triggered and hence an EA will not be required. In the event that water is abstracted from the pit lake for future use (Scenarios 1 and 2), an EA would only be required if the associated pipeline exceeds 1000 m in length and has an internal diameter of 0,36 metres or more, or a peak throughput of 120 litres per second or more, however, (i) the depth to the water table (>70 mbgl) and (ii) the expected water quality of the Pit Lake will not permit water use from the Pit Lake as a save and economic exercise. Furthermore, listed activities could be associated with Scenario 3 in the event that water would need to be intercepted and treated to mitigate the groundwater contamination risk associated with this scenario.

For scenarios 1 and 2, an EA amendment would however be required in terms of Part 2 of the 2017 EIA Regulations, to change the closure condition imposed by DMR from a backfilling to a pit lake scenario.

6.3.2 Duty of Care

Section 28 of the NEMA imposes the following Duty of Care obligations:

Duty of care and remediation of environmental damage – (as per subsections under Section (28))

(1) Every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment.

(1A) Subsection (1) also applies to a significant pollution or degradation that-

(a) occurred before the commencement of this Act;

(b) arises or is likely to arise at a different time from the actual activity that caused the contamination; or

(c) arises through an act or activity of a person that results in a change to pre-existing contamination.

(2) Without limiting the generality of the duty in subsection (1), the persons on whom subsection (1) imposes an obligation to take reasonable measures, include an owner of land or premises, a person in control of land or premises or a person who has a right to use the land or premises on which or in which -

(a) any activity or process is or was performed or undertaken; or

(b) any other situation exists,

which causes, has caused or is likely to cause significant pollution or degradation of the environment.

(3) The measures required in terms of subsection (1) may include measures to -

(a) investigate, assess and evaluate the impact on the environment;

(b) inform and educate employees about the environmental risks of their work and the manner in which their tasks must be performed in order to avoid causing significant pollution or degradation of the environment;

(c) cease, modify or control any act, activity or process causing the pollution or degradation;

(d) contain or prevent the movement of pollutants or the cause of degradation;

(e) eliminate any source of the pollution or degradation; or

(f) remedy the effects of the pollution or degradation.

4) The Director-General, the Director-General of the department responsible for mineral resources or a provincial head of department may, after having given adequate opportunity to affected persons to inform him or her of their relevant interests, direct any person who is causing, has caused or may cause significant pollution or degradation of the environment to:

(a) cease any activity, operation or undertaking;

(b) investigate, evaluate and assess the impact of specific activities and report thereon;

(c) commence taking specific measures before a given date;

(d) diligently continue with those measures; and

(e) complete those measures before a specified reasonable date:

Provided that the Director-General or a provincial head of department may, if urgent action is necessary for the protection of the environment, issue such directive, and consult and give such opportunity to inform as soon thereafter as is reasonable.

5) The Director-General, the Director-General of the department responsible for mineral resources or a provincial head of department, when considering any measure or time period envisaged in subsection (4), must have regard to the following;

(a) the principles set out in section 2;

(b) the provisions of any adopted environmental management plan or environmental implementation plan;

(c) the severity of any impact on the environment and the costs of the measures being considered;

(d) any measures proposed by the person on whom measures are to be imposed;

(e) the desirability of the State fulfilling its role as custodian holding the environment in public trust for the people; and

(f) any other relevant factors.

6) If a person required under this Act to undertake rehabilitation or other remedial work on the land of another, reasonably requires access to, use of or a limitation on use of that land in order to effect rehabilitation or remedial work, but is unable to acquire it on reasonable terms, the Minister may -

(a) expropriate the necessary rights in respect of that land for the benefit of the person undertaking the rehabilitation or remedial work, who will then be vested with the expropriated rights; and

(b) recover from the person for whose benefit the expropriation was affected all costs incurred.

7) Should a person fail to comply, or inadequately comply, with a directive under subsection (4), the Director-General or a provincial head of department may take reasonable measures to remedy the situation or apply to a competent court for appropriate relief.

8) Subject to subsection (9), the Director-General, the Director-General of the department responsible for mineral resources or provincial head of department may recover costs for reasonable remedial measures to be undertaken under subsection (7), before such measures are taken and all costs incurred as a result of acting under subsection (7), from any or all the following persons-

(a) any person who is or was responsible for, or who directly or indirectly contributed to, the pollution or degradation or the potential pollution or degradation;

(b) the owner of the land at the time when the pollution or degradation or the potential for pollution or degradation occurred, or that owner's successor in title;

(c) the person in control of the land or any person who has or had a right to use the land at the time when -

(i) the activity or the process is or was performed or undertaken; or

(ii) the situation came about; or

(d) any person who negligently failed to prevent -

(i) the activity or the process being performed or undertaken; or

(ii) the situation from coming about:

Provided that such person failed to take the measures required of him or her under subsection (1).

(9) The Director-General, the Director-General of the department responsible for mineral resources or provincial head of department may in respect of the recovery of costs under subsection (8), claim proportionally from any other person who benefited from the measures undertaken under subsection (7).

(10) The costs claimed under subsections (6), (8) and (9) must be reasonable and may include, without being limited to, labour, and administrative and overhead costs.

(11) If more than one person is liable under subsection (8), the liability must be apportioned among the persons concerned according to the degree to which each was responsible for the harm to the environment resulting from their respective failures to take the measures required under subsections (1) and (4).

(12) Any person may, after giving the Director-General, the Director-General of the department responsible for mineral resources or provincial head of department 30 days' notice, apply to a competent court for an order directing the Director-General, the Director-General of the department responsible for mineral resources or any provincial head of department to take any of the steps listed in subsection (4) if the Director-General, the Director-General of the department responsible for mineral resources or provincial head of department fails to inform such person in writing that he or she has directed a person contemplated in subsection (8) to take one of those steps, and the provisions of section 32(2) and (3) shall apply to such proceedings, with the necessary changes.

(13) When considering any application in terms of subsection (12), the court must take into account the factors set out in subsection (5).

6.4 National Environmental Management: Waste Act (Act 59 of 2008) (NEMWA) and its regulations

For scenarios 1 and 2, an application for a waste management licence in terms of the National Environmental Management Waste Act for decommissioning the WRD and any other facilities that fall within the definition of residue stockpiles and deposits that will no longer be backfilled into the pit. This process will be supported by a Basic Assessment in terms of the 2017 EIA Regulations.

For scenario 3, an application for a waste management licence in terms of the NEMWA would be required for the following waste management activity:

- GN R.633, Activity 3(11).

This process will be supported by a full EIA in terms of the 2017 EIA Regulations.

6.5 Legal requirements summary

The legal requirements related to the Voorspoed Closure scenarios can be summarised in Table 30.

Table 30: Legal requirements related to closure scenarios

Legislation	Pit Scenario I	Pit Scenario II	Pit Scenario III
National Water Act, 1998 (Act 36 of 1998)	No water use licence required	No water use licence required. Since this scenario is associated with increasing the clean water catchment reporting to the pit lake, there is a risk that the DWS will not favour this approach. This scenario will need to be defended/motivated on the basis that this scenario will prevent health and safety risks associated with illegal miners and is associated with minimal "additional" loss to catchment yield in comparison to Scenario 1.	Water use licence required for in-pit disposal of waste rock

Legislation	Pit Scenario I	Pit Scenario II	Pit Scenario III
Government notice 704 of 4 June 1999	GN 704 compliant	GN 704 compliant	Exemption from GN 704 required for backfill of pit
National Environmental Management Act (Act 107 of 1998) (NEMA) as amended	None – considering the depth to water level and potential poor water quality status of the pit lake, abstraction from this water body is not an option. An EA amendment will be required in terms of Part 2 of the 2017 EIA Regulations, to change the closure condition imposed by DMR from a backfilling to a pit lake scenario. It is assumed that since the pit lake scenario was already assessed as part of the original approved EMP, no additional impact on the environment would be expected. The EA amendment would therefore only constitute a request to amend the relevant DMR conditions.	None – considering the depth to water level and potential poor water quality status of the pit lake, abstraction from this water body is not an option. An EA amendment will be required in terms of Part 2 of the 2017 EIA Regulations, to change the closure condition imposed by DMR from a backfilling to a pit lake scenario. As part of the amendment application, the impact of increasing the clean water catchment reporting to the pit lake would need to be assessed.	None, provided that water treatment will not be required to manage the risk to water quality that is associated with this scenario.
National Environmental Management: Waste Act (Act 59 of 2008) (NEMWA) and it regulations	An application for a waste management licence in terms of the National Environmental Management Waste Act for decommissioning the WRD and any other facilities that fall within the definition of residue stockpiles and deposits that will no longer be backfilled into the pit. This process will be supported by a Basic Assessment in terms of the 2017 EIA Regulations.	An application for a waste management licence in terms of the National Environmental Management Waste Act for decommissioning the WRD and any other facilities that fall within the definition of residue stockpiles and deposits that will no longer be backfilled into the pit. This process will be supported by a Basic Assessment in terms of the 2017 EIA Regulations.	Since backfilling was never assessed as part of the original EMP, an application for a waste management licence in terms of the NEMWA would be required for the following waste management activity: GN R.633, Activity 3(11). This process will be supported by a full EIA in terms of the 2017 EIA Regulations.

The DWS supports a principle for mine rehabilitation and closure of “free draining and no final voids”. Scenarios 1 and 2 presents a deviation from this preferred approach, <u>but it does not necessarily constitute a fatal flaw</u>.

In order to obtain DWS approval for the planned closure scenario it is proposed that Voorspoed Mine presents the selected Closure Scenario to the DWS. The De Beers Consolidated Mines WUL number 27/2/2/C870/1/1 as issued to De Beers Consolidated Mines on 20 June 2011 and it was subsequently amended on 4 February 2013 required in Appendix IV condition 11.3 that the mine notify the DWS 180 days prior to the intended closure of a activity of such intention and also submit any final amendment to the IWWMP and RSIP as well as a Closure Plan for approval. This clause in the WUL offers Voorspoed Mine an opportunity to obtain the necessary DWS approval for the selected closure scenario.

7.0 RISK/IMPACT ASSESSMENT AND MANAGEMENT REQUIREMENTS

This section high-lights specific aspects that may arise from the three scenarios addressed in this technical evaluation of the final Voorspoed Mine closure plan. Although Scenario's 1 and 2 deals with the development of pit lake conditions, which will act for several decades as a local sink in terms of the hydrogeological characteristics of the site area, Scenario 3 is a potential risk due to the leaching potential of the "activated, and newly oxidised" condition of the waste rock material once (i) removed, ((ii) dumped, and (iii) becoming saturated from groundwater and local rainfall recharge. With regard to Scenario 3, the WRD footprint holds significant risks for groundwater contamination once established and a land/waste classification followed by an EIA are required (as per Table 30 above and section 7.2 below).

Two main aspects were proposed in the initial project scope of work, i.e.

7.1 Backfill Leachate Generation:

The leachate from waste rock used as pit backfill material is likely to be alkaline due to low sulphur content with a high neutralization capacity. PCoC's are expected in the backfill leachate once becoming saturated, viz. pH (alkaline), aluminium, iron, manganese, arsenic and sodium absorption ratio, zinc and calcium. It is therefore possible given the relatively quick (~32 years) recovery of the natural water level in the pit excavation under Scenario 3, that these substances could migrate in to the surrounding groundwater flow domain The indication is that it will remain as a local concentration, but as the filled excavation becomes [positively] saturated, lateral migration towards the surrounding groundwater resources may become a significant risk. It should be noted that the site area lies in the head waters part of the local surface drainage systems. Although down-gradient dilution in the aquifer systems may decrease the source term concentrations, the leaching process is expected to last for several decades, as predicted by the GoldSim Model results (see section 4.4.3, page 52).

Management of the Scenario 3 condition will require a dedicated post-mining monitoring plan and directed by specific management requirements (or protocols) – the following items need to be recognized[7]:

- A monitoring plan focussing on tracking the migration patterns of elevated constituents migrating beyond the mine site area. Special hydrochemical tracers such an environmental stable isotopes (ESI's) could be considered for example;
- A long-term groundwater quality monitoring programme supported by a long-term financial and logistic support program;
- A representative hydrological[8] monitoring network, i.e. deep/shallow boreholes and stream channels, on the mine site area and on private land at least within 2 kilometres from the mine site area; and
- Periodic, i.e. semi-annual, assessment of the monitoring results. If there are any indications of migrating subterraneous contaminants from the filled pit excavation, serious measures such as interceptor wells

[7] Part of a Closure/Post-Closure Water Management Programme.

[8] Included in the 2017 Upgrade of the Voorspoed Hydrological Monitoring Network and Programme (May 2018)

will have to be considered which requires special treatment facilities, i.e. (i) leachate/evaporation ponds, (ii) removal of precipitated products from leachate/evaporation ponds [probably to a hazardous waste storage facility], and (iii)

7.2 Waste Rock Dump Footprint Geochemical Signature:

Under Scenario 3, the waste rock dump is removed and backfilled in the pit excavation leaving a footprint area. This footprint will require special management and by regulation the terrain will require a "Contaminated Land Assessment". The footprint area must be tested for any leachate/contaminants present in the soil/ground profile by means of specific test pit procedures. As per regulation, at least 0.6 m of the soil profile will have to be removed from the foot print area, and (i) if "not contaminated", the removed soil could be dumped with the waste rock material as part of the backfilling procedure, or (ii) if the soil is "contaminated", it must be removed away from Voorspoed Mine Area and stored on a special waste site. Finally, the excavation will have to be rehabilitated with "virgin" soil to its original ground elevation and vegetated.

Based on the current geochemical characteristics and the fact that the waste rock dump is "in-lined", potential leachates generated over time finally settled in the ground profile underneath the dump, thus polluting the soil profile. <u>These leached constituents may include carbon, bismuth, antimony, boron, chromium, arsenic, sulphur, tungsten, lithium, selenium, nickel, magnesium and uranium as per the 2017 and 2018 geochemistry assessments of the waste rock material.</u> This should be confirmed/quantified by undertaking a contaminated land assessment of the foot print area.

Management requirements for the waste rock footprint will include the same procedures as mentioned above (i.e. section 7.1 above). This will require a special local monitoring network with a few shallow/deep monitoring boreholes, and a long-term commitment to monitoring and evaluations. It is foreseen that selecting Scenario 3 is the final option for the pit excavation closure, several risks are on hand –these risks are discussed in detail under section 5.2, page 59.

8.0 CONCLUSIONS

The following conclusions lists three important guiding indicators of this Technical Evaluation:

8.1 Conclusions from Geochemistry Assessment

The acid rock drainage risk of waste rock materials is low due to low sulphur content and high neutralisation capacity. The pH (alkaline), aluminium, iron, manganese, arsenic and sodium absorption ratio, zinc and calcium are PCoC in drainage from the waste rock materials as they exceeded at least one water quality guideline in ASLP and NAG leachate. Constituents of concern in pit water are total dissolved solids, electrical conductivity, sulphate, fluoride, SAR, nitrate, sodium, selenium and molybdenum. The waste rock materials do not constitute a physical hazard, are not a health hazard, and are not hazardous to the environment.

The waste rock material is not Type 4 classification, but it does not meet the full definition of Type 3 waste due to low risk from leachable concentrations.

In addition, the waste classification high-lights the following: (i) the waste rock materials from the Voorspoed waste rock dump (WRD) is not a health hazard, (ii) the waste rock material from the WRD is considered to be non-hazardous to the environment due to low solubility of elements, and (iii) the total concentration of aluminium, calcium, iron, magnesium, potassium and silicon and sodium exceeded 1% in the waste rock samples. <u>However, none of these parameters exceed 1% in leachate and therefore do not constitute a health risk.</u>

The waste rock and wall rock materials are likely to produce predominantly near-neutral, low-metal drainage upon exposure to rainfall, and the NAG leachate results indicate that the waste rock materials are likely to generate neutral mine to acid rock drainage with low to high metal concentrations and report to the Pit Lake which will remain as groundwater sink under Scenario 1 & 2.

The pit water status (for the May 2017 and February 2018 sample runs) exceeded the water quality guidelines (i.e. domestic and life stock) for (i) TDS and NO_3, (ii) sodium and selenium, (iii) SAR (for irrigation water due to the elevated Sodium concentrations), (iv) Sulphate and Fluoride (for domestic water use), and (v) Molybdenum (for irrigation and livestock). The Pit Lake waterbody is therefore not recommended for any future use and should remain as a local sink in the piezometric surface of the mine site and surrounding area.

8.2 Conclusions from Numerical and GoldSim models

Simulation results indicate that Scenarios 1 and 2 are similar with water quality generally below the limit for domestic use but indicates a slight deterioration in decades to come. For Scenario 3, however, the water quality is above the domestic water limit at least for the first 64 years after closure for Calcium and up to 100 years after closure for Sodium. Furthermore, [for Scenario 3] the poor water quality will migrate away from the pit are and thus contaminate the surrounding aquifer and ultimately the catchment.

Based on the water quality after closure, it is concluded that Scenario 3 is not an option.

Both Scenarios 1 and 2 can be considered for closure. Water quality is generally below the domestic water quality limits, except for Selenium. Based on the high levels of Selenium that can rise above domestic and livestock limits. The Pit Lake water should not be used for any water supply activities due to practical and special treatment requirements which will require several safety issues, environmental authorizations and cost implications.

The simulated Pit water level after 200 years for:

- Scenario 1 will be at 1313 mamsl (or 94 m below surface); and for
- Scenario 2 will be at 1332 mamsl (or 75 m below surface).

These water levels are still far from the surface and create a safety risk in terms of environmental conditions. It is recommended that the Pit Lake should therefore be fenced off to prevent animals and humans to come near the lake.

8.3 Conclusions from Environmental and Socio-Economic Option Analysis (Phase II - GoldSet)

A risk assessment was undertaken on the 3 pit closure scenarios for Voorspoed mine to identify possible environmental, social and economic risks. The outcome of the risk assessment, as well as the pit closure objectives, were then used to inform the GoldSET option analysis.

Scenario 3 was highlighted as the option with the highest risk related to groundwater contamination within the pit, and the expected impact on groundwater users through the movement of a contaminated pollution plume into the surrounding groundwater resource. The cost of backfilling the pit was found to be R 3.3 billion, which will clearly have a large business impact, to a point where this option will likely be impractical and economically unfeasible. Scenario 3 does however have the benefit of returning catchment yield, with the added advantage of reducing safety concerns.

Scenarios 1 and 2 will result in a groundwater “sink” and any potential contaminants will be contained within the pit. The water quality within the pit is expected to be better for Scenario 1 than Scenario 2. Scenarios 1 and 2 both have an overall reduction in the original catchment yield, and for Scenario 1 there is a risk of erosion and contaminated runoff from the rehabilitated dump entering the environment. Scenarios 1 and 2 both pose a safety risk due to the depth of the pit as animals and humans could fall into the pit, which will require well-maintained access control measures.

The GoldSET results show that Scenario 1 scores best in terms of environmental aspects and Scenario 1 and Scenario 2 score the same in social and economic aspects. The preferred option recommended after a holistic consideration of all three sustainability measures, and by aiming to minimise trade-offs, would be **Scenario 1**.

8.4 Conclusions from Legal Consequences Evaluation

The water in the final void/pit lake does meet the NWA definition of waste, however the final void/pit lake does not meet the definition of “disposing of”, provided no mine water is pumped into the final void/ Pit Lake.

Scenario 1 and 2 do not entail a section 21 (g) water use, but Scenario 3 will trigger a new section 21(g) water use associated with the backfill of the pit excavation with waste rock.

The construction of storm water drains/ berms as proposed in Scenario I and 2 does not constitute a water use and does not require authorisation.

Any other water use associated with the abstraction of water from the pit or the dewatering thereof would constitute water uses and would require authorisation.

The proposed backfill of the opencast pit with mine residue, as proposed in Scenario 3 would constitute a section 21(g) water use and would require authorisation by means of a new water use licence. In order to support the authorisation for the backfill of the pit, the mine would need to prepare a technical motivation to the DWS.

In addition to the applicability of the National Environmental Management: Waste Act (NEM: WA) regulations, the DWS requires that an appropriate liner design is the basis for separation of dirty water in a residue disposal facility from clean water in the groundwater. Any deviation from the regulation would require a risk assessment and quantitative modelling. Voorspoed Mine will have to demonstrate to the DWS that closure Scenario 3 poses less of a risk to the environment than Scenarios 1 and 2.

Golder is of the opinion that a water use licence is not the appropriate legal instrument to manage a final void / pit lake as proposed in Scenario 1 and 2. Voorspoed Mine is advised not to apply for authorisation of the final void / pit lake.

In terms of Government notice 704 of 4 June 1999 (GN 704 – Clean and dirty water separation), Proposed Scenario 2 will be in accordance with GN 704, although the catchment area reporting to the pit will not be minimised. No exemption from GN 704 will be required.

In terms of National Environmental Management Act (Act 107 of 1998) (NEMA) as amended (EIA Regulations), and the closure scenarios described in section 1.0 of this Technical Evaluation, an application for an EA amendment will need to be submitted to the DMR to change the closure condition imposed by DMR for backfilling the pit excavation, i.e. Scenario 3. For Scenario 2, the impact of increasing the clean water catchment reporting to the Pit Lake would need to be assessed as part of a NWA motivation.

In terms of the National Environmental Management: Waste Act (Act 59 of 2008) (NEMWA) and its regulations, an application for a waste management licence will need to be submitted to the DMR for decommissioning the waste rock dump for Scenarios 1 and 2; this process will need to be supported by a basic assessment process. For Scenario 3, an application for a waste management licence will also need to be submitted for the disposal of the waste rock into the pit; this process however will need to be supported by a full EIA.

From a legal perspective, Scenario 3 is associated with a more complex regulatory approval process, followed by Scenario 2 and then Scenario 1.

To note: The DWS supports a principle for mine rehabilitation and closure of “free draining and no final voids”. Scenarios 1 and 2 presents a deviation from this preferred approach, but it does not necessarily constitute a fatal flaw. In order to obtain DWS approval for the planned closure scenario it is proposed that Voorspoed Mine presents the selected Closure Scenario to the DWS. The De Beers Consolidated Mines WUL number 27/2/2/C870/1/1 as issued to De Beers Consolidated Mines on 20 June 2011 and it was subsequently amended on 4 February 2013 required in Appendix IV condition 11.3 that the mine notify the DWS 180 days prior to the intended closure of a activity of such intention and also submit any final amendment to the IWWMP and RSIP as well as a Closure Plan for approval. This clause in the WUL offers Voorspoed Mine an opportunity to obtain the necessary DWS approval for the selected closure scenario.

9.0 RECOMMENDATION

The following recommendations are proposed:

- In terms of economic and environmental considerations, Scenario 1 is probably the best option due to the lower cost (land form rehabilitation included in the overall mine rehabilitation program) and environmental aspects (i.e. limited runoff from surrounding unprotected land and prohibit migration of contaminated water to the surrounding environment). Final environmental conditions won’t be comparable directly with pre-mining conditions, as there would be limited aesthetic improvements.
- In Scenario 2, rewatering of the pit will be quicker than Scenario 1 but the water quality in the Pit Lake is expected to be impacted more than Scenario 1. However, Scenario 2 will improve the protection of the Pit Lake area over a shorter period than Scenario 1. Final conditions won’t be comparable directly with pre-mining conditions, as there would be limited aesthetic improvements and land access will not be re-gained specifically on the engineered local catchment. Possibility that the Department of Water and Sanitation might argue against the development of a local engineered catchment directing the runoff in to the Pit Lake instead of discharging into the catchment.
- Scenario 3 is not recommended due to extraordinary costs of backfilling activity, the creation of a potential pollution footprint (i.e. remaining foot print of the current waste rock dump) and the potential impact on the surrounding environment due to polluted groundwater migration from the saturated backfilled excavation as early as ~32 years after closure towards surrounding users.
- In closing, it is recommended that a representative hydrological monitoring network and programme is developed and implemented to guide the final Voorspoed Mine Closure and post-Closure management requirements. Logistical and economic support for a monitoring program should be secured.

10.0 REFERENCES

Golder (2017). Hydrogeological Investigation. Golder report number 1663605-315698-2.

Spitz, K. and Moreno, J. (1996). A Practical Guide to Groundwater and Solute Transport Modelling. John Wiley & Sons, Inc., New York.

Department of Water Affairs and Forestry, (2000). Operational Guideline No. M6.1. Guideline document for the implementation of regulations on use of water for mining and related activities aimed at the protection of water resources. Second Edition.

Redco and Uvuna Sustainability (Uvuna) (2018) *Voorspoed Mine: Final Closure Plan 2017, Draft Rev 0*. Project No: DB 031.

Signature Page

Golder Associates Africa (Pty) Ltd.

Maria Heyneke	Keretia Lupankwa	Talita van Zyl	Eddie van Wyk
Civil Engineer	*Geochemist*	*Hydrogeologist*	*Senior Hydrogeologist*

MH/TvZ-KL-EvW/ck

\\joh1-s-fs1\gaadata\projects\1792363 - dbcm voorspdpitbackfilling\6. deliverables\03_final client deliverables\1792363-318923-1\1792363-318923-1_vsp_techeval_rev1_260219.docx

APPENDIX A

GoldSET Scores

Theme	Indicator	Description	Weighting	Scenario 1: Pit lake status quo	Scenario 2: Pit lake with enhanced drainage	Scenario 3: Backfilled pit lake
Environmental Aspects						
Hydrological Regime	Catchment Yield	Efficacy of the option in returning the clean catchment yield of the site (WRD and pit) to pre-mining conditions.	1	33	0	100
Groundwater Quality	Pit Water Quality	Efficacy of the option in not affecting the groundwater quality within the pit and plume (if applicable) during and after rehabilitation to ensure long-term availability, use and environmental sustainability.	2	66	33	0
Groundwater Quality	Groundwater Plume	Efficacy of the option in dealing with the migration of the contaminated groundwater plume emanating from the pit.	3	66	66	0
Surface Water Quality	Runoff Water Quality	Efficacy of the option in minimizing the impact of remediation activities on the quality of surface water runoff, and associated erosion on the site, and the potential impact on the surrounding environment. This indicator measures the sustainability of the WRD.	2	33	66	100
Land capability	Value of End Land Use	End-of-life potential of the property resulting from the implementation of the option	2	33	33	66
Social Aspects						
Community Wellbeing	Access to Lands and Resources	Efficacy of the option in maximizing the beneficial use of the site and its surroundings by the public post-closure, also taking into account the FRD and CRD which will be present at closure.	2	33	33	100
Water Supply	Groundwater Supply	Efficacy of the option in ensuring that water supplies are protected (potable wells, surface water or aquifers used for domestic, livestock and irrigation water supply) both during and after the rehabilitation.	3	100	100	0
Health & Safety	Public Safety	Potential negative impacts of the option on public safety. Goal is to ensure that there is adequate access control (fencing, envirobund and water within pit to prevent artisanal mining) and a stable final land form.	3	66	66	100
Landscape	Aesthetic Impact	Consider impact on the landscape (aesthetic value) resulting from the implementation of the pit and WRD closure option, in the form of improving the aesthetic value	1	66	66	100
Economic Aspects						
Additional financial risks and opportunities	Value of End Land Use	End-of-life potential of the property resulting from the implementation of the option	3	66	100	33
Cost	Present Value of Options' Costs	Measure of the present value of the costs over the life of the project	3	R 39 709 000	R 53 470 000	R 3 264 684 000

APPENDIX B

Document Limitations

GOLDER

golder.com

APPENDIX G

Voorspoed Mine Basic Assessment Report and Environmental Management Programme and Closure Plan for Decommissioning, Centre for Environmental Management, 2019

VOORSPOED MINE BASIC ASSESSMENT REPORT AND ENVIRONMENTAL MANAGEMENT PROGRAMME AND CLOSURE PLAN FOR DECOMMISSIONING

De Beers Group

CEM 2019/003

NWU® | CEM Centre for Environmental Management

mineral resources

Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

BASIC ASSESSMENT REPORT
AND
ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT

SUBMITTED FOR ENVIRONMENTAL AUTHORIZATIONS IN TERMS OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 AND THE NATIONAL ENVIRONMENTAL MANAGEMENT WASTE ACT, 2008 IN RESPECT OF LISTED ACTIVITIES THAT HAVE BEEN TRIGGERED BY APPLICATIONS IN TERMS OF THE MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT, 2002 (MPRDA) (AS AMENDED).

NAME OF APPLICANT: De Beers Voorspoed Diamond Mine

TEL NO: 056 216 8605
FAX NO: 011 374 5659
POSTAL ADDRESS: PO Box 1964, Kroonstad, 9500
PHYSICAL ADDRESS: Voorspoed Farm, Fezile Dabi District, Free State Province
FILE REFERENCE NUMBER SAMRAD: FS 30/5/1/2/3/2/1(12) EM

1) IMPORTANT NOTICE

In terms of the Mineral and Petroleum Resources Development Act (Act 28 of 2002 as amended), the Minister must grant a prospecting or mining right if among others the mining "will not result in unacceptable pollution, ecological degradation or damage to the environment".

Unless an Environmental Authorisation can be granted following the evaluation of an Environmental Impact Assessment (EIA) and an Environmental Management Programme report in terms of the National Environmental Management Act (Act 107 of 1998) (NEMA), it cannot be concluded that the said activities will not result in unacceptable pollution, ecological degradation or damage to the environment.

In terms of section 16(3)(b) of the EIA Regulations, 2014, any report submitted as part of an application must be prepared in a format that may be determined by the Competent Authority and in terms of section 17(1)(c) the Competent Authority must check whether the application has taken into account any minimum requirements applicable or instructions or guidance provided by the Competent Authority to the submission of applications.

It is therefore an instruction that the prescribed reports required in respect of applications for an environmental authorisation for listed activities triggered by an application for a right or a permit are submitted in the exact format of, and provide all the information required in terms of, this template. Furthermore please be advised that failure to submit the information required in the format provided in this template will be regarded as a failure to meet the requirements of the Regulation and will lead to the Environmental Authorisation being refused.

It is furthermore an instruction that the Environmental Assessment Practitioner (EAP) must process and interpret his/her research and analysis and use the findings thereof to compile the information required herein. (Unprocessed supporting information may be attached as appendices). The EAP must ensure that the information required is placed correctly in the relevant sections of the Report, in the order, and under the provided headings as set out below, and ensure that the report is not cluttered with un-interpreted information and that it unambiguously represents the interpretation of the applicant.

2) Objective of the basic assessment process

The objective of the basic assessment process is to, through a consultative process –

(a) Determine the policy and legislative context within which the proposed activity is located and how the activity complies with and responds to the policy and legislative context;

(b) Identify the alternatives considered, including the activity, location, and technology alternatives;

(c) Describe the need and desirability of the proposed alternatives;

(d) Through the undertaking of an impact and risk assessment process inclusive of cumulative impacts which focused on determining the geographical, physical, biological, social, economic, heritage and cultural sensitivity of the sites and locations within sites and the risk of impact of the proposed activity and technology alternatives on the these aspects to determine:

(i) The nature, significance, consequence, extent, duration, and probability of the impacts occurring to; and

(ii) The degree to which these impacts -

aa) Can be reversed;

bb) May cause irreplaceable loss of resources; and

cc) Can be managed, avoided or mitigated;

(e) Through a ranking of the site sensitivities and possible impacts the activity and technology alternatives will impose on the sites and location identified through the life of the activity to -

(i) Identify and motivate a preferred site, activity and technology alternative;

(ii) Identify suitable measures to manage, avoid or mitigate identified impacts; and

(iii) Identify residual risks that need to be managed and monitored.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

COMPLIANCE CHECKLISTS

Regulation 982 of NEMA, Appendix 1: Basic Assessment Report

3(1) A basic assessment report must contain the information that is necessary for the competent authority to consider and come to a decision on the application, and must include—

Reference	Requirement	Section of report, Part A
(a)	details of—	
(i)	the EAP who prepared the report; and	1(a)
(ii)	the expertise of that EAP, including a curriculum vitae	1(b), App 10
(b)	the location of the activity, including:	2
(i)	the 21 digit Surveyor General code of each cadastral land parcel;	2
(ii)	where available, the physical address and farm name;	2
(c)	a plan which locates the proposed activity(ies) applied for, as well as associated structures and infrastructure at an appropriate scale;	App 1 & 2
(d)	a description of the scope of the proposed activity, including -	4
(i)	all listed and specified activities triggered and being applied for; and	4(a)
(ii)	a description of the activities to be undertaken, including associated structures and infrastructure;	4(b)
(e)	a description of the policy and legislative context within which the development is proposed, including—	5
(i)	an identification of all legislation, policies, plans, guidelines, spatial tools, municipal development planning frameworks, and instruments that are applicable to this activity and have been considered in the preparation of the report; and	5
(ii)	how the proposed activity complies with and responds to the legislation and policy context, plans, guidelines, tools frameworks, and instruments;	5
(f)	a motivation for the need and desirability for the proposed development, including the need and desirability of the activity in the context of the preferred location;	6
(g)	a motivation for the preferred site, activity and technology alternative;	7
(h)	a full description of the process followed to reach the proposed preferred alternative within the site, including—	8
(i)	details of all the alternatives considered;	8(a)
(ii)	details of the public participation process undertaken in terms of regulation 41 of the Regulations, including copies of the supporting documents and inputs;	8(b)
(iii)	a summary of the issues raised by interested and affected parties, and an indication of the manner in which the issues were incorporated, or the reasons for not including them;	8(b)
(iv)	the environmental attributes associated with the alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects;	9
(v)	the impacts and risks identified for each alternative, including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts can be reversed, may cause irreplaceable loss of resources; and can be avoided, managed or mitigated;	10(a)
(vi)	the methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts & risks associated with the alternatives;	10(b)
(vii)	positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community that may be affected focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects;	10(c)
(viii)	the possible mitigation measures that could be applied and level of residual risk;	10(d)

Reference	Requirement	Section of report, Part A
(ix)	the outcome of the site selection matrix;	10(e)
(x)	if no alternatives, including alternative locations for the activity were investigated, the motivation for not considering such; and	10(e)
(xi)	a concluding statement indicating the preferred alternatives, including preferred location of the activity;	7
(i)	a full description of the process undertaken to identify, assess and rank the impacts the activity will impose on the preferred location through the life of the activity, including—	11
(i)	a description of all environmental issues and risks that were identified during the environmental impact assessment process; and	10(c)
(ii)	an assessment of the significance of each issue and risk and an indication of the extent to which the issue and risk could be avoided or addressed by the adoption of mitigation measures;	12
(j)	an assessment of each identified potentially significant impact and risk, including—	
(i)-(vii)	cumulative impacts; the nature, significance and consequences of the impact and risk; the extent and duration of the impact and risk; the probability of the impact and risk occurring; the degree to which the impact and risk can be reversed; the degree to which the impact and risk may cause irreplaceable loss of resources; and the degree to which the impact and risk can be avoided, managed or mitigated;	12 & App 7 & 8
(k)	where applicable, a summary of the findings and impact management measures identified in any specialist report complying with Appendix 6 to these Regulations and an indication as to how these findings and recommendations have been included in the final report;	13
(l)	an environmental impact statement which contains—	14
(i)	a summary of the key findings of the environmental impact assessment;	14(a)
(ii)	a map at an appropriate scale which superimposes the proposed activity and its associated structures and infrastructure on the environmental sensitivities of the preferred site indicating any areas that should be avoided, including buffers; and	14(b) & App 7
(iii)	a summary of the positive and negative impacts and risks of the proposed activity and identified alternatives;	14(c)
(m)	based on the assessment, and where applicable, impact management measures from specialist reports, the recording of the proposed impact management outcomes for the development for inclusion in the EMPr;	15
(n)	any aspects which were conditional to the findings of the assessment either by the EAP or specialist which are to be included as conditions of authorisation;	16
(o)	a description of any assumptions, uncertainties, and gaps in knowledge which relate to the assessment and mitigation measures proposed;	17
(p)	a reasoned opinion as to whether the proposed activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation;	18
(q)	where the proposed activity does not include operational aspects, the period for which the environmental authorisation is required, the date on which the activity will be concluded, and the post construction monitoring requirements finalised;	19
(r)	an undertaking under oath or affirmation by the EAP in relation to—	20
(i)-(iv)	the correctness of the information provided in the reports; the inclusion of comments and inputs from stakeholders and I&APs; the inclusion of inputs and recommendations from the specialist reports where relevant; and any information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested and affected parties;	Part B 2
(s)	where applicable, details of any financial provision for the rehabilitation, closure, and ongoing post decommissioning management of negative environmental impacts;	21
(t)	any specific information that may be required by the competent authority; and	22
(u)	any other matters required in terms of section 24(4)(a) and (b) of the Act.	23

Regulation 982 of NEMA, Appendix 4: Environmental Management Programme

1(1) An EMPr must comply with section 24N of the Act and include—

Reference	Requirement	Section of report, Part B
(a)	details of—	
(i)	the EAP who prepared the CP; and	1(a)
(ii)	the expertise of that EAP to prepare an CP, including a curriculum vitae	Part A 1(b) & App 10
(b)	a detailed description of the aspects of the activity that are covered by the EMPr, as identified by the project description	Part A 4 & 9(b)
(c)	a map at an appropriate scale which superimposes the proposed activity, its associated structures, and infrastructure on the environmental sensitivities of the preferred site, indicating any areas that should be avoided, including buffers	App 9
(d)	a description of the impact management outcomes, including management statements, identifying the impacts and risks that need to be avoided, managed and mitigated as identified through the environmental impact assessment process for all phases of the development, including planning and design; pre-construction activities; construction activities; rehabilitation of the environment after construction and where applicable post closure; and where relevant, operation activities	1(d)(iv) & 1(e)
(f)	description of proposed impact management actions, identifying the manner in which the impact management outcomes will be achieved, and must, where applicable, include actions to—	1(f)
(i)	avoid, modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation during closure;	1(f)
(ii)	comply with any prescribed environmental management standards or practices;	1(f)
(iii)	comply with any applicable provisions of the Act regarding closure; and	1(a)-(d), (f), (g)
(iv)	comply with any provisions of the Act regarding financial provision for rehabilitation	(1)(e), (f), (g)
(g)	the method of monitoring the implementation of the impact management actions	1(h)
(h)	the frequency of monitoring the implementation of the impact management actions	1(h)
(i)	an indication of the persons who will be responsible for the implementation of the impact management actions	1(h)
(j)	the time periods within which the impact management actions must be implemented	1(f)
(k)	the mechanism for monitoring compliance with the impact management actions	1(h)
(l)	a program for reporting on compliance, taking into account the requirements as prescribed by the Regulations	1(i)
(m)	an environmental awareness plan describing the manner in which the applicant intends to inform his or her employees of any environmental risk which may result from their work; and risks must be dealt with in order to avoid pollution or the degradation of the environment	1(j)
(n)	any specific information that may be required by the competent authority	1(k)

Regulation 982 of NEMA, Appendix 5: Closure Plan

1(1) A CP must include—

Reference	Requirement	Section of report, Part B	Closure Plan GN 1147
(a)	details of—		
(i)	the EAP who prepared the CP; and	1(a)	
(ii)	the expertise of that EAP to prepare an CP, including a curriculum vitae	Part A 1(b) & App 10	
(b)	closure objectives	1(d)(i)	4.2
(c)	proposed mechanisms for monitoring compliance with and performance assessment against the closure plan and reporting thereon	1(h)	8
(d)	measures to rehabilitate the environment affected by the undertaking of any listed activity or specified activity and associated closure to its natural or predetermined state or to a land use which conforms to the generally accepted principle of sustainable development, including a handover report, where applicable;	1(d)(iv) & 1(e)	7 & Annex A
(e)	information on any proposed avoidance, management and mitigation measures that will be taken to address the environmental impacts resulting from the undertaking of the closure activity;	1(f)	7 & Annex A
(f)	description of the manner in which it intends to—		
(i)	modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation during closure;	1(f)	7 & Annex A
(ii)	remedy the cause of pollution or degradation and migration of pollutants during closure;	1(f)	7 & Annex A
(iii)	comply with any prescribed environmental management standards or practices;	1(f)	6, 7 & Annex A
(iv)	comply with any applicable provisions of the Act regarding closure; and	1(f), 1(g)(1)(a) - (d)	2.1
(g)	the time periods within which the measures contemplated in the closure plan must be implemented;	1(f)	6.2 & Annex B
(h)	the process for managing any environmental damage, pollution, pumping and treatment of extraneous water or ecological degradation as a result of closure;	1(f)	7 & Annex A
(i)	details of all public participation processes conducted in terms of regulation 41 of the Regulations, including—	Part A 8(b)	
(i)	copies of any representations and comments received from registered interested and affected parties;	App 29-41	
(ii)	a summary of comments received from, and a summary of issues raised by registered interested and affected parties, the date of receipt of these comments and the response of the EAP to those comments;	Part A 8(b)	
(iii)	the minutes of any meetings held by the EAP with interested and affected parties and other role players which record the views of the participants;	App 29-38	
(iv)	where applicable, an indication of the amendments made to the plan as a result of public participation processes conducted in terms of regulation 41 of these Regulations; and	1(g), (h)	
	where applicable, details of any financial provision for the rehabilitation, closure and on-going post decommissioning management of negative environmental impacts.	(1)(e), (f), 1(g)	12

PART A
SCOPE OF ASSESSMENT AND BASIC ASSESSMENT REPORT

1) *Contact person and correspondence address details*

a) *Details of the EAP*

Name of the practitioner: Theunis Meyer
Tel no.: 0182991467 / 0836270637
Fax no. : 0865137996
E-mail address: Theunis.Meyer@nwu.ac.za

b) *Expertise of the EAP*

(i) *The qualifications of the EAP*

(With evidence.)
Mr Meyer holds Masters Degrees in Pasture Science and Environmental Management from the Free State and North-West Universities respectively, as well as an Honours Degree in Wildlife Management from the University of Pretoria.

(ii) *Summary of the EAP's past experience*

(In carrying out the Environmental Impact Assessment Procedure.)
Mr Meyer has 18 years' experience in the environmental management and environmental assessment fields and another 14 years as plant ecologist.

In terms of professional affiliation, he is registered as Professional Natural Scientist with the South African Council for Natural Scientific Professions in Ecological Science and in Environmental Science. He is also a member of the Grassland Society of Southern Africa (GSSA), the South-African chapter of the International Association of Impact Assessment (IAIAsa) and a registered Senior Environmental Management System (EMS) Auditor with the Southern African Auditor Training and Certification Association (SAATCA).

Mr Meyer has been involved in numerous EIAs throughout South Africa, conducted in terms of the Environmental Conservation Act (No. 73 of 1989) (ECA), the National Environmental Management Act (No. 107 of 1998) (NEMA) and the Mineral and Petroleum Resources Development Act (No. 28 of 2002) (MPRDA). His responsibilities in these EIAs included the facilitation of the EIA and public participation processes, the identification and assessment of environmental impacts and the development of environmental management plans and programmes.

From 2016 to 2018, Mr Meyer co-ordinated the EIA reviewer training for competent authorities that was developed and delivered on behalf of the Department of Environmental Affairs and trained nearly 600 EIA reviewers from 11 competent authorities. He also co-ordinated the popular environmental law public short course at the CEM for many years and regularly lectures on the legal EIA requirements to various audiences. These presentations cover the requirements of Section 24 of the

NEMA (No. 107 of 1998), the various regulations and listing notices published in terms of the NEMA, as well as the EIA guidelines published by Department of Environmental Affairs (DEA), Gauteng Department of Agriculture and Rural Development (GDARD) and the Western Cape Department of Environmental Affairs and Development Planning (DEADP).

As registered senior EMS Auditor, Mr Meyer is regularly involved in environmental legal compliance and performance audits for clients to establish their legal compliance status. He has also assisted a number of organizations in identifying not only environmental impacts, but also the root causes of these impacts (environmental aspects) during the development of ISO 14001 Environmental Management Systems.

2) *Location of the overall activity*

Farm name:	Voorspoed 2480 (consolidation of subdivision 1 of the Farm Voorspoed 401, Subdivision 1 of the Farm Geldenhuys 1477, Subdivision 2 of the Farm Morgenster 772), Voorspoed 2480, Geldenhuys 1477, Morgenster 772
Application area (Ha):	994.662
Magisterial district:	Fezile Dabi
Distance and direction from nearest town:	30 km north-east of Kroonstad, 50 km south of Vredefort
21 digit Surveyor General Code for each farm portion:	Voorspoed 2480 - 0000F020000000002480000000 Voorspoed 401 - 0000F020000000000401000000 Geldenhuys 1477 - 0000F020000000001477000000 Morgenster 772 - 0000F020000000000772000001

3) *Locality map*

(Show nearest town, scale not smaller than 1:250000.)

See Appendices 1 and 2.

4) *Description of the scope of the proposed overall activity*

(Provide a plan drawn to a scale acceptable to the Competent Authority but not less than 1: 10 000 that shows the location, and area (hectares) of all the aforesaid main and listed activities, and infrastructure to be placed on site.)

See Appendices 3, 4 & 5.

a) *Listed and specified activities*

Name of activity	Aerial extent of the activity	Listed Activity	Applicable listing notice
(E.g. for prospecting: drill site, site camp, ablution facility, accommodation, equipment storage, sample storage, site office, access route etc. E.g. for mining: excavations, blasting, stockpiles, discard dumps or dams, loading, hauling and transport, water supply dams and boreholes, accommodation, offices, ablution, stores, workshops, processing plant, storm water control, berms, roads, pipelines, power lines, conveyors, etc.)	**(Ha or m²)**	**(Mark with an X where applicable or affected.)**	**(*GNR 983, GNR 984 or GNR 985)***
The decommissioning of any activity requiring (i) a closure certificate in terms of section 43 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)	994.662 ha	22	GNR 983
The current mining activity that will be decommissioned include the following facilities:			
Open Pit	74 ha	x	GNR 983
Treatment Plant area	20 ha	x	GNR 983
Other mine infrastructure	29 ha	x	GNR 983
Return water and storm water control dams	9 ha	x	GNR 983
Waste rock dump	230 ha	x	GNR 983
Coarse Residue deposit	35 ha	x	GNR 983
Fine Residue deposit	120 ha	x	GNR 983
Topsoil stockpiles	5 ha	x	GNR 983
Northern & southern pans	13 ha	x	GNR 983
Wetland adjacent to the mining area	64 ha	x	GNR 983
Eucalyptus plantation	19 ha	x	GNR 983
Natural veld areas	494 ha	x	GNR 983
Access road from the district road to the mine	2 ha	x	GNR 983
Water pipeline from the Renoster River weir to the mine	15 ha	x	GNR 983

b) *Description of the activities to be undertaken*

(Describe the methodology or technology to be employed, including the type of commodity to be prospected / mined and for a linear activity, a description of the route of the activity.)

The Voorspoed Mine Rehabilitation Plan 2019[1] (Appendix 12) that was developed to support the Voorspoed Mine Final Closure Plan[2] (Appendix 11) provides details of the

[1] Voorspoed Mine, Rehabilitation Plan 2019 (Annexure A to Final Closure Plan 2019), June 2019, Redco & Uvuna Sustainability

[2] Voorspoed Mine, Final Closure Plan, June 2019, Redco & Uvuna Sustainability

actions that will be taken to rehabilitate the footprint of the Voorspoed Mine to a sustainable state, in order to mitigate environmental risks and achieve the predetermined end land use.

The closure vision for Voorspoed Mine is to close the mine in line with the relevant legal requirements, in such a way that the mining area can be utilised in a sustainable manner after closure.

The overarching closure objective is to ensure sustainability beyond mine closure and leaving a positive legacy. This is supported by the following specific objectives:

- Restore as much as possible of the mining area to a condition consistent with the pre-determined post closure land use objectives;
- Ensure that the area is left in a condition that poses an acceptable level of risk to public health and safety; and
- Reduce the need for post closure intervention, either in the form of monitoring or on-going remedial work, as far as is practicably possible.

The end land use for Voorspoed Mine is to reinstate most of the rehabilitated footprint area back to agricultural land. The aim is to achieve a sustainable land use, comply with the closure vision and match the rehabilitated footprint with the surrounding area as far as reasonably practical.

The potential of the grazing land on the mining area will be reinstated, but the utilisation and stocking rate will be controlled to protect the rehabilitated areas that will remain more sensitive than the surrounding natural grazing areas for some time. Sensitive biodiverse rich areas will only be grazed under controlled circumstances to protect the biodiversity. Areas such as the open pit and top of the Fine Residue Deposit facility will be restricted areas, due to their limited land use potential and arrangements will be put in place to prevent access to these facilities as far as possible.

The above will be achieved by:

- A phased decommissioning of the existing structures and infrastructure on the site;
- Preparing areas, i.e. implement earthworks, to create suitable habitats and support the ecological stability (e.g. erosion resistant) of rehabilitated areas.

  This includes the following actions:

  - Reshaping the steep slopes of the Mine Residue Deposits (MRDs) in balanced cut and fill operations, in order to minimize the effects of water erosion on the slopes;
  - Covering all mining related residues, to ensure that potentially contaminated material is isolated from the environment;
  - Covering the disturbed areas with suitable soil or material that can serve as growth medium, to establish vegetation that can reach the planned carrying capacity;

  - Ripping of rehabilitation areas to alleviate compaction and/or mix the cover layer with the underlying material;
  - Reinstating affected surface drainage lines and catchment areas to pans, as far as possible;
  - Ameliorating, fertilising and cultivating the rehabilitation areas with compost and fertilizer as specified, based on soil analysis of the growth medium at the time of rehabilitation.
- Establishing vegetation that will have the desired ecological functioning and be stable over the long term, but also provide suitable diversity of species for utilisation by animals.

  This includes the following actions:

  - Seeding the area with a mixture of local indigenous grass and tree seeds that are adapted to the area;
  - Applying follow-up fertiliser where specified;
  - Controlling weeds and invader plant species;
  - Stimulating the vegetation on rehabilitated areas by selective and controlled grazing that will also aid to spread seeds to increase bio-diversity over the area.
- Conducting on-going monitoring programmes, to provide key data regarding surface and groundwater, as well as biodiversity responses to the rehabilitation efforts.

All rehabilitation actions will be aimed at ensuring that rehabilitated areas are self-sustainable over the long term, with limited on-going care and maintenance.

Rehabilitation actions for all facilities and footprints on the Voorspoed mining area were designed with the land capability and end land use in mind.

These rehabilitation actions are outlined below:

- **Open pit area**

  The open pit void will not be backfilled, but access control measures will be implemented to restrict access to the pit as far as possible. A security fence, storm water trench and an enviro berm will be constructed outside the provided Zone of Relaxation (ZOR).

  Decommissioning activities and Earthworks

  - Construct 2m high waste rock barriers / berms at top of remaining access ramps;
  - Erect security fence 10m outside of indicated ZOR;
  - Construct a 5m deep trench and 5m high enviroberm in balanced cut and fill operation outside of security fence;

Water management actions

- Align trench and berm to divert clean storm water away from the pit towards the wetland area

Soil amelioration, vegetation establishment and fencing actions

Area between enviroberm and pit perimeter:

- Rip compacted area;
- Establish vegetation, including 50 trees per ha.

Enviroberm and trench:

- Ameliorate soil based on soil analysis of final mixture of growth medium;
- Seed the area with a mixture of local indigenous grass and tree seeds that are adapted to the area;
- Apply follow-up fertiliser where specified;
- Control weeds and invader plant species.

- **On-site plant, workshops, offices, roads, power lines, pipelines**

The objective for the dismantling and demolition of physical infrastructure is to ensure that a clear footprint area will remain. Once rehabilitation of the disturbed footprint areas are complete, these areas will return to an area with grazing potential.

Demolition and dismantling actions

- Clear all infrastructure from site;
- Dismantle all steel structures in a safe manner;
- Remove all salvageable equipment and material to make available for selling;
- Auction off all salvageable equipment and remove from site;
- Transport steel to scrap metal dealer (allow 50km) for resale;
- Demolish and remove all concrete and brick structures to a depth of 500mm below ground level; dispose all inert concrete and building rubble in primary crusher void;
- Break and remove all walkways and paved areas and dispose with other inert building rubble in primary crusher void;
- Remove all container and mobile buildings and transport off site (allow 50km) for resale;

Earthwork actions

- Shape the area to fill excavations and be free draining;

- Rip all plant footprint areas to a depth of 500mm to alleviate compaction;
- Rip all other building footprint areas to a depth of 300mm to alleviate compaction;
- Rip roads outside the plant and buildings footprint to a depth of 500mm;
- Cover all plant and related footprint areas with 300mm soil;
- Cover all building and related footprint areas with 200mm soil;
- Cover roads outside the plant and buildings footprint with 200mm soil

Water management actions

- Backfill low laying areas to make free draining;
- Decommission existing trenches from plant area to Storm Water Control Dam (SWCD)/ Return Water Dam (RWD)
- Make the area free draining and fit in with surrounding drainage patterns;
- Remove all culvert structures from roads;
- Construct water control berms / contour drains on covered area; final alignment of drains to be confirmed after earthworks

Soil amelioration, vegetation establishment and fencing actions

- Ameliorate soil based on soil analysis of final mixture of growth medium;
- In hydrocarbon contaminated areas, in-situ bioremediation will be applied by applying the bio-remediation agent, wetting, aerating and mixing the contaminated soil until expected thresholds have been reached;
- Seed the area with a mixture of local indigenous grass and tree seeds that are adapted to the area;
- Apply follow-up fertiliser where specified;
- Control weeds and invader plant species;
- Fence the area to fit in with the rest of the camp system

- **Mine residue facilities**

Waste Rock Dump (WRD)

Decommissioning actions and Earthworks

- Reshape steep slopes in balanced cut and fill operation to form single slope to reduce gradient and slope length:
  - Slope gradient = max 18° and Slope length = ±45m
  - Slope surface to be uniform and be concave, rather than convex;

- Cover reshaped slopes with 200mm soil to form growth medium together with underlying material;
- Cover reshaped top area with 100mm soil;
- Rip top area to alleviate compaction and mix soil with underlying material.

<u>Water management actions</u>

- Contain rainfall and runoff on rehabilitated facility, except for bottom slopes;
- Reshape or fill low laying areas next to dump edge to drain away from edge;
- Construct crest berm walls and paddocks (or low points) on top of facility;
- Construct cross berm walls on existing bench between lifts 1 and 2;
- Construct toe paddocks at seepage points to capture and evaporate seepage until seepage stops; decommission toe paddocks during maintenance period.

<u>Soil amelioration, vegetation establishment and fencing actions</u>

- Ameliorate soil based on soil analysis of final mixture of growth medium;
- Seed the area with a mixture of local indigenous grass and tree seeds that are adapted to the area;
- Apply follow-up fertiliser where specified;
- Control weeds and invader plant species;
- Fence the area in several separate camps to control grazing.

<u>Coarse Residue Deposit (CRD)</u>

<u>Decommissioning actions and Earthworks</u>

- Reshape steep slopes in balanced cut and fill operation to reduce gradient and form single slope:
  - Slope gradient = max 16° and Slope length = ±145m
- Cover reshaped slopes with 300mm coarse basalt material;
- Cover the 300mm basalt armour layer with 200mm soil;
- Cover reshaped top area with 200mm soil to form growth medium together with underlying material;
- Rip top area and slopes on contour to a depth of at least 500mm to alleviate compaction and mix soil and basalt material with underlying material

<u>Water management actions</u>

- Reshape slopes to be free draining;
- Contain all rainfall and runoff on the top of the rehabilitated facility;

- Construct crest berm walls and paddocks on top of facility;
- Reshape top of facility to drain inwards, i.e. away from edge;
- Construct toe paddocks on eastern side towards the Northern Pan to prevent sediment transport into the pan;
- Construct toe paddocks at seepage points to capture and evaporate seepage until seepage stops; decommission toe paddocks during maintenance period;
- Decommission existing seepage trenches to SWCD / RWD – backfill and cover with surrounding material

Soil amelioration, vegetation establishment and fencing actions

- Ameliorate soil based on soil analysis of final mixture of growth medium;
- Seed the area with a mixture of local indigenous grass and tree seeds that are adapted to the area;
- Apply follow-up fertiliser where specified;
- Control weeds and invader plant species;
- Fence the area in several separate camps to control grazing

Fine Residue Deposit (FRD)

Decommissioning / Earthworks

North-eastern Embankment:

- Cut top of FRD 2 embankment off to specified level and use as buttress material at toe of embankment of FRD 1B to reduce cutting back into starter wall during reshaping;
- Reshape steep outside slopes of FRD 1B & 2 in balanced cut and fill operation to reduce gradient and form single slope:
  - Slope gradient = max 16° and Slope length = ±75m;
- Reshape inside slopes in balanced cut and fill operation to form single slope to reduce gradient (to 18°) and slope length (to ±45m);
- Cover reshaped slopes with 200mm soil to form growth medium together with underlying material

South-western Embankment: Outer and inner slopes of FRD 1A & 2:

- Cut top of FRD 2 embankment off to specified level and doze material over outer slopes to reduce reshaped slope lengths;
- Reshape inside and outside slopes in balanced cut and fill operation to form single slope to reduce gradient and slope length:
  - Slope gradient = 18° and Slope length = ±45m;
- Cover reshaped slopes with 200mm soil to form growth medium together with underlying material

All top areas:

- No earthworks due to safety risk (fine tailings remain wet for very long)

Specified portion of north-western slope of FRD 1B:

- Cover bottom portion of slope with soil, ameliorate and vegetate

<u>Water management</u>

- Reshape slopes to be free draining;
- Contain all runoff on the top of the facility (do not spill more than once in 100 years);
- Construct waterways and stabilise waterways with gabions and reno mattresses;
- Construct crest berm walls on outside of inspection road on top of embankments;
- Construct toe paddocks at seepage points to capture and evaporate seepage until seepage stops;
- Decommission existing seepage trenches to SWCD / RWD – backfill and cover with surrounding material

<u>Soil amelioration, vegetation establishment and fencing actions</u>

- Spread fertiliser and seeds by hand on the top areas that can be safely accessed on foot
- Ameliorate soil on slopes, based on soil analysis of final mixture of growth medium;
- Seed the slopes with a mixture of local indigenous grass and tree seeds that are adapted to the area;
- Apply follow-up fertiliser on the slopes where specified;
- Control weeds and invader plant species on the slopes;
- Fence the slopes into two separate camps to control grazing

- **Topsoil stockpiles**

<u>Decommissioning actions and Earthworks</u>

- Reshape steep slopes to reduce gradient and form single slope
- Rip top area to alleviate compaction

<u>Water management</u>

- Reshape slopes to be free draining;

<u>Soil amelioration, vegetation establishment and fencing actions</u>

- Ameliorate soil based on soil analysis of final mixture of growth medium;
- Seed the area with a mixture of local indigenous grass and tree seeds that are adapted to the area;

- Apply follow-up fertiliser where specified;
- Control weeds and invader plant species;
- Fence the area in several separate camps to control grazing

- **Pans and wetlands**

  Decommissioning actions and Earthworks

  Southern Pan:

  - Construct compacted berm wall on existing walkway alignment to separate undisturbed western portion from disturbed and rehabilitated eastern portion;
  - Cover disturbed eastern portion with 500mm soil to prevent impact to the western portion

  Northern Pan:

  - Construct a coarse filter berm wall of basalt between the rehabilitated plant footprint and the pan to prevent sediment from entering the pan area;
  - Construct toe paddocks at the toe of the reshaped eastern slope of the CRD to contain possible seepage & sediment laden runoff until the area has stabilised

  Wetland adjacent to the mining area:

  - No direct earthworks

  Water management actions

  Southern Pan:

  - Route runoff from rehabilitated plant and buildings areas within the catchment to the undisturbed eastern portion;
  - Make a shallow channel from the southern pan to the wetland on the estimated full level

  Northern Pan:

  - Route runoff from the northern portion of the rehabilitated plant area towards the northern pan

  Wetland adjacent to the mining area:

  - Divert clean runoff from the southern WRD area to the catchment of the wetland to reinstate original catchment as far as possible
  - Construct a drift in the main access road to the mine to ensure hydraulic connection to the downstream pan system

<u>Soil amelioration, vegetation establishment and fencing actions</u>

Southern Pan:

- Remove alien tree and weed species mechanically with selective chemical stem treatment with approved herbicides;
- Spread the seeds of available selected wetland grass species in the pan area

Northern Pan:

- Spread the seeds of available selected wetland grass species in the pan area

Wetland adjacent to the mining area:

- Remove weed and invader plant species mechanically within the catchment of the wetland;
- Spread the seeds of available selected wetland grass species in the pan area

5) *Policy and legislative context*

Applicable legislation and guidelines used to compile the report	Reference where applied	How does this development comply with and respond to the legislation and policy context?
(A description of the policy and legislative context within which the development is proposed including an identification of all legislation, policies, plans, guidelines, spatial tools, municipal development planning frameworks and instruments that are applicable to this activity and are to be considered in the assessment process.)		(E.g. In terms of the National Water Act (No. 36 of 1998) a Water Use License has / has not been applied for.)
Legal/Regulatory Requirements		
Mineral and Petroleum Resources Development Act 28 of 2002 (MPRDA) and Mineral and Petroleum Resources Development Regulations (GNR 527 of 23 April 2004) (MPRDR)	-	The MPRDA is the main act regulating mining activities in South Africa, granting the requisite rights and permissions to conduct mining activities. Prior to the 2014 amendments to the legal regime, the MPRDA together with the MPRDA regulations regulated the environmental impacts of mines. Included in this was the regulation of closure objectives and activities. Operations conducted under the MPRDA prior to the implementation of the NEMA legal regime, still have valid EMPRs and Closure Plans.
Mineral and Petroleum Resources Development Act 28 of 2002 (MPRDA) and Mineral and Petroleum Resources	-	The provisions dealing with EMPrs under the MPRDA were transferred to the NEMA with effect from 2 December 2014 further aligning the EMPr and environmental authorisation processes as referred to

Applicable legislation and guidelines used to compile the report	**Reference where applied**	**How does this development comply with and respond to the legislation and policy context?**
Development Regulations (GNR 527 of 23 April 2004) (MPRDR)		below. In addition, provisions associated with mine closure obligations are now dealt with in terms of the Financial Provisioning Regulations, 2015 (GNR 1147 of 20 November 2015) (new Regulations) which set out certain transitional arrangements in respect of financial provision made under the MPRDA.
Mineral and Petroleum Resources Development Act 28 of 2002 (MPRDA)	S 38(1)(d)	The MPRDA was historically the main source of mine closure obligations. It required rights holders to 'as far as reasonably practicable' rehabilitate the land affected by the operation' to its natural or predetermined state, or to a land use which conforms to the generally accepted principle of sustainable development'. Any historic EMPrs, which as part of the transitional arrangements regulated mining activities in the MEA regime post 2014, will have been influenced by these provisions. Mining-related activities invariably also trigger a range of environmental provisions contained in legislation including (but not necessarily limited to) the National Environmental Management Act, 107 of 1998 (NEMA), the National Water Act, 36 of 1998 (NWA) and the National Environmental Management: Waste Act, Act 59 of 2008 (NEMWA).
Mineral and Petroleum Resources Development Act 28 of 2002 (MPRDA) and Mineral and Petroleum Resources Development Regulations (GNR 527 of 23 April 2004)	Ss 43(1) and 43(5)	The closure of mines and relinquishment of rights as issued by the MPRDA is regulated by section 43 of the MPRDA. Section 43(1) provides an outline of the process which should be followed by regulatory bodies to grant closure certificates. Section 43(1) states that the holder of a mining right remains responsible for any environmental liability, pollution, ecological degradation, the pumping and treatment of extraneous water, compliance to the conditions of the environmental authorisation and the management and sustainable closure thereof, until the Minister has issued a closure certificate in terms of this Act.. Furthermore, section 43(5) of the MPRDA stipulates that no closure certificate may be issued unless the Chief Inspector and each government department charged with the administration of any law, which relates to any matter affecting the environment have

Applicable legislation and guidelines used to compile the report	Reference where applied	How does this development comply with and respond to the legislation and policy context?
		confirmed in writing that the provisions pertaining to health and safety and management pollution to water resources, the pumping and treatment of extraneous water and compliance to the conditions of the environmental authorisation have been addressed..
National Environmental Management Act 107 of 1998 (NEMA)	-	The NEMA is the overarching environmental legislation governing the undertaking of listed activities, environmental authorisations, EMPRs, and the duty of care in respect of prevention and remediation of pollution. NEMA, as framework legislation, also regulates all environmental aspects related to the undertaking and closure of mining operations.
Environmental Impact Assessment (EIA) Regulations (GNR 982 of 4 December 2014) and Listing Notices 1, 2 and 3 GNR 983 – 985 of 4 December 2015)	Listing Notice 1, Activity 22(i)	With effect from 8 December 2014 activities requiring, inter alia, a mining right, license or closure certificate furthermore require an environmental authorisation. The 2014 EIA Regulations set out the procedure in respect of applications for environmental authorisation that require either a basic assessment or a scoping and environmental impact reporting process to be followed. The regulations also specify the contents of impact assessment reports, as well as Environmental Management Programmes and Closure Plans.
Financial Provisioning Regulations, 2015 (GNR 1147 of 20 November 2015) (Financial Provisioning Regulations) To be repealed	-	The Financial Provisioning Regulations under the NEMA came into effect on 20 November 2015. These Regulations set out details with respect to 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 environmental impacts that may become known in the future." On 10 November 2017, the Minister of Environmental Affairs gave notice of her intention to make (new) regulations pertaining to the financial provision for prospecting, exploration, mining or production operations under various sections of the National Environmental Management Act (Act No.107 of 1998).

Applicable legislation and guidelines used to compile the report	Reference where applied	How does this development comply with and respond to the legislation and policy context?
		The proposed new financial provisioning regulations were published for comment in GN 1228. Once finalized and approved, these new regulations will replace the current regulations. These regulations are important in the planning and execution of mine closure, as they set out the envisaged mine closure actions and activities.
National Environmental Management: Biodiversity Act 10 of 2004 (NEMBA)	-	NEMBA provides for the management and conservation of South Africa's biodiversity; the protection of species and ecosystems that warrant protection; the sustainable use of indigenous biological resources; the fair and equitable sharing of benefits arising from bioprospecting involving indigenous biological resources; the establishment and functions of a South African National Biodiversity Institute, and matter connected therewith. In the context of planning for mine closure, cognizance must be taken of the presence of ecosystems within the broader mine boundaries that have been designated as protected.
National Environmental Management: Protected Areas Act (NEMPAA)	-	The NEMPA provides for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes; for the establishment of a national register of all national, provincial and local protected areas; for the management of those areas in accordance with national norms and standards; for intergovernmental co-operation and public consultation in matters concerning protected areas; and for matters in connection therewith.
National Water Act 36 of 1998 (NWA)	Chaper 40	This Act provides for the protection of water resources and the control of entitlements to water use. It sets out certain water uses that require licensing prior to the undertaking thereof (subject to specific exceptions) and makes provision for the duty of care in respect of the prevention and remediation of pollution of water resources.

Applicable legislation and guidelines used to compile the report	Reference where applied	How does this development comply with and respond to the legislation and policy context?
		When undertaking mine closure activities it is important to understand the legislative provisions around the use of water and any impacts on the water resource. Closure activities must ensure that any past impacts on water resources are mitigated and rehabilitated in accordance with the prescripts of the NWA.
Regulations on Use of Water for Mining and Related Activities aimed at the Protection of Water Resources (GNR 704 of 4 June 1999) (Regulations on Use of Water for Mining)	Regs 3, 4, 5 and 6)	The Regulations on Use of Water for Mining sets out certain legal obligations with regard to the management of water resources. The following regulations are of specific relevance: • Regulation 4 sets out restrictions on locality of infrastructure including, inter alia, residue deposits and dams; • Regulation 5 places a restriction on the use of residue or other substances which may cause water pollution for construction of, inter alia, dams or roads; • Regulation 6 provides for the capacity requirements of clean and dirty water systems; • Regulation 3 allows for exemption to be granted in respect of having to comply with the aforesaid provisions.
National Environmental Management: Waste Act 59 of 2008 (NEMWA)	Chapter 4, Part 8	The purpose of the NEMWA is to provide reasonable measures for the prevention of pollution and ecological degradation and to provide for the licensing and control of waste management activities, and matters incidental thereto. The Act relies on the cradle-to-grave principle in respect of waste management. As such, waste generators are required to ensure that waste is segregated, transported and disposed of in accordance with the requirements of the Act. With effect from 2 May 2014, Chapter 4: Part 8 of the NEMWA, dealing with contaminated land, came into effect. As such, when it is anticipated that land has been significantly contaminated (note: this also includes historical contamination that occurred prior to the coming into effect of these provisions) notification to the Department of Environmental Affairs (DEA) is required and site investigations need to be carried out. In addition, if land is found to be contaminated, this must be disclosed to a buyer during property transfer.

Applicable legislation and guidelines used to compile the report	Reference where applied	How does this development comply with and respond to the legislation and policy context?
		With effect from 2 September 2014 residue stockpiles and residue deposits, previously managed under the MPRDA, are no longer excluded from the ambit of the NEMWA and are now governed as hazardous waste. All activities undertaken during the closure and rehabilitation processes will have to comply with the provisions of the NEMWA.
Waste Classification and Management Regulations GNR 634 in GG 36784 of 23 August 2013		The waste classification and management regulations, read with the regulations for assessment of waste for disposal to landfill (GNR 635), dictate that all waste generated be managed and classified correctly, so as to ensure the correct management, transport and disposal of such waste. During the mine closure process, all waste generated from the site will have to be managed and disposed of in accordance with these regulations.
List of Waste Management Activities that have or are likely to have a Detrimental Effect on the Environment (GNR 921 of 29 November 2013) (List of Waste Management Activities)	-	In terms of the NEMWA, no person may commence, undertake or conduct a waste management activity except in accordance with, inter alia, a waste management license (WML) issued in respect of that activity (if a license is required). The activities requiring licensing are set out in the List of Waste Management Activities which came into effect on 29 November 2013 (replacing the old List of Waste Management Activities (GN 718 of 3 July 2009)). Certain of the important changes in the new List of Waste Management Activities include: • Storage of general and hazardous waste no longer requires a WML (see below); and • Remediation of contaminated land is, with effect from 2 May 2014, dealt with under the NEMWA and also does not require licensing.
National Norms and Standards for the Storage of Waste (GNR 926 of 29 November 2013) (Norms and Standards for Storage of Waste)	-	As stated above, a new List of Waste Management Activities came into effect on 29 November 2013, which makes provision for three categories of waste management activities: • Category A: Activities requiring a basic assessment process to be conducted (including, inter alia, recycling, disposal or treatment of general waste or

Applicable legislation and guidelines used to compile the report	Reference where applied	How does this development comply with and respond to the legislation and policy context?
		hazardous waste, or the establishment or reclamation of residue deposits or stockpiles requiring a prospecting right); • Category B: Activities requiring a scoping and environmental impact reporting process to be conducted (including, inter alia, recycling, treatment or disposal of larger quantities of hazardous waste, or the establishment or reclamation of residue deposits or stockpiles requiring a mining right); and • Category C: Activities requiring compliance with certain Norms and Standards (including, inter alia, the storage of general and hazardous waste). The activities related to storage of general and hazardous waste at facilities of specified capacities which previously required a WML are now included in Category C with the effect being that the undertaking of these activities must be in accordance with the Norms and Standards for Storage of Waste. The Norms and Standards set out requirements for, inter alia, the registration of new waste storage facilities; location, construction and design; management of the facilities; training of personnel; preparation of an emergency preparedness plan; investigations; auditing; and reporting.
National Norms and Standards for the Remediation of Contaminated Land and Soil Quality in the Republic of South Africa (GNR 331 of 2 May 2014) (Norms and Standards for the Remediation of Contaminated Land)	-	The Norms and Standards for the Remediation of Contaminated Land came into effect on 2 May 2014 in conjunction with the contaminated land provisions referred to under the NEMWA above. The purpose of the Norms and Standards for the Remediation of Contaminated Land is to: • Provide a uniform national approach to determine the "contamination" status of an investigation area; • Limit uncertainties about the most appropriate criteria and method to apply in the assessment of "contaminated" land; and • Provide minimum standards for assessing necessary environmental protection measures for remediation activities.
National Environmental Management Air Quality Act 39 of 2008		All closure operations at the mine must take cognisance of the provisions related to dust

Applicable legislation and guidelines used to compile the report	Reference where applied	How does this development comply with and respond to the legislation and policy context?
		management as set out in the National Environmental Management Air Quality Act 39 of 2004 (NEMAQA), specifically the regulations pertaining to dust management i.e. GNR 827 in GG 36974 of 1 November 2013. The minister must also be notified of the intention to close the mine, as required by NEMAQA.
Mine Health and Safety Act 29 of 1996 (MHSA)	-	The MHSA is the key piece of legislation governing health and safety at South African mines. The Act is designed to promote mine health and safety by setting minimum standards and guidelines for the following key issues: • Identifying hazards and risks; • Providing for employee participation in matters relating to health and safety; • Providing for effective monitoring of health and safety conditions; • Providing for enforcement of health and safety standards; • Promoting a culture of health and safety at mines; • Promoting training in health and safety; and • Promoting co-operations and consultation on health and safety between the state, employer and employee.
Occupational Diseases in Mines and Works Act 78 of 1973 (ODIMWA)	-	The ODIMWA sets out the framework for the payment of compensation in respect of certain diseases contracted by persons employed in mines and works, and matters incidental thereto.
DMR principles to govern mine closure in the South African context	-	• 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 pre-determined 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

Applicable legislation and guidelines used to compile the report	Reference where applied	How does this development comply with and respond to the legislation and policy context?
		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.
Closure Conditions and Commitments		
Voorspoed Mine approved Environmental Management Programme Report (EMPR)	-	Existing closure criteria are approved in the Environmental Management Programme Report (EMPR) for Voorspoed Diamond Mine (Metago, 2005a) and Amended Environmental Management Programme Report to include new areas (Shangoni, 2010).
Voorspoed Mine Water Use Licence No. 09/C70H/ABGJ/1031, dated 21/06/2011	-	Water Use Licence in terms of Chapter 40 of the National Water Act (2011) • The licensee must, at least 180 days prior to the intended closure of any facility, or any portion thereof, notify the Regional Head: Free State of such intention and submit any final amendments to the IWWMP and RSIP as a final Closure Plan, for approval. • The licensee shall make full financial provision for all investigations, designs, construction, operation and maintenance for a water treatment plant should it become a requirement as a long-term water management strategy.
Voorspoed Mine Closure Plan	-	The closure plan gives effect to the various legal and corporate requirements that govern the process and requirements for the closure of Voorspoed Mine.

6) *Need and desirability of the proposed activities*

(Motivate the need and desirability of the proposed development, including the need and desirability of the activity in the context of the preferred location.)

The Voorspoed Mining Right was granted on 05 September 2006. De Beers opened the Voorspoed Diamond mine on November 4, 2008. The mine was expected to be operational for 12 to 16 years, which included the mine's pre-strip, ramp-up of production and closure.

The Voorspoed Mine mining right was granted until October 2023 and the life of mine projected until 2021. Despite this, the mining operations ceased in December 2018. The economics and mine life of Voorspoed mine was significantly negatively affected by the combined impact of slope instability, complex geology and size of the Voorspoed open-pit. The mine is, therefore, formally in the decommissioning and mine closure phase.

During the operational phase, infrastructure was developed and upgraded on and off the mining area, as described in section 9(c). Waste rock and kimberlite ore was blasted, loaded and hauled from the pit, using conventional truck and excavation methods. A Waste Rock Dump (WRD) was created to receive waste rock that was removed from the pit in order to access the kimberlite ore. Ore was stockpiled and fed into the treatment plant. In the treatment plant, ore was crushed, scrubbed and screened to recover the diamonds. Crushed ore was fed into a Dense Medium Separation plant, where diamond-bearing gravel was separated from lighter, non-diamond-bearing ore. Two residue streams were created by the treatment plant. The crushed non-diamond-bearing ore was disposed of on the Coarse Residue Deposit (CRD), and fine material emanating from the crushing and scrubbing process was pumped to and disposed of on the Fine Residue Deposit (FRD) facility.

After the decision was taken to cease production in 2018, Voorspoed Mine tried to find a suitable buyer for the operation, with the assistance of Standard Bank. Letters were sent to more than 50 parties, including the operators of other diamond mines in SA. However, none was able to meet the criteria set by De Beers of not only having the financial capacity to run Voorspoed Mine, but also the capital to invest in order to expand the pit and add another five years to the life of the mine. The Department of Mineral Resources also participated unsuccessfully in the process to find a buyer for the mine (Appendix 24).

As the mine went through a ramp-down and down-scaling process to prepare the operation for mine closure, the headcount reduced significantly in terms of both the number of employees, as well as equipment usage. In addition, concurrent rehabilitation was undertaken.

Following the completion of production there will be a 4-year period of active closure and rehabilitation. If the Rehabilitation Plan 2019 is implemented, the mine will be rehabilitated by the end of 2022. Thereafter, environmental monitoring will be undertaken for at least another 5 years before the closure certificate will be applied for.

A workable and practical decommissioning and mine closure will result in the attainment of the closure objectives aligned with all applicable legal requirements and pursuant to the NEMA section 2 principles. In the absence thereof, the mine infrastructure and unrehabilitated mine residue deposits will remain, while the open pit will also remain easily accessible to both humans and animals. The land will not be available for farming activities and environmental pollution in terms of land, water and air pollution would continue unabated. In addition, the owner of the mine will remain liable for any environmental liability, pollution, ecological degradation, the pumping and treatment of extraneous water, compliance to the conditions of the environmental authorisation and the management and sustainable closure of the mine. It is thus imperative that a feasible and sustainable mine closure plan be approved.

7) *Motivation for the overall preferred site, activities and technology alternatives*

A detailed investigation and comparative assessment of the alternative options for the Voorspoed Mine decommissioning and closure were undertaken, including the positive and negative implications of the proposed activity and identified alternatives. Alternatives identified and assessed include Strategic mine extension alternatives, pit closure alternatives, rehabilitation design alternatives and end land use alternatives.

No site alternatives were considered and are evidently not possible, as the mine is already established on the mining area.

a) Preferred pit lake alternative

The preferred decommissioning alternative that is assessed in this report is the option of the development of a pit lake in the open pit under current conditions. The pit will be left to fill/re-water by groundwater ingress, rainfall recharge directly into the pit and local runoff from the pit footprint area, with normal evaporation. Human and animal access to the pit will be restricted by the construction of waste rock barriers/berms at top of the remaining open pit access ramps, which have already collapsed naturally lower down in the pit. In addition, a high-end (Clearvu) security fence will be erected around the open pit, outside of the indicated Zone of Relaxation (break-back zone). Furthermore, a 5 m deep trench and 5 m high enviroberm will be constructed around the open pit, outside the security fence. This option is illustrated in Figure 1.

Security guards will monitor access to the pit until the rehabilitation plan is implemented. Thereafter, security cameras and alarms will be installed to inform the Mine of any trespassers trying to access the pit in future.

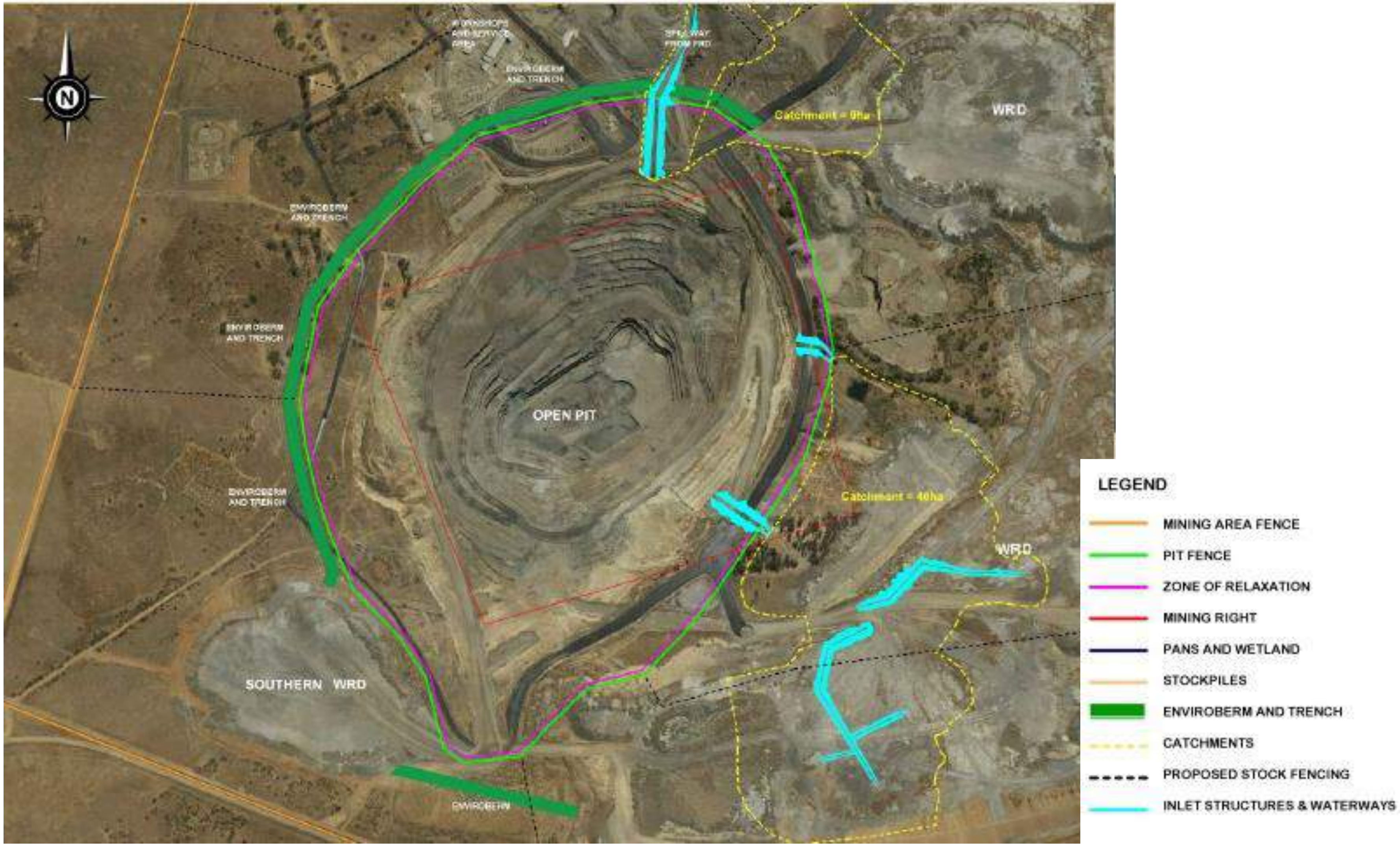


Figure 1. Preferred pit lake decommissioning alternative, indicating the security fence, as well as the enviroberm and trench outside the Zone of Relaxation

Apart from that, the remaining mine residue deposits will be reshaped, covered with cover material and/or soil and rehabilitated with a vegetation cover. This reshaping, topsoiling and revegetation of the Waste Rock Dump that has already taken place is illustrated by figure 2.

Figure 2. Current rehabilitation of the waste rock dump showing how the mine residue deposits will be reshaped, covered with topsoil and revegetated.

The vegetation will be managed and utilised until closure to ensure that the success criteria are achieved. Furthermore, surface and groundwater, as well as vegetation and biodiversity monitoring will be undertaken after the rehabilitation to track the ground and surface water, as well as vegetation and biodiversity responses to the rehabilitation practices.

b) Open pit backfilling alternative

In this report, the alternative decommissioning option that will be assessed is the option of backfilling the open pit, primarily with material from the waste rock dump. The remaining mine residue deposits will be reshaped, covered with cover material and/or soil and rehabilitated with a vegetation cover. Apart from this major difference compare to the preferred option, the rehabilitation, management and monitoring commitments for this option are the same as for the preferred option.

c) No-go alternative

The no-go alternative for the decommissioning of Voorspoed Mine will be to not undertake any decommissioning of the mine activities and infrastructure and furthermore to not rehabilitate the areas disturbed by the mining activities and the mine residue deposits. This alternative will result in a deserted mine that will be illegally stripped from anything of value. In addition, it will also result in a dangerous environment where neither the open pit nor the steep slopes of the mine residue deposits are secured and protected to prevent people from being harmed. From an environmental perspective, the areas disturbed by the mining activities will degrade over time through erosion and invader plant invasions, while potential pollutants from the mine residue deposits and other polluted areas will be spilled into the areas around the mining area and result in pollution of land, as well as surface and groundwater resources.

In terms of the various alternatives considered, the preferred alternatives, as well as the motivation for the selection of each are provided in Table 1. A full description of the alternatives assessed and the process followed is provided in section 8.

Figure 3 presents a summary of the strategic alternatives assessment process and the preferred mine closure option.

Table 1: Preferred alternatives for the decommissioning and closure of Voorspoed Mine, with motivations

Type of alternative	Preferred alternative	Motivation
Strategic mine extension alternatives	Execution of the current Business Plan, including execution of the closure plan after operations have ceased.	Of the five Life of Mine extension scenarios that were formally considered and investigated, none proved to be economically viable. All alternatives would reduce the Nett Present Value of the mining asset. The investigation into the possible divestment of the mine via the sale thereof to suitable buyers were also not feasible, as no commercially viable bid was received. None of the prospective buyers could demonstrate on reasonable grounds that a viable operation could be sustained should they take ownership of the Voorspoed mine.
Pit closure alternatives	The development of a pit lake under current conditions, where all the diamond-bearing ore was removed from the pit and the access ramps have already failed. The pit will fill/re-water by groundwater ingress, rainfall recharge directly into the pit and local runoff from the pit footprint area, with normal evaporation. Human and animal access to the pit will be restricted by the construction of waste rock barriers/berms at top of the remaining open pit access ramps, which have already collapsed naturally lower down in the pit. In addition, a high-end (Clearvu) security fence will be erected around the open pit, outside of the indicated Zone of Relaxation (break-back zone). Furthermore, a 5 m deep trench and 5 m high enviroberm will be constructed around the open pit, outside the security fence. Security guards will monitor access to the pit until the rehabilitation plan is implemented. Thereafter, security cameras and alarms will be installed to inform the Mine of any trespassers trying to access the pit in future.	Three strategic pit closure alternatives scenario, were considered, primarily in terms of the end land state of the open pit and MRDs. This involved an initial, high level screening, followed by a more detailed investigation of three alternatives identified in the screening. The backfilling of the open pit offers a beneficial option towards the social aspects, specifically in terms of public safety and is close to re-establishing a pre-mining environment. However, the backfilling of the pit would result in excessive costs that are not economically viable and is disproportionate to the benefits achieved by mining activities over the life of the mine. It is also more than what could be considered proportional to the benefits gained by the backfilling of the open pit. This scenario also introduces the possible pollution of groundwater and possibly even surface water from the saturated backfilled excavation, for approximately 100 years post closure. It is therefore, not regarded the best practicable environmental option. The development of a pit lake with enhanced drainage to reduce the time between closure and the development of the pit lake will provide earlier protection of the property against illegal mining and unauthorised

Type of alternative	Preferred alternative	Motivation
	Apart from that, the remaining mine residue deposits will be reshaped, covered with cover material and/or soil and rehabilitated with a vegetation cover. The vegetation will be managed and utilised until closure to ensure that the success criteria are achieved. Furthermore, surface and groundwater, as well as vegetation and biodiversity monitoring will be undertaken to track the ground and surface water, as well as vegetation and biodiversity responses to the rehabilitation practices.	trespassing, with potential fatal consequences than the preferred option. However, this benefit comes at an additional cost of approximately R14 million, which is not considered to be proportional to the benefit gained. In addition, it is expected that the water quality in the pit lake will be impacted more negatively than the preferred scenario. Furthermore, the agricultural use of the land for grazing post closure will be more limited than the preferred scenario, due to the inaccessibility of specifically the engineered local catchment around the open pit. In terms of economic and environmental considerations, the preferred scenario of allowing the open pit to fill under natural recharge conditions is the best practicable environmental option, due to the acceptable cost associated with rendering the open pit lake safe and the decommissioning and rehabilitation of the mining area. By limiting surface water run-off from the rehabilitated mining area, the migration of contaminated water to the surrounding environment will be limited. In addition, the agricultural use of the land for grazing post closure will be largely reinstated.
Rehabilitation design alternatives	• **On-site infrastructure** Demolish and remove all infrastructure. • **Off-site infrastructure** Retain selected off-site infrastructure for use by third parties post closure. • **Waste Rock Dump** o Profile of 18º single slope per lift, with benches between lifts o Contain all surface water run-off on the top area and run-off from the upper slopes on the benches.	• No opportunities for sustainable re-use of the infrastructure have been identified. • No opportunities have been identified and no agreed handover / maintenance agreements have been achieved for the use by third parties after mine closure • Flatter slopes will improve the chances of successful rehabilitation. • If runoff is shed, erosion risk is introduced and surface water management structures may be required, attracting cost and ongoing maintenance

Type of alternative	Preferred alternative	Motivation
	o Use 200 mm and 100 mm soil layers on the slopes and top areas respectively, with soil amelioration.	• Soil layers less than 300 mm thick will be sufficient to establish and sustain vegetation
	• **Coarse Residue Deposit** o Profile of long (up to 140 m) 16º single slope. o Only contain surface water run-off on the top area, while shedding the surface run-off from all the slopes. o Use a 300 mm basalt armour layer, with a 200 mm soil layer on top, with amelioration.	• Flatter slopes will improve the chances of successful rehabilitation. • Runoff from slopes will not introduce erosion risk and require surface water management structures • Basalt armour will increase stability and combat erosion • Soil layers less than 300 mm thick will be sufficient to establish and sustain vegetation
	• **Fine Residue Deposit** o Profile combination of long (up to 80 m) 16º single slope, and shorter 18º single slopes. o Contain surface water run-off on the top area, but shed the surface run-off from the slopes. o Use a 300 mm basalt armour layer, with a 200 mm soil layer on top of the armour, with amelioration of the growth medium.	• Flatter slopes will improve the chances of successful rehabilitation. • Top of FRD will not be rehabilitated and run-off will be contained to prevent potential surface water pollution • Runoff from slopes will not introduce erosion risk and require surface water management structures • Basalt armour will increase stability and combat erosion • Soil layers less than 300 mm thick will be sufficient to establish and sustain vegetation
End Land Use alternatives	The land capability assessment indicated that the Voorspoed properties could be utilised for extensive sheep, cattle and game farming, with limited cropping on existing cultivated lands. The agricultural use of the mining area and other Voorspoed properties post-closure was deemed to be the most appropriate in the regional context, and the most likely to be sustainable in the long term. The financial modelling done for the different preferred ELU options indicated that none of the identified ELU options presented a positive business case for Voorspoed to take	An extensive list of potential end land use (ELU) options were developed to evaluate which of these options had the highest likelihood of succeeding beyond closure, as well as which were financially viable. Some potential end land uses were deemed unsuitable as post-closure activities, as they would delay the final rehabilitation of the mine residue facilities. In addition, a number of other potential ELU options would require environmental authorisation in terms of the National Environmental Management Act (No. 107 of 1998), such as cattle and sheep feed lots, commercial piggeries, and large chicken farming. These options would be more difficult to implement, because of the extended time line for acquiring

Type of alternative	Preferred alternative	Motivation
	forward as an option that would provide a "cash neutral" or profitable enterprise to fund all monitoring and maintenance work required during the post-closure monitoring period. Therefore, the study concluded that the mining area and other Voorspoed properties can be used for profitable extensive sheep, cattle and game farming, with limited cropping on existing cultivated lands. However, this could only be done if the mining area and other Voorspoed properties are integrated into existing and established farming enterprises in close proximity to the mine, in particular where the start-up capital needed is kept as low as possible. The preferred end land uses are as follows: • Retain the arable land use on existing croplands (on the properties around the mining area; • Reinstate the grazing potential of the land over as large as possible portion of the mining area; • Reinstate the grazing potential on the mining area (including the WRD, CRD and infrastructure footprints), but control the grazing utilisation to protect the rehabilitated areas that will remain more sensitive than the surrounding grazing areas; • Allow grazing on the more sensitive biodiversity rich areas around the mining area, but control the grazing utilisation to protect the biodiversity; and • Restrict any access to the open pit and top of the FRD due to the safety risk; these areas will therefore have a very limited land use.	the necessary environmental authorisations, as well as the potential opposition from neighbouring stakeholders, because of nuisance odours associated with these enterprises. None of these ELU options were therefore evaluated further. The agricultural ELU options that were selected for economic evaluation, included the production of selected crops (maize and sunflower), domestic livestock farming (cattle and sheep), and also game farming, and combinations of these. The general shortage of surface and groundwater in the area mitigated against the selection of intensive agriculture in the form of large-scale centre pivot irrigation of maize and vegetables, and the greenhouse cultivation of vegetables and cut flowers. The high cost of importing/pumping irrigation water from remote water sources, if this water use could be licenced, would render the irrigation enterprises marginal to unprofitable. The results of the financial modelling done for the different preferred ELU options indicated that none of these presented a positive business case for Voorspoed to take forward as an option that would provide a "cash neutral" or profitable enterprise to fund all monitoring and maintenance work required during the post-closure monitoring period. The main impediment for each of the options evaluated was the high cost of capital for monies loaned from the bank for the purchase of stock and equipment, and the relatively low margins made on crops and stock, or game, sold.

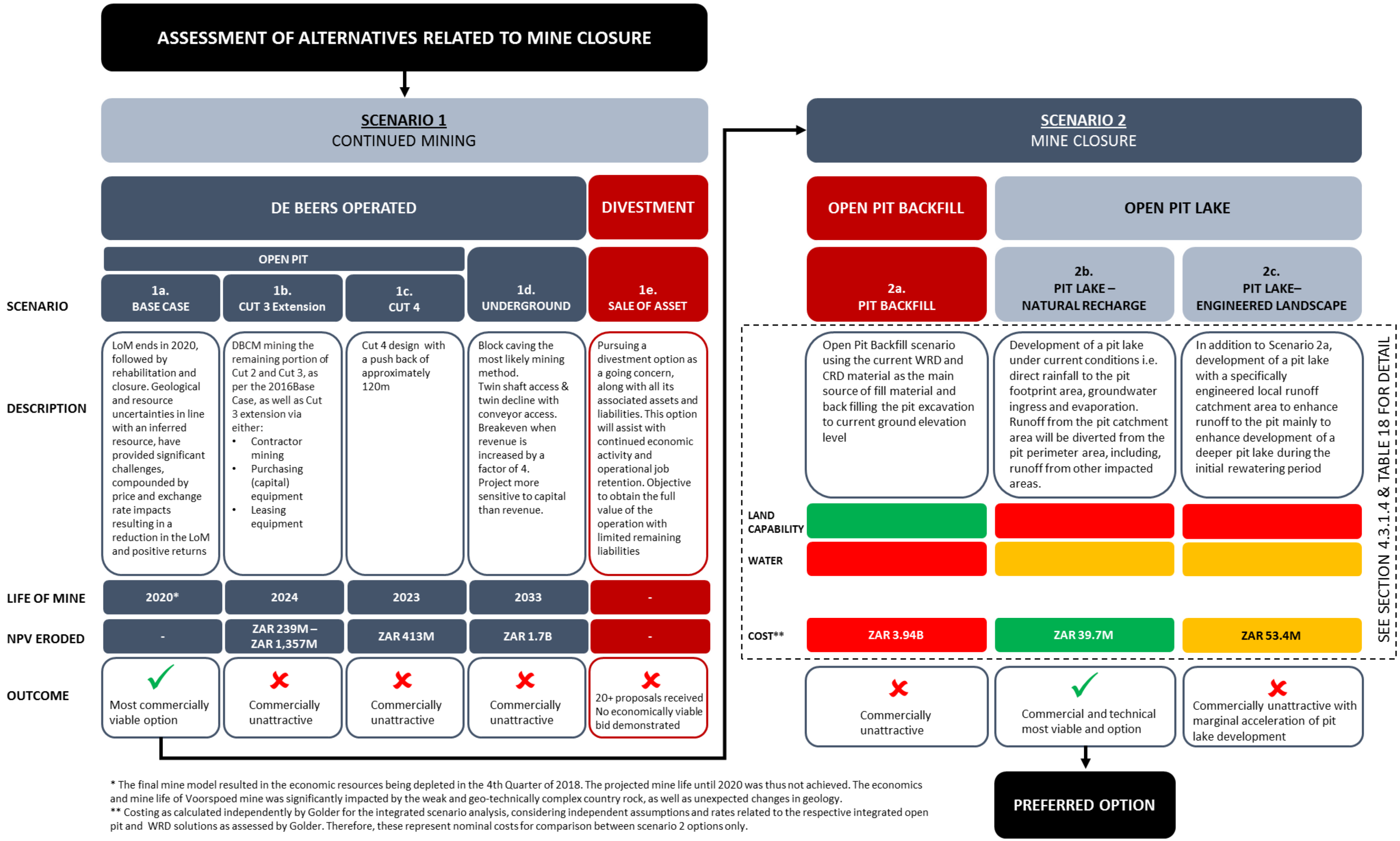


Figure 3. Strategic Alternatives assessment process and preferred options (from Redco & Uvuna Sustainability, 2019)

8) Full description of the process followed to reach the proposed preferred alternatives within the site

(NB! This section is about the determination of the specific site layout and the location of infrastructure and activities on site, having taken into consideration the issues raised by interested and affected parties, and the consideration of alternatives to the initially proposed site layout.)

a) Details of the development footprint alternatives considered

With reference to the site plan provided as Appendices 3 and 4 and the location of the individual activities on site, provide details of the alternatives considered with respect to:

a) The property on which or location where it is proposed to undertake the activity;
b) The type of activity to be undertaken;
c) The design or layout of the activity;
d) The technology to be used in the activity;
e) The operational aspects of the activity; and
f) The option of not implementing the activity.

No site alternatives were considered and are evidently not possible, as the mine is already established on the mining area.

The application also does not involve the determination of a specific site lay-out, i.e. the location of infrastructure and activities on the site, as these were constructed and established during the construction and operational phases of the mine.

However, the alternatives considered involve the determination of how the existing infrastucture and facilities on and off the mining area must be decommissioned and rehabilitated, in such a way that the mining area can be utilised in a sustainable manner after closure. These relate to design, lay-out, technology and operational aspect alternatives. These alternatives will be discussed below.

If the activity is not implemented, i.e. in the absence of decommissioning and mine closure, the mine infrastructure and unrehabilitated mine residue deposits will remain, while the open pit will also remain easily accessible to both humans and animals. The land will not be available for farming activities and environmental pollution in terms of land, water and air pollution will continue unabated. In addition, the mine will remain liable for any environmental liability, pollution, ecological degradation, the pumping and treatment of extraneous water, compliance to the conditions of the environmental authorisation and the management and sustainable closure of the mine

(i) Evaluation of alternatives considered

A detailed investigation and comparative assessment of the alternative options for the Voorspoed Mine decommissioning and closure alternatives were undertaken, including the positive and negative implications of the proposed activity and identified alternatives. The process to evaluate the following alternatives that were identified for the project and assessed will be briefly discussed below:

- Strategic mine extension alternatives;
- Pit closure alternatives;

- Rehabilitation design alternatives; and
- End Land Use alternatives.

<u>Strategic mine extension alternatives</u>

Voorspoed Mine identified a series of strategic mine closure alternatives for detailed investigation in an attempt to minimise, or mitigate the impacts of mine closure. These primarily involved continuing with the mining activities and are discussed below.

- **Execution of the current Business Plan, including execution of the closure plan after operations have ceased**
  In spite of the numerous challenges and the high proportion of inferred resources, Voorspoed Mine has largely achieved its business plan targets since commencement of mining activities. The current Business Plan includes the execution of the closure plan after operations have ceased.
- **Assessment of potential economically feasible life extension scenarios**
  Various Life of Mine (LoM) extension scenarios were formally considered and investigated. These included three Cut 3 extension scenarios, a Cut 4 pushback of the open pit, as well as an Underground Mine scenario.

  Economic studies indicated that there are no reasonable prospect for any economically viable LoM extension opportunity by DBCM at Voorspoed Mine. All Cut 3 and the Cut 4 extension options evaluated were commercially unattractive. The Cut 3 extension options evaluated would erode Net Present Value (NPV) by between R 239 million and R 1,357 million, while the Cut 4 design would erode NPV by an estimated R 413 million. The Whittle analyses also indicated that another pushback would not be feasible if the costs of replacement fleet or contractor operations were taken into account. The underground scenario was also deemed to be commercially unattractive and would erode NPV by an estimated R 1.7 billion.
- **Divestment of the mine via the investigation of a sale option to identify suitable buyers.**
  The divestment scenario entailed pursuing a divestment option as a going concern, along with all its associated assets and liabilities. It was envisaged that this option would assist with continued economic activity and operational job retention from a community perspective. From a commercial perspective, the objective would be to obtain the full value of the operation with limited remaining liabilities.

  Following a comprehensive bidding process where proposals were received from more than 20 bidders, no commercially viable bid was presented, and the divestment option is, therefore, not feasible. The Department of Mineral Resources also participated unsuccessfully in the process to find a buyer for the mine (Appendix 24).

The strategic mine extension alternatives assessment concluded that the termination of Life of Mine in 2018, followed by a mine closure phase reflects the only commercially attractive option for De Beers (Figure 3).

Pit closure alternatives

- **Initial screening of pit closure alternatives**
  Seven pit closure scenarios were considered initially, at a screening level, primarily in terms of the feasibility and costs thereof, as well as the likelihood of a pit lake forming and the extent to which the projected water level will rise over time. The pit closure costs for the various options ranged from approximately R48 million (excluding VAT) for the option to render the pit safe without any further interventions, to approximately R3 billion (excluding VAT) for the option to backfill the pit with the mine residue deposits on the mining area. This high level modelling and cost estimation screening study concluded that backfilling of the pit would result in excessive costs that were not economically viable. Furthermore, it also concluded that the costs associated with the backfilling of the open pit is more than what could be considered proportional to the benefits achieved by mining activities over the life of the mine.

  This information was derived from the *Voorspoed Mine – Pit Closure Study* report (E-Tek Consulting and Redco 2016)[3] (Appendix 13).

- **Detailed evaluation of three pit closure alternatives**
  After the initial screening, three pit closure scenario alternatives, primarily in terms of the end land state of the open pit and MRDs, were identified in the 2017 Voorspoed Closure Plan (Redco 2017) and evaluated (Golder 2019)[4].
  The three scenarios are briefly as follows:

  1. **Scenario 1:** Development of a Pit Lake under current conditions i.e. direct rainfall to the pit footprint area, groundwater ingress and evaporation. Runoff from the pit catchment area will be diverted from the pit perimeter area, including, runoff from other impacted areas. The pit will be left to fill/re-water by direct rainfall recharge and local runoff from the pit footprint area;
  2. **Scenario 2:** Development of a Pit Lake where, in addition to Scenario 1 above, the development of a pit lake with a specifically engineered local runoff catchment area to enhance runoff to the pit mainly to enhance development of a deeper pit lake during the initial re-watering period. This scenario addresses a larger

[3] *Voorspoed Mine – Pit Closure Study*, Report E-TEK 10079, E-TEK Consulting & Redco, 21 June 2016.

[4] *Technical Evaluation of the Risks, Impacts and Management Requirements into Pit Backfilling versus Current Mine Plan (Pit Lake)*, Report 1792363-318923-1_Rev1, Golder Associates Africa (Pty) Ltd., February 2019.

"engineered" local catchment that will enhance the runoff to the pit and subsequently the re-watering progress; and

3. **Scenario 3:** Open Pit Backfill Scenario using the current waste rock dump as main source of fill material and back filling the pit excavation to current ground elevation level. The other residue deposits (CRD and FRD) will remain on surface and be rehabilitated.

These scenarios are illustrated in Figure 4.

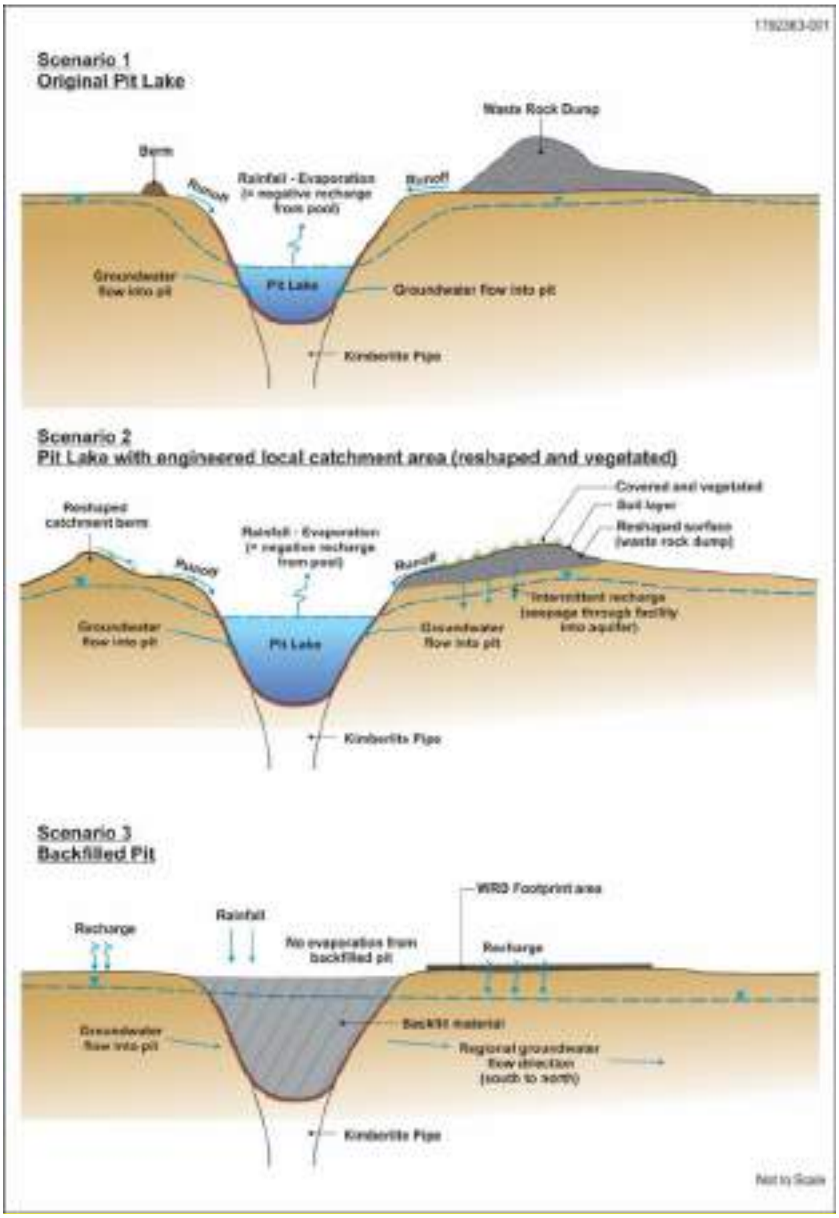


Figure 4. Three mine closure scenarios considered during the mine closure strategic alternatives assessment (from Golder 2019).

In selecting the most appropriate closure strategy for the open pit, the technical evaluation evaluated all options in a risk-based assessment in terms of the following:

- Hydrology (rate of re-watering and water level elevation)

- Hydrogeology and geochemistry (Geochemical source terms of the pit (i.e. rock faces) and the backfilling material (i.e. mainly the waste rock dump), as well as Water quality signatures of the pit lake waterbody);
- The closure cost of each of the scenarios; as well as
- The post closure environmental risks and management requirements (Risk of polluting the surrounding aquifer system(s), based on the final hydraulic nature/relief of the rehabilitated site).

Information in this section has been derived from the *Technical Evaluation of the Risks, Impacts and Management Requirements into Pit Backfilling versus Current Mine Plan (Pit Lake)* report (Appendix 14). The contents in this report have either been reproduced verbatim or extracted from this source and edited.

Hydrological evaluation

Due to the high surface elevation of the mine, i.e. situated close the runoff-water divides of three quaternary catchments, the local runoff is directed away from the pit area; thus, any contribution from local runoff to enhance the development of a deep pit lake, is limited. The only physical contribution to the re-watering process is from direct rainfall recharge and local groundwater ingress. In addition, evaporation in the Voorspoed region is much higher than the total rainfall and groundwater ingress into the pit, the pit lake water level elevation is predicted to remain as a local piezometric sink i.e. the final water level elevation will settle several metres below the surrounding natural groundwater level elevation.

The numerical modelling, confirmed the impact of the high evaporation rate and the low groundwater ingress observed during LoM and that the re-watering rate in terms of scenarios 1 and 2 will be retarded [under the current climate conditions, 200 years after closure, the water table could be in the order of 94 m below ground surface]. In the case of scenario 2, where a “local catchment” feeding local runoff into the pit excavation is engineered, the simulated re-watering water level elevation over a 200-year period will be ~75 m below ground surface. The gain is in the order of 19 m.

Re-watering of the back filled pit excavation (scenario 3) will be driven by recharge from local rainfall infiltration and groundwater ingress and could reach the pre-mining water level elevation in ~32 years post backfilling, primarily due to the absence of the evaporation component in the modelling. Hence after 32 years the pit will no longer act as a sink and potentially contaminated water will thus migrate away from the pit area and potentially impact on surrounding aquifers.

Hydrogeological and geochemical evaluation

The water quality characteristics [modelling] in the case of scenarios 1 and 2 for the pit lake water body are based on the groundwater quality of the pit water source, i.e. seepages in the pit floor area that can be regarded as deep, crustal/Kimberlite type water. It shows that the initial TDS concentration is generally below the water quality limits for life stock water quality limits. However, other important chemical constituents such as Sodium, Sulphate and Calcium indicates long-term increases for scenario’s 1 and 2, due to the evaporation impact. However, as noted above, the water level elevation will remain as a local “sink” under the current drier climate conditions, due to a low groundwater inflow and high evaporation rate.

With scenario 3 (backfilling), no pit lake will develop. Re-watering of the back filled pit excavation will be driven by recharge from local rainfall infiltration and groundwater. The water level in backfilled excavation area is likely to become a groundwater mound and result in subsurface flow of potentially poor-quality water to the surrounding aquifer occurs. Due to leaching of dissolved substances from the semi-consolidated waste rock filling mass, the concentrations of the potential contaminants of concern: TDS, sodium, sulphate, calcium and selenium in the water contained in the semi-consolidated waste rock filling mass will exceed the livestock and domestic water quality limits for 64 to more than 100 years. Thereafter, the contaminant levels will reduce to acceptable levels, as the contaminants are flushed out of the backfilled pit system to the surrounding aquifer system. Consequently, it is possible that the aquifer and potential groundwater users could be impacted by this poor groundwater quality seepage from the backfilled and re-watered pit.

The post closure environmental risks and management requirements

Scenario 3 (backfilling) puts a risk on migration of poorer quality groundwater from the filled excavation to the local groundwater resources, due to leaching of dissolved substances from the semi-consolidated waste rock filling mass. This will require a long-term responsibility and liability for water quality observations/monitoring on the mine site and surrounding land, followed by mitigation procedures, for example designing a special pollution plume borehole capturing system and subsequent polluted water storage and/or treatment processes.

- **Comparison of the three pit closure alternatives**

  Table 2 summarises the advantages and disadvantages associated with each scenario.

Table 2. Advantages and disadvantages associated with each pit closure scenario (from Golder 2019).

Scenario 1: Pit lake *status quo*	Scenario 2: Pit lake with enhanced drainage	Scenario 3: Backfilled pit
Advantages		
• Low cost for option development • Pit water quality remain largely within domestic and livestock limits, only selenium could be a problem for domestic use • Water level remain below the natural ground water level, so the pit will continue to act as a pollution sink, with no plume migration.	• Higher cost for WRD reworking, but still much less than backfilling • Pit water quality remain largely within domestic and livestock limits, only selenium could be a problem for domestic and livestock use • Water level below natural ground level so pit will continue to act as a sink with no plume migration • Possible vegetation failure and soil erosion losses of the WRD will report to the pit and not to the environment	• Excessive cost of backfilling • Backfilling costs is disproportionate to the benefits achieved by mining activities over the life of the mine • Reuse of the post-closure WRD footprints • Increase in catchment yield • WRD will no longer pose a contamination risk, and the pit will no longer pose a safety risk
Disadvantages		
• Pit crest instability with associated break back, posing a safety risk requiring proper protection • Possibility of illegal mining taking place immediately post-closure • Continuous monitoring of WRD, CRD and FRD. Possible vegetation failure and soil erosion losses on the WRD, CRD and FRD would result in silt and other contaminants reporting to the environment	• Pit crest instability with associated break back, posing a safety risk requiring proper protection • Possibility of illegal mining taking place immediately post-closure, although the period for water to fill the pit will be marginally shorter than for Scenario 1 • Reduction of catchment yield from the WRD, CRD and FRD • Continuous monitoring of WRD, CRD and FRD. Possible vegetation failure and soil erosion losses on the WRD, CRD and FRD would result in silt and other contaminants reporting to the environment	• Extreme cost to backfill • Water level will rebound to the natural groundwater table level • Groundwater quality exceeds constituents of concern and contaminated groundwater plume will migrate down gradient to the surrounding aquifer system(s) • Water quality in the pit improve after ±100 years, but the contaminants move to the surroundings in the contaminated groundwater plume • Possible additional cost of abstraction and treatment of polluted groundwater plume

Scenario 3 offers the best option towards the social aspects, specifically in terms of public safety and is close to having a pre-mining environment established. However, the backfilling of the pit would result in excessive costs that were not economically viable. Furthermore, the costs associated with the backfilling of the open pit is more than what could be considered proportional to the benefits achieved by mining activities over the life of the mine. Scenarios 1 and 2 would require special mitigation measures in terms of security and protection of the property against illegal mining and unauthorised trespassing, with potential fatal consequences. These measures, that includes the construction of a best available security fence and an enviroberm around the pit, will have to be funded and managed for a considerable time after final closure.

Re-watering of the pit will be marginally quicker in Scenario 2 than in Scenario 1, which will provide earlier protection of the property against illegal mining and unauthorised trespassing. However, this benefit come at a cost of approximately R14 million, which is not considered to be proportional to the benefit gained.

From an environmental perspective, the water quality in the Pit Lake will be impacted more in Scenario 2 than in Scenario 1. Scenario 3 introduces the possible pollution of groundwater and possibly even surface water from the saturated backfilled excavation for approximately 100 years. After 32 years the backfilled pit will no longer act as a sink and potentially result in the migration of contaminated water away from the pit area, with potential impacts on surrounding aquifers. This will require a long-term responsibility and liability for water quality observations/monitoring on the mine site and surrounding land, followed by mitigation procedures, for example designing a special pollution plume borehole capturing system and subsequent polluted water storage and/or treatment processes.

Furthermore, the final environmental conditions post closure won't be comparable with pre-mining conditions for Scenarios 1 and 2, due to the remaining open pit and rehabilitated mine residue deposits. In scenario 2 the agricultural use of the land for grazing will be more limited than Scenario 1, due to the inaccessibility of specifically the engineered local catchment around the open pit.

Rehabilitation design alternatives

Voorspoed Mine also assessed various rehabilitation design alternatives. These include two or three alternatives each for on-site and off-site infrastructure, considering maintaining, demolishing or selling the infrastructure. With regard to the Mine Residue Deposits, the options relate to the profiling, surface water management and growth medium selection for the Waste Rock Dump, Coarse Residue Deposit and Fine Residue Deposit. The alternatives considered, as well as the preferred options are indicated in Table 3.

Table 3. Rehabilitation design alternatives considered (from Redco & Uvuna Sustainability, 2019).

Mine closure element	Alternative 1	Alternative 2	Alternative 3
ON SITE INFRASTRUCTURE			
Treatment plant and associated equipment	Maintain plant *in situ* for future use	Demolish and remove all infrastructure	Sell plant to another mine
Outcomes	Resource is depleted and there is no commercially viable option for continued mining. Received no commercially viable bids from other operators (see **Error! Reference source not found.**).		If the plant is successfully sold, the plant will be demolished & removed.
Preferred Option	✗	✓	**As for Alternative 2, if sold**
Offices, workshops, stores	Maintain use of infrastructure for third parties	Demolish and remove all infrastructure	
Outcomes	Due to the mine's location and nature of the infrastructure (e.g. temporary offices), no opportunities for sustainable re-use of the infrastructure have been identified.		
Preferred Option	✗	✓	**As for Alternative 2**
OFF-SITE INFRASTRUCTURE			
	Retain all off-site infrastructure for use by third parties post closure	Demolish and remove all off-site infrastructure	Retain selected off-site infrastructure for use by third parties post closure
Outcomes	No opportunities have been identified and no agreed handover / maintenance agreements have been achieved	Selected infrastructure (access road, *Eskom* substations & Renoster River weir) will not be demolished.	As for Alternative 2
Preferred Option	✗	✗	✓

Mine closure element	Alternative 1	Alternative 2	Alternative 3
WASTE ROCK DUMP (WRD)			
Profiling	24° single slope per lift with benches between lifts	18° single slope per lift with benches between lifts	
Outcomes	Stable, non-eroding slopes with sustainable vegetation establishment may not be achievable	Flatter angle facilitates improved chance of establishing sustainable slopes.	
Preferred Option	✗	✓	
Surface Water Management	Contain all runoff on top area; contain all runoff from upper slopes on benches	Shed all runoff from top area; shed all runoff from upper slopes and benches	Shed runoff from top area; contain all runoff from upper slopes on benches
Outcomes		Erosion risk are introduced & may require surface water management structures, attracting cost & maintenance	As for Alternative 2
Preferred Option	✓	✗	✗
Growth Medium	300 mm soil cover layer on entire facility	200 mm soil cover layer on slopes and 100 mm soil cover layer on top area, both areas with soil amelioration	
Outcomes			
Preferred Option	✗	✓	
COARSE REVENUE DEPOSIT (CRD)			
Profiling	Short slope (45m) with 2x benches; Intra bench slope at 18°	Long (up to 140 m) single slope at 16°	
Outcomes		Flatter angle facilitates improved chance of establishing sustainable slopes.	
Preferred Option	✗	✓	

Mine closure element	Alternative 1	Alternative 2	Alternative 3
Surface Water Management	Non-water shedding except for lower slope	Slopes water shedding and only contain runoff on top area	
Outcomes			
Preferred Option	✗	✓	
Growth Medium	Soil cover of 300 mm	Basalt armour of 300mm; Soil cover of 200 mm	
Outcomes		Increased stability and combatting of erosion	
Preferred Option	✗	✓	
FINE RESIDUE DEPOSIT (FRD)			
Profiling	Short slope (45m) with 1x benches on longer slopes, other slopes single 18°slope; Intra bench slope at 18°	Long (up to 80 m) single slope at 16°; shorter slopes at 18° single slope with only soil cover	
Outcomes			
Preferred Option	✗	✓	
Surface Water Management	Contain max of 50,000m^3 water on facility and construct emergency spillways	Slopes water shedding and contain runoff on top areas	
Outcomes			
Preferred Option	✗	✓	
Growth Medium	Soil cover of 300mm	Basalt armour of 300mm; Soil cover of 200 mm	
Outcomes			
Preferred Option	✗	✓	

End Land Use Alternatives

Voorspoed Mine commissioned a study to develop an End Land Use Plan that is aligned with the mine's closure planning initiatives; preliminary Mine Closure plan (2011 & 2014); Rehabilitation plan (2014); Social closure plan; as well as the Fezile Dabi district municipality's Integrated Development Plan. The study developed an extensive list of potential end land uses to evaluate which of the options had the highest likelihood of succeeding beyond closure. In addition, it also evaluated the business case (financial viability) of the selected end land use (ELU) options. Further detail regarding the ELU options and their feasibility assessments is available in the *Proposed End Land Use Plan for Voorspoed Diamond Mine* report (Neka 2017)[5] (Appendix 15).

Following a key stakeholder workshop held at Voorspoed Mine on 25 August 2016, the mine identified 22 potentially viable end land use options:

Livestock and Game production

- Extensive cattle farming;
- Extensive sheep farming;
- Intensive cattle farming (feedlot);
- Intensive sheep farming (feedlot);
- Commercial piggery;
- Chicken farming (broilers and layers);
- Game farming;
- Game farming with high value species.

Crop production

- Dryland maize and other crops (sunflower/soya);
- Maize under centre pivot irrigation (utilising pit lake water);
- Vegetable production under centre pivot irrigation (utilising pit lake water)
- Vegetable production in greenhouses.
- Sunflower, soya bean and other alternative oil producing crops (for bio-fuel);
- Cut flower production;
- Pecan nut production.

Other land uses

- Conservation - wetlands/biodiversity;
- *Aggregate production from the Waste Rock Dump;*
- *Brick making from the Coarse Residue Deposit;*
- *Brick making Fine Residue Deposit;*
- Solar farm; and
- Mining tourism.

[5] *Proposed End Land Use Plan for Voorspoed Diamond Mine*, Dr M. E. Aken, NEKA Sustainability Solutions.

Although the ELU options indicated in italics were identified, they were deemed unsuitable as post-closure activities, as they would delay the final rehabilitation of the mine residue facilities. In addition, a number of other potential ELU options identified that would require environmental authorisation in terms of the National Environmental Management Act (No. 107 of 1998) Environmental Impact Assessment regulations, such as cattle and sheep feed lots, commercial piggeries, and large chicken farming. These options would be more difficult to implement, because of the extended time line for acquiring the necessary environmental authorisations, as well as the potential opposition from neighbouring stakeholders, because of nuisance odours associated with these enterprises. None of these options were therefore, evaluated further.

The land capability assessment indicated that the mining area and adjacent Voorspoed properties could be utilised for extensive sheep, cattle and game farming, with limited cropping on existing cultivated lands.

However, the general shortage of surface and groundwater in the area mitigated against the selection of intensive agriculture in the form of large-scale centre pivot irrigation of maize and vegetables, and the greenhouse cultivation of vegetables and cut flowers. The high cost of importing/pumping irrigation water from remote water sources, if this water use could be licenced, would render the irrigation enterprises marginal to unprofitable. In addition, the limited surface and groundwater resources on Voorspoed were evaluated to likely be insufficient to water the high densities of livestock kept.

A further challenge regarding the intensive livestock production farming enterprises (feedlots) identified was that they are likely to contribute significantly to the pollution of the existing surface and groundwater resources in the area.

Amongst the variety of potential End Land Use options proposed, the agricultural use of the mining area and adjacent Voorspoed properties post-closure was deemed to be the most appropriate in the regional context, and the most likely to be sustainable in the long term. The agricultural ELU options that were selected for economic evaluation, included the production of selected crops (maize and sunflower), domestic livestock farming (cattle and sheep), and also game farming, and combinations of these.

The financial modelling done for the different preferred ELU options indicated that none of these presented a positive business case for Voorspoed to take forward as an option that would provide a “cash neutral” or profitable enterprise to fund all monitoring and maintenance work required during the post-closure monitoring period.

Therefore, the study concluded that the mining area and other Voorspoed properties can be used for profitable extensive sheep, cattle and game farming, with limited cropping on existing cultivated lands. However, this could only be done if the mining area and other Voorspoed properties are integrated into existing and established farming enterprises in close proximity to the mine, in particular where the start-up capital needed is kept as low as possible.

DBCM is, however, considering other land use alternatives and may, depending on feasibility, present further alternatives for the use of the land associated with Voorspoed mine at the appropriate time.

(ii) Preferred mine decommissioning option

The National Environmental Management Principles in section 2 of the National Environmental Management Act (NEMA) (No. 107 of 1998) requires that environmental management must be integrated, acknowledging that all elements of the environment are linked and interrelated. In addition, it requires that environmental management must take the effects of decisions on all aspects of the environment and all people in the environment into account, by pursuing the selection of the best practicable environmental option. The best practicable environmental option is defined in section 1 of the NEMA as the option that provides the most benefit or causes the least damage to the environment as a whole, at a cost acceptable to society, in the long term as well as in the short term. This clearly establishes the opportunity to not only consider the best environmental option, but to also consider the cost thereof in order to arrive at the best practicable environmental option.

Pit closure option

In terms of economic and environmental considerations, scenario 1 is the best practicable environmental option, due to the more acceptable cost associated with rendering the open pit lake safe and the decommissioning and rehabilitation of the mining area. By limiting surface water run-off from the rehabilitated mining area, the migration of contaminated water to the surrounding environment will be limited. However, the final environmental conditions post closure won't be comparable with pre-mining conditions, but the agricultural use of the land for grazing will be largely reinstated.

Scenario 3 offers the best option towards the social aspects, specifically in terms of public safety. In addition, it is the option that would be the closest to re-establishing a pre-mining environment. However, due to the excessive cost thereof, and the potential long-term groundwater pollution post closure, scenario 3 is not regarded as the best practicable environmental option.

Rehabilitation design option

The preferred option for the decommissioning and rehabilitation of the remainder of the mining area is the same for all of the pit closure scenarios, i.e:

- On-site infrastructure
  Demolish and remove all infrastructure.

- Off-site infrastructure
  Retain selected off-site infrastructure for use by third parties post closure.
- Waste Rock Dump
  - Profile of 18º single slope per lift, with benches between lifts.
  - Contain surface water run-off on the top area and run-off from the upper slopes on the benches.
  - Use 200 mm and 100 mm soil layers on the slopes and top areas respectively, with soil amelioration.
- Coarse Residue Deposit
  - Profile of long (up to 140 m) 16º single slope.
  - Only contain surface water run-off on the top area, while shedding the surface run-off from the slopes.
  - Use a 300 mm basalt armour layer, with a 200 mm soil layer on top of the armour, with amelioration of the growth medium.
- Fine Residue Deposit
  - Profile combination of long (up to 80 m) 16º single slope, and shorter 18º single slopes.
  - Contain surface water run-off on the top area, but shed surface run-off from the slopes.
  - Use a 300 mm basalt armour layer, with a 200 mm soil layer on top of the armour, with amelioration of the growth medium.

End Land Use option

The mining area and other Voorspoed properties will be used for profitable extensive sheep, cattle and game farming, with limited cropping on existing cultivated lands. In order to do this, the mining area and other Voorspoed properties will be integrated into existing and established farming enterprises in close proximity to the mine, to keep the start-up capital needed as low as possible.

b) Details of the public participation process followed

(Describe the process undertaken to consult interested and affected parties including public meetings and one on one consultation. NB! The affected parties must be specifically consulted, regardless of whether or not they attended public meetings. (Information to be provided to affected parties must include sufficient detail of the intended operation to enable them to assess what impact the activities will have on them or on the use of their land.)

Voorspoed Mine has been engaging extensively with stakeholders during the operational phase of the mine. This was done in terms of stakeholder engagement processes as part of the mine's social and labour plan commitments, socio-economic impact assessment for mine closure[6], as well as their enterprise development hub and local economic development initiatives. The mine also developed and implemented a comprehensive stakeholder engagement plan for mine closure, which included an extensive stakeholder participation process.

It must therefore be noted that the public participation process for the environmental impact assessment is another stakeholder engagement processes that occurs late in a process that has already spanned many years and extensively consulted numerous stakeholder groups at various levels of society. This process therefore focussed exclusively on the environmental consequences of the decommissioning and mine closure process, including the socio-economic consequences, despite the fact that there was an extensive process that focussed exclusively on the socio-economic consequences and involved a wide range of stakeholder groups.

Stakeholders for the EIA process were identified using the existing stakeholder engagement plan, while also including the legally identified stakeholders. An invitation letter was circulated to all identified Interested and Affected Parties (I&APs), inviting them to register as an I&AP and peruse the Background Information Document (BID). The BID contained information about the decommissioning and mine closure process, as well as the EIA process and the role of interested and affected parties in the process, with a registration and feedback form.

In addition, site and newspaper advertisements were published to invite potential interested and affected parties to participate in the EIA process. The newspaper advertisements were published in the Kroonnuus, Parys Gazette, Dumelang News, as well as The Sunday Times. Radio advertisements on Mozolo FM were also used to invite potential interested and affected parties to participate in the EIA process.

Two public meetings were arranged to provide information about the decommissioning application and mine closure process to interested and affected parties. These were held on Monday, 19 August 2019 in Kroonstad (Moqhaka LM) at the Kroonstad Town Hall and on Tuesday, 20 August 2019 in Parys (Ngwathe LM) at the Parys Town Hall. The minutes of the two public meetings are attached

In addition, dedicated meetings were arranged with relevant government stakeholders, such as the Departments of Water and Sanitation (DWS), environmental affairs (FS DESTEA), agriculture and rural development (FS DARD), as well as the local municipalities (Ngwathe, Moqhaka and Fezile Dabi).

[6] *Socio-economic impact assessment - Voorspoed Mine closure*, Environmental Resources Management (ERM), April 2019.

The draft Basic Assessement Report and combined Environmental Management Programme and Closure Plan were made available to interested and affected parties for review and comment at Voorspoed Mine, the Moqhaka & Ngwathe Municipal offices in Kroonstad, Parys and Viljoenskroon, as well as the Kroonstad, Parys, Vredefort, Koppies and Viljoenskroon public libraries. The documents were also made available online on the website of the Centre for Environmental Management. In addition, these documents were also distributed to the regional offices of the Department of Mineral Resources, Department of Agriculture, Forestry and Fisheries, Department of Rural Development and Land Reform, the regional and national offices of the Department of Water and Sanitation, the office of the Free State Department of Economic, Small Business Development, Tourism and Environmental Affairs, as well as to the offices of the Moqhaka and Ngwathe Local Municipalities.

The following information was provided to all the I&APs:

- The site plan and list of activities to be authorised;
- Scale, extent and duration of activities to be authorised;
- Typical impacts of those activities (e.g. surface disturbance, dust, noise, drainage etc.)
- Sufficient detail of the intended decommissioning and closure process to enable them to assess what impact the activities will have on them or on the use of their land)

All I&APS were subsequently requested to:

- provide information on environmental features and current land uses and their locations within the mining area;
- provide information on how the proposed activities will impact on them or their socio-economic conditions and make written proposals as to how and to what standard the anticipated environmental and socio economic impacts can be remedied or mitigated;
- to make written proposals as to how the potential impacts on infrastructure can be managed, avoided or remedied.

The issues raised by the I&APs, as well as the applicant's/EAP's responses to these are captured in table 4.

(i) Summary of issues raised by I&APs

(Complete the table summarising comments and issues raised, and reaction to those responses.)

Table 4: Summary of the comments and issues raised by interested and affected parties, as well as EAP's (applicants) responses to these

Interested and affected parties		**Date of comments received**	**Issues raised**	**EAP's response to issues as mandated by the applicant**	**Section & paragraph reference in this report where the issues and/or response were incorporated**
(List the names of persons consulted in this column, and mark with an X where those who must be consulted were in fact consulted.)					
Affected parties					
Landowner/s					
Not applicable. Voorspoed Mine is the land owner					
Lawful occupier/s of the land					
Not applicable. Voorspoed Mine is the lawful occupier of the land					
Landowners or lawful occupiers on adjacent properties	X				
Ronel Leonard	X	2019/08/19	Heard rumours that a party is busy moving some of the historic mine dump from the Mine's	*Response by PJ Jordaan (on behalf of the Mine):*	7, 8(a)(i)

Interested and affected parties		Date of comments received	Issues raised	EAP's response to issues as mandated by the applicant	Section & paragraph reference in this report where the issues and/or response were incorporated
			premises to another site where it is being re-mined for diamonds	One party was interested in re-mining the historic dump. The Mine requested that this party must first conform to all of the regulatory requirements to proceed with this activity. The party has to date not conformed to the requirements, thus the dump is currently not being reworked.	
Ronel Leonard	X	2019/08/19	Suggested that Renosterkop be transformed into a conservation area as an alternative mitigation/rehabilitation measure	*Response by PJ Jordaan (on behalf of the Mine) and by Theunis Meyer, the EAP:* The Renosterkop area referred to is situated outside the mining area and was not negatively impacted by the Mine. Strictly speaking, it does not fall within the ambit of the decommissioning scope of the EIA. The conservation proposal, previously made by the adjacent land owners, was not pursued by the Mine, due to constraints the Mine faced at the time. Land owners are requested to submit a new proposal for consideration.	
Municipal councillor					
Ward councillor	X	None			
Municipality					
Moqhaka Municipality	X	None			

Interested and affected parties		**Date of comments received**	**Issues raised**	**EAP's response to issues as mandated by the applicant**	**Section & paragraph reference in this report where the issues and/or response were incorporated**
Ngwathe Municipality	X	None			
Competent authority	**X**				
Department of Mineral Resources and Energy	X	2019/03/01	Requested a copy of the communication regarding the mine closure to the Section 52 Board	Included in the BAR	7, 8(a)(i)
			Decommissioning cannot proceed without the necessary EA. The partial/temporary removal of some of the valuable components of the processing plant is debated, with the caution to not take the plant out of active service permanently.	Included in the BAR	7, 8(a)(i)
			Also involve the Chief-Director mine safety in the decommissioning process.	This has been done, as the Chief-Director is an important stakeholder in the decommissioning and mine closure process. Struggled to source the contact details for the relevant person.	8(b)(i)
			Also publish the newspaper advertisement regarding the EA application in one national newspaper.	Has been done.	8(b) & Appendix 28
Organs of state **(that regulate aspects of the environment that may be affected, e.g. Water, Environment, Agriculture, DRDLR, etc.**	**X**				

Interested and affected parties		Date of comments received	Issues raised	EAP's response to issues as mandated by the applicant	Section & paragraph reference in this report where the issues and/or response were incorporated
DWS Chief Director: Water Quality Regulation	X	2019/06/04	What will the impact be of the preferred pit closure option and the formation of the pit lake?	Specialist studies have shown that • the pit lake will form very slowly and the surface will always remain way (approximately 40-75 m) below the ground level and never decant into the receiving environment. The quality of the pit water has elevated TDS levels, which is expected to increase over time. No acid drainage will be generated. • if the pit is back-filled, it could create a matrix of soil and rock that could facilitate the upward mobility of the polluted water and result in the decanting thereof into the receiving environment.	7, 8(a)(i)
DWS Chief Director: Water Quality Regulation	X	2019/10/02	Taking into consideration the gaps in information identified, the Chief Directorate: Water Quality Regulation does not support closure of the mine, as proposed.	This statement does not relate to the application under consideration to decommission the mine infrastructure, not to close the mine. In addition, it does not seem to provide clear reasons for the decision, apart from the generic reference to the gaps in the information identified.	
			Use of the pit water for irrigation is not supported, since the pit water exceeds the South African Water Quality Guidelines for domestic, irrigation and livestock use.	Agreed. This is also reflected in the End Land Use options considered.	8(a)(i), 13

Interested and affected parties		Date of comments received	Issues raised	EAP's response to issues as mandated by the applicant	Section & paragraph reference in this report where the issues and/or response were incorporated
DWS Chief Director: Water Quality Regulation	X	2019/10/02	A model that describes the current and post closure pit water quality must be developed.	Models to describe the pit water quality have been developed and included in two specialist reports from Golder Associates, i.e. Voorspoed Mine Summary of Surface and Groundwater Study for Mine Closure (October 2017) and Voorspoed Diamond Mine, Technical Evaluation of the Risks, Impacts and Management Requirements into Pit Backfilling Versus Current Mine Plan (Pit Lake) (February 2019). It is not clear if these models are inadequate or what is further required	8(a)(i), 13
			A geotechnical study must be conducted to determine the stability of the pit wall. This is necessary in order to identify the potential impacts on the land adjacent to the pit. It is also important in determining how the eroded side-wall material may contribute to further deterioration of the pit water quality. Further collapse of the pit side-walls may lead to the collapse of the fencing surrounding the pit, which poses a risk to public safety and animals.	The decision to not extend the Life of Mine (LoM) primarily considered geotechnical studies to determine the stability of the pit wall. The identification of the preferred pit closure options with the associated cost calculations were also primarily based on such studies. Voorspoed Mine will be requested to make such a studies available for the Department's consideration.	7, 8(a)(i), 13

Interested and affected parties		Date of comments received	Issues raised	EAP's response to issues as mandated by the applicant	Section & paragraph reference in this report where the issues and/or response were incorporated
DWS Chief Director: Water Quality Regulation	X	2019/10/02	According to the EMPr, backfilling was a requirement for the mine. However, it has been indicated that the mine is not in a position to backfill the pit due to unforeseen circumstances.	This statement is not true. The decision to not backfill the pit has been motivated in the BAR with regard to the potential for long term groundwater pollution if this is done, as well as the cost thereof that is orders of magnitude more than the other closure options and disproportionate to the benefits associated with implementing such an option.	???
			An impact prediction model must be developed in terms of the Department of Water Affairs and Forestry (DWAF) Best Practice Guidelines (BPG) G4 (Impact Prediction) to indicate the potential groundwater pollution impacts should the pit be backfilled.	Models to describe the pit water quality have been developed and included in two specialist reports from Golder Associates, i.e. Voorspoed Mine Summary of Surface and Groundwater Study for Mine Closure (October 2017) and Voorspoed Diamond Mine, Technical Evaluation of the Risks, Impacts and Management Requirements into Pit Backfilling Versus Current Mine Plan (Pit Lake) (February 2019). It is not clear if these models are inadequate or what is further required.	8(a)(i), 13
			Baseline groundwater quality data must be provided.	Baseline groundwater quality data has already been provided in the specialist report Voorspoed Mine Summary of Surface & Groundwater Study for Mine Closure, Golder Associates (Oct 2017)	13

Interested and affected parties		Date of comments received	Issues raised	EAP's response to issues as mandated by the applicant	Section & paragraph reference in this report where the issues and/or response were incorporated
DWS Chief Director: Water Quality Regulation	X	2019/10/02	Groundwater monitoring must be conducted quarterly for five years after cessation of mining operations and reported on an annual basis.	This is in line with the groundwater monitoring commitments in the Environmental Management Programme and Closure Plan.	16, 18b, EMPr 1(h)
DWS, Geohydrology	X	2019/10/02	The specialist studies are acceptable as they have gone into details regarding the geohydrological status of the mine and also looked at possible impacts on the resource as well as providing the mitigation measures to all the anticipated impacts.	Acknowledge comment	13
			The impact to the groundwater resource is mostly from the dump sites as indicated on the geochemical analyses diagrams; but the contaminant transport model indicates that contamination will not exceed sulphate limits on the neighbouring farms post mine closure.	Acknowledge comment	13
DWS, Geohydrology	X	2019/10/02	The groundwater monitoring program is adequate and acceptable. The Department supports the recommendation to develop three (3) surface water monitoring sites.	This is in line with the groundwater monitoring commitments in the Environmental Management Programme and Closure Plan.	16, 18b, EMPr 1(h)
			Groundwater monitoring should be done as follows: • Groundwater levels should be monitored on a monthly basis during the Decommissioning-	This is in line with the groundwater monitoring commitments in the Environmental Management Programme and Closure Plan.	16, 18b, EMPr 1(h)

Interested and affected parties		Date of comments received	Issues raised	EAP's response to issues as mandated by the applicant	Section & paragraph reference in this report where the issues and/or response were incorporated
			Closure Phase and biannually in the post-closure phase. • Groundwater quality should be sampled and analysed by an accredited laboratory, using the correct scientific methods to avoid alien and cross contamination. • Analyses should include major cations (i.e.: Ca, Mg, Na & K), major anion (i.e. Cl, F & SO_4), Physic-chemical determinants (i.e. conductivity, pH, TDS and Total Alkalinity), as well as metals & trace metals (i.e. Fe, Cr, Se, Pb, Mn, Al & Zn).		
DWS, Geohydrology	X	2019/10/02	A programme should be initiated to generate hydrological data that will be used as a baseline dataset for future planning and to confirm the numerical modelling and predictions modelled during the mine closure study.	Included in the groundwater monitoring commitments in the Environmental Management Programme and Closure Plan.	16, 18b, EMPr 1(h)
			A transport contamination model should be upgraded at least every 5 years, using the latest monitoring data.	Included in the groundwater monitoring commitments in the Environmental Management Programme and Closure Plan.	16, 18b, EMPr 1(h)
Department of Agriculture	X	2019/04/12	Before the mining activities commenced, the land had been farming land and therefore needs to go back to farming land that could be used for agricultural production.	This is in line with the preferred End Land Use.	4(b), 5, 7, 8(a)(i)

Interested and affected parties		Date of comments received	Issues raised	EAP's response to issues as mandated by the applicant	Section & paragraph reference in this report where the issues and/or response were incorporated
Department of Agriculture	X	2019/04/12	The slope of the remaining rehabilitated residue deposits should facilitate farming activities.	This is in line with the preferred End Land Use.	4(b), 5, 7, 8(a)(i)
			The depth of the soil cover on the rehabilitated residue deposits. If the soil cover is only 200 mm deep, it must not compromise the ability of the land to be used for agricultural production and the ability of the vegetation to reach a stable state.	A 200 mm soil cover has been used on the concurrent rehabilitation areas and proven to be sustainable, even during droughts and periods of above average rainfall.	4(b), 5, 7, 8(a)(i)
			During and after the mine rehabilitation and closure process, the area may be susceptible to invasion by alien invader plants. Measures need to be implemented to control such plants during the rehabilitation and closure process until a stable vegetation cover has been achieved.	Invader plants will be controlled during and after the mine rehabilitation and closure process, as indicated in the EMPR, as well as rehabilitation and closure plans.	12, 15, EMPr 1 (e), (f)
			Some parts of the mining land is currently covered by the indigenous encroacher plant, commonly known as Bankrupt Bush or Slangbos. Measures must be implemented to control these plants during the rehabilitation and closure process.	Indigenous encroacher plants will be controlled during and after the mine rehabilitation and closure process, as indicated in the EMPR, as well as rehabilitation and closure plans.	12, 15, EMPr 1 (e), (f)
South African Heritage Resources Agency	X	2019/09/25	As this is a decommissioning application of an existing mine, the SAHRA Archaeology, Palaeontology and Meteorites (APM) Unit has no objection against the activities subject to specific conditions that must be adhered to.	The specific conditions have been included as conditions that must be included in the environmental authorisation	Section 18b

Interested and affected parties		**Date of comments received**	**Issues raised**	**EAP's response to issues as mandated by the applicant**	**Section & paragraph reference in this report where the issues and/or response were incorporated**
Dept. Rural Development and Land Affairs	X	2019-04-10	None		
Free State Dept. Environmental Affairs	X	2019-04-10	None		
Organs of state **(Responsible for infrastructure that may be affected, e.g. Roads Department, Eskom, Telkom, etc.**	**X**				
Roads Department	X		None		
Telkom	X		None		
Eskom	X		None		
Traditional Leaders					
Not applicable					
Communities	**X**				
Mpaka Stephen Sehume	X	2019/08/19	Why has the surrounding farm labourers never benefited economically and socially from the Mine's activities, i.e. employments, education etc.	*Response by PJ Jordaan, Andrew Moremi, Lungile Zinnu, Rebotile Kgaka and Mojabeng Pinkoane (on behalf of the Mine):* The Mine did not directly/specifically target the surrounding farm labourers as beneficiaries. Neither did the Mine directly/specifically exclude the surrounding farm labourers as beneficiaries.	BAR section 13 & 22(a)(i)

Interested and affected parties		Date of comments received	Issues raised	EAP's response to issues as mandated by the applicant	Section & paragraph reference in this report where the issues and/or response were incorporated
				The corporate social responsibility programmes of the Mine are administered through the Moqhaka and Ngwathe Local Municipalities and other stakeholders, such as the Department of Labour. These parties were tasked to identify beneficiaries that meet the specifications of the projects, i.e. equipment, level of education needs etc. Thus, the surrounding farm labourers need to meet these needs to be eligible beneficiaries, e.g. currently five people from the surrounding communities are employed by the Mine, of which two work in the Supply Chain Department.	
Mpho Leboa	X	2019/08/20	Mine closure is a very technical process. Not everyone from the community understands this process. Thus, if any unexpected impacts result from this process, the community may be angered and express this anger by way of protests. How best can the Mine involve the community in this process to avoid these unwanted protests?	*Response by PJ Jordaan (on behalf of the Mine):* The Mine will, outside the scope of this mine closure process, arrange another engagement to inform the community in layman's terms of the closure process and its implications.	
Mpho Leboa and Sylvester Motlolometsi	X	2019/08/20	The Mine has contributed significantly to the community in terms of education, employment, providing facilities etc. How will the, for example,	Response by Andrew Moremi (on behalf of the Mine): The Mine's current Social and Labour Plan is effective from 2017 – 2021. Thus the Mine is	BAR section 13 & 22(a)(i) EMPr section 1(e)

Interested and affected parties		Date of comments received	Issues raised	EAP's response to issues as mandated by the applicant	Section & paragraph reference in this report where the issues and/or response were incorporated
			Ratang Maqheku Centre for the Aged in Parys, be sustained post mine closure?	committed to supporting all of its social commitments until 2021. The Mine is also in communication with the Department of Social Development to revise the grants to, for example, Ratang Maqheku, to be more inclusive for the Centre to be sustained.	
Xolani Sochiva	X	2019/08/20	The mine should not close. It should remain open to create job opportunities for the youth in the Frees State Province that is poverty-stricken.	*Response by PJ Jordaan (on behalf of the Mine):* Unfortunately there is no other option, but to close the mine. There are no more diamonds to mine and as a result no more job opportunities. The Mine had to get approval from the Minister for closure. Thus, the decision to close was not taken lightly.	BAR sections 6
M George Koba	X	2019/08/20	Who is going to be responsible for the risks in the mining area post mine closure? The government did not create the mining area and thus do not know all the risks. De Beers created it, they understand the risks and how to manage it and should remain liable.	*Response by PJ Jordaan (on behalf of the Mine):* The Mine will be responsible for rehabilitating the mining area until approximately 2028. Thus the Mine will manage and mitigate all risks. The mining area will be monitored post rehabilitation to ascertain that no risks remain before the government gives the mine the authority to walk close the mining area. The government will thus	BAR section 6 & 15 EMPr sections 1(e) & (f)

Interested and affected parties		Date of comments received	Issues raised	EAP's response to issues as mandated by the applicant	Section & paragraph reference in this report where the issues and/or response were incorporated
				not issue a closure certificate, if any risks still remain.	
M George Koba	X	2019/08/20	Will the community be informed of the progress made with rehabilitation?	*Response by Theunis Meyer, the EAP:* The environmental authorisation or permission that the government (DMR) will give to the Mine to decommission and rehabilitate will contain monitoring and auditing requirements. Monitoring and auditing will be done on an annual basis and the audit report will be made publically available. Thus the community can access the report for a progress update on the rehabilitation commitments made by the Mine.	BAR section 18(a) EMPr section 1(h)
Mpho Leboa	X	2019/08/20	Can the community visit the Mine during the decommissioning, rehabilitation and closure phases to view progress made against the commitments communicated in the presentation tonight?	*Response by PJ Jordaan (on behalf of the Mine):* The Mine invites and will be happy to welcome all visitors. Andrew Moremi from the Mine will facilitate the visits.	
M George Koba	X	2019/08/20	Can the pit water be provided to the community as a sustainable water source?	*Response by PJ Jordaan (on behalf of the Mine):* Unfortunately it is not safe to access the water, the pit walls have already failed. Also, the quality of water in the pit is not good. Furthermore, the water level in the pit will never reach above a certain point, since the	BAR section 10(a)

Interested and affected parties		**Date of comments received**	**Issues raised**	**EAP's response to issues as mandated by the applicant**	**Section & paragraph reference in this report where the issues and/or response were incorporated**
				evaporation rate is much higher than the water inflow rate. It is thus not a sustainable water source.	
M George Koba	X	2019/08/20	The mine pit is unsafe for people and animals. How will access into the pit be prevented?	*Response by PJ Jordaan (on behalf of the Mine):* Several mitigation measures are in place to prevent access into the mine pit, i.e. there is no road leading into the pit, since the pit walls have already failed; a high quality fence will be put up around the pit; a berm and trench will be constructed outside the fence to prevent accidental driving to the pit; an outside perimeter fence will also be put up; and security guards are currently monitoring the pit area. In future, cameras and alarms will monitor the area for movement.	BAR sections 7 & 8
Mr. Mafuma, Koppies	X	2019/09/30	I have realized that there was a Public Participation in Parys that was held on the 20th of August 2019 between DeBeers Group, Parys Stakeholders and community members about the application for Environmental Authorization for the proposed Decommissioning of the Voorspoed Diamond Mine in the Ngwathe Local Municipality.	The legal framework for public participation require that must give all potential or registered interested and affected parties a period of at least 30 days to submit comments on each of the basic assessment report, EMPr, scoping report and environmental impact assessment report, and where applicable the closure plan. It must also provide access to all information that	

Interested and affected parties		Date of comments received	Issues raised	EAP's response to issues as mandated by the applicant	Section & paragraph reference in this report where the issues and/or response were incorporated
			The MPRDA acknowledges that all towns within the District in which the mine is located to benefit. Koppies, not Parys, has provided De Beers Group with water from Koppies Dam or Renoster River, which I believe helped the Mine to implement their operational plan with regards to achieving both their financial and operational targets and objectives. Therefore, the mine should also have had a consultation process with the community of Koppies. When are you going to hold participatory meeting with the people of Koppies?	reasonably has or may have the potential to influence any decision with regard to an application to all potential or registered interested and affected parties. The public participation process for the application, including the public meetings, was discussed with the Department of Mineral Resources. Due to logistical reasons and time constraints, only two public meetings were held, one each in the major town of the Moqhaka and Ngwathe municipalities, since it was not possible to arrange meetings in all five towns in proximity to the mine. Details of these are extensively included in the Environmental Management Programme report. Unfortunately, no public meeting is planned with the people of Koppies. As you are aware the following actions were undertaken in Koppies: • Displaying of the notice about the public participation process and invitation to register as interested party and participate in the process at the beginning of August	

Interested and affected parties		Date of comments received	Issues raised	EAP's response to issues as mandated by the applicant	Section & paragraph reference in this report where the issues and/or response were incorporated
				• Making a copy of the relevant reports available for public review and comment for a period of 30 days from early September If you have any specific issues that you need clarity on or any specific comments regarding the decommissioning process or the reports, you are welcome to forward such to Mr Seobi and we will respond appropriately.	
Other affected parties					
None					
Interested parties					
Nico Palm	X	2019/08/19	Does the Mine have a plan in place to deal with illegal Miners (Zama-Zamas)?	*Response by PJ Jordaan (on behalf of the Mine):* The Mine recognises the potential threat that illegal Miners may pose and has thus made provision for this in the closure plan in the following manners: 1. All diamonds have been mined from the pit, thus there are no reason/incentive to enter the pit; 2. The access ramps to the pit have already failed and can not be used to access the pit; 3. The pit will be filled with water;	BAR sections 7 & 8 EMPr section 1(f)

Interested and affected parties		Date of comments received	Issues raised	EAP's response to issues as mandated by the applicant	Section & paragraph reference in this report where the issues and/or response were incorporated
				4. The pit will be fenced with a ClearVu security fence restricting access; and 4. Security guards will monitor access to the pit until the rehabilitation plan is implemented. Thereafter, security cameras and alarms will be installed to notify the Mine of any trespassers in future.	
Nico Palm	X	2019/08/19	Can the aggregate be used to make bricks?	*Response by PJ Jordaan (on behalf of the Mine):* The Mine has previously explored the option of making bricks from the aggregate. It was found to be an unsuccessful endeavour, since the bricks deteriorate over time. The untreated aggregate is thus not suitable for brickmaking.	BAR section 8
Nico Palm	X	2019/08/19	How economically viable is the option of constructing a solar farm on the disturbed mining area as an alternative end land use?	*Response by PJ Jordaan (on behalf of the Mine) and Theunis Meyer, the EAP:* The construction of a solar farm is not currently considered as an economically viable alternative end land use for this site. This option is however still being explored and if it is found to be viable, the correct process will be followed in terms of this application to amend the documentation and inform interested and affected parties accordingly.	BAR section 8

Interested and affected parties		Date of comments received	Issues raised	EAP's response to issues as mandated by the applicant	Section & paragraph reference in this report where the issues and/or response were incorporated
Pakiso Mofokeng	X	2019/08/19	Is there a possibility, post closure, to create an educational tourism facility, i.e. a museum and pit view point, similar to the one in Kimberley?	*Response by PJ Jordaan (on behalf of the Mine):* This is not possible, since the geology around the pit is too unstable to allow for the construction of a ramp for a view point. In addition, access to the pit will be restricted by means of a security fence. Therefore, it will not be possible to see the open pit after decommissioning. Creating an educational tourism opportunity during the decommissioning and closure process, based on responsible mine closure is a more viable option, thus teaching students about mine rehabilitation.	BAR section 3(h)
Pakiso Mofokeng	X	2019/08/19	Pakiso Tech and Gadgets submitted a tender for the rehabilitation of the Mine. Has the tender been awarded to anyone yet?	*Response by PJ Jordaan (on behalf of the Mine):* The 2019 tender for rehabilitation has not been awarded yet.	
Pakiso Mofokeng	X	2019/08/19	Will the public participation slide deck displayed today be made available to the public?	*Response by Theunis Meyer, the EAP* Yes, all documents relating to this application for decommission will be made available in both hard copy ad electronic format. Interested and affected parties will be notified of the when and where the copies are available.	BAR section 8(b)

9) *The environmental attributes associated with the alternatives*

(The environmental attributes described must include socio-economic, social, heritage, cultural, geographical, physical and biological aspects.)

a) Baseline environment affected by the proposed activity

(Its current geographical, physical, biological, socio- economic and cultural character.)

(i) Biophysical environment

The physical environment include the topography, geology, soils, climate, air quality, as well as surface water and ground water resources.

Climate:

Voorspoed Mine falls within the Highveld Climate Zone. Temperatures in this climatic zone are generally high, with moist wet summers and dry winters. The long-term average annual rainfall is 560 mm, of which approximately 80% falls from October to March. The average evaporation over the same period is 2 085 mm. Temperatures vary from an average monthly maximum and minimum of 29.8°C and 15.8°C for January to 18.7°C and -0.3°C for July respectively. Frost is likely to form over the months of May to September. Generally, winds are light except for short periods during thunderstorms. Extreme weather events that may be experienced in the area include frost that is common during winter, rainfall in the form of showers and thunderstorms, primarily during summer, as well as tornados that may occur, although very infrequently.

The climate at Voorspoed Mine does not pose any severe challenges for rehabilitation activities. However, cognisance must be taken of heavy thunderstorms, as these do not only increase the risk of extensive erosion across rehabilitated and non-rehabilitated areas, but can also damage stormwater management structures.

Topography:

The topography of the area in which the mine is located can be described as generally flat to rolling rural land, sloping gently to the north. There is a small koppie (known as Renosterkop) to the south-east of the mine, rising approximately 100 m above the surrounding land. It is a prominent natural feature, which is the focal point of most views in the area.

Geology and Geochemistry:

Sub-horizontal sediments of the Ecca Group dominate the local surface geology in the vicinity of the Voorspoed site. Dolerite sills and dykes and a series of Kimberlites have intruded the Ecca Group sediments. The Kimberlite pipe located at Voorspoed is an irregular, roughly oval shaped body with maximum dimensions of 490m by 350m. The total area of the pipe at the base of the existing open pit at the start of the current mining activities was 12,5 ha.

Soils:

Area around the mine

The parent material of the soils in the area around the mine is mainly derived from the underlying Ecca sandstone and shale, with dolerite sills. Consequently, most of the area consists of moderately deep to deep, brown, apedal to weakly structured sandy loam to sandy clay loam topsoils, underlain by brown to yellow-brown, apedal sandy clay loam sub-soils on a mottled soft plinthite layer. Unconsolidated material with signs of wetness may often be found deeper down. The dominant soil forms are Avalon (Av). Small areas have been found were soft plinthite occurs higher in the profile. The soft plinthite horizon is an indication of a fluctuating water table in the sub-soil in parts of the year, rising in summer and falling in winter. Usually, even at the end of the winter, the sub-soil is moist (Figure 5).

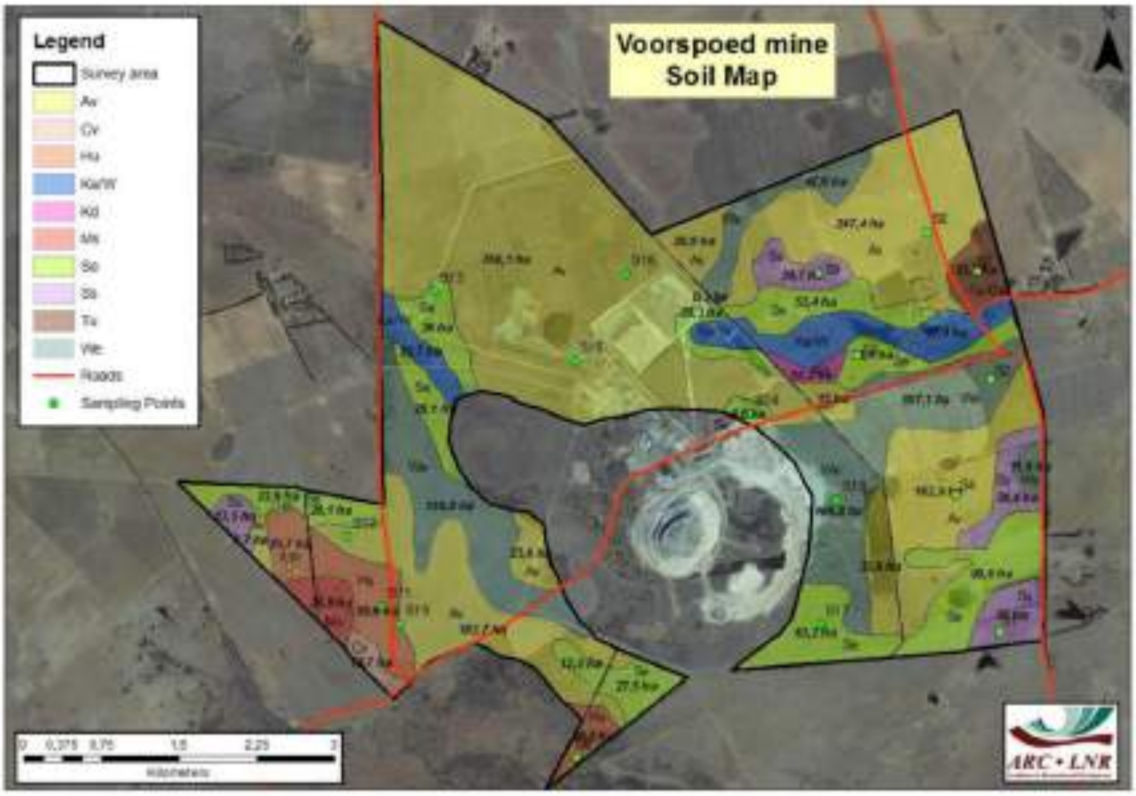


Figure 5. Voorspoed Mine soil map (ARC-ISCW 2016)[7]

Lower positions in the landscape are dominated by soils where plinthic material is found higher up in the profile, which means that water may occur closer to the surface, especially in the wetter parts of the year. The dominant soil form is Westleigh (We). The lowest parts

[7] Voorspoed Mine Soil Survey Report, Agricultural Research Council – Institute for Soil, Climate & Water, 2016.

of the landscape, around vleis, dams and streams, are occupied by a dark brown, loam to clay loam topsoil horizon, underlain by a brown to black, moderately to strongly structured, blocky clay loam subsoil, usually calcareous. Lighter grey, calcareous, unconsolidated material with signs of wetness often occurs deeper in the profile. The dominant soil form is Sepane (Se).

Mining area

The mining area is dominated by moderately deep soils of the Avalon (Av) form with a depth of 0.5 to 1.2 m, which are brown, apedal to weakly structured sandy loam to sandy clay loam topsoils, underlain by brown to yellow-brown, apedal sandy clay loam sub-soils over a grey-brown, mottled, soft plinthite layer. The Avalon soils primarily occur in the northern part of the mining area, with small pockets in the western and south-eastern parts (Figure 5). These soils have a moderate arable potential.

The soils in smaller sections of the site have low arable or only grazing potential. These sections, primarily in the southern part of the mining area are covered by Westleigh (We) and Sepane (Se) soils. Westleigh (We) soils characteristically have soft plinthite occurring directly under the topsoil. Sepane (Se) soils have a dark brown, loam to clay loam topsoil horizon, underlain by a brown to black, moderately to strongly structured, blocky clay loam subsoil, usually calcareous. Lighter grey, calcareous, unconsolidated material with signs of wetness often occurs deeper in the profile.

Soils in and around vleis, dams and streams in the north-eastern and north-western parts of the mining area typically have dark brown, loam to clay loam topsoil, underlain by grey-brown, mottled sandy clay to clay subsoil with signs of wetness. The dominant soil form in these areas is Katspruit (Ka/W map unit). The dominant soil form around these wetland areas in the mining area is the Sepane soil form. These soils also have low arable or only grazing potential.

Soil Chemistry

Soil analysis indicated clear textural differences between the apedal soils (Avalon) and more structured soils (Westleigh, Sepane, Katspruit). Topsoil textures are generally in the sandy loam to sandy clay loam range (10-20% clay).

The phosphorus (P) levels in the soils are variable, generally reflecting cultivation practices, where topsoils on cultivated land have higher levels of P. The organic carbon levels also often reflect the effects of cultivation, with values generally below 1%, and often significantly so. Apedal soils are neutral to acidic, while clay soils are often slightly alkaline. The soils did not have any major cation imbalances that would affect agricultural potential of the soils.

Surface Water:

Area around the mine

The Voorspoed Mine falls into quaternary catchment C70H. Water emanating from the mining area drains into streams and farm dams, which eventually drain into the Heuningspruit River, a tributary of the Renoster River that is part of the Vaal River system. The mean annual runoff (MAR) for the quaternary catchment is 7.3 million m^3 over a catchment area of $251km^2$ (Shangoni, 2010[8]).

Surface water users immediately downstream of Voorspoed Mine includes the neighbouring properties Welvaart 1011, Cumberland 1228 and Rusting 850, while surface water also flows into farm dams on these properties, as well as the farm Grasvlakte 1887 (via Cumberland 1228).

Mining area

The mine is situated on a watershed, with five (5) sub-catchments on the mining area that influence the direction of surface water flows (Figure 6). There are no well-defined drainage lines in the mining areas and surface water generally flows as sheet flow after heavy rainfall events. There are, however, three poorly defined, ephemeral drainage lines within or in close proximity of the mining area that only flow periodically during and after heavy rainfall events.

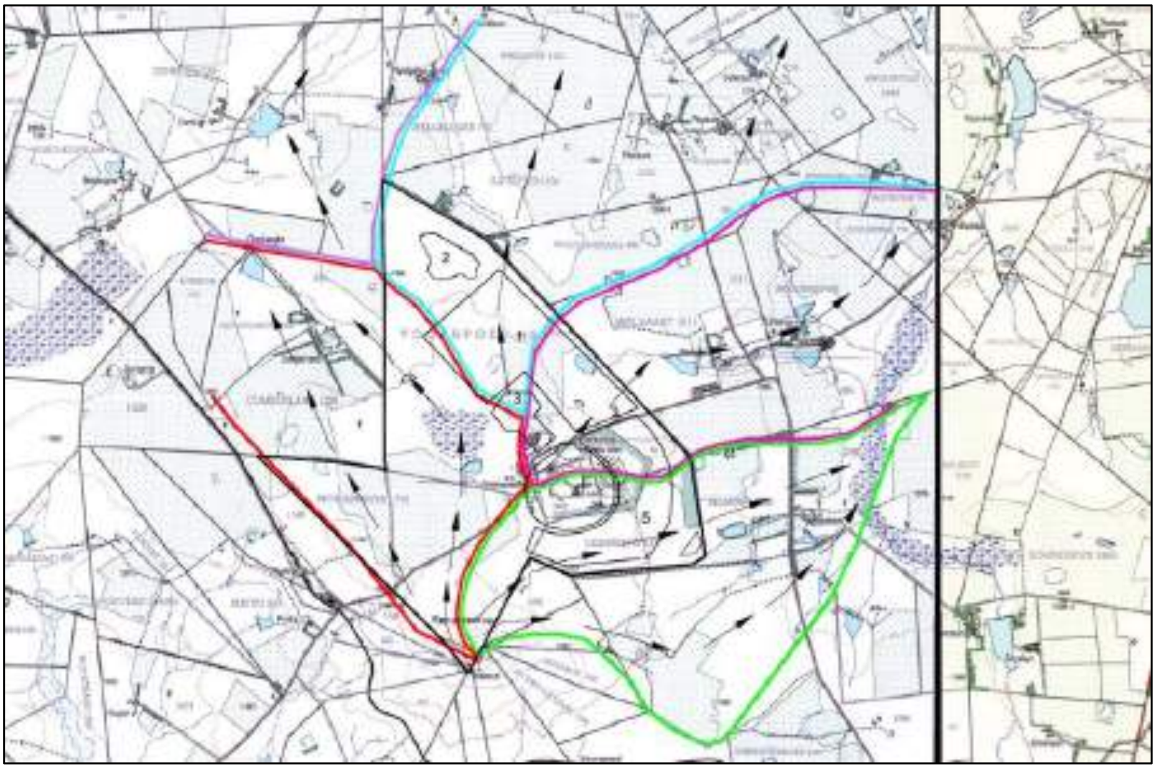


Figure 6. Sub-catchment boundaries (from Metago, 2005) [9]

[8] De Beers Consolidated Mine: Voorspoed Mine Amended Environmental Management Programme, Shangoni Management_Services (Pty) Ltd, February 2010.
[9] Environmental Management Programme Report for Voorspoed Diamond Mine, Metago Environmental Engineers, 2005.

- The western drainage line, downstream of the wetland located on Voorspoed 401, approximately 899 m long, draining toward the dam on the farm Grasvlakte 1887.
- The eastern drainage line downstream of the farm dam on the eastern border of Voorspoed 401, approximately 194 m long, makes up the headwaters of a stream that drains towards the dam on the farm Welvaart 1011.
- The southern drainage line emanating from the northern slopes of Renosterkop on the farm Morgenster 772, approximately 210 m long, which forms the headwaters of a stream that drains toward the farm dams on Renosterkop 347.

The open mine pit did not constitute a significant surface water feature in the operational phase of the mine, as any accumulation of rain water and groundwater in the Pit was pumped out to ensure the safety of mining operations. However, since the mining operations stopped, the pumping of water from the pit has also ceased. Therefore, a pit lake has developed due to direct rainfall to the pit footprint area and groundwater ingress. The pit will fill/re-water by direct rainfall recharge and local runoff from the pit footprint area. Due to the fact that evaporation in the Voorspoed area is much higher than the total rainfall and groundwater ingress into the pit, the pit lake water level is predicted to remain as a local piezometric sink i.e. the final water level will settle several metres below the surrounding natural groundwater level.

Wetlands are important features in the Renoster River and Heuningspruit catchments. Two endorheic pans, the Northern and Southern pans are notable surface water features in the mining area and cover 12.3 ha and 7.7 ha respectively. There is also another, bigger endorheic pan immediately west, adjacent to the mining area. This pan is classified as a hillslope wetland and covers an area of approximately 29 ha.

All three pans are ephemeral and the volume of water in the pans fluctuates according to rainfall conditions. Inundation of the wetlands is likely after heavy rainfall, which normally occurs any time from November to April. Wetland plant species such as *Junctus* and *Scirpus* have been observed in these wetland after rains. These species area adapted to waterlogged conditions and also to the ephemeral nature of these wetlands, remaining in the soil as seeds, bulbs and rhizome during the dry periods.

In terms of their pre-mining baseline condition, the Southern and Northern pans were impacted to a greater or lesser extent by land use practices (Figure 7). While the Northern pan was functioning well, the Southern pan had been modified to function as a drainage line, which reduced the pan's functionality and conservation importance. The wetland adjacent to the mining area was also modified by land use practices, but still provided a range of ecological functions (Strategic Environmental Focus, 2004[10]).

[10] Wetland assessment of the farm Voorspoed 401, Free State, Strategic Environmental Focus, 2004.

Figure 7. Delineation of the pans and wetland (pre-mining)

The three pans are listed as natural wetlands (NWCS L4 class) and form part of a National Freshwater Ecosystem Priority Areas (NFEPA) wetland cluster (Figure 8).

Figure 8. National Freshwater Ecosystems Priority Areas (NFEPAs) wetland cluster at Voorspoed Mine (SANBI, 2007) 11

[11] National freshwater ecosystem priority areas (NFEPA) project, South African National Biodiversity Institute (SANBI), 2007.

Surface Water Quality

Area around the mine

Deteriorating water quality impacts on the quantity of water available for use, not only in the Free State, but also in the area around the mine. Key issues of concern include the poor-quality effluent discharged from municipal sewage treatment works due to overloading and/or poor operations and maintenance, polluted storm water run-off, high salinity pollution due to mining activities and elevated salinity and nutrient pollution from poor farming practises. Consequently, river health has deteriorated, resulting in loss of river functions and services, as well as sustainability of river ecosystems. In addition, many wetlands in the province have also been directly and/or indirectly impacted by various different land uses and from chemical and biological pollutants (Free State DTEEA, 2008[12]).

Mining area

No surface water quality samples were obtained during the sampling undertaken as part of the EIA process prior to the establishment of the current mining activities (in 2003/2004), as all features were dry at the time (Metago, 2005). However, some baseline water quality data (from 2007) is captured in the mine's water monitoring database.

Various clean and dirty water management facilities were constructed and utilized during the operational phase of the Voorspoed Mine. The polluted water facilities captured run-off from the various mine residue facilities and dirty infrastructure areas and directed it via trenches to settling ponds and into the Return Water Dam and the Storm Water Control Dam. The water quality in these dams were monitored and the dirty water re-used as process water (Jones & Wagener, 2012[13]).

Water quality monitoring results, obtained from the surface water monitoring locations around Voorspoed Mine over the life of the mine, identified areas where water quality concerns will need to be addressed as part of the mine closure planning process. Increasing trends were noted in the concentrations of Na, TDS, SO4, Cl and EC, above baseline levels. Although the actual concentrations remained within drinking water limits for these parameters, the increasing trend could reflect impacts from surface runoff originating from the Fine Residue Deposit and the Coarse Residue Deposit.

Samples of the seepage generated by the various Mine Residue Deposits were also analysed in 2017. The results indicate that concentrations of some parameters exceeded the official DWS Class 1 drinking water standards, notably EC, TDS, SO_4, Nitrate and Na.

[12] Free State Environment Outlook: A report on the state of the environment, Free State Department of Tourism, Environmental and Economic Affairs (DTEEA), 2008.

[13] Water balance investigation report, Report No JW044/12/C746-Rev B, Jones and Wagener Consulting Civil Engineers (Jones & Wagener), 2012.

Groundwater:

Area around the mine

Groundwater in the Free State Province has been, and continues to be used for rural domestic supplies, stock watering and water supply to several towns, where surface water supply is inadequate or bulk water supply is not financially feasible. This is also the case in the area around the mine. Groundwater is well utilised for water supply in the Middle Vaal water management area, within which the mine is located.

Groundwater does not directly contribute to the base flow of local streams in the direct vicinity of Voorspoed Mine. These streams and/or drainage lines are non-perennial and are only active during and after rain events.

Mining area

A regional shallow aquifer, related to the layered sedimentary Karoo rocks, dominated by shale and mudrock of the Ecca Group that has a general low permeability, is found at Voorspoed Mine. Static water levels in this aquifer range from 3 to 30 m below ground level for the boreholes surveyed within a 6 km radius of the Voorspoed site before the start of the current mining activities. There is also a localised, deep aquifer (100 m to 400 m) that is defined by faulting and brecciated rocks associated with the kimberlite intrusions in the area. Groundwater flow directions generally follow the topography from higher areas to lower lying areas.

Before the current mining operations commenced, a hydrocensus was conducted where a total of 32 boreholes within a 6km radius of the pit area were surveyed. It found that water from these boreholes was used exclusively for domestic supply (1 borehole on the farm Welvaart), livestock watering only (7 boreholes) and for both stock watering as well as domestic water supply (9 boreholes). None of the boreholes surveyed was used for irrigation supply (SAGC, 2004). The average borehole depth ranged from 20 m to 200 m, with domestic and stock watering boreholes drilled up to 50 m deep. Regional static water levels ranged from 3 m to 30 m below ground level.

As a result of mining operations and pit dewatering, a local dewatering cone developed around the pit area during the operational phase of the mine. The cone did not extend beyond the borders of the mining area. On the eastern side of the pit, seepage from the Waste Rock Dump limited the lateral movement of the dewatering cone, which extended further to the west of the pit.

Groundwater quality

The quality of groundwater in the area around the mine is variable. The natural groundwater quality evolves from recently recharged waters, characterised by a Ca/Mg-HCO3 signature, to water representative of dynamic flow, characterised by a Na-HCO3 signature, and gradually towards a deep Karoo water quality signature, which is characterised by Na-Cl signatures.

Before the start of the current mining activities, 14 groundwater samples were taken in the vicinity of Voorspoed Mine. These results were compared against the DWS Target Water Quality Range for Domestic Use (TWQR, 1996). Of the 14 samples, eight were found to be within the Target Water Quality Range for Domestic Use, while six exceeded these limits. The electrical conductivity (EC) values from all the samples exceeded the DWAF TWQR.

During a groundwater hydrocensus conducted in 2017, 12 boreholes outside of the mining area were surveyed of which eight could be recorded for water level and / or water quality. The hydrocensus reached the following conclusions regarding the current state of groundwater quality within and beyond the Voorspoed Mine area (Golder 2017)[14]:

- Groundwater quality from the mining area has slightly elevated salinity levels (TDS ~750mg/l) compared to the surrounding far field area (TDS <500mg/l).
- Stagnant groundwater, or groundwater impacted by mining activity is characterised by elevated levels of Cl and SO4.

In addition, a review of the water quality data for a specific borehole (MBH-02) located off-site indicates a steady increase in salinity (Nitrate) over the life of the mine. Whilst the current concentrations are still within drinking water limits, the increase above baseline concentrations is notable and indicates a potential risk for surface water quality downstream of Voorspoed Mine after closure.

Air quality:

There are numerous external sources of dust in the vicinity of Voorspoed Mine, primarily farming activates, including soil cultivation and the use of gravel roads. During the operational phase of the mine, the mine also contributed to the regional generation of dust, primarily via its earthmoving and road traffic activities.

Mitigation measures to minimise the generation of dust during the operational phase included the use of dust allaying chemicals/materials on the major haul roads, traffic areas and parking areas, as well as the implementation of other dust suppression measures. A dust monitoring programme was also implemented to monitor the extent of fall-out dust.

Biodiversity: Vegetation

<u>Area around the mine</u>

The mining area is located in the Grassland biome, but elements of the savanna vegetation of the Vredefort Dome region further north from the site are also present on Renosterkop to the south of the site, in the form of Vredefort Dome Granite Grassland (Figure 9). The vegetation types on the flatter plains lies at the intersection of two

[14] De Beers Voorspoed Mine Summary of Surface and Groundwater Study for Mine Closure, Report No. 1663605-316475-5, Golder Associates Africa (Pty) Ltd., October 2017.

grassland vegetation types, the Central Free State Grassland and Vaal-Vet Sandy Grassland. The wetland adjacent to the mining area forms part of an azonal vegetation type, the Highveld Salt Pans vegetation type (Mucina & Rutherford 2006[15]).

Groups of large blue gum trees are scattered across the area, and are most often associated with property boundaries, farmsteads, and roads.

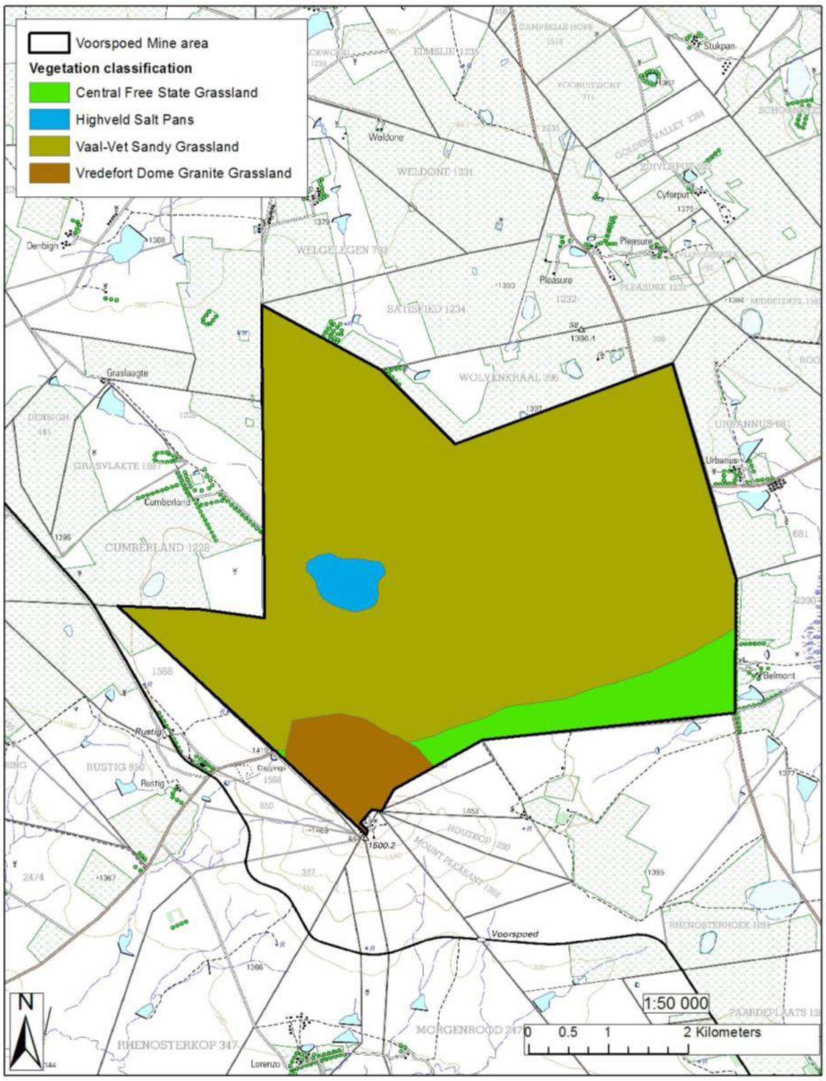


Figure 9. Vegetation classification for Voorspoed Mine and surrounding area.

<u>Mining area</u>

According to Mucina & Rutherford (2006) two grassland vegetation types occur in the mining area, i.e. Vaal-Vet Sandy Grassland and Central Free State Grassland (Figure 9). These will be briefly discussed.

Vaal-Vet Sandy Grassland

This vegetation type occurs in the North-West and Free State Provinces in a landscape dominated by plains, with some scattered, slightly irregular undulating plains and hills. The relative dominance of the grass species *Themeda triandra* is an important feature of this

[15] The Vegetation of South Africa, Lesotho and Swaziland, Mucina & Rutherford, 2006.

vegetation type. It is primarily found on aeolian and colluvial sand that overlay sandstone, shale, and mudstone of the Karoo Supergroup (mostly Ecca Group), such as in the mining area, while the soil forms are mostly Avalon and Westleigh, and Clovelly, of which the first two are also found in the mining area (Mucina & Rutherford, 2006).

This vegetation type is endangered, because approximately 63% thereof has already been transformed due to commercial crop cultivation and grazing pressure from cattle and sheep, while only 0.3% is currently statutorily conserved (Mucina & Rutherford, 2006). The Vaal-Vet Sandy Grassland ecosystem is also listed as Endangered in the National list of ecosystems that are threatened and in need of protection, published in terms of the National Environmental Management: Biodiversity Act (Gov. Gazette 34809, Gov. Notice 1002, 09 December 2011).

Central Free State Grassland (Gh6)

This vegetation type in the Free State is situated in a landscape, characterised by undulating plains supporting short grassland. Under natural conditions it is dominated by *Themeda triandra*, but is dominated by *Eragrostis curvula* and *E. chloromelas* in disturbed habitats. Dwarf Karoo-shrubs establish in severely degraded clayey bottomlands, while overgrazed and trampled low-lying areas are prone to *Acacia Karoo* encroachment. The geology of this vegetation type is generally dominated by sedimentary mudstones and sandstone of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) as well as those of the Ecca Group (Karoo Supergroup), which give rise to vertic, melanic and red soils, typically of the Arcadia, Bonheim, Kroonstad, Valsrivier and Rensburg soil forms (Mucina & Rutherford, 2006).

The vegetation type is described by Mucina & Rutherford (2006) as vulnerable, due to fact that almost 25% thereof has been transformed for crop cultivation and building of large dams, such as the Koppies and Kroonstad Dams, while only small portions are conserved.

The Highveld Salt Pans

The Highveld Salt Pans Vegetation Type occurs over a wide distribution area that stretches across a number of provinces. It is characterised by depressions in the landscape, containing primarily seasonal water bodies, supporting vegetation with a zoned concentric pattern and open grassland to sparse grassy dwarf shrub land on the edges of the pans. Geologically shales of the Ecca Group usually form the depressions of this vegetation type, giving rise to vertic clayey soils. The pans are only inundated and/or saturated during the wet, summer months (Mucina & Rutherford, 2006).

About 4% of this vegetation type has been transformed because of agriculture, building of roads, mining and urbanisation. All these threats are increasing and putting pressure on more areas of this vegetation type. Only a small portion of this vegetation type is statutorily conserved (Mucina & Rutherford, 2006).

The pans provide a valuable ecological ecosystem service, supporting a variety of plants and animals, including aquatic invertebrates, amphibians, reptiles, small and large mammals and local bird populations.

Plant species of particular conservation priority

A specialist study of the mining area indicated that no threatened or near-threatened plant species are suspected to occur in the mining area. However, a few plant species that are likely to occur in the natural grassland near or at the present wetland site are declining, although not threatened. Their presence at the site was not confirmed (Bucandi 2013[16]).

Alien Invasive Plants

Various alien invasive species have established in the Voorspoed mining area in response to disturbances of surface areas. The majority of these species are annuals that can be controlled either by mechanical cultivation or the used of broad-leave herbicides. These plants will negatively affect the rehabilitation efforts, as they will compete with the indigenous grasses used for re-seeding the rehabilitated areas, unless controlled. There are also a number of woody plant species, such as blue gum (*Eucalyptus camaldulensis*), pepper tree (*Schinus molle*), as well as pink tamarisk (*Tamarix chinensis*) that are more difficult and costly to control and cannot only negatively affect the rehabilitation efforts, but also spread to neighbouring properties (Exigo, 2016[17]).

Biodiversity: Animals

<u>Mining area and surroundings</u>

Various specialist studies have documented the fauna that are likely to appear at the Voorspoed mining area. Such identified species that roam throughout the area, which is primarily used for agricultural purposes.

Although one study identified numerous amphibian, reptile, bird and mammal species that occur or could potentially occur in the mining area, it concluded that surveys that are more specific are necessary to determine the exact level of biodiversity and the presence of species of conservation concern in the area (Bucandi 2010[18]).

It is noteworthy that photographic evidence suggests that Giant Bullfrog exists near the Voorspoed mining area and it is highly likely that this species utilise the wetland adjacent to the mining area as breeding site (Bucandi 2010).

Biodiversity: Critical Biodiversity Areas and Ecological Support Areas

<u>Mining area and surroundings</u>

[16] A Determination of Floristic Biodiversity at De Beers Voorspoed Mine, Bucandi Environmental Solutions, March 2013.

[17] An Alien Invasive Management Plan for the De Beers Voorspoed Mine, Exigo Sustainability, December 2016.

[18] Baseline biodiversity assessment at De Beers Voorspoed Mine, Bucandi Environmental Solutions, October 2010.

The 2015 Free State Biodiversity Plan (Figure 10) identified a number of Critical Biodiversity Areas (CBA) and Ecological Support Areas (ESA) in and around the Voorspoed mining area.

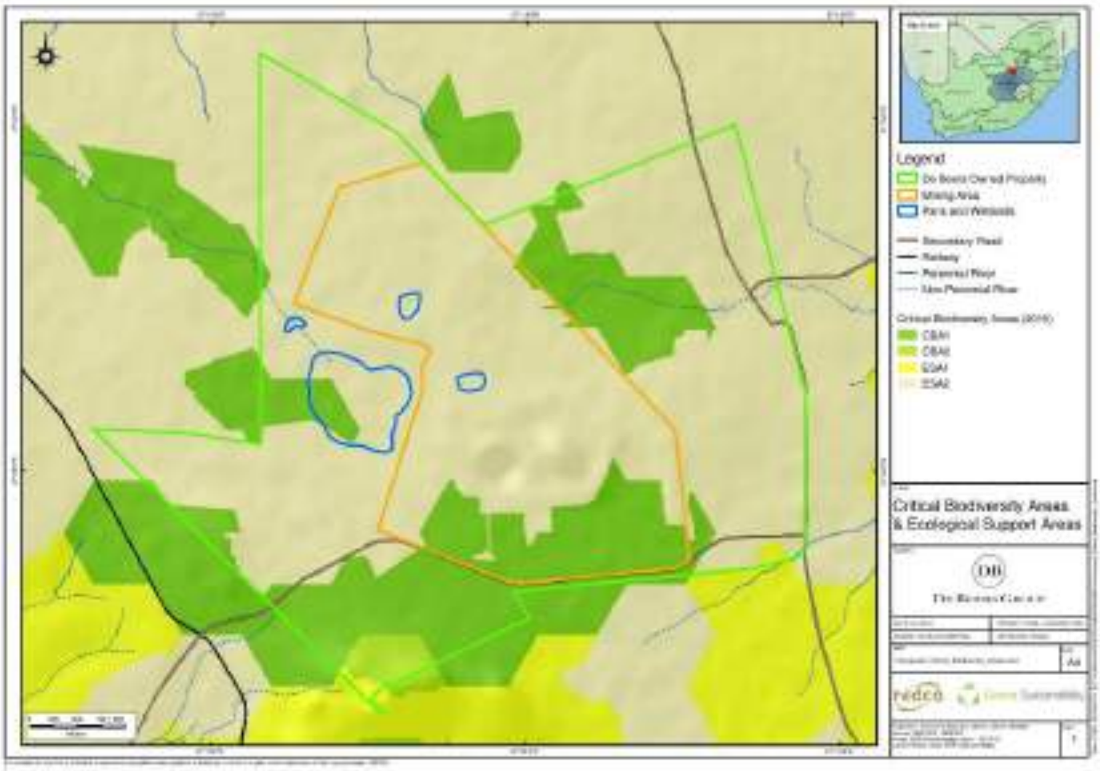


Figure 10. CBA and ESA areas associated with the Voorspoed site (DESTEA, 2015 Free State Terrestrial CBAs).

Critical Biodiversity Areas (CBAs) are (terrestrial and aquatic) areas required to meet biodiversity targets for ecosystems, species and ecological processes, as identified in a systematic biodiversity plan. CBAs can include one or more of the following: threatened ecosystems, special and important habitats, areas of high irreplaceability, ecological corridors, and existing or proposed protected areas and protected area development nodes. These parts of the landscape need to be maintained in a natural or near-natural state, in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. However, maintaining an area in a natural state can include a variety of biodiversity-compatible land uses.

Ecological Support Areas (ESAs) are (terrestrial and aquatic) areas that are not essential for meeting biodiversity targets, but play an important role in supporting the ecological functioning of CBAs and/or in delivering ecosystem services such as water provision, flood mitigation or carbon sequestration that support socio-economic development. ESAs need to stay functional in order to maintain the integrity of the CBAs, but do not need to be maintained in a natural state, as long as their natural function is retained. The degree or extent of restriction on land use and resource use in these areas may be lower than that recommended for CBAs. ESAs may include terrestrial wetland buffer areas, groundwater recharge areas, ecological corridors and stepping-stones, as well as protected area buffers around more crucial CBAs.

In the mining area, CBA 1 areas have been identified in the southern parts, south of the open pit, where the WRD is situated. This means that once the WRD is rehabilitated, the area needs to be need to be maintained in a natural or near-natural state, in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services.

CBA 1 and CBA 2 areas were also identified west of the wetland adjacent to the mining area, on Voorspoed owned properties immediately east of the mining area, as well as on the southern parts of the Voorspoed owned properties adjacent to the mining area, in the vicinity of Renosterkop.

For the features associated with CBA 1 areas, there are no or very few other options for meeting biodiversity targets, whereas CBA 2 areas are based on the principles of complementarity, efficiency, connectivity and/or avoidance of conflict with other land or resources uses.

Heritage Resources

Area around the mine

An archaeological and cultural assessment of Voorspoed Mine and the area around the mining area was conducted before the start of the current mining operations[19], revealed several types of heritage resources, as outlined in the National Heritage Resources Act (No. 25 of 1999). These resources included the following:

- Stone tools that date from the Stone Age (no cultural heritage significance);
- Stone walled settlements that date from the Late Iron Age that could be associated with the predecessors of the Sotho-Tswana;
- Two graveyards, located outside the mining area, were considered to be of “outstanding significance”.

Mining Site

The following heritage resources found on the mining area were assessed as having limited cultural significance, due to the poor state of the buildings or of no cultural significance:

- A historical building associated with either the settlement of the earliest farmers in the area or with the historical Voorspoed Diamond Mine;
- Other remains associated with the historical Voorspoed Diamond Mine; and

[19] Pistorius, J. 2004. A Heritage Impact Assessment (HIA) Study for an EMP for the Voorspoed Diamond Mine near Kroonstad in the Free State Province of South Africa.

- *Remains dating from the relatively recent past, including a face-brick building with* associated buildings, a compound for labourers and an explosives magazine.

The assessment recommended that De Beers documented the historical building before it was demolished, and prepare a display relating to the historical Voorspoed Mine and display and maintain this, either in a museum in the Free State Province or at a De Beers office (Pistorius, 2004).

(ii) *Social and socio-economic environment*

The broader socio-economic influence of the Voorspoed Mine extends to a large area that encompasses both the Ngwathe and Moqhaka Local Municipalities within the Fezile Dabi District Municipality. However, for the purposes of evaluating the impact of Voorspoed Mine on the local socio-economic environment, the town of Kroonstad was identified as the “mine community” in the recent Social Impact Assessment.

All information in this section has been derived from the *Voorspoed Mine Closure Socio-economic impact assessment* report[20] (Appendix 16), which comprehensively described the social and socio-economic context of the mine, identified and assessed the social impacts of the mine closure and suggested impact mitigation measures.

Mine Community

- *Unemployment*

  The highest unemployment rate and the biggest number of employed people with an income below the Food Poverty Line are in the residential areas of Maokeng).

- *Social Environment*

  The key antisocial behaviours experienced in Kroonstad include substance abuse amongst the youth, child abuse, sexual abuse, neglect of children, increasing unemployment, abuse of elderly pensions and neglect of the elderly by grandchildren. There is a resultant demand for placement of children in foster care.

  There are currently no rehabilitation centres to address the high levels of substance and various other forms of abuse prevalent in Kroonstad. Due to the lack of public health facilities, patients have to find services located a considerable distance from Kroonstad. Owing to the high levels of unemployment and distance of services, patients cannot access medical care.

  There is also a lack of social development structures to manage and address social development issues within Kroonstad. These include a lack of facilities such as schools for children with disabilities, homes for the disabled, as well as shelters for children who are living on the streets.

[20] *Socio-economic impact assessment - Voorspoed Mine closure*, Environmental Resources Management (ERM). April 2019.

- *Crime*

  Criminal trends from 2013 to 2018 in Kroonstad indicate a decrease in most crimes, apart from driving under the influence of alcohol or drugs and the illegal possession of firearms and ammunition. The top three crimes in the mine community in 2015 were common assault, burglary at residential premises and drug-related crime. These crimes are related to the high unemployment, high rates of substance abuse and lack of social development services.

  There are a number of police stations in the greater northern Free State, but there is no police station located near the Voorspoed Mine. Consequently, a community-based organisation was founded to address safety and security issues in the communities around the mine. The organisation, the Mine Crime Combatting Forum (MCCF), works with the Mine and farmers in the area. It is currently led by one of the brigadiers' in Kroonstad and supported by local police officers.

- *Healthcare Sector*

  There are a limited number of health care facilities in the northern Free State, including the greater area of Kroonstad. The location and capacity of these health care facilities place considerable strain on existing facilities to treat patients and cope with the needs of the population. This is reflected in the health related issues faced in the broader District. The FDDM performs poorly in terms of health related indicators such as maternal mortality rate, malnutrition, HIV/Aids, and TB. It currently has the highest proportion of TB patients dying of TB in the country.

  Despite this situation, Kroonstad plays an important role in providing health care services in the District. There are two hospitals and one clinic in Kroonstad; the regional Boitumelo Hospital, the Kroon Netcare Private Hospital and the Seeisoville Clinic.

- *Mine Community Dependency*

  Direct and indirect community dependency was calculated at 13% for the town of Kroonstad. This means that 11 507 livelihoods out of a population of 88 489 were financially dependent on the Mine. It means that every job on the Mine accounted for the livelihood of at least 13.7 people.

- *Local Economic Benefit*

  When comparing the salaries of mine employees with those of the other employed residents of Kroonstad, the income of the average Voorspoed mineworker is significantly higher than what the average working resident in Kroonstad earns. A disposable income of approximately R149 million per annum was earned by workers from Voorspoed Mine living in Kroonstad. This represents 12% of the total disposable income earned by the employed population in Kroonstad. About R126 million of the disposable income was retained for household consumption expenditure, which was primarily used for food, imputed rentals and insurance.

There was also a significant contribution to the purchasing of vehicles, the actual operation of personal vehicles and transport services such as taxis.

- *Supply Chain*

  The direct economic impact of Voorspoed Mine was mostly due to operational expenditures by the mining operation. The Mine supported various local and national industries through its supply chain processes by creating wealth, jobs and taxable income. Although national companies provided certain highly specialised equipment and technical services, some goods and services were sourced locally.

  In 2015, the Mine spent approximately R791 million on procurement. The main industrialised areas of Gauteng received 48% of that expenditure, while 49% was spent in the Free State. About 5% of the total purchases in 2015, to the value of R40.3 million, were procured from 67 vendors in the town of Kroonstad. In terms of black economic empowerment, 58% of Voorspoed Mine's vendors in Kroonstad were black owned, while only seven percent were white owned. The remaining 35% were black empowered.

  The De Beers Zimele Hub in Kroonstad was operational since 2009 and provided funding for the development of local enterprises in the mine community. The Hub had disbursed loans to the value of R26.5 million to 72 local business entities. In 2015, Voorspoed Mine procured services and consumables from seven of the business entities that were supported by Zimele to the value of R7.5 million.

  The Mine, in partnership with Zimele, were also instrumental in the development of local black-owned suppliers and service providers.

- *Benefit to government*

  The analyses of economic benefits to Government from the mining activities at Voorspoed indicated that government on a national level was benefiting more than R100 million per annum. In 2015, Voorspoed employees that were living in Kroonstad contributed almost R20 million per annum to the Moqhaka Local Municipality's revenue, which represents approximately 5% of the total revenue generated in Kroonstad, which was around R600 million.

- *Total local economic benefit*

  The overall economic impact of the Mine's expenditure on labour and intermediate inputs in Kroonstad amounted to roughly R170 million per annum.

b) Description of the current land uses

During the development and operational phase of the mine, virtually the complete mining area have been altered to a mining land use. This includes the development of the open pit and associated mine residue deposits. Infrastructure was developed to support the diamond mining, as discussed under Part A, section 3(iv)(1)(c) (Appendices 3 and 4).

Although most natural areas on the periphery of the mining area was disturbed to some extent, an area in the northern part of the mining area remains in a natural state.

De Beers-owned properties that are located around the mining area and not directly impacted by the mining activities are leased to neighbouring farmers, who use the land for grazing and crop cultivation purposes. The mine restricts access to certain ecologically sensitive areas on these surrounding properties.

c) Description of specific environmental features and infrastructure on the site

Specific pre-mining environmental features on the mining area include a number of pans, some of which has been lost due to the mining activities, while the southern pan will be reinstated and rehabilitated, and the protection of the northern pan will be enhanced. Post mining environmental features that will remain in the mining area are three rehabilitated mine residue deposits, as well as the rehabilitated open mine pit.

(i) On-site infrastructure

Since the start of the current mining operations, Voorspoed Mine developed and/or upgraded the following infrastructure on the mining area (Appendix 3):

- Access Road;
- Electrical power distribution network and associated infrastructure;
- Mobile (temporary) offices and administrative buildings;
- Stores and freight yard;
- Workshops;
- Laydown areas, service areas and salvage yard;
- Concrete surfaces associated with infrastructure;
- Explosives magazine;
- Main treatment plant and associated infrastructure;
- Conveyor belts and associated infrastructure;
- Internal roads, parking areas and walkways;
- Open pit and associated haul road network and supporting infrastructure;
- Security fencing;
- Return water dam and Storm water control dam.
- Mine Residue Deposits
    - Waste Rock Dump, Coarse Residue Deposit and Fine Residue Deposits.

(ii) Off-site infrastructure

Voorspoed Mine also developed the following off-site infrastructure to support the mining activities (Appendix 4):

- an access road from the secondary road to the mine, constructed and maintained by the mine;
- the Renoster River weir and associated water pumping infrastructure that was not constructed by mine, but upgraded and maintained; and

- a raw water supply pipeline from the Renoster River weir to the mine.

In addition, Eskom constructed and maintained an electrical distribution network and associated infrastructure that exclusively supplied Voorspoed Mine.

(iii) Environmental features

The primary environmental features that will remain after decommissioning if the preferred decommissioning option is approved, will be the open mine pit, as well as the three types of mine residue deposists, i.e. the Waste Rock Dump (WRD), Coarse Residue Deposit (CRD) and Fine Residue Deposit (FRD).

The current status of the open mine pit is indicated in figure 11, looking north from the southern edge of the pit. The figure clearly indicates that pit instability, with multiple ramp failures (N21/N22 and N28), as well as tension cracks on C3 N ramp. Due to the N22/21 and N28 Ramp Failures, the pit is now permanently inaccessible below bench 12. The figure also indicates the pit lake that is slowly forming at the bottom of the pit.

The pit water is currently alkaline and brackish, with sodium, sulphate, nitrate and fluoride levels that frequently exceeded DWAF (1996) domestic irrigation or livestock guidelines. The water is also neutral mine drainage with low metal concentrations. If the preferred decommissioning option is implemented, the pit water level will always remain below the natural ground water level so pit will continue to act as a pollution sink, capturing a component of seepage from the WRD and FRD. Due to the low permeability of the aquifer, the radius of influence of the pit is limited there will be no pollution plume migration from the pit.

None of the three types of mine residue deposits (WRD, CRD & FRD) is potentially acid generating. All the mine residues are likely to produce predominantly near-neutral, low-metal drainage upon exposure to rainfall, with a pH that is likely to exceed the Resource Water Quality Objective for the local catchment management unit (C70H), if not rehabilitated. Aluminium, iron & manganese concentrations in the drainage are likely to exceed the domestic & irrigation water quality guidelines, while the Sodium Absorption Ratio is likely to only exceed the irrigation water quality guideline. However, if rehabilitated, all surface water will be retained on the rehabilitated mine residue deposits and the exposure of the deposits to rainfall will virtually be eliminated.

d) Environmental and current land use map

(Show all environmental and current land use features.)

See attached map (Appendix 6).

Figure 11. Current status of the open mine pit, looking north, indicating the ramp failures and tension cracks, as well as the forming of the pit lake at the bottom of the pit. Due to the N22/21 and N28 Ramp Failures, the pit is now permanently inaccessible below bench 12, marked with a red cross.

10) *Impacts and risks identified, including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts can be avoided, managed or mitigated.*

(Provide a list of the potential impacts identified of the activities described in the initial site layout that will be undertaken, as informed by both the typical known impacts of such activities, and as informed by the consultations with affected parties, together with the significance, probability, and duration of the impacts. Please indicate the extent to which they can be reversed, the extent to which they may cause irreplaceable loss of resources, and can be avoided, managed or mitigated.)

As stated in Part A, section 3(g), the preferred open pit decommissioning alternative that is assessed in this report is the option of the development of a pit lake in the open pit under current conditions. The pit will be left to fill/re-water by natural process, while human and animal access to the pit will be restricted. Waste rock barriers/berms will be constructed of at top of the remaining open pit access ramps, while a high-end (Clearvu) security fence will be erected around the open pit, outside of the indicated Zone of Relaxation (break-back zone). Furthermore, a 5 m deep trench and 5 m high enviroberm will also be constructed around the open pit, outside the security fence. The remaining mine residue deposits will be reshaped, covered with cover material and/or soil and rehabilitated with a vegetation cover. The rehabilitated area and vegetation will be managed and maintained until closure, to ensure that the success criteria are achieved. Surface and groundwater, as well as vegetation and biodiversity monitoring will be undertaken to track the ground and surface water, as well as vegetation and biodiversity responses to the rehabilitation practices.

The alternative decommissioning option that is assessed, is the option of backfilling the open pit, primarily with material from the waste rock dump. The remaining mine residue deposits will be reshaped, covered with cover material and/or soil and rehabilitated with a vegetation cover. The rehabilitation, management and monitoring commitments for this option are furthermore the same as for the preferred option.

a) Environmental impacts and risks identified

The identified possible positive and negative environmental impacts of the preferred and alternative decommissioning options are summarised in Tables 5 and 6. Negative environmental impacts are indicated in red and positive impacts in green. The nature of the impacts are described in Table 7.

Table 5: Identified potential positive and negative environmental impacts of the preferred open pit decommissioning option, as informed by both the typical known impacts of such activities and the consultation with interested and affected parties.

Phase	Aspect	ABIOTIC						ECOLOGICAL			VISUAL	SOCIO-ECONOMIC	
		Soil (compaction & pollution)	Land use potential	Surface water (run-off & pollution)	Ground water (pollution)	Air quality (dust & fumes)	Noise	Vegetation (clearance & modification)	Wildlife (disturbance, injury & killing)	Ecosystem services	Visual impact	Archaeological & cultural sites	Socio-economic impacts
	Activity												
Decommissioning of existing structures and infrastructure	**On-site structures & infrastructure**												
	Clear infrastructure from site & dismantle steel structures	X	X	X		X	X				X		
	Remove all salvageable equipment and material from the mining area	X	X	X		X	X						X
	Demolish and remove concrete & brick structures, walkways & paved areas	X	X	X		X	X				X		
	Remove all container and mobile buildings and transport off site	X	X	X		X	X						
	Remove all culvert structures from roads and decommission trenches	X	X	X		X	X	X	X				
	Disposal of all inert concrete and building rubble in primary crusher void	X	X	X		X	X						
	Remove HDPE liner from RWD and dispose of at registered waste site	X	X	X			X		X				
	Renoster River Weir pump station												
	Dismantle and remove steel structures	X	X	X		X	X		X		X		
	Remove salvageable equipment and material	X	X	X		X	X						X
	Demolish and remove concrete and brick structures	X	X	X		X	X	X	X		X		
	Shape the area to fill excavations and be free draining	X	X	X		X	X	X	X				
	Pipeline from the Renoster River Weir pump station to the mine												
	Break and remove all manholes on the Renoster River water supply pipeline and backfill to ground level	X	X	X		X	X	X	X				

Phase	Aspect	ABIOTIC						ECOLOGICAL			VISUAL	SOCIO-ECONOMIC	
		Soil (compaction & pollution)	Land use potential	Surface water (run-off & pollution)	Ground water (pollution)	Air quality (dust & fumes)	Noise	Vegetation (clearance & modification)	Wildlife (disturbance, injury & killing)	Ecosystem services	Visual impact	Archaeological & cultural sites	Socio-economic impacts
	Activity												
	Open pit												
Decommissioning	Construct waste rock barriers / berms at top of remaining pit access ramps	X	X	X		X	X						X X
Decommissioning	Erect security fence around open pit outside of indicated ZOR	X	X				X		X				X X
Decommissioning	Construct trench and enviroberm around open pit outside of security fence	X	X	X		X	X	X	X				X
Earthworks & preparation for rehabilitation	**Mine Residue Deposits**												
Earthworks & preparation for rehabilitation	Reshape steep slopes of WRD & CRD and inside & outside slopes of FRD to be free draining, form single slope & reduce gradient & slope length	X	X	X		X	X				X		
Earthworks & preparation for rehabilitation	Cover roads, plant, building & related footprint areas & disturbed areas with soil	X	X	X		X	X						
Earthworks & preparation for rehabilitation	Cover reshaped slopes of MRDs & top areas of WRD & CRD with cover material and soil	X	X	X	X X	X	X				X		
Earthworks & preparation for rehabilitation	Fill hollows to make all areas free draining & aligned with natural drainage patterns	X	X	X		X	X		X	X			
Earthworks & preparation for rehabilitation	Align trench & berm around the open pit to divert storm water away from the pit	X	X	X		X	X						
Earthworks & preparation for rehabilitation	Confirm final alignment & construct water control berms/drains on decommissioned plant & infrastructure footprints	X	X	X		X	X						
Earthworks & preparation for rehabilitation	Construct crest berm walls & paddocks to contain rainfall runoff on rehabilitated MRD facilities	X	X	X		X	X						
Earthworks & preparation for rehabilitation	Construct and stabilise waterways on FRD with gabions & reno-mattresses			X		X	X						

Phase	Aspect	ABIOTIC						ECOLOGICAL			VISUAL	SOCIO-ECONOMIC	
		Soil (compaction & pollution)	Land use potential	Surface water (run-off & pollution)	Ground water (pollution)	Air quality (dust & fumes)	Noise	Vegetation (clearance & modification)	Wildlife (disturbance, injury & killing)	Ecosystem services	Visual impact	Archaeological & cultural sites	Socio-economic impacts
	Activity												
Earthworks & rehabilitation preparation	Construct toe paddocks at seepage points around MRD facilities to capture seepage & prevent siltation of the northern pan	X	X	X	X	X	X			X			
	Reinstate affected surface drainage lines & catchment areas to pans as far as possible	X	X	X		X	X	X	X	X			
Rehabilitation of disturbed areas	Conduct in-situ bio-remediation of hydro carbon contaminated areas	X	X	X	X								
	Rip roads, plant & building footprint areas to alleviate compaction	X	X	X		X	X						
	Rip top areas of WRD & CRD & slopes of MRDs to alleviate compaction & mix cover material and soil with underlying material	X	X	X		X	X						
	Ameliorate growth medium in rehabilitated areas, based on analysis of growth medium		X	X			X						
	Seed rehabilitated areas with mixture of indigenous grass and tree seeds		X	X			X	X	X	X	X		
	Apply follow-up fertiliser on rehabilitated areas where specified		X	X			X	X	X				
	Control weeds & invader plants in the mining area & on rehabilitated areas		X	X				X	X	X			
	Fence the rehabilitated area to create a camp system to control grazing & protect rehabilitation works		X						X				
	Stimulate the vegetation on rehabilitated areas by selective and controlled grazing		X	X				X	X	X			
	Create and maintain firebreaks to prevent veld fires from destroying the newly established vegetation		X	X		X		X	X	X			X

Phase	Aspect	ABIOTIC						ECOLOGICAL			VISUAL	SOCIO-ECONOMIC	
		Soil (compaction & pollution)	Land use potential	Surface water (run-off & pollution)	Ground water (pollution)	Air quality (dust & fumes)	Noise	Vegetation (clearance & modification)	Wildlife (disturbance, injury & killing)	Ecosystem services	Visual impact	Archaeological & cultural sites	Socio-economic impacts
	Activity												
Post rehabilitation management & monitoring	Maintain & manage all rehabilitated areas as appropriate in accordance with success criteria		X	X	X	X		X		X	X		X
	Decommission toe paddocks around WRD & CRD		X	X			X						
	Conduct ground and surface water monitoring programmes on water quality responses to rehabilitation			X	X					X			X
	Conduct vegetation and biodiversity monitoring programmes on vegetation & biodiversity responses to rehabilitation					X				X			X

Table 6: Identified possible potential and negative environmental impacts of the alternative pit backfilling decommissioning option, as informed by the typical impacts of such activities and the consultation with interested and affected parties

Phase	Aspect	ABIOTIC						ECOLOGICAL			VISUAL	SOCIO-ECONOMIC	
		Soil (compaction & pollution)	Land use potential	Surface water (run-off & pollution)	Ground water (pollution)	Air quality (dust & fumes)	Noise	Vegetation (clearance & modification)	Wildlife (disturbance, injury & killing)	Ecosystem services	Visual impact	Archaeological & cultural sites	Socio-economic impacts
	Activity												
Decommissioning of existing structures and infrastructure	**On-site structures & infrastructure**												
	Clear infrastructure from site & dismantle steel structures	X	X	X		X	X				X		
	Remove all salvageable equipment and material from the mining area	X	X	X		X	X						X
	Demolish and remove concrete & brick structures, walkways & paved areas	X	X	X		X	X				X		
	Remove all container and mobile buildings and transport off site	X	X	X		X	X						
	Remove all culvert structures from roads and decommission trenches	X	X	X		X	X		X				
	Disposal of all inert concrete and building rubble in primary crusher void	X	X	X		X	X						
	Remove HDPE liner from RWD and dispose of at registered waste site	X	X	X			X		X				
	Renoster River Weir pump station												
	Dismantle and remove steel structures	X	X	X		X	X		X		X		
	Remove salvageable equipment and material	X	X	X		X	X						X
	Demolish and remove concrete and brick structures	X	X	X		X	X		X		X		
	Shape the area to fill excavations and be free draining	X	X	X		X	X		X				
	Pipeline from the Renoster River Weir pump station to the mine												
	Break and remove all manholes on the Renoster River water supply pipeline and backfill to ground level	X	X	X		X	X	X	X				

Phase	Aspect	ABIOTIC						ECOLOGICAL			VISUAL	SOCIO-ECONOMIC	
		Soil (compaction & pollution)	Land use potential	Surface water (run-off & pollution)	Ground water (pollution)	Air quality (dust & fumes)	Noise	Vegetation (clearance & modification)	Wildlife (disturbance, injury & killing)	Ecosystem services	Visual impact	Archaeological & cultural sites	Socio-economic impacts
	Activity												
	Mine Residue Deposits												
Earthworks & preparation for rehabilitation	Load and haul material from the WRD and CRD and deposit into the open pit	X	X	X	X	X	X	X	X	X	X		
	Reshape inside & outside slopes of FRD to be free draining, form single slope & reduce gradient & slope length	X	X	X		X	X				X		
	Cover roads, plant, building & related footprint areas & disturbed areas with soil	X	X	X		X	X						
	Cover reshaped slopes of FRD with cover material and soil	X	X	X	X	X	X				X		
	Fill low laying areas to make all areas free draining & aligned with natural drainage patterns	X	X	X		X	X		X	X			
	Rip roads, plant & building footprint areas to alleviate compaction		X	X		X	X						
	Confirm final alignment & construct water control berms/drains on decommissioned plant & infrastructure footprint areas	X	X	X		X	X						
	Construct crest berm walls & paddocks to contain rainfall & runoff on rehabilitated FRD	X	X	X		X	X						
	Rip slopes of all FRD to alleviate compaction and mix cover material and soil with underlying material		X	X		X	X						
	Construct and stabilise waterways on FRD with gabions & reno-mattresses		X	X		X	X						
	Construct toe paddocks at seepage points around the FRD to capture & evaporate seepage	X	X	X	X	X	X			X			
	Reinstate affected surface drainage lines and catchment areas to pans as far as possible after mining operations	X	X	X		X	X	X	X	X			

Phase	Aspect	ABIOTIC						ECOLOGICAL			VISUAL	SOCIO-ECONOMIC	
		Soil (compaction & pollution)	Land use potential	Surface water (run-off & pollution)	Ground water (pollution)	Air quality (dust & fumes)	Noise	Vegetation (clearance & modification)	Wildlife (disturbance, injury & killing)	Ecosystem services	Visual impact	Archaeological & cultural sites	Socio-economic impacts
	Activity												
Rehabilitation of disturbed areas	Conduct in-situ bio-remediation of hydro carbon contaminated areas		X	X	X								
	Ameliorate growth medium in all rehabilitated areas, based on analysis of growth medium mixture		X	X			X						
	Seed rehabilitated areas with mixture of indigenous grass and tree seeds		X	X			X	X		X	X		
	Apply follow-up fertiliser on rehabilitated areas where specified		X	X			X	X					
	Control weeds & invader plants in the mining area & on rehabilitated areas		X	X				X	X	X			
	Fence the rehabilitated area to create a camp system to control grazing & protect rehabilitation works		X										
	Stimulate the vegetation on rehabilitated areas by selective and controlled grazing		X	X				X		X			
	Create and maintain firebreaks to prevent veld fires from destroying the newly established vegetation		X	X		X		X	X	X			X
Post rehabilitation management & monitoring	Maintain & manage all rehabilitated areas as appropriate in accordance with success criteria		X	X	X	X		X		X	X		X
	Conduct ground and surface water monitoring programmes on water quality responses to rehabilitation			X	X					X			X
	Conduct vegetation and biodiversity monitoring programmes on vegetation & biodiversity responses to rehabilitation					X				X			X
	Construct scavenger boreholes and treat the abstracted polluted groundwater				X								X

Table 7: Nature of the identified potential positive and negative environmental impacts of the preferred and alternative decommissioning options, as informed by the typical impacts of such activities & consultation with interested & affected parties

Impact	Phases	Nature of impact	Activity
Negative environmental impacts			
Soil compaction	Decommissioning & earthworks	• Soil compaction due to movement of vehicles and equipment used during decommissioning and earthwork (both options)	Clear infrastructure from site & dismantle steel structures
			Demolish & remove concrete & brick structures, walkways & paved areas
			Remove all culvert structures from roads and decommission trenches
			Remove all salvageable equipment and material from the mining area
			Remove all container and mobile buildings and transport off site
			Disposal of inert concrete & building rubble in primary crusher void
			Remove HDPE liner from RWD and dispose of at registered waste site
			Shape the area to fill excavations and be free draining
			Construct waste rock barriers / berms at top of open pit access ramps
			Erect security fence around open pit outside of indicated ZOR
			Construct trench & enviroberm around open pit outside of security fence
			Reshape steep slopes of WRD & CRD and inside & outside slopes of FRD to be free draining, form single slope & reduce gradient & slope length
			Cover roads, plant, building & related footprints & disturbed areas with soil
			Cover reshaped slopes of MRDs & top areas of WRD & CRD with cover material and soil
			Confirm final alignment & construct water control berms/drains on decommissioned plant & infrastructure footprint areas
			Construct crest berm walls & paddocks to contain rainfall and runoff on rehabilitated MRD facilities

Impact	Phases	Nature of impact	Activity
Soil compaction	Decommissioning & earthworks	• Soil compaction due to movement of vehicles & equipment used (both options)	Construct toe paddocks at seepage points around MRD facilities to capture seepage & prevent siltation of the northern pan
			Reinstate affected surface drainage lines & catchment areas to pans as far as possible
Soil pollution	Decommissioning & earthworks	• Soil pollution and contamination due to spillages of hydrocarbons, fertilisers and other contaminants used during decommissioning and rehabilitation activities (both options)	Clear infrastructure from site & dismantle steel structures
			Demolish & remove concrete & brick structures, walkways & paved areas
			Erect security fence around open pit outside of indicated ZOR
			Construct trench & enviroberm around open pit outside of security fence
			Shape the area to fill excavations and be free draining
			Reshape steep slopes of WRD & CRD and inside & outside slopes of FRD to be free draining, form single slope & reduce gradient & slope length
			Cover roads, plant, building & related footprints & disturbed areas with soil
			Cover reshaped slopes of MRDs & top areas of WRD & CRD with cover material and soil
			Confirm final alignment & construct water control berms/drains on decommissioned plant & infrastructure footprint areas
Change in land use potential	Decommissioning & earthworks	• Reduced land use potential due to soil compaction and pollution, as well as loss of topsoil due to soil erosion during decommissioning and rehabilitation activities (both options)	All activities causing soil compaction, soil pollution and soil loss indicated above & below

Impact	Phases	Nature of impact	Activity
Surface water run-off	Decommissioning & earthworks	• Increased surface water run-off due to an increase in bare areas during decommissioning and rehabilitation activities (both options)	Reshape steep slopes of WRD & CRD and inside & outside slopes of FRD to be free draining, form single slope & reduce gradient & slope length
			Cover roads, plant, building & related footprints & disturbed areas with soil
			Cover reshaped slopes of MRDs & top areas of WRD & CRD with cover material and soil
			Fill hollows to make all areas free draining & aligned with natural drainage patterns
			Confirm final alignment & construct water control berms/drains on decommissioned plant & infrastructure footprint areas
			Reinstate affected surface drainage lines & catchment areas to pans
Surface water pollution	Decommissioning, earthworks & rehabilitation	• Increased pollutant concentrations and silt in surface water run-off due to the pollutants used, as well as increased soil disturbance, decreased vegetation cover and increased water run-off during decommissioning and rehabilitation activities (both options)	All activities causing soil compaction and soil pollution indicated above
			Ameliorate growth medium in all rehabilitated areas, based on analysis of growth medium mixture
			Seed rehabilitated areas with mixture of indigenous grass and tree seeds
			Apply follow-up fertiliser on rehabilitated areas where specified
Groundwater pollution	Decommissioning & earthworks	• Potential long term groundwater pollution from unrehabilitated mine residue deposits (preferred option) • Increased long term groundwater pollution due to leaching of contaminants from the saturated groundwater mound in the backfilled pit, consisting of a semi-consolidated waste rock filling, for approximately 100 years post closure (backfill option)	Disposal of mine residue deposits on the surface of the land
			Backfilling of the open pit with mine residue deposits
Generation of dust and fumes	Decommissioning, earthworks & rehabilitation	• Increased generation of dust and fumes from machinery used, as well as increased soil disturbance and reduced vegetation cover during decommissioning and rehabilitation activities (both options)	All activities causing soil compaction and soil pollution indicated above
			Ameliorate growth medium in all rehabilitated areas, based on analysis of growth medium
			Seed rehabilitated areas with mixture of indigenous grass and tree seeds
			Apply follow-up fertiliser on rehabilitated areas where specified

Impact	Phases	Nature of impact	Activity
Noise	Decommissioning, earthworks & rehabilitation	• Noise generated by machinery used during decommissioning and rehabilitation activities (both options)	All activities causing soil compaction and soil pollution indicated above
			Ameliorate growth medium in all rehabilitated areas, based on analysis of growth medium
			Seed rehabilitated areas with mixture of indigenous grass and tree seeds
			Apply follow-up fertiliser on rehabilitated areas where specified
Vegetation impacts	Decommissioning & earthworks	• Reduced vegetation cover and increased competition from weeds & invader plants that establish in disturbed areas during decommissioning and rehabilitation activities (both options)	All activities causing soil compaction and soil pollution indicated above
Wildlife disturbance & killing/injury	Decommissioning, earthworks & rehabilitation	• Displacement of wildlife due to habitat destruction and transformation, restriction of wildlife movement, as well as potential snaring, hunting and killing of wildlife due to decommissioning and rehabilitation activities (both options)	All decommissioning activities causing soil compaction and soil pollution
			Apply follow-up fertiliser on rehabilitated areas where specified
			Fence the rehabilitated area to create a camp system to control grazing & protect rehabilitation works
			Construct trench and enviroberm around open pit outside of security fence
Wildlife disturbance & killing/injury	Decommissioning, Earthworks, Rehabilitation & Post-rehabilitation management & monitoring	• Wildlife injury and death caused by sliding/falling down the steep unrehabilitated slopes of the mine residue deposits and open pit, as well as drowning in the pit lake (preferred option)	All decommissioning activities causing soil compaction and soil pollution
			Apply follow-up fertiliser on rehabilitated areas where specified
			Fence the rehabilitated area to create a camp system to control grazing & protect rehabilitation works
			Construct trench and enviroberm around open pit outside of security fence
Visual impact	Decommissioning & earthworks	• Visual impact caused by the removal and demolishing of buildings and structures, as well as the earthworks (both options)	All decommissioning activities causing soil compaction & pollution indicated above
			All earthworks causing soil compaction and soil pollution indicated above
Ecosystem services	Decommissioning & earthworks	• Disruption or destruction of ecosystem services due to decommissioning activities and earthworks (both options)	All decommissioning activities causing soil compaction & pollution indicated above
			All earthworks causing soil compaction, soil pollution and destruction of ecosystem services indicated above

Impact	Phases	Nature of impact	Activity
Social impacts due to safety risks	Decommissioning, earthworks & post rehabilitation management	• Increased risk of human injury and death caused by sliding/falling down the steep unrehabilitated slopes of the mine residue deposits (both options) • Increased risk of human death from sliding/falling into the pit & drowning (preferred option).	Construct waste rock barriers / berms at top of remaining pit access ramps
			Erect security fence around open pit outside of indicated ZOR
			Construct trench and enviroberm around open pit outside of security fence
Social & socio-economic impacts	Decommissioning & earthworks	• Negative social & socio-economic impacts due to further job losses, reduced economic activity, loss of support for mine (CSI & LED) beneficiaries, as well as reduced levels of security and emergency response capacity during the decommissioning and rehabilitation activities (both options)	All decommissioning activities that result in permanent job losses
Positive environmental impacts			
Soil compaction	Rehabilitation	• Reversal of soil compaction due to ripping of compacted areas to alleviate compaction (both options)	Rip roads, plant & building footprint areas to alleviate compaction
			Rip top areas of WRD & CRD & slopes of MRDs to alleviate compaction & mix cover material and soil with underlying material
Soil pollution	Rehabilitation	• Clean-up of polluted soils due to in-situ bio-remediation of hydrocarbon contaminated areas (both options)	Conduct in-situ bio-remediation of hydro carbon contaminated areas
Change in land use potential	Rehabilitation & post rehabilitation management	• Improved land use potential due to rehabilitation of mine residue deposits and disturbed areas, as well as reduction/ elimination of top soil losses due to reshaped land forms, water management features, improved vegetation cover & reduced surface water run-off (both options)	Ameliorate growth medium, based on analysis of growth medium
			Seed rehabilitated areas with mixture of indigenous grass and tree seeds
			Apply follow-up fertiliser on rehabilitated areas where specified
			Control weeds & invader plants in the mining area & on rehabilitated areas
			Fence the rehabilitated area to create a camp system to control grazing & protect rehabilitation works
			Stimulate vegetation on rehabilitated areas by selective & controlled grazing
			Create and maintain firebreaks to prevent veld fires from destroying the newly established vegetation
			Maintain & manage all rehabilitated areas in accordance with success criteria

Impact	Phases	Nature of impact	Activity
Surface water run-off	Earthworks, rehabilitation & post rehabilitation	• Reduced surface water run-off due to retention of potential polluted surface run-off on rehabilitated mine residue deposits, as well as rehabilitation and post rehabilitation management and monitoring activities that rehabilitate soil disturbance, improve vegetation cover, increase water infiltration & reduce surface water run-off (both options)	Construct crest berm walls & paddocks to contain rainfall and runoff on rehabilitated MRD facilities
			Confirm final alignment & construct water control berms/drains on decommissioned plant & infrastructure footprint areas
			Construct toe paddocks at seepage points around MRD facilities to capture seepage & prevent siltation of the northern pan
			Reinstate affected surface drainage lines & catchment areas to pans
			Maintain & manage all rehabilitated areas in accordance with success criteria
Surface water pollution	Earthworks, rehabilitation & post rehabilitation management	• Reduced surface water pollution due to retention of potential polluted surface run-off on rehabilitated mine residue deposits, as well as reduced silt loading due to rehabilitation activities to rehabilitate soil disturbance, improve vegetation cover, increase water infiltration & reduce surface water run-off (both options) • Reduced surface water pollution due to the removal of some of the mine residue deposits for backfilling (backfilling option)	Construct crest berm walls & paddocks to contain rainfall and runoff on rehabilitated MRD facilities
			Confirm final alignment & construct water control berms/drains on decommissioned plant & infrastructure footprint areas
			Construct toe paddocks at seepage points around MRD facilities to capture seepage & prevent siltation of the northern pan
			Ameliorate growth medium, based on analysis of growth medium
			Seed rehabilitated areas with mixture of indigenous grass and tree seeds
			Apply follow-up fertiliser on rehabilitated areas where specified
			Control weeds & invader plants in the mining area & on rehabilitated areas
			Stimulate the vegetation on rehabilitated areas by selective and controlled grazing
			Create and maintain firebreaks to prevent veld fires from destroying the newly established vegetation
			Reinstate affected surface drainage lines & catchment areas to pans
			Maintain & manage all rehabilitated areas in accordance with success criteria

Impact	Phases	Nature of impact	Activity
Groundwater pollution	Earthworks, rehabilitation & post rehabilitation management	• Reduced potential long-term groundwater pollution from rehabilitated mine residue deposits (both options) • Reduced potential long term long term groundwater pollution from mine residue deposits due to the use of these for backfilling the pit (backfill option)	Backfilling of the open pit with mine residue deposits
			All activities to shape, cover and rehabilitate the mine residue deposits
			Maintain & manage all rehabilitated areas in accordance with success criteria
Generation of dust and fumes	Rehabilitation & post rehabilitation management	• Reduced generation of dust from the rehabilitated mining area due to rehabilitation and post rehabilitation management and monitoring activities that rehabilitate soil disturbance and improve vegetation cover (both options)	Ameliorate growth medium, based on analysis of growth medium
			Seed rehabilitated areas with mixture of indigenous grass and tree seeds
			Apply follow-up fertiliser on rehabilitated areas where specified
			Control weeds & invader plants in the mining area & on rehabilitated areas
			Stimulate the vegetation on rehabilitated areas by selective and controlled grazing
			Create and maintain firebreaks to prevent veld fires from destroying the newly established vegetation
			Maintain & manage all rehabilitated areas in accordance with success criteria
Noise	Post rehabilitation management	• Elimination of noise caused by mining equipment and activities after rehabilitation and closure (both options)	All post rehabilitation management and maintenance activities
Vegetation impacts	Rehabilitation & post rehabilitation management	• Improvement of natural vegetation due to rehabilitation and post rehabilitation management and monitoring activities that establish and maintain a vegetation cover similar to the natural comparable surrounding environment & control weed and invader plant invasions so that it will not outcompete the indigenous grass & tree species (both options)	All rehabilitation activities
			Control weeds & invader plants in the mining area & on rehabilitated areas
			Maintain & manage all rehabilitated areas in accordance with success criteria
Wildlife disturbance & killing/injury	Rehabilitation & post rehabilitation management	• Return of wildlife to new habitats in the rehabilitated areas created through the rehabilitation activities, as well as improved wildlife habitats due to the control of weeds & invader plants (both options)	All rehabilitation activities that create new habitats
			Control weeds & invader plants in the mining area & on rehabilitated areas
			Create and maintain firebreaks to prevent veld fires from destroying the newly established vegetation
			Maintain & manage all rehabilitated areas in accordance with success criteria

Impact	Phases	Nature of impact	Activity
Ecosystem services	Earthworks, rehabilitation & post rehabilitation management	• Resumption or improvement of ecosystem services due to rehabilitation and post rehabilitation management and maintenance activities (both options) • Increased surface water run-off volume from the rehabilitated areas to the wetland areas and pans, resulting in improved ecosystem integrity and functioning (both options) • Improved surface water run-off quality from the rehabilitated areas to the wetland areas and pans, resulting in improved ecosystem integrity and functioning (both options)	All earthworks that re-established ecosystem functioning
			All rehabilitation activities that improve ecosystem services
			Control weeds & invader plants in the mining area & on rehabilitated areas
			Create and maintain firebreaks to prevent veld fires from destroying the newly established vegetation
			All rehabilitation and post-rehabilitation management & maintenance activities
Visual impact	Decommissioning, earthworks, rehabilitation & post rehabilitation management	• Reduction of visual impact due to rehabilitation and post rehabilitation management and maintenance of the mine residue deposits and mining area (both options)	All earthworks that re-establish more visually pleasing landscapes
			All rehabilitation and post-rehabilitation management & maintenance activities
			All decommissioning activities that result in reduced economic activity
			All decommissioning activities that result in increased safety risk
Social impacts due to safety risks	Decommissioning	• Reduced risk of human injury or death from sliding/falling down the steep slopes of the mine residue deposits (both options) • Reduced risk of human and animal injury or death from sliding/falling down the steep slopes of the open pit and drowning in the pit lake (preferred option) • Complete elimination of the risk of human and animal injury or death from sliding/falling down the steep slopes of the open pit due to backfilling of the open pit (backfill option)	All decommissioning activities & earthworks that restrict access to the open pit (preferred option)
			All decommissioning activities & earthworks to backfill the open pit (backfill option)
Social & socio-economic impacts	Decommissioning, earthworks, rehabilitation & post rehabilitation management	• Positive social and socio-economic impacts through the creation of temporary employment opportunities, as well as economic benefits during decommissioning and rehabilitation (both options)	All decommissioning activities, earthworks, rehabilitation activities and post rehabilitation management and monitoring activities that result in creation of temporary jobs & modified economic activity

b) *Methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks*

(Describe how the significance, probability, and duration of the identified impacts that were identified were determined in order to decide the extent to which the site layout needs revision.)

The assessment of impacts was done according to a synthesis of the following criteria:

- Nature of the impact
- Extent (spatial scale) and duration of the impact
- Magnitude or intensity of the impact (severity)
- Probability, reversibility and irreplaceability of the impact
- Ability to prevent/control/mitigate
- Significance

The criteria were used to determine significance as described below.

- **Nature of the impact**
  This is an appraisal of the type of effect the activity would have on the affected environment. The description includes what is being affected and how, whether it is positive or negative, as well as whether it is direct or indirect.

- **Extent (spatial scale)**

Extent of impact	Description
Site specific	Direct & indirect impacts limited to site of impact only.
Local	Direct & indirect impacts affecting environmental elements around the mining area.
Regional	Direct & indirect impacts affecting environmental elements in the Fezile Dabi district.
National	Direct & indirect impacts affecting environmental elements on a national level.
Global	Direct & indirect impacts affecting environmental elements on a global level.

- **Duration (Reversibility)**

Duration of impact	Description
Very short	Less than 1 year
Short	1 to 5 years
Medium	6 to 12 years
Long	13 to 50 years
Very long	Longer than 50 years
Permanent	Permanent

- **Magnitude or intensity of the impact (severity)**

Magnitude/intensity	Description
Low	The impact affects the environment in such a way that natural, social and cultural functions and processes are not affected
Moderate	The affected environment is altered, but natural, social and cultural functions & processes continue albeit in a modified way
Severe	Natural, social and cultural functions or processes are altered to the extent that it will temporarily or permanently cease

- **Probability**

Probability of impact occurrence	Description
Very low	<20% sure of particular fact or likelihood of impact occurring
Low	20 to 39% sure of particular fact or likelihood of impact occurring.
Moderate	40 to 59% sure of particular fact or likelihood of impact occurring.
High	60 to 79% sure of particular fact or likelihood of impact occurring.
Very high	80 to 99% sure of particular fact or likelihood of impact occurring.
Definite	100% sure of particular fact or likelihood of impact occurring.

- **Reversibility**

High	Impact can be reversed fairly easily
Moderate	Impact can only be reversed with difficulty
Low	Virtually impossible to reverse impact

- **Extent of avoidance and/or management and/or mitigation**

High	Impact can be fairly easily avoided and/or managed and/or mitigated
Moderate	Impact can only be avoided and/or managed and/or mitigated with difficulty
Low	Virtually impossible to avoid and/or manage and/or mitigate impact

- **Extent of irreplaceable loss of resources**

High	Almost complete loss of irreplaceable resources
Moderate	Some loss of irreplaceable resources
Low	Virtually no loss of irreplaceable resources

- **Impact significance**

Impact significance	**Description**	
	Negative impacts	**Positive impacts**
No impact.	There would be no impact at all - not even a very low impact on the system or any of its parts.	
Very low Impact would be negligible.	Almost no mitigation and/or remedial activity would be needed, and any minor steps, which might be needed, would be easy, cheap and simple.	Alternative means would almost always be better, in one or a number of ways, than this means of achieving the benefit.
Low Impact would be of a low order and with little real effect.	Mitigation and/or remedial activity would be either easily achieved or little would be required, or both.	Alternative means for achieving this benefit would likely be easier, cheaper, more effective, less time-consuming, or some combination of these.
Moderate Impact would be real but not substantial within the bounds of those which could occur.	Mitigation and/or remedial activity would be both feasible and fairly easily possible.	Other means of achieving these benefits would be about equal in time, cost and effort.
High Impacts of a substantial order.	Mitigation and/or remedial activity would be feasible but difficult, expensive, time-consuming or some combination of these.	Other means of achieving this benefit would be feasible, but these would be more difficult, expensive, time-consuming or some combination of these.
Very high Of the highest order possible within the bounds of impacts that could occur.	There would be no possible mitigation and/or remedial activity to offset the impact at the spatial or time scale for which it was predicted.	There is no real alternative to achieving the benefit.

c) The positive and negative impacts that the proposed activity (in terms of the initial site layout) and alternatives will have on the environment and the community that may be affected

(Provide a discussion in terms of advantages and disadvantages of the initial site layout compared to alternative layout options to accommodate concerns raised by affected parties.)

The majority of the decommissioning activities and associated with preferred open pit decommissioning and mine closure option and the alternative open pit backfilling decommissioning and mine closure option are the same, i.e. the two options do not differ much. Consequently, the two options also do not differ much in terms of the environmental impacts associated with them, as evident from the impact identification matrices in section 10(a). The two matrices (Tables 3 and 4) indicate that the preferred open pit decommissioning and alternative pit backfill decommissioning options would result in approximately 140 negative and 60 positive environmental impacts.

The primary difference between the two options is that the preferred option will not backfill the open pit, while the alternative pit backfilling option will use mine residue deposits, primarily the waste rock dump to backfill the open pit.

Both decommissioning and mine closure options will involve the following rehabilitation actions, aimed at ensuring that rehabilitated areas are self-sustainable over the long term, with limited on-going care and maintenance:

- A phased decommissioning of the existing structures and infrastructure on the site;
- Preparing areas, i.e. implement earthworks, to create suitable habitats and support the ecological stability (e.g. erosion resistant) of rehabilitated areas.
  This includes reshaping the steep slopes of the Mine Residue Deposits (MRDs), covering all mine residues and disturbed areas with suitable soil or growth medium, ripping of rehabilitation areas to alleviate compaction and/or mix the cover layer with the underlying material, reinstating affected surface drainage lines and catchment areas, as well as cultivating, ameliorating and fertilising the rehabilitation areas.
- Establishing vegetation that is stable over the long term, fulfil the desired ecological functions and also provide suitable diversity of species for utilisation by animals.
  This includes seeding the area with a mixture of local indigenous grass and tree seeds, applying follow-up fertiliser, controlling weeds and invader plants, as well as stimulating the vegetation on rehabilitated areas by selective and controlled grazing.

From an environmental perspective, the primary advantages of the alternative pit backfill option are the following:

- The open pit will be backfilled, eliminating any potential impacts/risks of humans/animals falling down the pit slopes in attempts to access the pit, which could result in injury, death and drowning.
- An additional area of 70 hectares of land will become available for rehabilitation and post closure utilisation as grazing land, which will be able to sustain approximately 10 additional head of cattle.
- The grazing potential of the rehabilitated footprint of the waste rock dump will probably be slightly higher than that the rehabilitated waste rock dump itself that would have remained.
- Lastly, the removal of the waste rock dump will remove the potential for a ground water pollution plume from the rehabilitated waste rock dump that would have remained.

The disadvantages of the alternative pit backfill option, from an environmental perspective, are primary twofold:

- The cost associated with the backfilling option is orders of magnitude (hundred times) more than the preferred option, i.e. R 4 billion vs R 40 million. This cost is disproportionate to the benefits achieved by mining activities over the life of the mine. In addition, the cost is also more than what could be considered proportional to the benefits gained by the backfilling of the open pit.
- The backfilling of the pit will potentially lead to the release of polluted water from the saturated backfilled pit, as early as 32 years after closure, for a period of approximately 60 years, due to the leaching of dissolved contaminants of concern from the semi-consolidated waste rock mass. This could potentially result in the pollution of the groundwater aquifer, thereby affecting potential groundwater users.
- The potential release of polluted water from the saturated backfilled pit may result in a long-term responsibility and liability for water quality monitoring in and around the mining area. followed by mitigation procedures. This could include the development of a special pollution plume borehole capturing system, as well as polluted water storage and treatment processes, which could be prohibitively expensive.
- The Fine Residue Deposit and a large part of the Course Residue Deposit will remain on the surface of the mining area, although both will be rehabilitated, therefore having the potential to sustain ground water pollution plumes beneath them.

From an environmental perspective, the primary disadvantages of the preferred open pit option are as follows:

- The open mine pit will remain open after decommissioning and mine closure, resulting in a continued potential impacts/risk of humans/animals falling down the pit slopes in attempts to access the pit, which could result in injury, death and drowning. However, the access ramps to the pit will be decommissioned, while two layers of additional security measures will be constructed around the open pit to restrict access to the pit.
- The open pit will also result in a loss of 70 ha of land that could have been rehabilitated and utilised as grazing land post closure, which would have been able to sustain approximately 10 additional head of cattle.
- In addition, the grazing potential of the rehabilitated waste rock dump will probably be slightly lower than the rehabilitated footprint of the waste rock dump that could have been created.
- All the Mine Residue Deposits will remain on the surface of the mining area, although rehabilitated, therefore having the potential to sustain ground water pollution plumes beneath them.

The primary advantages of the preferred open pit option are as follows:

- The decommissioning and closure efforts will be sufficient to achieve the overarching closure objective of ensuring sustainability beyond mine closure and leaving a positive legacy. They will also be sufficient to achieve the specific closure objectives of restoring as much as possible of the mining area to a condition consistent with the pre-determined post closure land use objectives; ensuring that the area is left in a condition that poses an acceptable level of risk to public health and safety; and reducing the need for post closure intervention, either in the form of monitoring or on-going remedial work, as far as is practicably possible.

- The cost associated with the preferred option is orders of magnitude (approximately hundred times) less than the backfilling option, i.e. R 4 billion vs R 40 million. This cost is disproportionate to the benefits achieved by mining activities over the life of the mine, while it is also considered disproportionate to the benefits gained by the measures that will be implemented to restrict access to the open pit.

d) The possible mitigation measures that could be applied and the level of risk

(With regard to the issues and concerns raised by affected parties, provide a list of the issues raised and an assessment / discussion of the mitigations or site layout alternatives available to accommodate or address their concerns, together with an assessment of the impacts or risks associated with the mitigation or alternatives considered).

Possible mitigation measures to that could be applied to address the potential environmental impacts of the decommissioning and rehabilitation activities related to the preferred option include the following:

Earthworks mitigation measures

- Construct waste rock barriers / berms at top of remaining open pit access ramps
- Erect security fence around open pit outside of indicated ZOR
- Construct trench and enviroberm around open pit outside of security fence
- Reshape inside and outside slopes of FRD to form single slope and reduce gradient and slope length
- Reshape steep slopes of WRD & CRD to reduce gradient and slope length and be free draining
- Cover roads, plant, building and related footprint areas with soil
- Cover reshaped slopes and top areas of WRD & CRD with suitable material and soil to form growth medium together with underlying material
- Rip roads, plant & building footprint areas to alleviate compaction
- Rip top areas and slopes of WRD & CRD to alleviate compaction and mix cover material and soil with underlying material

Water management actions

- Align trench and berm around the open pit to divert clean storm water away from the pit
- Construct water control berms / contour drains on covered plant area
- Contain rainfall and runoff on rehabilitated MRD facilities
- Construct crest berm walls and paddocks on top of MRD facilities
- Construct waterways of FRD and stabilise waterways with gabions and reno mattresses

- Construct toe paddocks at seepage points around MRD facilities to capture and evaporate seepage and prevent sediment transport into the northern pan
- Decommission existing seepage trenches around CRD & FRD, backfill and cover with surrounding material

Soil amelioration, vegetation establishment and fencing

- Implement in-situ bioremediation in hydrocarbon contaminated plant areas
- Spread fertiliser and seeds by hand on the top areas that can be safely accessed on foot
- Ameliorate growth medium in all rehabilitated areas, based on analysis of final growth medium mixture
- Seed the rehabilitated areas with a mixture of local indigenous grass and tree seeds
- Apply follow-up fertiliser on rehabilitated areas where specified
- Control weeds and invader plant species on rehabilitated areas
- Fence the rehabilitated areas to create a camp system
- Stimulate the vegetation on rehabilitated areas by grazing

Post-rehabilitation management and maintenance

- Maintain all rehabilitated areas as appropriate in accordance with succes criteria
- Decommission toe paddocks around WRD & CRD during maintenance period

Environmental monitoring

- Conduct on-going environmental monitoring programmes

See Part A, section 15 and Part B for an elaborate assessment and discussion of the mitigation measures mentioned here.

e) *Motivation where no alternative sites were considered*

The mine has been operational since 2008 on this site, thus the decommissioning activity can only occur on the mining site. Limited decommissioning will also occur at the Renoster River weir, where water was abstracted for the mining activities, as well as along the pipeline from the abstraction point to the mine, where the manholes along the pipeline will be demolished and rehabilitated.

f) *Statement motivating the alternative development location within the overall site*

(Provide a statement motivating the final site layout that is proposed.)

There is no alternative development location with the mining area. With the preferred open pit alternative, the open pit will remain, while the mine residue deposits will also remain on the surface of the land and rehabilitated to limit environmental pollution and reinstate the agricultural use of the land.

With the pit backfill alternative, the waste rock dump and part of the Course Residue Deposit will be returned to fill the open pit to current ground level. The Fine Residue Deposit and part of the Course Residue Deposit will remain on the surface of the land and rehabilitated to limit environmental pollution and reinstate the agricultural use of the grazing land. This option will remove some of the visual impacts of the mine, as well as some of the potential sources of environmental pollution from the mining area. However, it will introduce an additional risk in terms of potential long-term groundwater pollution. In addition, the backfilling of the pit would result in excessive costs (100 times more than the preferred option) that are not economically viable and is disproportionate to the benefits achieved by mining activities over the life of the mine. It is also more than what could be considered proportional to the benefits gained by the backfilling of the open pit.

11) Full description of the process undertaken to identify, assess and rank the impacts and risks the activity will impose on the preferred site (in respect of the final site layout plan) through the life of the activity

(Including (i) a description of all environmental issues and risks that were identified during the environmental impact assessment process and (ii) an assessment of the significance of each issue and risk and an indication of the extent to which the issue and risk could be avoided or addressed by the adoption of mitigation measures.)

The expert knowledge of the Environmental Assessment Practitioner and the specialists were used to identify, assess and rank the negative impacts and risks that the decommissioning activity will impose on the environment at the site, in accordance with the methodology described in section 10(b). For the positive impacts identified in section 10(a), the assessment was only done with regards to the first four criteria mentioned in section 10(b), i.e. extent, duration, magnitude and probability, before assessing their significance. There is no need to reverse, avoid or manage positive impacts and they do not result in the irreplaceable loss of resources. Therefore, these criteria were not assessed.

Engagements with specialists and specialist reports were the primary sources for evaluating the nature and potential impacts of the decommissioning activity. These specialist reports are summarised in section 12 and attached to this application.

In addition, the mining area was visited on numerous occasions and aerial images and maps of the decommissioning area were also studied to inform my understanding and decisions.

Furthermore, experience gained during similar past projects was invaluable in the process. Lastly, engagement with the public/communities, as well as interested and affected parties also contributed to the impact identification, assessment and ranking process.

Details of the environmental issues and risks identified and assessed are provided in sections 10(a), 10(c) above and 12 below.

12) Assessment of each identified potentially significant impact and risk

(This section of the report must consider all the known typical impacts of each of the activities (including those that could or should have been identified by knowledgeable persons) and not only those that were raised by registered interested and affected parties.)

The impact assessments for the preferred and alternative open pit decommissioning options are summarised in Tables 7 and 8. The supporting impact assessments conducted by the EAP for the preferred open pit and alternative pit backfill options are attached as appendices, marked Appendices 7 and 8.

An impact assessment has not been undertaken for the no-go option. Although all the potential environmental impacts identified for the preferred open pit and alternative backfill options will also apply for the no-go option, there will be neither any positive impacts, nor any mitigation measures. It is therefore imminent that this option will be environmentally much more disastrous in all aspects, than any of the other two options.

In both the tables and the appendices, negative impacts are indicated in red, while positive impacts are indicated in green. The results does not only assess the raw or pre-mitigated environmental impacts or risks, but also suggest mitigation types and assess the post-mitigated or residual impacts/risks.

The results indicate that the majority of the environmental impacts for both the preferred open pit and alternative backfill decommissioning options are negative during the decommissioning and earthworks phases of the project, while the majority of the environmental impacts for both options are positive during the rehabilitation, as well as post-rehabilitation management and monitoring phases.

From the results, it is clear that the assessed impacts of the preferred and alternative decommissioning options are virtually similar. These relate to positive and negative impacts of various decommissioning and rehabilitation activities on soil compaction and pollution, land use potential, surface water run-off and pollution, ground water pollution, vegetation and wildlife, dust and fumes, noise, visual landscape, as well as the social and socio-economic landscape.

The difference in environmental impacts between the two options reflect the primary difference between the two, i.e. that the preferred option will not backfill the open pit, while the alternative pit backfilling option will use mine residue deposits, primarily the waste rock dump to backfill the open pit.

These are as follows:

- With the preferred open pit decommissioning option, there will be a permanent potential social impact due to the residual risks of human and animal injury or death from sliding/falling down the slopes of the open pit and perhaps even drowning, despite the decommissioning activities to reduce these risks.

These potential social impacts will only be eliminated by the alternative pit backfilling option.

- The alternative pit backfill decommissioning option will introduce additional long-term groundwater pollution impact after rehabilitation and closure, due to the leaching of dissolved contaminants of concern from the semi-consolidated waste rock filling mass and the release of polluted water from the saturated backfilled pit over a period of approximately 100 years. The concentrations of the contaminants would potentially result in the pollution of the groundwater aquifer and possibly even surface water, thereby affecting potential groundwater users around the mining area. Alternatively, this will require a long-term responsibility and liability for water quality monitoring and management (pollution plume borehole capturing system, with storage and/or treatment) on & around the mining area.

  This potential impact will not materialise with the preferred open pit option, as the pit water level will remain below the natural ground level and continue to act as a pollution sink, with no groundwater plume migration.

Table 8: Assessment of the identified potential positive and negative environmental impacts of the preferred open pit decommissioning option, as informed by the typical impacts of such activities & consultation with interested & affected parties

Name of activity	**Potential impact**	**Aspects affected**	**Phases in which impact is anticipated**	**Significance if not mitigated**	**Mitigation type**	**Significance if mitigated**
(E.g. for mining: blasting, excavations, loading, hauling & transport, stockpiles, water supply dams & boreholes, workshops, processing plant, accommodation, offices, ablution, stores etc.)	(Including potential cumulative impacts, e.g. dust, noise, disturbance of water flow, surface & groundwater pollution, air pollution, etc.)		(E.g. construction, commissioning, operational decommissioning, closure, post-closure.)		(Modify, remedy, control, or stop through (e.g. noise control, storm-water control, dust control, design measures, rehabilitation, blasting controls, avoidance, relocation, alternative activity etc.)	
Relevant decommissioning activities and earthworks, as identified in table 5.	Soil compaction due to movement of vehicles & equipment used	Soil	Decommissioning & Earthworks	Moderately negative	Remedy compaction through rehabilitation actions	Moderately negative
Relevant rehabilitation activities, as identified in table 5.	Reversal of soil compaction due to ripping of compacted areas to alleviate compaction	Soil	Rehabilitation	Very high positive		Very high positive
Relevant decommissioning activities and earthworks, as identified in table 5.	Soil pollution and contamination due to spillages of hydrocarbons, fertilisers and other contaminants used during decommissioning and rehabilitation activities	Soil	Decommissioning & Earthworks	Low negative	Control soil pollution and remedy through rehabilitation actions	Highly positive
Relevant earthworks, as identified in table 5.	Clean-up of polluted soils due to *in-situ* remediation of hydrocarbon contaminated areas	Soil	Rehabilitation	Highly positive		Highly positive
Relevant decommissioning activities and earthworks, as identified in table 5.	Reduced land use potential due to soil compaction and pollution, as well as loss of topsoil due to soil erosion during decommissioning and rehabilitation activities	Land use potential	Decommissioning & Earthworks	Moderately negative	Remedy through rehabilitation actions to address soil compaction and pollution	Moderately negative

Name of activity	Potential impact	Aspects affected	Phases in which impact is anticipated	Significance if not mitigated	Mitigation type	Significance if mitigated
Relevant rehabilitation and post rehabilitation management and monitoring activities, as identified in table 5.	Improved land use potential due to rehabilitation of mine residue deposits and disturbed areas, as well as reduction/ elimination of top soil losses due to reshaped land forms, water management features, improved vegetation cover & reduced surface water run-off	Land use potential	Rehabilitation & Post-rehabilitation management & monitoring	Highly positive	Maintain land use potential through ongoing monitoring and management	Highly positive
Relevant decommissioning activities, and earthworks, as identified in table 5.	Increased surface water run-off due to an increase in bare areas during decommissioning and rehabilitation activities	Surface water	Decommissioning & Earthworks	Low negative	Control surface water runoff volumes and remedy through earthworks & rehabilitation actions	Low negative
Relevant earthworks, rehabilitation and post rehabilitation management and monitoring activities, as identified in table 5.	Reduced surface water run-off due to retention of potential polluted surface run-off on rehabilitated mine residue deposits, as well as rehabilitation and post rehabilitation management and monitoring activities that rehabilitate soil disturbance, improve vegetation cover, increase water infiltration & reduce surface water run-off	Surface water	Earthworks, Rehabilitation and Post-rehabilitation management & monitoring	Highly positive	Retain sufficient surface water on-site through ongoing monitoring and management to sustain rehabilitation success	Highly positive

Name of activity	Potential impact	Aspects affected	Phases in which impact is anticipated	Significance if not mitigated	Mitigation type	Significance if mitigated
Relevant decommissioning activities and earthworks, as identified in table 5.	Increased pollutant concentrations and silt in surface water run-off due to the pollutants used, as well as increased soil disturbance, decreased vegetation cover and increased water run-off during decommissioning and rehabilitation activities	Surface water	Decommissioning, Earthworks & Rehabilitation	Moderately negative	Control surface water pollution and remedy through rehabilitation actions	Low negative
Relevant rehabilitation activities, as identified in table 5.	Reduced surface water pollution due to retention of potential polluted surface run-off on rehabilitated mine residue deposits, as well as reduced silt loading due to rehabilitation activities to rehabilitate soil disturbance, improve vegetation cover, increase water infiltration & reduce surface water run-off	Surface water	Earthworks, Rehabilitation and Post-rehabilitation management & monitoring	Highly positive	Prevent surface water pollution through ongoing monitoring and management to sustain rehabilitation success	Highly positive
Relevant decommissioning activities and earthworks, as identified in table 5.	Potential long term groundwater pollution from unrehabilitated mine residue deposits	Groundwater	Decommissioning & Earthworks	Highly negative	Control groundwater pollution & remedy through earthworks & rehabilitation	Low negative
Relevant earthworks, as well as rehabilitation and post rehabilitation management and monitoring activities, as identified in table 5.	Reduced potential long-term groundwater pollution from rehabilitated mine residue deposits	Groundwater	Rehabilitation & post-rehabilitation management & monitoring	Moderately negative	Prevent groundwater pollution through ongoing monitoring and management to sustain rehabilitation success	Moderately positive

Name of activity	Potential impact	Aspects affected	Phases in which impact is anticipated	Significance if not mitigated	Mitigation type	Significance if mitigated
Relevant decommissioning activities and earthworks, as identified in table 5.	Increased generation of dust and fumes from machinery used, as well as increased soil disturbance and reduced vegetation cover during decommissioning and rehabilitation activities	Air quality	Decommissioning, Earthworks & Rehabilitation	Low negative	Control dust and fumes and remedy dust through rehabilitation actions	Low negative
Relevant rehabilitation and post rehabilitation management and monitoring activities, as identified in table 5.	Reduced generation of dust from the rehabilitated mining area due to rehabilitation and post rehabilitation management and monitoring activities that rehabilitate soil disturbance and improve vegetation cover	Air quality	Rehabilitation and post-rehabilitation management & monitoring	Low negative	Prevent dust generation through ongoing monitoring & management to sustain rehabilitation success	Moderately positive
Relevant decommissioning activities, and earthworks, as identified in table 5.	Noise generated by machinery used during decommissioning and rehabilitation activities	Air quality	Decommissioning, Earthworks & Rehabilitation	Low negative	Control noise and eliminate through decommissioning and rehabilitation actions	Low negative
Relevant earthworks, rehabilitation and post rehabilitation management and monitoring activities, as identified in table 5.	Elimination of noise caused by the mining activities & equipment after decommissioning & rehabilitation	Air quality	Post-rehabilitation management & monitoring	Low negative	Prevent noise through ongoing monitoring and management	Very high positive

Name of activity	Potential impact	Aspects affected	Phases in which impact is anticipated	Significance if not mitigated	Mitigation type	Significance if mitigated
Relevant decommissioning activities, earthworks and activities, as identified in table 5.	Reduced vegetation cover and increased competition from weeds and invader plants that establish in disturbed areas during decommissioning and rehabilitation activities	Vegetation	Decommissioning, Earthworks & Rehabilitation	Low negative	Control vegetation impacts and remedy through rehabilitation actions	Low negative
Relevant earthworks, rehabilitation and post rehabilitation management & monitoring activities, as identified in table 5.	Improvement of natural vegetation due to rehabilitation and post rehabilitation management and monitoring activities that establish and maintain a vegetation cover similar to the natural comparable surrounding environment & control weed and invader plant invasions so that it will not outcompete the indigenous grass & tree species	Vegetation	Rehabilitation and Post-rehabilitation management & monitoring	Moderately positive	Control vegetation impacts and remedy through rehabilitation actions	Highly positive
Relevant earthworks, as identified in table 5.	Displacement of wildlife due to habitat destruction and transformation, restriction of wildlife movement, as well as potential snaring, hunting and killing of wildlife due to decommissioning and rehabilitation activities	Animal life	Decommissioning, Earthworks & Rehabilitation	Low negative	Control wildlife disturbance and remedy through rehabilitation actions	Low negative

Name of activity	Potential impact	Aspects affected	Phases in which impact is anticipated	Significance if not mitigated	Mitigation type	Significance if mitigated
Relevant rehabilitation and post rehabilitation management and monitoring activities, as identified in table 5.	Wildlife injury and death caused by sliding/falling down the steep unrehabilitated slopes of the mine residue deposits and open pit, as well as drowning in the pit lake	Animal life	Decommissioning, Earthworks, Rehabilitation & Post-rehabilitation management & monitoring	Highly negative	Restrict wildlife access to the open pit	Low negative
Relevant decommissioning activities, earthworks and rehabilitation activities, as identified in table 5.	Return of wildlife to new habitats in the rehabilitated areas created through the rehabilitation activities, as well as improved wildlife habitats due to the control of weeds & invader plants	Animal life	Rehabilitation and Post-rehabilitation management & monitoring	Highly positive	Prevent wildlife disturbance through ongoing monitoring & management to sustain rehabilitation success	Highly positive
Relevant earthworks, rehabilitation and post rehabilitation management and monitoring activities, as identified in table 5.	Disruption and destruction of ecosystem services due to rehabilitation activities	Ecosystem services	Earthworks, Rehabilitation and Post-rehabilitation management & monitoring	Highly negative	Remedy through rehabilitation	Moderately negative
Relevant earthworks, rehabilitation & post rehabilitation management and monitoring activities, as identified in table 5.	Resumption and improvement of ecosystem services, improved water run-off volume and quality to the wetland and pans, as well as improved ecosystem integrity and functioning due to rehabilitation and post rehabilitation management and monitoring activities	Ecosystem services	Earthworks, Rehabilitation & Post-rehabilitation management & monitoring	Highly positive	Prevent disruption and destruction of ecosystem services through ongoing monitoring & management to sustain rehabilitation success	Highly positive

Name of activity	Potential impact	Aspects affected	Phases in which impact is anticipated	Significance if not mitigated	Mitigation type	Significance if mitigated
Relevant decommissioning activities, earthworks, rehabilitation & post rehabilitation management and monitoring activities, as identified in table 5.	Visual impacts caused by the demolishing and removal of buildings and structures, as well as earthworks during decommissioning and rehabilitation activities	Visual impact	Decommissioning, Earthworks, Rehabilitation & Post-rehabilitation management & monitoring			
Relevant decommissioning activities, earthworks, rehabilitation and post rehabilitation management and monitoring activities, as identified in table 5.	Reduction of visual impact of mining activities due to the rehabilitation and post rehabilitation management and monitoring of the mine residue deposits and mining area	Visual impact	Decommissioning, Earthworks, Rehabilitation & Post-rehabilitation management & monitoring	Highly negative	Decommissioning and rehabilitation of facilities & infrastructure	Highly positive
Relevant rehabilitation and post rehabilitation management and monitoring activities, as identified in table 5.	Social impacts due to human injury and death caused by falling down the steep unrehabilitated slopes of the mine residue deposits and open pit, as well as drowning in the pit lake	Social aspects	Decommissioning	Highly negative	Control through pit access control measures	Low negative
Relevant decommissioning activities, earthworks and rehabilitation activities, as identified in table 5.	Negative social & socio-economic impacts due to job losses, reduced economic activity, loss of support for mine (CSI & LED) beneficiaries, as well as reduced levels of security and emergency response capacity during the decommissioning and rehabilitation activities	Social and socio-economic aspects	Decommissioning	Moderately negative	Control and remedy through social impact management measures	Moderately negative

Name of activity	Potential impact	Aspects affected	Phases in which impact is anticipated	Significance if not mitigated	Mitigation type	Significance if mitigated
Relevant decommissioning activities, earthworks and rehabilitation activities, as identified in table 5.	Positive social and socio-economic impacts through the creation of temporary employment opportunities, as well as economic benefits during decommissioning and rehabilitation	Social and socio-economic aspects	Earthworks, Rehabilitation & Post-rehabilitation management & monitoring	Moderately positive		Moderately positive

Table 9: Assessment of the identified potential positive and negative environmental impacts of the alternative pit backfill decommissioning option, as informed by the typical impacts of such activities & consultation with interested & affected parties

Name of activity	**Potential impact**	**Aspects affected**	**Phases in which impact is anticipated**	**Significance if not mitigated**	**Mitigation type**	**Significance if mitigated**
(E.g. for mining: blasting, excavations, loading, hauling & transport, stockpiles, water supply dams & boreholes, workshops, processing plant, accommodation, offices, ablution, stores etc.)	(Including potential cumulative impacts, e.g. dust, noise, disturbance of water flow, surface & groundwater pollution, air pollution, etc.)		(E.g. construction, commissioning, operational decommissioning, closure, post-closure.)		(Modify, remedy, control, or stop through (e.g. noise control, storm-water control, dust control, design measures, rehabilitation, blasting controls, avoidance, relocation, alternative activity etc.)	
Relevant decommissioning activities and earthworks, as identified in table 6.	Soil compaction due to movement of vehicles & equipment used	Soil	Decommissioning & Earthworks	Moderately negative	Remedy compaction through rehabilitation actions	Moderately negative
Relevant rehabilitation activities, as identified in table 6.	Reversal of soil compaction due to ripping of compacted areas to alleviate compaction	Soil	Rehabilitation	Very high positive		Very high positive
Relevant decommissioning activities and earthworks, as identified in table 6.	Soil pollution and contamination due to spillages of hydrocarbons, fertilisers and other contaminants used during decommissioning and rehabilitation activities	Soil	Decommissioning & Earthworks	Low negative	Control soil pollution and remedy through rehabilitation actions	Highly positive
Relevant earthworks, as identified in table 6.	Clean-up of polluted soils due to *in-situ* remediation of hydrocarbon contaminated areas	Soil	Rehabilitation	Highly positive		Highly positive
Relevant decommissioning activities and earthworks, as identified in table 6.	Reduced land use potential due to soil compaction and pollution, as well as loss of topsoil due to soil erosion during decommissioning and rehabilitation activities	Land use potential	Decommissioning & Earthworks	Moderately negative	Remedy through rehabilitation actions to address soil compaction and pollution	Moderately negative

Name of activity	**Potential impact**	**Aspects affected**	**Phases in which impact is anticipated**	**Significance if not mitigated**	**Mitigation type**	**Significance if mitigated**
Relevant rehabilitation and post rehabilitation management and monitoring activities, as identified in table 6.	Improved land use potential due to rehabilitation of mine residue deposits and disturbed areas, as well as reduction/ elimination of top soil losses due to reshaped land forms, water management features, improved vegetation cover & reduced surface water run-off	Land use potential	Rehabilitation & Post-rehabilitation management & monitoring	Highly positive	Maintain land use potential through ongoing monitoring and management	Highly positive
Relevant decommissioning activities, and earthworks, as identified in table 6.	Increased surface water run-off due to an increase in bare areas during decommissioning and rehabilitation activities	Surface water	Decommissioning & Earthworks	Low negative	Control surface water runoff volumes and remedy through earthworks & rehabilitation actions	Low negative
Relevant earthworks, rehabilitation and post rehabilitation management and monitoring activities, as identified in table 6.	Reduced surface water run-off due to retention of potential polluted surface run-off on rehabilitated mine residue deposits, as well as rehabilitation and post rehabilitation management and monitoring activities that rehabilitate soil disturbance, improve vegetation cover, increase water infiltration & reduce surface water run-off	Surface water	Earthworks, Rehabilitation and Post-rehabilitation management & monitoring	Highly positive	Retain sufficient surface water on-site through ongoing monitoring and management to sustain rehabilitation success	Highly positive

Name of activity	Potential impact	Aspects affected	Phases in which impact is anticipated	Significance if not mitigated	Mitigation type	Significance if mitigated
Relevant decommissioning activities and earthworks, as identified in table 6.	Increased pollutant concentrations and silt in surface water run-off due to the pollutants used, as well as increased soil disturbance, decreased vegetation cover and increased water run-off during decommissioning and rehabilitation activities	Surface water	Decommissioning, Earthworks & Rehabilitation	Moderately negative	Control surface water pollution and remedy through rehabilitation actions	Low negative
Relevant rehabilitation activities, as identified in table 6.	Reduced surface water pollution due to retention of potential polluted surface run-off on rehabilitated mine residue deposits, as well as reduced silt loading due to rehabilitation activities to rehabilitate soil disturbance, improve vegetation cover, increase water infiltration & reduce surface water run-off	Surface water	Earthworks, Rehabilitation and Post-rehabilitation management & monitoring	Highly positive	Prevent surface water pollution through ongoing monitoring and management to sustain rehabilitation success	Highly positive
Relevant decommissioning activities and earthworks, as identified in table 6.	Potential long term groundwater pollution from unrehabilitated mine residue deposits, and increased long term groundwater pollution due to leaching of contaminants from the saturated groundwater mound in the backfilled pit, consisting of a semi-consolidated waste rock, for approximately 100 years post closure	Groundwater	Earthworks & rehabilitation	Highly negative	Control groundwater pollution & remedy through earthworks & rehabilitation, as well as post-closure pumping and treatment	Highly negative

Name of activity	Potential impact	Aspects affected	Phases in which impact is anticipated	Significance if not mitigated	Mitigation type	Significance if mitigated
Relevant earthworks, as well as rehabilitation and post rehabilitation management and monitoring activities, as identified in table 6.	Reduced potential long term long term groundwater pollution from mine residue deposits due to the use of some of these for backfilling the pit & the rehabilitation of the remaining facilities	Groundwater	Earthworks, rehabilitation & post-rehabilitation management & monitoring	Moderately negative	Prevent groundwater pollution through ongoing monitoring and management to sustain rehabilitation success	Moderately positive
Relevant decommissioning activities and earthworks, as identified in table 6.	Increased generation of dust and fumes from machinery used, as well as increased soil disturbance and reduced vegetation cover during decommissioning and rehabilitation activities	Air quality	Decommissioning, Earthworks & Rehabilitation	Low negative	Control dust and fumes and remedy dust through rehabilitation actions	Low negative
Relevant rehabilitation and post rehabilitation management and monitoring activities, as identified in table 6.	Reduced generation of dust from the rehabilitated mining area due to rehabilitation and post rehabilitation management and monitoring activities that rehabilitate soil disturbance and improve vegetation cover	Air quality	Rehabilitation and post-rehabilitation management & monitoring	Low negative	Prevent dust generation through ongoing monitoring & management to sustain rehabilitation success	Moderately positive
Relevant decommissioning activities, and earthworks, as identified in table 6.	Noise generated by machinery used during decommissioning and rehabilitation activities	Air quality	Decommissioning, Earthworks & Rehabilitation	Low negative	Control noise and eliminate through decommissioning and rehabilitation actions	Low negative
Relevant earthworks, rehabilitation and post rehabilitation management and	Elimination of noise caused by the mining activities & equipment	Air quality	Post-rehabilitation management & monitoring	Low negative	Prevent noise through ongoing monitoring and management	Very high positive

Name of activity	Potential impact	Aspects affected	Phases in which impact is anticipated	Significance if not mitigated	Mitigation type	Significance if mitigated
monitoring activities, as identified in table 6.	after decommissioning & rehabilitation					
Relevant decommissioning activities, earthworks and activities, as identified in table 6.	Reduced vegetation cover and increased competition from weeds and invader plants that establish in disturbed areas during decommissioning and rehabilitation activities	Vegetation	Decommissioning, Earthworks & Rehabilitation	Low negative	Control vegetation impacts and remedy through rehabilitation actions	Low negative
Relevant earthworks, rehabilitation and post rehabilitation management & monitoring activities, as identified in table 6.	Improvement of natural vegetation due to rehabilitation and post rehabilitation management and monitoring activities that establish and maintain a vegetation cover similar to the natural comparable surrounding environment & control weed and invader plant invasions so that it will not outcompete the indigenous grass & tree species	Vegetation	Rehabilitation and Post-rehabilitation management & monitoring	Moderately positive	Control vegetation impacts and remedy through rehabilitation actions	Highly positive
Relevant earthworks, as identified in table 6.	Displacement of wildlife due to habitat destruction and transformation, restriction of wildlife movement, as well as potential snaring, hunting and killing of wildlife due to decommissioning and rehabilitation activities	Animal life	Decommissioning, Earthworks & Rehabilitation	Low negative	Control wildlife disturbance and remedy through rehabilitation actions	Low negative

Name of activity	Potential impact	Aspects affected	Phases in which impact is anticipated	Significance if not mitigated	Mitigation type	Significance if mitigated
Relevant decommissioning activities, earthworks and rehabilitation activities, as identified in table 6.	Return of wildlife to new habitats in the rehabilitated areas created through the rehabilitation activities, as well as improved wildlife habitats due to weed & invader plant control	Animal life	Rehabilitation and Post-rehabilitation management & monitoring	Highly positive	Prevent wildlife disturbance through ongoing monitoring & management to sustain rehabilitation success	Highly positive
Relevant rehabilitation and post rehabilitation management and monitoring activities, as identified in table 6.	Disruption and destruction of ecosystem services due to rehabilitation activities	Ecosystem services	Rehabilitation and Post-rehabilitation management & monitoring	Highly negative	Remedy through rehabilitation	Moderately negative
Relevant decommissioning activities, earthworks & rehabilitation activities, as identified in table 6.	Resumption and improvement of ecosystem services, improved water run-off volume and quality to the wetland and pans, as well as improved ecosystem integrity and functioning due to rehabilitation and post rehabilitation management and monitoring activities	Ecosystem services	Decommissioning, Earthworks, Rehabilitation & Post-rehabilitation management & monitoring	Highly positive	Prevent disruption and destruction of ecosystem services through ongoing monitoring & management to sustain rehabilitation success	Highly positive
Relevant post rehabilitation management and monitoring activities, as identified in table 6.	Visual impacts caused by the demolishing and removal of buildings and structures, as well as earthworks during decommissioning and rehabilitation activities	Visual impact	Decommissioning, Earthworks, Rehabilitation & Post-rehabilitation management & monitoring			

Name of activity	Potential impact	Aspects affected	Phases in which impact is anticipated	Significance if not mitigated	Mitigation type	Significance if mitigated
Relevant decommissioning activities, earthworks and rehabilitation activities, as identified in table 6.	Reduction of visual impact of mining activities due to the rehabilitation and post rehabilitation management and monitoring of the mine residue deposits and mining area	Visual impact	Decommissioning, Earthworks, Rehabilitation & Post-rehabilitation management & monitoring	Highly negative	Decommissioning and rehabilitation of facilities & infrastructure	Highly positive
Relevant rehabilitation and post rehabilitation management and monitoring activities, as identified in table 6.	Complete elimination of the risk of human and animal injury or death from sliding/falling down the steep slopes of the open pit due to backfilling of the open pit	Social aspects	Decommissioning	Highly positive		Highly positive
Relevant decommissioning activities, earthworks and rehabilitation activities, as identified in table 6.	Negative social & socio-economic impacts due to further job losses, reduced economic activity, loss of support for mine (CSI & LED) beneficiaries, as well as reduced levels of security and emergency response capacity during the decommissioning and rehabilitation activities	Social and socio-economic aspects	Decommissioning	Moderately negative	Control and remedy through social impact management measures	Moderately negative
Relevant decommissioning activities, earthworks and rehabilitation activities, as identified in table 6.	Positive social and socio-economic impacts through the creation of temporary employment opportunities, as well as economic benefits during decommissioning and rehabilitation	Social and socio-economic aspects	Earthworks, Rehabilitation & Post-rehabilitation management & monitoring	Moderately positive		Moderately positive

13) Summary of specialist reports

Attach copies of specialist reports as appendices.

The specialist reports that were used during the impact assessment is listed in table 10, which also indicates the number of the appendix where it can be found. A summary of the specialist reports, with an indication of where it was used in this report is provided in table 11.

Table 10: Specialist reports that were used during the impact assessment

Appendix	Title	Authors
11	Voorspoed Mine Final Closure Plan, June 2019	Redco & Uvuna Sustainability
12	Voorspoed Mine Rehabilitation Plan 2019, (Annexure A to Final Closure Plan 2019), June 2019	Redco & Uvuna Sustainability
13	Voorspoed Mine – Pit Closure Study, Report E-TEK 10079, 21 June 2016	E-TEK Consulting & Redco
14	Technical Evaluation of the Risks, Impacts and Management Requirements into Pit Backfilling versus Current Mine Plan (Pit Lake), February 2019, Report 1792363-318923-1_Rev1	Golder Associates Africa (Pty) Ltd.
15	Proposed End Land Use Plan for Voorspoed Diamond Mine, not dated	NEKA Sustainability Solutions
16	Socio-economic impact assessment - Voorspoed Mine closure, April 2019	Environmental Resources Management
17	Voorspoed Mine Geochemical Assessment Report, September 2017	Golder Associates
18	Voorspoed Mine - Summary of Surface and Groundwater Study for Mine Closure, October 2017	Golder Associates
19	Voorspoed Mine's Hydrological Monitoring Program (2018+) - Monitoring Sites Program and Network Upgrade, August 2018	Golder Associates Africa (Pty) Ltd
20	Baseline biodiversity assessment at De Beers Voorspoed Mine, October 2010	Bucandi Environmental Solutions
21	A Determination of Floristic Biodiversity at De Beers Voorspoed Mine, March 2013	Bucandi Environmental Solutions
22	A Wetland Delineation, Management and Rehabilitation Plan for the De Beers Voorspoed Mine, July 2017	Exigo Sustainability
23	An Alien Invasive Management Plan for the De Beers Voorspoed Mine, December 2016	Exigo Sustainability
24	A Heritage Impact Assessment (HIA) study for an EMP for the Voorspoed Diamond Mine near Kroonstad in the Free State Province of South Africa	Dr Julius CC Pistorius

(The summary must be completed if any specialist reports informed the impact assessment and final site layout process and must be in the following tabular form.)

Table 11: Summary of the specialist reports that were used during the impact assessment, with an indication of where it was used in this report.

Specialist studies undertaken	Recommendations of specialist reports	Specialist recommendations that have been included	Reference to sections of report where recommendations have been included
Final Closure Plan	Identifies three pit closure scenarios and the preferred option	X	7 & 8
	Assesses residual environmental risks and identifies risk mitigation measures	X	10(a), 10(c), 12
	Identifies overarching and specific closure objectives	X	4(b), 10(c), 14(a), 14(c)
	Specifies environmental closure and success criteria	X	3(m) & EMPr (Part B)
	Identifies post rehabilitation monitoring requirements	X	EMPr (Part B)
	Identifies a number of gaps that need to be addressed before mine closure	X	17
Rehabilitation Plan 2019	Presents details and proposals to address environmental risks	X	EMPr (Part B)
	Translate closure criteria into rehabilitation designs		
	Identifies rehabilitation actions towards mine closure	X	EMPr (Part B)
Voorspoed Mine – Pit Closure Study	Considered seven pit closure scenarios at a screening level, primarily in terms of the feasibility and costs thereof, as well as the likelihood of a pit lake forming and the extent to which the projected water level will rise over time	X	8
	Considered risks associated with the various options		
	Pit backfilling would result in excessive costs that were not economically viable	X	7, 8
	The costs of the backfilling of the open pit is more than what could be considered proportional to the benefits achieved by mining activities over the life of the mine.	X	7, 8

Specialist studies undertaken	Recommendations of specialist reports	Specialist recommendations that have been included	Reference to sections of report where recommendations have been included
Mine closure socio-economic impact assessment	Presents outputs of the socio-economic impact assessment to support mine closure		
	Assesses eleven socio-economic impacts that could stem from mine closure	X	10(a), 10(c)
	Assesses residual social risks and identifies risk mitigation measures		EMPR (Part B)
	Specifies social closure and success criteria		15 & EMPr (Part B)
	Specifies reasonably practicable management measures to address the social impacts during the phased closure (ramp-down), decommissioning (closure execution) and post closure (monitoring) phases.	X	15 & EMPr (Part B)
Technical Evaluation of the Risks, Impacts & Management Requirements into Pit Backfilling versus Current Mine Plan (Pit Lake)	Evaluated three different pit closure scenarios for the closure of the Voorspoed Mine, primarily in terms of the end land state of the open pit and MRDs	X	7, 8
	Evaluated options in a risk-based assessment in terms of hydrogeology & geochemistry, hydrology, closure costs, as well as post closure environmental risks & management requirements		
	Due to high evaporation, the pit lake water levels will settle several metres below the surrounding natural groundwater level elevation and remain as a local piezometric sink	X	7, 8
	The water level in backfilled pit is likely to become a groundwater mound and result in subsurface flow of potentially poor-quality water to the surrounding aquifer occurs.	X	7, 8
	Pit water quality remain largely within domestic and livestock quality limits	X	7, 8
	Due to leaching of dissolved substances from the semi-consolidated waste rock in the backfilled pit, the concentrations of potential contaminants of concern will exceed the livestock & domestic water quality limits for more than 100 years.	X	7, 8
	The poor groundwater quality seepage from the backfilled and re-watered pit could affect the groundwater aquifer and groundwater users. This will require a long-term responsibility and liability for water quality monitoring and management (pollution plume borehole capturing system, with storage and/or treatment) on & around the mining area.	X	7, 8

Specialist studies undertaken	Recommendations of specialist reports	Specialist recommendations that have been included	Reference to sections of report where recommendations have been included
Proposed End Land Use Plan	Develops a comprehensive list of potential end land uses for evaluation	X	7, 8
	Evaluates selected end land use (ELU) options to identify preferred option	X	7, 8
	Land capability assessment indicated that the mining area and Voorspoed properties around the mining area could be utilised for extensive sheep, cattle and game farming, with limited cropping on existing cultivated lands	X	7, 8
	The general shortage of surface and groundwater in the area mitigated against the selection of intensive agriculture, such as large-scale centre pivot irrigation and greenhouse cultivation	X	7, 8
	None of the ELU options evaluated met the business case “success metrics” of having a positive cash flow within three years, generating a minimum annual cash flow of R2.5 million, and paying back all debt within 10 years.		
	The agricultural use of the mining area and Voorspoed properties post-closure was the most appropriate in the regional context, and the most likely to be sustainable in the long term	X	7, 8
	Agricultural use could only be economically sustainable if the mining area & other Voorspoed properties are integrated into existing established farming enterprises close to the mine, where start-up capital needed is kept as low as possible	X	7, 8
Voorspoed Mine - Geochemical Assessment Report	The geochemistry study aimed to characterize geological materials from potential contaminant sources with regard to environmental risks to surface water and groundwater receptors, and provide source terms for a groundwater contaminant transport model.		
	The pit water is alkaline and brackish, with sodium, sulphate, nitrate and fluoride that frequently exceeded DWAF (1996) domestic irrigation or livestock guidelines. It is also neutral mine drainage with low metal concentrations.	X	10(a), 10(c), 12
	Neither the waste rock, nor the coarse or fine residues is potentially acid generating. All the mine residues are likely to produce predominantly near-neutral, low-metal drainage upon exposure to rainfall, with pH likely to exceed RWQO for the local catchment management unit (C70H). Aluminium, iron & manganese are likely to exceed the domestic & irrigation water quality guidelines, while the Sodium Absorption Ratio is likely to only exceed the irrigation water quality guideline.	X	10(a), 10(c), 12

Specialist studies undertaken	**Recommendations of specialist reports**	**Specialist recommendations that have been included**	**Reference to sections of report where recommendations have been included**
Voorspoed Mine - Summary of Surface and Groundwater Study for Mine Closure	Surface and groundwater study for mine closure included a geohydrological assessment (groundwater flow and quality), a geochemistry study assessment (characterisation of potential contaminant sources to surface and groundwater resources), a dynamic water balance model and a hydrological assessment of potential flood line risks.		
	Geochemical assessment focussed on the acid producing characteristics, geochemical constituents of the seepages, and the leachates of the mine residue deposits.		
	Pit water is alkaline and brackish, with sodium, sulphate, nitrate and fluoride that frequently exceeded DWAF domestic irrigation or livestock quality guidelines		
	Due to the low permeability of the aquifer rock, the current radius of influence of the pit is limited.		
	During post operational times, the pit will remain as a sink (i.e. capturing local seepages via the shallow aquifer system), due to the effect of evaporation.	X	10(a), 10(c), 12
	A component of the pit seepage is expected to migrate down gradient. Where the sulphate plume migrates to the land around the mining area, the mass transport model predicts that the concentration will unlikely exceed drinking water and livestock limits for sulphate.	X	10(a), 10(c), 12
	Salt balance indicates a steady increase, based on the primary salt loads of the rock mass on the mine site area.		
	Seepages from the CRD and FRD are managed and a management protocol of “no discharge to the environment” retains the salt load on the mine site area.		
	Groundwater quality monitoring on land surrounding the mining area does not indicate any specific increase in the normal salt loads in the groundwater systems.	X	10(a), 10(c), 12
	Water quality impacts via the surface water flow system has been identified in the drainage path of an unnamed, non-perennial tributary just east of the storm water and return water dams.	X	10(a), 10(c), 12
	Due to the accumulation of salt loads in the mining area during dry periods, periodic surface flooding will flush these salts downstream and may impact on surface water resources further downstream.	X	10(a), 10(c), 12

Specialist studies undertaken	Recommendations of specialist reports	Specialist recommendations that have been included	Reference to sections of report where recommendations have been included
Voorspoed Mine - Summary of Surface and Groundwater Study for Mine Closure	Quality of the seepage is likely to exceed the recommended water quality objectives for the quaternary catchment (with regard to pH, EC, turbidity and ammonia)	X	10(a), 10(c), 12
	Seepage concentrations of aluminium, iron and manganese are likely to exceed the domestic, as well as irrigation water quality guidelines, with the Sodium Absorption Ratio likely to exceed the irrigation water quality guideline.	X	10(a), 10(c), 12
	Based on the elevation model, mining related water impacts such as dewatering and migration of potential contaminants from the mining area does not progress significantly onto the land surrounding the mining area.	X	10(a), 10(c), 12
	Monitoring of the surface water runoff around the mining area is important – especially downstream of the storm and return water storage facilities.	X	10(a), 10(c), 12
Voorspoed Mine's Hydrological Monitoring Program (2018+) - Monitoring Sites, Program and Network Upgrade	Investigation addressed the design and implementation for a long-term hydrological monitoring program for the Voorspoed Mine for the closure-decommissioning and post-closure timeframes.		
	The hydrological monitoring program will support the mine's efforts towards closure and cover the requirement for hydrological monitoring in the post-closure phase.		
	The revised hydrological monitoring network contains monitoring sites at critical sites, coverage of the local, shallow aquifer system and the deeper, regional aquifer system, as well as three surface water monitoring sites in western and eastern flow-directed streams that will receive storm water run-off from the mining area.		
	Water level monitoring, as well as sampling and water quality analyses from 18 boreholes (13 on the mining area and 5 around the mining are), as well as three surface water monitoring sites must be done quarterly during the decommissioning-closure phase.	X	EMPr (Part B)
	Monitoring must be done at biannual intervals in the post-closure phase, with a reduction in the water quality parameters.	X	EMPr (Part B)

Specialist studies undertaken	Recommendations of specialist reports	Specialist recommendations that have been included	Reference to sections of report where recommendations have been included
Voorspoed Mine's Hydrological Monitoring Program (2018+) - Monitoring Sites, Program and Network Upgrade	Water quality must be analysed for physic-chemical parameters (pH, conductivity, Total Dissolved Solids, Total Alkalinity), major cations (e.g. Ca, Mg, Na, and K), major anions (e.g. Cl-, F-, SO42- & NOX), as well as metals and trace metals (e.g. Fe, Cr, Se, Pb, Mn, Al, Zn & others determined by ICP-OES)	X	EMPr (Part B)
	The Hydrological Monitoring Programme supports the hydrological monitoring audits required by the regulators for closure permitting. Such an audit must be conducted annually.	X	EMPr (Part B)
	The Hydrological Monitoring Programme must be implemented to generate a set of hydrological data that can be used as a baseline dataset for future planning and ensure that data is available to confirm the numerical modelling & predictions from the Mine Closure (2017) and the Voorspoed Mine Backfilling versus Mine Plan – Pit Lake (2018) studies.	X	EMPr (Part B)
Baseline biodiversity assessment at De Beers Voorspoed Mine	Assessment focussed on recording plant species and selected faunal groups, as well as the integration of biodiversity information from past surveys, to assess possible mining impacts and develop a practical ecological management plan.		
	Preliminary investigation shows that the area adjacent to Voorspoed Mine contains a high level of biodiversity. This mostly refers to Renosterkop, the wetland adjacent to the mining area & the grassland linking these areas.	X	9(b)
	The mining area is obviously largely disturbed. Surrounding areas have previously been disturbed where fields have been cultivated or where overgrazing may have occurred.	X	9(b)
	Past overgrazing is reflected in areas where encroachment by the bankrupt bush (*Seriphium plumosum*) is encountered.	X	9(b)
	Exotic herbaceous weeds and invasive plant species are mostly confined to the disturbed plains and the areas around watercourses. A relatively high cover of pioneer species or exotic weeds were also observed In disturbed areas, such as along roads, previously cultivated fields and possibly overgrazed areas.	X	9(b)
	No threatened or near-threatened plant species are expected to occur on or around the mining area.	X	9(b)

Specialist studies undertaken	Recommendations of specialist reports	Specialist recommendations that have been included	Reference to sections of report where recommendations have been included
Baseline biodiversity assessment at De Beers Voorspoed Mine	Suitable breeding habitat for Giant Bullfrog (*Pyxicephalus adspersus*) exist in the wetland and it should be assumed that this species occur on the mine and utilise the wetland adjacent to the mining area for breeding habitat.	X	9(b)
	Three bird species of concern have been observed in the vicinity of the mine and are likely to occur on or around Voorspoed Mine, i.e. Blue Korhaan (*Eupodotis caerulescens*), Blue Crane (*Antrhopoides paradiseus*) & Melodious Lark (*Mirafra cheniana*).	X	9(b)
	Nine mammal species of conservation concern has been observed in the vicinity of the mine and are likely to occur on or around Voorspoed Mine. These include three bat species (Schreibers' Long-fingered Bat (*Miniopterus schreibersii*), Welwitsch's Hairy Bat (*Myotis welwitschii*), Geoffroy's Horseshoe Bat (*Rhinolophus clivosus*)), a mole (Highveld Golden Mole (*Amblysomus septentrionalis*)), as well as three rodent species (Least Dwarf Shrew (*Suncus infinitesimus*), Lesser Dwarf Shrew (*Suncus varilla*), White-tailed Rat (*Mystromys albicaudatus*)). These also include the South African Hedgehog (*Atelerix frontalis*) and Brown Hyaena (*Hyaena brunnea*).	X	9(b)
	Surveys that are more specific are necessary to determine the exact level of biodiversity and the presence of species of conservation concern in the area.		
A Wetland Delineation, Management & Rehabilitation Plan for the De Beers Voorspoed Mine	Study was undertaken to conduct a wetland delineation, functionality assessment and rehabilitation plan for the wetland area (pan) located adjacent to the mining area		
	In many instances, the soils in the wetland did not show any signs of wetness within 50cm of the surface and did not display typical hydromorphic characteristics, although they were still classified as wetlands, due to the state of the wetland in the past and the potential to become rehabilitated.		
	Parts of the wetland have become dewatered and invaded by terrestrial species.	X	9(b)
	Two man-made dams occur in the southwestern corner of the wetland, north of the mine access road. These dams were probably built to collect water for livestock in the past.		

Specialist studies undertaken	Recommendations of specialist reports	Specialist recommendations that have been included	Reference to sections of report where recommendations have been included
A Wetland Delineation, Management & Rehabilitation Plan for the Voorspoed Mine	The Present Ecological Status of the wetland is moderately modified, i.e. the resource base reserve has been moderately decreased, while the habitat and biota have been modified. The ecosystem functions are still predominantly unchanged.	X	9(b)
	The main negative impacts that cause changes to the wetland conditions at present are the impoundments (dams), alien species invasion, dewatering, mining infrastructure and roads.	X	9(b)
	The Ecological Importance and Sensitivity status of the wetland is moderate, i.e. it is ecologically important and sensitive at least on a local scale.	X	9(b)
	The biodiversity of the wetland is not sensitive to flow and habitat modifications and it plays a small role in moderating the quantity and quality of water of major rivers.	X	9(b)
	The hydrological most important function of the wetland is its flood attenuation, which is largely modified, due to the large loss of natural habitats and basic ecosystem functions.	X	9(b)
	Direct human benefits from the wetland is very low, with local people rarely relying on the wetland and almost never benefiting from it.	X	9(b)
	The wetlands in the mining area have been impacted through direct wetland destruction, dewatering of the wetlands, soil erosion and sedimentation, water pollution from spillages, vehicle emissions and dust, as well as the spread and establishment of alien invasive species in these wetlands.	X	9(b)
	Specific mitigation measures need to be implemented in the areas around the wetlands to prevent any impacts on the wetland.	X	9(b)
	With regard to the wetland adjacent to the mining area, the dams must be destroyed to allow natural flow of water into the wetlands, while the alien invasive plant species must also be eradicated.	X	9(b)
Determination of Floristic Biodiversity at De Beers Voorspoed Mine	289 plant species were recorded in five broad vegetation units in in and around the mining area, of which, 248 species are indigenous and 41 exotic.	X	9(b)
	Two declining red data and ten provincially protected plant (trees, succulents and bulbs) species, as well as one nationally protected tree species (Shepherd's Tree (*Boscia albitrunca*)) were recorded in and around the mining area.	X	9(b)

Specialist studies undertaken	Recommendations of specialist reports	Specialist recommendations that have been included	Reference to sections of report where recommendations have been included
Determination of Floristic Biodiversity at De Beers Voorspoed Mine	Fifteen of the 41 exotic plants recorded in and around the mining area are declared weeds and invaders and need to be eradicated and the further spread thereof controlled.	X	9(b)
	Due to the current positioning of the mine and the position of the most sensitive habitats in relation to the mine and its activities the level of expected impacts is relatively low.		
	The largest impact on the natural habitats in and around the mining area is estimated to be due to agricultural practices in the area.		
Alien Invasive Management Plan for De Beers Voorspoed Mine	The most important species for control inside the processing plant and mining areas are Common saltwort/tumbleweed (*Salsola kali*) - throughout plant areas, WRDs and stockpiles, Mexican poppy (*Argemone ochroleuca*) - throughout plant areas, WRDs and stockpiles and Blue gum (*Eucalyptus camaldulensis*) - in the wetland adjacent to the mining area, as well as in the surrounding mining area.	X	9(b)
	All other weeds and alien invasive species occur in isolated patches in and around the mining area.	X	9(b)
	The listed alien invasive plants and other exotic weeds should be controlled as indicated per species, in priority areas, according to the density of alien invasive and weed species.	X	15, EMPr (Part B)
Heritage Impact Assessment study for the Voorspoed Diamond Mine near Kroonstad	The HIA study revealed the presence of scattered stone tools; a Historical Building; the Historical Voorspoed Diamond Mine; remains dating from the Relatively Recent Past and two Graveyards.	X	9(b)
	The scattered stone tools have been exposed by agricultural and other activities and have no cultural heritage significance, as they no longer occur in their original archaeological context.		
	The Historical Building can be considered to be significant. However, this structure is very dilapidated and it is doubtful that it can be restored to its former grandeur – even if it can be conserved. It is recommended that the building be subjected to a Phase II investigation before it is demolished to allow the mining activities.	X	9(b)

Specialist studies undertaken	Recommendations of specialist reports	Specialist recommendations that have been included	Reference to sections of report where recommendations have been included
Heritage Impact Assessment study for the Voorspoed Diamond Mine	The Historical Voorspoed Diamond Mine qualifies as part of the national estate, as the mine was one of the oldest diamond mines in the Free State and in South Africa. De Beers should protect the roots of South African diamond mining – perhaps by preserving the history of the Historical Voorspoed Diamond Mine in a display and maintaining it in a museum in the Free State or at any of De Beers' offices.	X	9(b)
	The Graveyards can be considered to be of outstanding significance but the proposed expansions to the Voorspoed Diamond Mine will not have an impact on these Graveyards.		
	The remains dating from the Relatively Recent Past are not considered to be significant and can therefore be demolished after the necessary permit has been acquired.		

14) Environmental impact statement

a) Summary of the key findings of the environmental impact assessment

The Voorspoed Mine Rehabilitation Plan 2019 (Appendix 12) that was developed to support the Voorspoed Mine Final Closure Plan (Appendix 11) provides details of the actions that will be taken to rehabilitate the footprint of the Voorspoed Mine to a sustainable state, in order to mitigate environmental risks and achieve the predetermined end land use.

The closure vision for Voorspoed Mine is to close the mine in line with the relevant legal requirements, in such a way that the mining area can be utilised in a sustainable manner after closure. The overarching closure objective is to ensure sustainability beyond mine closure and leaving a positive legacy. The end land use for Voorspoed Mine is to reinstate most of the rehabilitated footprint area back to agricultural land. The aim is to achieve a sustainable land use, comply with the closure vision and match the rehabilitated footprint with the surrounding area as far as reasonably practical.

A workable and practical decommissioning and mine closure will result in the attainment of the closure objectives aligned with all applicable legal requirements and pursuant to the NEMA section 2 principles. In the absence thereof, the mine infrastructure and unrehabilitated mine residue deposits will remain, while the open pit will also remain easily accessible to both humans and animals. The land will not be available for farming activities and environmental pollution in terms of land, water and air pollution would continue unabated. In addition, the owner of the mine will remain liable for any environmental liability, pollution, ecological degradation, the pumping and treatment of extraneous water, compliance to the conditions of the environmental authorisation and the management and sustainable closure of the mine. It is thus imperative that a feasible and sustainable mine closure plan be approved.

A detailed investigation and comparative assessment of the alternative options for the Voorspoed Mine decommissioning and closure were undertaken. Alternatives identified and assessed include strategic mine extension alternatives, pit closure alternatives, rehabilitation design alternatives and end land use alternatives. This process resulted in the identification of the following alternatives that have been assessed in this report:

- **Preferred alternative**

  The preferred decommissioning alternative is the option of the development of a pit lake in the open pit under current conditions. The pit will be left to fill/re-water to form a pit lake. Human and animal access to the pit will be restricted by the construction of waste rock barriers/berms at top of the remaining open pit access ramps, the erection of a high-end security fence around the open pit, outside of the indicated break-back zone, as well as the construction of a 5 m deep trench and 5 m high enviroberm around the open pit, outside the security fence.

Furthermore, the remaining mine residue deposits will be reshaped, covered with cover material and/or soil and rehabilitated with a vegetation cover. The vegetation will be managed and utilised until closure to ensure that the success criteria are achieved. Furthermore, surface and groundwater, as well as vegetation and biodiversity monitoring will be undertaken after the rehabilitation to track the ground and surface water, as well as vegetation and biodiversity responses to the rehabilitation practices.

- **Open pit backfilling alternative**

  This alternative decommissioning option involves backfilling the open pit, primarily with material from the waste rock dump, while the remaining mine residue deposits will be reshaped, covered with cover material and/or soil and rehabilitated with a vegetation cover. Apart from this major difference compare to the preferred option, the rehabilitation, management and monitoring commitments for this option are the same as for the preferred option.

- **No-go alternative**

  The no-go alternative is to not undertake any decommissioning of the mine activities and infrastructure and not rehabilitate the areas disturbed by the mining activities and the mine residue deposits. This alternative will result in a deserted mine that will be illegally stripped from anything of value. In addition, it will also result in a dangerous environment where neither the open pit nor the steep slopes of the mine residue deposits are secured and protected, to prevent people from being harmed. From an environmental perspective, the areas disturbed by the mining activities will degrade over time through erosion and invader plant invasions, while potential pollutants from the mine residue deposits and other polluted areas will be spilled into the areas around the mining area and result in pollution of land, as well as surface and groundwater resources.

The majority of the decommissioning activities and associated with preferred open pit decommissioning and mine closure option and the alternative open pit backfilling decommissioning and mine closure option are the same, i.e. the two options do not differ much. Consequently, the two options also do not differ much in terms of the environmental impacts associated with them.

The assessed environmental impacts of the preferred and alternative decommissioning options relate to positive and negative impacts of various decommissioning and rehabilitation activities on soil compaction and pollution, land use potential, surface water run-off and pollution, ground water pollution, vegetation and wildlife, dust and fumes, noise, visual landscape, as well as the social and socio-economic landscape.

The difference in environmental impacts between the two options reflect the primary difference between the two, i.e. that the preferred option will not backfill the open pit, while the alternative pit backfilling option will use mine residue deposits, primarily the waste rock dump to backfill the open pit.

These are as follows:

- With the preferred open pit decommissioning option, there will be a permanent potential social impact due to the residual risks of human and animal injury or death from sliding/falling down the slopes of the open pit and perhaps even drowning, despite the decommissioning activities to reduce these risks.

  These potential social impacts will only be eliminated by the alternative pit backfilling option.

- The alternative pit backfill decommissioning option will, introduce an additional long-term groundwater pollution impact post rehabilitation and closure, due to the leaching of dissolved contaminants of concern from the semi-consolidated waste rock filling mass and the release of polluted water from the saturated backfilled pit over a period of approximately 100 years. The concentrations of the contaminants would potentially result in the pollution of the groundwater aquifer and possibly even surface water, thereby affecting potential groundwater users around the mining area. Alternatively, this will require a long-term responsibility and liability for water quality monitoring and management (pollution plume borehole capturing system, with storage and/or treatment) on & around the mining area.

  This potential impact will not materialise with the preferred open pit option, as the pit water level will remain below the natural ground level and continue to act as a pollution sink, with no groundwater plume migration.

Another major consideration in the selection of the best practicable environmental option is the cost associated with the implementation thereof. The cost for the preferred option is orders of magnitude (approximately hundred times) less than the backfilling option, i.e. approximately R 40 million vs approximately R 4 billion. These costs only reflect the open pit decommissioning cost, while the cost for the rehabilitation of the mining area, which is similar for the two decommissioning options, needs to be added to the costs mentioned above. The cost of backfilling the pit is therefore not only disproportionate to the benefits achieved by mining activities over the life of the mine, but also to the benefits gained over the measures that will be implemented to restrict access to the open pit in the case of the preferred option.

b) Final site map

Provide a map at an appropriate scale, which superimposes the proposed overall activity and its associated structures and infrastructure on the environmental sensitivities of the preferred site indicating any areas that should be avoided, including buffers. Attach as Appendix 7.

See Appendix 7.

c) Summary of the positive and negative impacts and risks of the proposed activity and identified alternatives;

From an environmental perspective, the primary positive impacts of the alternative pit backfill option are the following:

- The open pit will be backfilled, eliminating any potential impacts/risks of humans/animals falling down the pit slopes in attempts to access the pit, which could result in injury, death and drowning.
- An additional area of 70 hectares of land will become available for rehabilitation and post closure utilisation as grazing land, which will be able to sustain approximately 10 additional head of cattle.
- The grazing potential of the rehabilitated waste rock dump footprint will probably be slightly higher than that of the rehabilitated waste rock dump, had it not been removed.
- Lastly, the removal of the waste rock dump will remove the potential for a ground water pollution plume from the rehabilitated waste rock dump, had it not been removed.

From an environmental perspective, the primary negative impacts of the alternative pit backfill option are the following:

- The backfilling of the pit will potentially lead to the release of polluted water from the saturated backfilled pit over a period of approximately 100 years, as early as 32 years after closure, due to the leaching of dissolved contaminants of concern from the semi-consolidated waste rock filling mass. The concentrations of these contaminants would potentially result in the long-term pollution of the groundwater aquifer and possibly even surface water, thereby affecting potential groundwater users.
- The potential release of polluted water from the saturated backfilled and re-watered pit may also result in a long-term responsibility and liability for water quality observations/monitoring and management on the rehabilitated mining area and surrounding land. This could include the design and implementation of a pollution plume borehole capturing system and subsequent polluted water storage and/or treatment processes, which could be prohibitively expensive over the long term.
- The cost associated with the backfilling option is orders of magnitude (hundred times) more than the preferred option, i.e. approximately R 4 billion vs approximately R 40 million. These costs only reflect the open pit decommissioning cost, while the cost for the rehabilitation of the mining area, which is similar for the two decommissioning options, needs to be added to the costs mentioned above. The cost of backfilling the pit is therefore not only disproportionate to the benefits achieved by mining activities

over the life of the mine, but also to the benefits gained over the measures that will be implemented to restrict access to the open pit in the case of the preferred option.
- The Fine Residue Deposit and a large part of the Course Residue Deposit will remain on the surface of the mining area, although both will be rehabilitated, therefore having the potential to sustain ground water pollution plumes beneath them.

From an environmental perspective, the negative impacts of the preferred open pit option are as follows:
- The mine pit will remain open after decommissioning and mine closure, resulting in a permanent potential impacts/risk of humans/animals falling down the pit slopes in attempts to access the pit, which could result in injury, death and drowning. However, the access ramps to the pit will be decommissioned, while two layers of additional security measures will be constructed around the open pit to restrict access to the pit.
- The open pit will also result in a loss of 70 ha of land that could have been rehabilitated and utilised as grazing land post closure, which would have been able to sustain approximately 10 additional head of cattle.
- The grazing potential of the rehabilitated waste rock dump will probably be slightly lower than the rehabilitated waste rock dump footprint, had it not been removed.
- All the Mine Residue Deposits will remain on the surface of the mining area, although rehabilitated, therefore having the potential to sustain ground water pollution plumes beneath them.

From an environmental perspective, the primary positive impacts of the preferred open pit option are as follows:
- The decommissioning and closure efforts will be sufficient to achieve the overarching closure objective of ensuring sustainability beyond mine closure and leaving a positive legacy. The efforts will also be sufficient to achieve the specific closure objectives of restoring as much as possible of the mining area to a condition consistent with the pre-determined post closure land use objectives; ensuring that the area is left in a condition that poses an acceptable level of risk to public health and safety; and reducing the need for post closure intervention, either in the form of monitoring or on-going remedial work, as far as is practicably possible.
- The cost associated with the preferred option is orders of magnitude (approximately hundred times) less than the backfilling option, i.e. approximately R 4 billion vs approximately R 40 million. The cost of backfilling the pit is therefore not only disproportionate to the benefits achieved by mining activities over the life of the mine, but also to the benefits gained over the measures that will be implemented to restrict access to the open pit in the case of the preferred option.

15) Proposed impact management outcomes for inclusion in the EMPr;

(Based on the assessment and where applicable the recommendations from specialist reports, the recording of proposed impact management outcomes for the development for inclusion in the EMPr as well as for inclusion as conditions of authorisation.)

The detailed proposed impact management outcomes for the identified environmental impacts are provided in Table 12.

Table 12: Detailed impact management outcomes

Environmental impact	Impact management outcome
Soil compaction	Minimal soil compaction
Soil pollution	Minimal soil pollution
Reduced land use potential	Land use potential restored
Surface water run-off	Minimal surface water run-off and soil erosion
Surface water pollution	• Revise the water specialist studies to close the gaps and address the shortcomings identified through independent specialist reviews • Minimal surface water pollution (contaminants & silt)
Groundwater pollution	• Revise the water specialist studies to close the gaps and address the shortcomings identified through independent specialist reviews • Minimal surface water pollution (contaminated plumes)
Dust and fumes	Minimal release of dust and fumes
Noise	Minimal noise nuisance
Vegetation impacts	Optimal vegetation cover & plant species composition & minimal invader plant presence
Wildlife disturbance, snaring, hunting & killing	Wildlife protection and re-introduction in rehabilitated areas
Ecosystem services	Optimal provision of ecosystem services
Visual impact	Minimal visual impact in the rehabilitated mining area
Social impacts due to safety risks	Minimal social impact due to safety risks • No human injury or death due to uncontrolled access to the open pit or other Mine areas
Other impacts on social fabric & socio-economic conditions	Minimal adverse impacts on social fabric and socio-economic conditions • Retrenchment, redeployment & reskilling processes adequately communicated and executed • Minimal negative impacts on the lives of individuals & local communities • Minimal adverse impacts on rights to adequate standards of living, education, health, etc. • Minimal adverse impacts on local suppliers & service providers • Minimal impacts on CSI/LED & SMME beneficiaries • No unauthorised entry to mine premises and the illegal occupation of mine land, including for illegal mining • Minimal risks of injury & fatalities due to increased traffic during decommissioning

16) *Aspects for inclusion as conditions of authorisation*

(Any aspects which must be made conditions of the Environmental Authorisation.)

Conditions of the Environmental Authorisation must cover the following aspects:

- Implement all mitigation measures, as contained in the Environmental Management Programme, Closure Plan and Rehabilitation Plan to achieve the proposed outcomes, in line with the mine closure success criteria;
- Implement actions to ensure that key outstanding information is available within one year of the issuing of the environmental authorisation;
- Monitor identified environmental aspects, e.g. surface and groundwater, as well as vegetation establishment and condition for a sufficient period to prove the sustainability of the rehabilitation actions;
- Audit/evaluate and report on the implementation of the environmental management programme, Closure plan and Rehabilitation plan;

17) *Description of any assumptions, uncertainties and gaps in knowledge*

(Which relate to the assessment and mitigation measures proposed.)

The primary assumption made in this impact assessment is that all the specialist studies provided are adequate, still valid and scientifically sound.

All of the reports, however, are based on assumptions, uncertainties and knowledge gaps. These assumptions, uncertainties and knowledge gaps is therefore also relevant to this impact assessment report.

Where specialist studies provided have been found to be inadequate or not valid anymore, additional studies will be undertaken to close the gaps and address the shortcomings identified.

Voorspoed Mine Closure Plan

During the compilation of the final Closure Plan, a number of gaps and uncertainties were identified, due to the absence of adequate information, specialist studies that provide clarity on the nature and/or extent of identified risks, as well as proven results that demonstrate the effectiveness of planned success criteria. These are primarily related to the following:

- The presence and extent of hydrocarbon contaminated soil near the plant, workshops and oil and fuel handling facilities is not known;
- A groundwater pollution plume has developed as a result of seepage from the various mine residue deposits. Although the rate of movement and potential impact to surface

water and groundwater has been modelled, the actual changes in quality and resultant impacts can only be tracked through regular monitoring of groundwater qualities;

- The nature and extent of impacts to soil as a result of seepage from the coarse residue deposit is unknown;
- The period that the return water dam will need before decommissioning, to capture and retain decant from the fine residue deposit is unknown. The anticipated quality of water in the dam post-closure is also unknown therefore, making it impossible to make a decision on how the effluent will be disposed of;
- The fine residue deposit was constructed across a non-perennial stream. The hydrological models indicate that seepage from the fine residue deposit and waste rock dump will impact the water quality in this stream post-closure. However, the actual impact can only be determined through the implementation of a post-closure ground and surface water monitoring programme;
- Contamination of off-site surface water resources due to run-off from the rehabilitated mine residue deposits is expected. However, there is a lack of understanding of the significance of current and post-closure impacts on off-site surface water receptors;
- Failure of the pit sidewalls is expected. The extent of the back-break zone has been estimated, but may not be completely accurate;
- To date, the post closure end-land use, ownership and associated maintenance of the external access road, Renoster River weir and pipeline has not been agreed upon with relevant stakeholders;
- The revised closure criteria for the raw water pipeline (above surface infrastructure demolished; sub surface infrastructure remains in situ) may not meet farmers' expectations. The commitment that was made to farmers during the Mine project development phase was that pipeline infrastructure adjacent to farm properties will become the property of the farmer post-closure;
- Despite every effort to remove the possibility or incentive for people to access the mine illegally, unauthorised access to the open pit is likely, based on experience at other closed diamond mines. Ongoing monitoring and maintenance of access control structures will be required to minimise the likelihood of human injury or death.

The Closure Plan recommended actions to address these gaps.

Voorspoed Mine Rehabilitation Plan 2019

The Rehabilitation Plan 2019 identified a number of uncertainties and gaps that must be addressed to improve the designs of the mine residue deposits and finalise the rehabilitation plan for implementation. These are related to the following:

- final reshaping volumes and footprints,
- duration of decommissioning activities and ecological processes, which could affect the scheduling of the rehabilitation process; and

- long term stability of the pit side walls, which could have a residual risk if future failures affects the measures to deter access to the pit, i.e. trench, berm and security fence.

Voorspoed Mine mine closure socio-economic impact assessment

The assessment identified the following limitations:

- the study was guided by the Anglo American Mine Closure Planning Toolbox Version 2, using the prescribed evaluation model, built on the mine's status in terms of mine closure planning, which was at the Final Closure Plan (5-0 years) stage;
- the study was limited by the unavailability of contractor specific information, which means that data analyses were narrowed down to a specific sample and certain assumptions were made, in order to fulfil the mandate as an acceptable baseline study;
- where information was not available, specific ratios where used, e.g. only 20 percent of contractor employees' demographic information was obtained and these numbers were adjusted with ratios to arrive at final figures for the entire contractor workforce;
- limited remuneration information was obtained from contractors, therefore their earnings per annum were projected against permanent employees' demographics.

Evaluation of the Risks, Impacts and Management Requirements into Pit Backfilling versus Current Mine Plan (Pit Lake)

Several assumptions were required to evaluate the hydrogeology, hydrology and geochemistry of the three potential pit closure scenarios in this report. Where valid, the assumptions were kept consistent in all three scenarios to allow for direct comparison of the outcomes.

Proposed End Land Use Plan

The report identified the following specific assumptions and limitations:

- The ELU options for Voorspoed were developed with input from a limited number of key stakeholders with technical expertise in soils and land capability, vegetation assessment and stock carrying capacity, as well as experts in biodiversity conservation, mine closure planning and the financial evaluation of different farming models;
- While every attempt has been made to ensure that the ELUP presented in this report is aligned with current regional and local planning, the objectives of government could shift in time, and may require the plan to be updated, if not revised;
- Scrutiny of the proposed ELU options presented in this report in a wider stakeholder forum as part of the mine closure public participation process may present additional ELU options for further consideration and evaluation. However, the work presented in the report may help to guide discussions on alternative ELU options that have not been considered.

The information presented may also help to moderate unrealistic expectations on ELU options that the Voorspoed properties could support on a sustainable basis.

- The different ELU options presented for economic evaluation were not intended to be detailed farm plans ready for implementation, but rather to provide sufficient detail in terms of the different farming approaches, to allow an economic comparison of the different farming options, with a reasonably robust level of confidence. If any of the proposed farming options were to be considered for implementation, it should be presented for detailed farm planning and refined financial evaluation, primarily to improve confidence in the quantum of investment capital required and to determine cash flow and profitability into the future.
- Many assumptions were made in the financial modelling, as described in the report. Most importantly it was assumed that the properties and existing buildings were already owned by De Beers and would therefore not need to be purchased, but that all other farming equipment, livestock and game, as well as fencing, would need to be purchased or installed.

Voorspoed Mine - Summary of Surface and Groundwater Study for Mine Closure

Three information gaps, crucial for guiding the closure process were identified during the preliminary Voorspoed data/information assessment:

- Uncertainty existed over the hydraulic parameters of the rock/formation units proximal to the Voorspoed pit, as highlighted in Geocon (2004) and Itasca (2014);
- Mass transport plumes associated with the tailings facility were not simulated for the period post-closure and hence no modelling work existed in 2017 to describe post closure mass transport; mitigation requirements, and time series monitoring datasets (specifically, for the area outside the Voorspoed mining area); and
- Existing models provided no insight of the pit lake conditions likely to develop in the post closure era (i.e. the rate of filling, the possibility for decant (although unlikely) and the water quality).

These gaps were addressed and improved during the project period. However, specific gaps, such as the actual water quality signature of the pit lake requires a detailed assessment of the pit sidewall-rock formation(s) and the anticipated local pit catchment area.

Voorspoed Mine's Hydrological Monitoring Program (2018+) - Monitoring sites, program and network upgrade

None

A Wetland Delineation, Management and Rehabilitation Plan for the De Beers Voorspoed Mine

Due to the large study area, data collection relied heavily on data from representative sections, as well as general observations and a desktop analysis.

Alien Invasive Management Plan for De Beers Voorspoed Mine

Due to the large study area, data collection relied heavily on data from representative sections, as well as general observations, generic data and a desktop analysis.

18) Reasoned opinion as to whether the proposed activity should or should not be authorised

a) Reasons why the activity should be authorized or not

The primary difference between the preferred and alternative decommissioning options assessed in this report is that the preferred option will not backfill the open pit, while the alternative pit backfilling option will use mine residue deposits, primarily the waste rock dump to backfill the open pit.

The majority of the decommissioning activities and associated with preferred open pit decommissioning and mine closure option and the alternative open pit backfilling decommissioning and mine closure option are the same, i.e. the two options do not differ much. Consequently, the two options also do not differ much in terms of the environmental impacts associated with them. These relate to positive and negative impacts of various decommissioning and rehabilitation activities on soil compaction and pollution, land use potential, surface water run-off and pollution, ground water pollution, vegetation and wildlife, dust and fumes, noise, visual landscape, as well as the social and socio-economic landscape.

The difference in environmental impacts between the two options reflect the primary difference between the two, i.e. that the preferred option will not backfill the open pit, while the alternative pit backfilling option will use mine residue deposits, primarily the waste rock dump to backfill the open pit.

- With the preferred open pit decommissioning option, there will be permanent potential social and biodiversity impacts, due to the residual risks of human and animal injury or death from sliding/falling down the slopes of the open pit and perhaps even drowning, despite the decommissioning activities to reduce these risks.

  These potential social and biodiversity impacts can only be eliminated by the alternative pit backfilling option. However, proposed mitigation actions include the construction and maintenance of three layers of security to control access to the open pit.

- The alternative pit backfill decommissioning option will introduce additional long-term groundwater pollution impact after rehabilitation and closure, due to the leaching of dissolved contaminants of concern from the semi-consolidated waste rock filling and the release of polluted water from the saturated backfilled pit over a period of approximately 100 years. The concentrations of the contaminants would potentially result in the pollution of the groundwater aquifer and possibly even surface water, thereby affecting potential groundwater users around the mining area. This will require a long-term responsibility and liability for water quality monitoring and management (pollution plume borehole capturing system, with storage and/or treatment) on & around the mining area.

  This potential impact will not materialise with the preferred open pit option, as the pit water level will remain below the natural ground level and continue to act as a pollution sink, with no groundwater plume migration.

Another important consideration in the selection of the best practicable environmental option for decommissioning and mine closure is the cost associated with the implementation thereof. The cost for the preferred option is orders of magnitude (approximately hundred times) less than the backfilling option, i.e. approximately R 40 million vs approximately R 4 billion. The cost of backfilling the pit is therefore not only disproportionate to the benefits achieved by mining activities over the life of the mine, but also to the benefits gained over the measures that will be implemented to restrict access to the open pit in the case of the preferred option.

The decommissioning and rehabilitation of the Voorspoed Mine through the implementation of the preferred pit closure, rehabilitation design and post closure end land use options, with a workable and practical decommissioning and mine closure process, will result in the attainment of the closure objectives, aligned with all applicable legal requirements and pursuant to the NEMA section 2 principles. This is, however, conditional to the implementation of the mitigation, management and monitoring measures outlined in this report, the Rehabilitation Plan 2019 and the Final Mine Closure Plan.

In the absence of the decommissioning, rehabilitation and closure, the mine infrastructure and unrehabilitated mine residue deposits will remain as potential sources of pollution, while the open pit will also remain easily accessible to both humans and animals. The land will not be available for farming activities and environmental pollution in terms of land, water and air pollution would continue unabated. In addition, the owner of the mine will remain liable for any environmental liability, pollution, ecological degradation, the pumping and treatment of extraneous water, compliance to the conditions of the environmental authorisation and the management and sustainable closure of the mine. It is thus imperative that a feasible and sustainable mine closure plan be approved.

b) *Conditions that must be included in the authorisation*

- The necessary actions must be taken to ensure that outstanding information is available within one year of the issuing of the environmental authorisation.
- The environmental management programme, final closure plan and rehabilitation plan must be reviewed and revised where necessary when the outstanding information becomes available.
- The applicant must ensure that the necessary resources are made available for the implementation of the environmental management programme, final closure plan and rehabilitation plan.
- The implementation of the environmental management programme, final closure plan and rehabilitation plan must be audited annually and dealt with according to the requirements in Chapter 5 of the 2014 EIA regulations.

With regard to objects of archaeological or palaeontological origin:

- Should any objects of archaeological or palaeontological remains be found during construction/decommissioning activities, work must immediately stop in that area and the Environmental Control Officer (ECO) or responsible person must be informed.
- The ECO/responsible person must inform the South African Heritage Recourse Agency (SAHRA) and contact an archaeologist and/or palaeontologist, depending on the nature of the find, to assess the importance and rescue them if necessary (with the relevant SAHRA permit).
- If the newly discovered heritage resource is considered significant a Phase 2 assessment may be required.
- No work may be resumed in this area without the permission from the ECO and SAHRA.
- A permit from the responsible heritage authority will be needed.

With regard to groundwater monitoring:

- Conduct groundwater monitoring quarterly for five years after cessation of the mining operations and report the results annually.
- Monitor groundwater levels monthly during the decommissioning-closure phase and biannually in the post-closure phase.
- Groundwater quality must be sampled and analysed by an accredited laboratory, using the correct scientific methods to avoid alien and cross contamination.
- Analyses must include major cations (i.e.: Ca, Mg, Na & K), major anion (i.e. Cl, F, & SO_4), physic-chemical determinants (i.e. pH, conductivity, TDS, and Total Alkalinity), as well as metals and trace metals (i.e. Fe, Cr, Se, Pb, Mn, Al and Zn).
- Initiate a programme to generate hydrological data that will be used as a baseline dataset for future planning and to confirm the numerical modelling and predictions modelled during the mine closure study.

- Upgrade the groundwater transport contamination model every 5 years, using the latest monitoring data.

19) *Period for which the Environmental Authorisation is required*

5 years

20) *Undertaking*

(Confirm that the undertaking required to meet the requirements of this section is provided at the end of the EMPr and is applicable to both the Basic Assessment report and the Environmental Management Programme report.)

The undertaking required to meet the requirements of this section is provided at the end of the EMPr and is applicable to both the Basic Assessment report and the Environmental Management Programme report

21) *Financial Provision*

(State the amount that is required to both manage and rehabilitate the environment in respect of rehabilitation.)

If the preferred decommissioning option is approved, an amount of R 183 233 689 would be required as financial provision to execute the decommissioning and rehabilitation measures indicated in the final Voorspoed Mine Closure Plan (Appendix 12) and associated 2019 Voorspoed Mine Rehabilitation Plan 2019 (Appendix 11). This includes the cost to implement the environmental management, maintenance and monitoring programmes for a period of 10 years post rehabilitation, as indicated in the final Closure Plan.

Furthermore, approximately R150 million would be required to implement the mine closure commitments in the Voorspoed Mine Social and Labour Plan[21].

a) *Explain how the aforesaid amount was derived*

A closure liability estimate was generated with respect to physical and bio-physical aspects of decommissioning, based on the proposed mine closure criteria, required actions and proposed implementation schedule.

An itemised closure liability was calculated using the quantities and rates for the decommissioning and rehabilitation activities described in the final Voorspoed Mine Closure Plan (Appendix 11).

The quantities for earthworks were calculated on a volume basis (m^3), in line with the standard method of measurement for civil engineering quantities, tendering and volume balances. The quantities for earthworks were modelled and calculated from a Digital Terrain Model (DTM) that was developed for Voorspoed Mine.

[21] De Beers Consolidated Mines Proprietary Limited, Voorspoed Mine, Social and Labour Plan (2017-2021), Version 03

Rates for dismantling and demolition of infrastructure were obtained from a national demolition contractor that visited the site to assess local conditions, while the rates for earthworks were calculated, based on site conditions and a combination of local and typical plant hire rates.

In line with the commitments included in its Social and Labour Plan, Voorspoed Mine also provides financially for the Human Resources Development Programme, Mine Community Development Programme, as well as the process to manage downscaling and retrenchment.

Although socio-economic baselines and impacts are addressed by the final Closure Plan, the social closure costs were calculated and provisioned separately by Voorspoed Mine, in line with the approved Social and Labour Plan.

b) Confirm that this amount can be provided for from operating expenditure

(Confirm that the amount is anticipated to be an operating cost and is provided for as such in the Mining Work Programme, Financial and Technical Competence Report or Prospecting Work Programme as the case may be.)

The decommissioning and closure costs, in terms of the Voorspoed Mine Final Closure Plan and the associated Rehabilitation Plan 2019, is provided for in terms of the Voorspoed Mine financial provision for rehabilitation and closure. Some aspects of the total financial provision for decommissioning and mine closure are provided for in terms of the Social and Labour Plan.

22) Specific Information required by the Competent Authority

a) Compliance with the provisions of sections 24(4)(a) and (b) read with section 24(3)(a) and (7) of the National Environmental Management Act (Act 107 of 1998).

(i) The EIA report must include the impact on the socio-economic conditions of any directly affected person

(Provide the results of investigation, assessment, and evaluation of the impact of the mining, bulk sampling or alluvial diamond prospecting on any directly affected person including the landowner, lawful occupier, or, where applicable, potential beneficiaries of any land restitution claim, attach the investigation report as an Appendix.)

A separate comprehensive Social Impact Assessment was undertaken to evaluate the impact of the decommissioning activities on the socio-economic conditions of directly and indirectly affected person. The report is attached as Appendix 16 and includes a comprehensive social impact assessment, social closure management measures, social closure success criteria, social monitoring actions, as well as a residual social closure risk assessment.

(ii) The EIA report must include the impact on any national estate referred to in section 3(2) of the National Heritage Resources Act.

(Provide the results of investigation, assessment, and evaluation of the impact of the mining, bulk sampling or alluvial diamond prospecting on any national estate referred to in section 3(2) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) with the exception of the national estate contemplated in section 3(2)(i)(vi) and (vii) of that Act, attach the investigation report as Appendix 23 and confirm that the applicable mitigation is reflected in 2.5.3; 2.11.6.and 2.12.herein).

Assessment of the impact of the mining activities on any national estate was already done by a heritage specialist in 2004. The investigation report is attached as Appendix 23[22]. Very little heritage resources were identified, virtually all of it outside the mining area. No mitigation is required during the decommissioning activities, as all required mitigation was completed when the mine was established.

23) Other matters required in terms of sections 24(4)(a) and (b) of the Act.

(The EAP managing the application must provide the competent authority with detailed, written proof of an investigation as required by section 24(4)(b)(i) of the Act and motivation if no reasonable or feasible alternatives, as contemplated in sub-regulation 22(2)(h), exist. The EAP must attach such motivation as Appendix).

No site alternatives were considered and are evidently not possible, as the mine is already established on the mining area.

The application also does not involve the determination of a specific site lay-out, i.e. the location of infrastructure and activities on the site, as these were constructed and established during the construction and operational phases of the mine. However, it involves the determination of how the existing infrastructure and facilities on and off the mining area must be decommissioned and rehabilitated, in such a way that the mining area can be utilised in a sustainable manner after closure. These relate to design, lay-out, technology and operational aspect alternatives. Reasonable and feasible alternatives that were considered include strategic mine extension alternatives, pit closure alternatives, rehabilitation design alternatives, as well as end land use alternatives. These were comprehensively discussed in sections 7 and 8(a).

[22] Pistorius, J. 2004. A Heritage Impact Assessment (HIA) Study for an EMP for the Voorspoed Diamond Mine near Kroonstad in the Free State Province of South Africa.

PART B

ENVIRONMENTAL MANAGEMENT PROGRAMME AND CLOSURE PLAN

1. Draft Environmental Management Programme and Closure Plan

a) Details of the EAP

(Confirm that the requirement for the provision of the details and expertise of the EAP are already included in PART A, section 1(a) herein as required.)

EAP:	Theunis Meyer
Company:	Centre for Environmental Management, North-West University
Professional affiliation/registration:	SACNASP 40029/08 SAATCA E056
Postal address:	Private Bag X6001, Potchefstroom, 2520
Cell:	0836270637
Fax:	0865137996
Telephone:	018 299 1467
E-mail:	theunis.meyer@nwu.ac.za

b) Description of the aspects of the activity

(Confirm that the requirement to describe the aspects of the activity that are covered by the draft environmental management programme is already included in PART A, section 1(h) herein as required.)

The requirement to describe the aspects of the activity that are covered by the draft environmental management programme is already included in Part A, section 1(h) of this report, as required.

c) Composite map

(Provide a map (Attached as an Appendix) at an appropriate scale which superimposes the proposed activity, its associated structures, and infrastructure on the environmental sensitivities of the preferred site, indicating any areas that should be avoided, including buffers.)

See Appendix 7.

d) Description of impact management objectives, including management statements

(i) Determination of closure objectives

(Ensure that the closure objectives are informed by the type of environment described.)

The closure objectives have been determined during a closure planning process that started with the development of a preliminary closure plan in 2011 that was revised and refined through iterations of the Closure Plan in 2014 and 2017. The closure objectives are clearly formulated in the final Closure Plan attached to the BAR (Appendix 11).

The closure vision for Voorspoed Mine is to close the mine in line with the relevant legal requirements, in such a way that the mining area can be utilised in a sustainable manner after closure.

The overarching closure objective is to ensure sustainability beyond mine closure and leaving a positive legacy. This is supported by the following specific objectives:

- Restore as much as possible of the mining area to a condition consistent with the pre-determined post closure land use objectives;
- Ensure that the area is left in a condition that poses an acceptable level of risk to public health and safety; and
- Reduce the need for post closure intervention, either in the form of monitoring or on-going remedial work, as far as is practicably possible.

The end land use for Voorspoed Mine is to reinstate most of the rehabilitated footprint area back to agricultural land. The aim is to achieve a sustainable land use, comply with the closure vision and match the rehabilitated footprint with the surrounding area as far as reasonably practical.

(ii) Volumes and rate of water use required for the operation

Not known at present

(iii) Has a water use licence has been applied for?

No water use license has been applied for, as Voorspoed Mine already has a water use license, Licence No. 09/C70H/ABGJ/1031, dated 21/06/2011.

(iv) Impacts to be mitigated in their respective phases

(Measures to rehabilitate the environment affected by the undertaking of any listed activity.)

Activities	Phase	Size & scale of disturbance	Mitigation measures	Compliance with standards	Time period for implementation
(E.g. For prospecting: drill site, site camp, ablution facility, accommodation, equipment storage, sample storage, site office, access route, etc.	(Of operation in which activity will take place. State: planning, pre-construction, construction, operational, rehabilitation, closure, post closure.)	(Volumes, tonnages and hectares or m².)	(Describe how each of the recommendations herein will remedy the cause of pollution or degradation and migration of pollutants.)	(A description of how each of the recommendations herein will comply with any prescribed environmental management standards or practices identified by Competent Authorities.)	(Describe the time period when the measures must be implemented. Rehabilitation must take place at the earliest opportunity. Therefore state upon cessation of the activity/ prospecting/bulk sampling/ mining, as the case may be.
Open Pit	Decommissioning	74 ha	• Construct 2m high waste rock barriers / berms at top of remaining access ramps • Erect security fence 10m outside of indicated ZOR	• Access deterred with waste rock barriers, security fence around the pit perimeter	As soon as decommissioning process start
	Earthworks		• Construct enviroberm and trench in balanced cut and fill operation outside of security fence • Align trench and berm to divert clean storm water away from the pit towards the wetland area	• Access deterred with trench & enviroberm around the pit, outside the security fence • Trench & enviroberm functional & stable	After the security fence has been completed
	Rehabilitation		• Rip compacted area between pit perimeter & enviroberm • Establish vegetation between pit perimeter & enviroberm • On enviroberm & trench, ameliorate growth medium, based on analysis thereof • Seed the enviroberm & trench with a mixture of adapted indigenous grass & tree seeds • Apply follow-up fertiliser on the enviroberm & trench, where specified	• Limited erosion that will not deteriorate to large dongas & unsafe area; • Vegetation cover similar to natural comparable surrounding environment • No weed invasion that will outcompete the grass & tree species	After construction of the enviroberm & trench

Activities	Phase	Size & scale of disturbance	Mitigation measures	Compliance with standards	Time period for implementation
Open Pit	Rehabilitation	74 ha	• Control weeds and invader plant species on the enviroberm & trench • Create & maintain firebreaks to prevent veld fires from destroying the newly established vegetation	See above	After construction of the enviroberm & trench
	Post rehabilitation management & monitoring		• Maintain & manage all rehabilitated areas in accordance with success criteria • Apply follow-up fertiliser on the enviroberm & trench, where specified • Control weeds and invader plant species on the enviroberm & trench • Create & maintain firebreaks to prevent veld fires from destroying the newly established vegetation	• Limited erosion that will not deteriorate to large dongas & unsafe area; • Vegetation cover similar to comparable surrounding natural environment • No weed invasion that will outcompete the grass & tree species	Periodically after rehabilitation has been completed until mine closure
Treatment plant area Other mine infrastructure	Decommissioning	20 ha 29 ha	• Clear infrastructure from site & dismantle steel structures • Remove all salvageable equipment & material, as well as containers & mobile buildings from the mining area • Demolish & remove concrete & brick structures, walkways & paved areas • Remove all culvert structures from roads and decommission trenches • Decommission existing trenches from plant area to return water and storm water control dams	• No infrastructure remains on site • No safety hazards remain on site • All artificial barriers removed	As soon as decommissioning process start
	Earthworks		• Dispose of inert concrete & building rubble in primary crusher void • Shape area to fill excavations, be free draining & fit in with surrounding drainage patterns • Reinstate affected surface drainage lines & catchment areas to pans	• Excavations have been filled and area is free draining • Effective soil cover ensure the agreed land capability	After the decommissioning has been completed

Activities	Phase	Size & scale of disturbance	Mitigation measures	Compliance with standards	Time period for implementation
Treatment plant area Other mine infrastructure	Earthworks	20 ha 29 ha	• Construct water control berms / contour drains on covered area • Cover roads, plant, building & related footprints & disturbed areas with soil	See above	After the decommissioning has been completed
	Rehabilitation		• Implement *in-situ* bioremediation in hydrocarbon contaminated plant areas • Rip roads, plant & building footprint areas to alleviate compaction • Ameliorate growth medium, based on analysis thereof • Seed the area with a mixture of adapted, indigenous grass & tree species • Apply follow-up fertiliser, where specified • Control weeds and invader plant species • Fence the area in camps to control grazing & protect rehabilitation work • Create & maintain firebreaks to prevent veld fires from destroying the newly established vegetation	• Soil compaction alleviated & soil pollution remedied • Hydrocarbon contaminated soil remediated *in-situ* • Limited erosion that will not deteriorate to large dongas & unsafe area • Vegetation cover similar to natural comparable surrounding environment & ensure the agreed grazing capacity • No weed invasion that will outcompete the grass & tree species	After the earthworks have been completed
	Post rehabilitation management & monitoring		• Maintain & manage all rehabilitated areas in accordance with success criteria • Apply follow-up fertiliser, where specified • Control weeds and invader plant species • Create & maintain firebreaks to prevent veld fires from destroying the newly established vegetation • Apply controlled grazing to stimulate the vegetation and improve biodiversity	• Limited erosion that will not deteriorate to large dongas & unsafe areas • Limited generation of dust • Vegetation cover similar to natural comparable surrounding environment • No weed invasion that will outcompete the grass & tree species	Periodically after rehabilitation has been completed until mine closure

Activities	Phase	Size & scale of disturbance	Mitigation measures	Compliance with standards	Time period for implementation
Return water and storm water control dams	Decommissioning	9 ha	• Remove HDPE liner from return water dam and dispose of at registered waste site	• HDPE liner removed and dispose of	As soon as decommissioning start
	Earthworks		• Backfill the return water & storm water control dam basins up to the surrounding ground level with waste rock material or tailings from the emergency stockpile • Cut embankments to ground level and cover basin with available material • Cover surrounding areas with soil	• The return water & storm water control dams are backfilled to ground level • Effective soil cover ensure the agreed land capability	After the decommissioning has been completed
	Rehabilitation		• Ameliorate growth medium, based on analysis thereof • Seed the area with a mixture of adapted, indigenous grass & tree species • Apply follow-up fertiliser, where specified • Control weeds and invader plant species • Fence the area in camps to control grazing & protect rehabilitation work • Create & maintain firebreaks to prevent veld fires from destroying the newly established vegetation	• Limited erosion that will not deteriorate to large dongas & unsafe area; • Vegetation cover similar to natural comparable surrounding environment & ensure the agreed grazing capacity • No weed invasion that will outcompete the grass & tree species	After the earthworks have been completed
	Post rehabilitation management & monitoring		• Maintain & manage all rehabilitated areas in accordance with success criteria • Apply follow-up fertiliser, where specified • Control weeds and invader plant species • Create & maintain firebreaks to prevent veld fires from destroying the newly established vegetation • Apply controlled grazing to stimulate the vegetation and improve biodiversity	• Limited generation of dust • Vegetation cover similar to natural comparable surroundings & ensure the agreed grazing capacity • No weed invasion that will outcompete the grass & tree species • Firebreaks maintained to prevent and control veld fires • Controlled grazing to agreed carrying capacity implemented	Periodically after rehabilitation has been completed until mine closure

Activities	Phase	Size & scale of disturbance	Mitigation measures	Compliance with standards	Time period for implementation
Waste rock dump (WRD)	Earthworks	230 ha	• Reshape steep slopes of WRD to be free draining, form single slope & reduce gradient & slope length • Cover top area & reshaped slopes of WRD with cover material and soil • Construct crest berm walls & paddocks on top of WRD, as well as on bench between lifts 1 & 2 to contain rainfall and runoff on rehabilitated WRD • Construct toe paddocks at seepage points around WRD to capture & evaporate seepage	• WRD slopes reshaped to be free draining, form single slope & reduce gradient & slope length • Effective soil cover ensure the agreed land capability • Water control measures contain run-off on rehabilitated WRD & capture & evaporate seepage in toe paddocks	Ongoing after cessation of mining activities
	Rehabilitation		• Rip top area to alleviate compaction and mix soil with underlying material • Ameliorate growth medium, based on analysis thereof • Seed the area with a mixture of adapted, indigenous grass & tree species • Apply follow-up fertiliser, where specified • Control weeds and invader plant species • Fence the area in camps to control grazing & protect rehabilitation works • Create & maintain firebreaks to prevent veld fires from destroying the newly established vegetation	• Soil compaction alleviated & soil pollution remedied • Limited erosion that will not deteriorate to dongas & unsafe area • Sediment transport limited to WRD toe • Capacity of benches remain sufficient; • Vegetation cover similar to natural comparable surroundings & ensure the agreed grazing capacity • Trees established on benches • No weed invasion that will outcompete the grass & tree species	After the earthworks have been completed
	Post rehabilitation management & monitoring		• Decommission toe paddocks around WRD • Maintain & manage all rehabilitated areas in accordance with success criteria • Apply follow-up fertiliser, where specified • Control weeds and invader plant species • Maintain firebreaks to prevent veld fires from destroying the newly established vegetation • Apply controlled grazing to stimulate the vegetation and improve biodiversity	• Limited erosion that will not deteriorate to dongas & unsafe areas • Limited ground water pollution • Limited generation of dust • Vegetation cover similar to natural comparable surroundings & ensure the agreed grazing capacity • No weed invasion that will outcompete the grass & tree species • Firebreaks maintained to prevent and control veld fires • Controlled grazing to agreed carrying capacity implemented	Periodically after rehabilitation has been completed until mine closure

Activities	Phase	Size & scale of disturbance	Mitigation measures	Compliance with standards	Time period for implementation
Coarse Residue deposit	Earthworks	35 ha	• Reshape steep slopes of CRD to be free draining, form single slope & reduce gradient & slope length • Cover reshaped slopes of CRD with coarse basalt material and cover basalt & top area with soil • Construct crest berm walls & paddocks on top of CRD & reshape top of CRD to drain inwards to contain rainfall and runoff on rehabilitated CRD • Construct toe paddocks at seepage points around CRD, as well as towards Northern Pan on eastern side to capture & evaporate seepage • Decommission existing seepage trenches to return water & storm water control dams, backfill and cover with surrounding material	• CRD slopes reshaped to be free draining, form single slope & reduce gradient & slope length • Effective soil cover ensure the agreed land capability • Water control measures contain run-off on rehabilitated CRD & capture & evaporate seepage in toe paddocks	Ongoing after cessation of mining activities
	Rehabilitation		• Rip top area & slopes of CRD to alleviate compaction & mix cover material and soil with underlying material • Ameliorate growth medium, based on analysis thereof • Seed the area with a mixture of adapted, indigenous grass & tree species • Apply follow-up fertiliser, where specified • Control weeds and invader plant species • Fence the area in camps to control grazing & protect rehabilitation works • Create & maintain firebreaks to prevent veld fires from destroying the newly established vegetation	• Soil compaction alleviated & soil pollution remedied • Limited erosion that will not deteriorate to large dongas & unsafe area • Sediment transport limited to toe of CRD & does not reach the northern pan • Vegetation cover similar to natural comparable surrounding environment & ensure the agreed grazing capacity • Area fenced off and grazing controlled to agreed carrying capacity • No weed invasion to the extent that it will outcompete the grass & tree species	After the earthworks have been completed

Activities	Phase	Size & scale of disturbance	Mitigation measures	Compliance with standards	Time period for implementation
Coarse Residue deposit	Post rehabilitation management & monitoring	35 ha	• Decommission toe paddocks around CRD • Maintain & manage all rehabilitated areas in accordance with success criteria • Apply follow-up fertiliser, where specified • Control weeds and invader plant species • Maintain firebreaks to prevent veld fires from destroying the newly established vegetation • Apply controlled grazing to agreed carrying capacity to stimulate the vegetation and improve biodiversity	• Limited erosion that will not deteriorate to large dongas & unsafe areas • Limited ground water pollution • Limited generation of dust • Vegetation cover similar to natural comparable surrounding environment & ensure the agreed grazing capacity • No weed invasion to the extent that it will outcompete the grass & tree species • Firebreaks maintained to prevent veld fires from destroying the vegetation • Controlled grazing to agreed carrying capacity implemented	Periodically after rehabilitation has been completed until mine closure
Fine Residue deposit	Earthworks	120 ha	• No earthworks on top of FRD, due to safety risk (fine tailings remain wet for very long) • Reshape steep inside & outside slopes of FRD to be free draining, form single slope & reduce gradient & slope length • Cover reshaped slopes of FRD with soil • Construct crest berm walls on outside of inspection road on top of embankments; • Contain all runoff on the top of the facility (do not spill more than once in 100 years) • Construct waterways & stabilise with gabions and reno mattresses to control run-off • Construct toe paddocks at seepage points to capture & evaporate seepage • Decommission existing seepage trenches to return water & storm water control dams, backfill and cover with surrounding material	• Top area of FRD is fenced off with security fence • FRD slopes reshaped to be free draining, form single slope & reduce gradient & slope length • Effective soil cover ensure the agreed land capability • Water control measures contain run-off on rehabilitated FRD and does not spill more than once in 100 years • Gabion waterway show no signs of undercutting, excessive sedimentation or subsidence • Water control measures capture & evaporate seepage in toe paddocks	Ongoing after cessation of mining activities

Activities	Phase	Size & scale of disturbance	Mitigation measures	Compliance with standards	Time period for implementation
	Rehabilitation		• Spread fertiliser and seeds by hand on the top areas that can be safely accessed on foot • Ameliorate growth medium, based on analysis thereof • Seed the area with a mixture of adapted, indigenous grass & tree species • Apply follow-up fertiliser, where specified • Control weeds and invader plant species • Fence the area in camps to control grazing & protect rehabilitation works • Create & maintain firebreaks to prevent veld fires from destroying the newly established vegetation	• Limited erosion on slopes that will not deteriorate to large dongas • Sediment transport limited to toe of FRD & does not reach the southern pan • Vegetation cover similar to natural comparable surroundings & ensure the agreed grazing capacity • No weed invasion that will outcompete the grass & tree species • Area fenced off and grazing controlled to agreed carrying capacity • Firebreaks created to prevent veld fires from destroying the vegetation	After the earthworks have been completed
Fine Residue deposit	Post rehabilitation management & monitoring	120 ha	• Decommission toe paddocks around FRD • Maintain & manage all rehabilitated areas in accordance with success criteria • Apply follow-up fertiliser, where specified • Control weeds and invader plant species • Maintain firebreaks to prevent veld fires from destroying the newly established vegetation • Apply controlled grazing to agreed carrying capacity to stimulate the vegetation and improve biodiversity	• Limited erosion that will not deteriorate to large dongas & unsafe areas • Limited ground water pollution • Limited generation of dust • Vegetation cover similar to natural comparable surroundings & ensure the agreed grazing capacity • No weed invasion that will outcompete the grass & tree species • Firebreaks maintained to prevent veld fires from destroying the vegetation • Controlled grazing to agreed carrying capacity implemented	Periodically after rehabilitation has been completed until mine closure
Remaining topsoil stockpiles	Earthworks	5 ha	• Reshape slopes of topsoil stockpiles to be free draining, form single slope & reduce gradient & slope length	• Topsoil stockpile slopes reshaped to be free draining, form single slope & reduce gradient & slope length	Ongoing after cessation of mining activities

Activities	Phase	Size & scale of disturbance	Mitigation measures	Compliance with standards	Time period for implementation
	Rehabilitation		• Ameliorate growth medium, based on analysis thereof • Seed the area with a mixture of adapted, indigenous grass & tree species • Apply follow-up fertiliser, where specified • Control weeds and invader plant species • Fence the area in camps to control grazing & protect rehabilitation works • Create & maintain firebreaks to prevent veld fires from destroying the newly established vegetation	• Limited erosion on slopes that will not deteriorate to large dongas • Sediment transport limited to toe of topsoil stockpiles & does not reach the wetland adjacent to the mining area • Vegetation cover similar to natural comparable surrounding environment & ensure the agreed grazing capacity • No weed invasion to the extent that it will outcompete the grass & tree species • Area fenced off and grazing controlled to agreed carrying capacity • Firebreaks created to prevent veld fires from destroying the vegetation	After the earthworks have been completed
	Post rehabilitation management & monitoring		• Maintain & manage all rehabilitated areas in accordance with success criteria • Apply follow-up fertiliser, where specified • Control weeds and invader plant species • Maintain firebreaks to prevent veld fires from destroying the newly established vegetation • Apply controlled grazing to agreed carrying capacity to stimulate the vegetation and improve biodiversity	• Limited erosion that will not deteriorate to large dongas & unsafe areas • Limited generation of dust • Vegetation cover similar to natural comparable surrounding environment • No weed invasion to the extent that it will outcompete the grass & tree species • Firebreaks maintained to prevent veld fires from destroying the vegetation • Controlled grazing to agreed carrying capacity implemented	Periodically after rehabilitation has been completed until mine closure

Activities	Phase	Size & scale of disturbance	Mitigation measures	Compliance with standards	Time period for implementation
Northern & southern pans	Earthworks	11 ha	• Construct compacted berm wall on existing walkway alignment at southern pan to separate undisturbed western portion from disturbed and rehabilitated eastern portion • Cover disturbed eastern portion of the southern pan with soil to prevent impact to the western portion • Construct a coarse filter berm wall of basalt between the rehabilitated plant footprint and the northern pan to prevent sediment from entering the pan area • Route runoff from rehabilitated plant and buildings areas within the catchment of the southern pan to the undisturbed eastern portion thereof • Make a shallow channel from the southern pan to the wetland adjacent to the mining area on the estimated full level • Route runoff from the northern portion of the rehabilitated plant area towards the northern pan	• No sediment transport to pan areas • Clean runoff volumes to pans are close to original condition	After the decommissioning of the mine infrastructure has been completed
	Rehabilitation		• Spread the seeds of available selected wetland grass species in both of the pan areas • Remove alien tree and weed species mechanically from southern pan with selective chemical stem treatment with approved herbicides	• Vegetation species composition reflects increased wetland species • No alien tree & weed invasion in the pans • Increase in wetland faunal species	After the earthworks have been completed
	Post rehabilitation management & monitoring		• Maintain & manage all rehabilitated areas in accordance with success criteria • Control weeds and invader plant species • Maintain firebreaks to prevent veld fires from destroying the newly established vegetation • Apply controlled grazing to agreed carrying capacity to stimulate the vegetation and improve biodiversity	• Vegetation cover similar to natural comparable surrounding environment & ensure the agreed grazing capacity • No weed invasion to the extent that it will outcompete the grass & tree species • Firebreaks maintained to prevent veld fires from destroying the vegetation • Controlled grazing to agreed carrying capacity implemented	Periodically after rehabilitation has been completed until mine closure

Activities	Phase	Size & scale of disturbance	Mitigation measures	Compliance with standards	Time period for implementation
Wetland adjacent to the mining area	Earthworks	64 ha	• Divert clean runoff from the southern WRD area to the wetland to reinstate original catchment • Construct a drift in the mine access road to ensure hydraulic connection to the downstream pan system	• Clean runoff volumes to pans are close to original condition • Wetland adjacent to mining area reconnected hydraulically to the downstream pan system	After the decommissioning of the mine infrastructure has been completed
	Rehabilitation		• Spread the seeds of available selected wetland grass species in the wetland area • Remove alien tree and weed species mechanically from the wetland and its catchment with selective chemical stem treatment with approved herbicides	• Vegetation species composition reflects increased wetland species; • No alien tree & weed invasion in the pans • Increase in wetland fauna species	After the earthworks have been completed
Eucalyptus plantation	Post rehabilitation management & monitoring	19 ha	• Control the spread of blue gum trees outside the plantation area • Maintain firebreaks to prevent veld fires from destroying the plantation	• No spread of blue gum trees outside the plantation area • Firebreaks maintained to prevent veld fires from destroying the plantation	Periodically after rehabilitation has been completed until mine closure
Natural veld areas	Post rehabilitation management & monitoring	494 ha	• Manage natural veld areas in accordance with success criteria • Control weeds and invader plant species • Maintain firebreaks to prevent veld fires from destroying the vegetation • Apply controlled grazing to agreed carrying capacity to stimulate the vegetation and improve biodiversity	• Vegetation cover similar to natural comparable surrounding environment & ensure the agreed grazing capacity • No weed invasion to the extent that it will outcompete the grass & tree species • Firebreaks maintained to prevent veld fires from destroying the vegetation • Controlled grazing to agreed carrying capacity implemented	Periodically after rehabilitation has been completed until mine closure

Activities	Phase	Size & scale of disturbance	Mitigation measures	Compliance with standards	Time period for implementation
Pump station & water pipeline from the Renoster River weir to the mine	Decommissioning	15 ha	• Clear infrastructure from pump station site & dismantle steel structures • Demolish & remove concrete & brick structures at pump station site • Break and remove all manholes on the pipeline and backfill to ground level	• No infrastructure remains on site • No safety hazards remain on site	As soon as decommissioning process start
	Earthworks		• Shape the areas to fill excavations and be free draining • Cover building & related footprints & disturbed areas with soil	• Excavations have been filled and area is free draining • Effective soil cover ensure the agreed land capability	After the decommissioning has been completed
	Rehabilitation		• Seed the area with a mixture of adapted, indigenous grass & tree species	• Vegetation cover similar to natural comparable surrounding environment & ensure the agreed grazing capacity	After the earthworks have been completed
Access road from the district road to the mine	Decommissioning	2 ha	• Road remain for future land users		

e) Impact management outcomes

(A description of impact management outcomes, identifying the standard of impact management required for the aspects contemplated in paragraph 1(d)(iv))

Activity	**Potential impact**	**Aspects affected**	**Phase**	**Mitigation type**	**Standard to be achieved**
(Whether listed or not, e.g. excavations, blasting, stockpiles, discard dumps or dams, loading, hauling and transport, water supply dams and boreholes, accommodation, offices, ablution, stores, storm water control, berms, workshops, processing plant, power lines, roads, pipelines, conveyors, etc.)	(E.g. dust, noise, drainage surface disturbance, fly rock, surface water contamination, groundwater contamination, air pollution etc.)		(In which impact is anticipated, e.g. construction, commissioning, operational, decommissioning, closure, post-closure.)	(Modify, remedy, control, or stop through, e.g. noise control measures, storm-water control, dust control, rehabilitation, design measures, blasting controls, avoidance, relocation, alternative activity etc. E.g.: • Modify through alternative method; • Control through noise control or through management & monitoring; • Remedy through rehabilitation.	(Impact avoided, noise levels, dust levels, rehabilitation standards, end use objectives etc.)
Relevant decommissioning activities & earthworks, as identified in table 5.	Soil compaction due to movement of vehicles & equipment used	Soil	Decommissioning & Earthworks	Remedy compaction through rehabilitation actions	• Soil compaction alleviated
Relevant rehabilitation activities, as identified in table 5.	Reversal of soil compaction due to ripping of compacted areas	Soil	Rehabilitation		
Relevant decommissioning activities & earthworks, as identified in table 5.	Soil pollution and contamination due to spillages of hydrocarbons, fertilisers & other contaminants used	Soil	Decommissioning & Earthworks	Prevent and remedy soil pollution through rehabilitation actions	• Soil pollution prevented & minimised • Hydrocarbon contaminated soil remediated *in-situ*
Relevant earthworks, as identified in table 5.	Clean-up of polluted soils due to *in-situ* remediation of hydrocarbon contaminated areas	Soil	Rehabilitation		

Activity	Potential impact	Aspects affected	Phase	Mitigation type	Standard to be achieved
Relevant decommissioning activities & earthworks, as identified in table 5.	Reduced land use potential due to soil compaction and pollution, as well as loss of topsoil due to soil erosion during decommissioning and rehabilitation activities	Land use potential	Decommissioning & Earthworks	Remedy through rehabilitation actions to replace soil cover where required, alleviate soil compaction & pollution and minimise soil loss	• Effective soil cover ensure the agreed land capability • Soil compaction alleviated & soil pollution remedied • Limited erosion that will not deteriorate to large dongas
Relevant rehabilitation and post rehabilitation management and monitoring activities, as identified in table 5.	Improved land use potential due to rehabilitation of mine residue deposits and disturbed areas, as well as reduction/ elimination of top soil losses due to reshaped land forms, water management features, improved vegetation cover & reduced surface water run-off	Land use potential	Rehabilitation & Post-rehabilitation management & monitoring	Maintain land use potential through ongoing management and monitoring	
Relevant decommissioning activities, and earthworks, as identified in table 5.	Increased surface water run-off due to vegetation clearance and soil disturbance during decommissioning and rehabilitation activities	Surface water	Decommissioning & Earthworks	Control surface water runoff volumes and remedy through earthworks & rehabilitation actions	• Water control measures contain run-off on rehabilitated FRD and does not spill more than once in 100 years • Water control measures contain run-off on other rehabilitated mine residue deposits • Gabion waterway show no signs of undercutting, excessive sedimentation or subsidence

Activity	Potential impact	Aspects affected	Phase	Mitigation type	Standard to be achieved
					• Clean runoff volumes to pans are close to original • Wetland adjacent to mining area reconnected hydraulically to the downstream pan system
Relevant earthworks, rehabilitation and post rehabilitation management and monitoring activities, as identified in table 5.	Reduced surface water run-off due to retention of potential polluted surface run-off on rehabilitated mine residue deposits, as well as rehabilitation and post rehabilitation management and monitoring activities that rehabilitate soil disturbance, improve vegetation cover, increase water infiltration & reduce surface water run-off	Surface water	Earthworks, Rehabilitation and Post-rehabilitation management & monitoring	Retain sufficient surface water on-site through rehabilitation activities and ongoing management and monitoring to sustain rehabilitation success	
Relevant decommissioning activities, earthworks and rehabilitation activities, as identified in table 5.	Increased pollutant concentrations and silt in surface water run-off due to the pollutants used, as well as increased soil disturbance, decreased vegetation cover and increased water run-off during decommissioning and rehabilitation activities	Surface water	Decommissioning, Earthworks & Rehabilitation	• Revise the water specialist studies to close the gaps and address the shortcomings identified through independent specialist reviews • Control surface water pollution and remedy through rehabilitation actions	• Water control measures capture and evaporate seepage in toe paddocks • Sediment transport limited to toe of mine residue deposits and does not reach the northern or southern pans, as well as the wetland adjacent to the mining area

Activity	Potential impact	Aspects affected	Phase	Mitigation type	Standard to be achieved
Relevant earthworks, rehabilitation and post rehabilitation management & monitoring activities, as identified in table 5.	Reduced surface water pollution due to retention of potential polluted surface run-off on rehabilitated mine residue deposits, as well as reduced silt loading due to rehabilitation activities to rehabilitate soil disturbance, improve vegetation cover, increase water infiltration & reduce surface water run-off	Surface water	Earthworks, Rehabilitation and Post-rehabilitation management & monitoring	Prevent surface water pollution through ongoing management and monitoring to sustain rehabilitation success	
Relevant earthworks, as identified in table 5.	Potential long term groundwater pollution from unrehabilitated mine residue deposits	Groundwater	Earthworks	• Revise the water specialist studies to close the gaps and address the shortcomings identified through independent specialist reviews • Control groundwater pollution & remedy through earthworks & rehabilitation, as well as post-closure pumping and treatment	• Limited ground water pollution
Relevant rehabilitation and post rehabilitation management and monitoring activities, as identified in table 5.	Reduced potential long-term groundwater pollution from rehabilitated mine residue deposits	Groundwater	Rehabilitation & post-rehabilitation management & monitoring	Prevent groundwater pollution through ongoing management and monitoring to sustain rehabilitation success	
Relevant decommissioning activities, earthworks and rehabilitation activities, as identified in table 5.	Increased generation of dust and fumes from machinery used, as well as increased soil disturbance and reduced vegetation cover during decommissioning and rehabilitation activities	Air quality	Decommissioning, Earthworks & Rehabilitation	Control dust and fumes and remedy dust through rehabilitation actions	• Limited generation of dust

Activity	Potential impact	Aspects affected	Phase	Mitigation type	Standard to be achieved
Relevant rehabilitation and post rehabilitation management and monitoring activities, as identified in table 5.	Reduced generation of dust from the rehabilitated mining area due to rehabilitation and post rehabilitation management and monitoring activities that rehabilitate soil disturbance and improve vegetation cover	Air quality	Rehabilitation and post-rehabilitation management & monitoring	Prevent dust generation through ongoing management and monitoring to sustain rehabilitation success	
Relevant decommissioning activities, earthworks & rehabilitation activities, as identified in table 5.	Noise generated by machinery used during decommissioning and rehabilitation activities	Air quality	Decommissioning, Earthworks & Rehabilitation	Control noise and eliminate through decommissioning and rehabilitation actions	• No noise after decommissioning and rehabilitation
Relevant post rehabilitation management and monitoring activities, as identified in table 5.	Elimination of noise caused by the mining activities & equipment	Air quality	Post-rehabilitation management & monitoring	Prevent noise through ongoing management and monitoring	
Relevant decommissioning activities, earthworks and rehabilitation activities, as identified in table 5.	Reduced vegetation cover and increased competition from alien weeds and invader plants, as well as indigenous encroachers that establish in disturbed areas during decommissioning and rehabilitation activities	Vegetation	Decommissioning, Earthworks & Rehabilitation	Control vegetation impacts and remedy through rehabilitation actions	• Vegetation cover similar to natural comparable surrounding environment & ensure the agreed grazing capacity • Vegetation species composition reflects increased wetland species • No alien tree & weed invasion in the pans • No weed or indigenous encroacher invasion in rehabilitated areas to the extent that it outcompetes the grass & tree species

Activity	Potential impact	Aspects affected	Phase	Mitigation type	Standard to be achieved
					• Firebreaks maintained to prevent veld fires from destroying the vegetation • Controlled grazing to agreed carrying capacity implemented
Relevant rehabilitation and post rehabilitation management and monitoring activities, as identified in table 5.	Improvement of natural vegetation due to rehabilitation and post rehabilitation management and monitoring activities that establish and maintain a vegetation cover similar to the natural comparable surrounding environment & control weed and invader plant invasions so that it will not outcompete the indigenous grass & tree species	Vegetation	Rehabilitation and	Remedy vegetation impacts through rehabilitation actions	
			Post-rehabilitation management & monitoring	Maintain natural vegetation through ongoing management and monitoring to sustain rehabilitation success	
Relevant decommissioning activities, earthworks and rehabilitation activities, as identified in table 5.	Displacement of wildlife due to habitat destruction and transformation, restriction of wildlife movement, as well as potential snaring, hunting and killing of wildlife due to decommissioning and rehabilitation activities	Animal life	Decommissioning, Earthworks & Rehabilitation	Control wildlife disturbance and remedy through rehabilitation actions	• Wildlife returned to rehabilitated areas • Increase in wetland faunal species
Relevant decommissioning activities, earthworks and rehabilitation activities, as identified in table 5.	Wildlife injury and death caused by sliding/falling down the steep unrehabilitated slopes of the mine	Animal life	Decommissioning, Earthworks, Rehabilitation & Post-rehabilitation	Restrict wildlife access to the open pit	• Wildlife access deterred with security fence, as well as trench & enviroberm around the

Activity	Potential impact	Aspects affected	Phase	Mitigation type	Standard to be achieved
	residue deposits and open pit, as well as drowning in the pit lake		management & monitoring		pit, outside the security fence • Trench and enviroberm functional and stable
Relevant rehabilitation and post rehabilitation management and monitoring activities, as identified in table 5.	Return of wildlife to new habitats in the rehabilitated areas created through the rehabilitation activities, as well as improved wildlife habitats due to the control of weeds & invader plants	Animal life	Rehabilitation	Promote the return of wildlife through rehabilitation activities	
			Post-rehabilitation management & monitoring	Prevent wildlife disturbance through ongoing management & monitoring activities to sustain rehabilitation success	
Relevant rehabilitation activities, as identified in table 5.	Disruption and destruction of ecosystem services due to rehabilitation activities	Ecosystem services	Earthworks	Prevent and minimise disruption and destruction of ecosystem services	• Ecosystem services resumed & improved
Relevant rehabilitation and post rehabilitation management and monitoring activities, as identified in table 5.	Resumption and improvement of ecosystem services, improved water run-off volume and quality to the wetland and pans, as well as improved ecosystem integrity and functioning due to rehabilitation and post rehabilitation management and monitoring activities	Ecosystem services	Rehabilitation and	Resume & improve ecosystem services through rehabilitation activities	
			Post-rehabilitation management & monitoring	Prevent disruption & destruction of ecosystem services through ongoing management & monitoring to sustain rehabilitation success	
Relevant decommissioning activities, earthworks, rehabilitation & post rehabilitation management and monitoring activities, as identified in table 5.	Visual impacts caused by the demolishing and removal of buildings and structures, as well as earthworks during decommissioning and rehabilitation activities	Visual impact	Decommissioning, Earthworks, Rehabilitation & Post-rehabilitation management & monitoring	Reduce visual impact of decommissioning and rehabilitation of facilities & infrastructure	• Visual impacts of mining activities reduced to an acceptable level

Activity	Potential impact	Aspects affected	Phase	Mitigation type	Standard to be achieved
Relevant decommissioning activities, earthworks, rehabilitation & post rehabilitation management and monitoring activities, as identified in table 5.	Reduction of visual impact of mining activities due to the rehabilitation and post rehabilitation management and monitoring of the mine residue deposits and mining area	Visual impact	Decommissioning, Earthworks, Rehabilitation & Post-rehabilitation management & monitoring	Decommissioning and rehabilitation of facilities & infrastructure	
Relevant decommissioning activities, as identified in table 5.	Social impacts due to increased risk of human injury and death caused by sliding/falling down the steep unrehabilitated slopes of the mine residue deposits and open pit, as well as drowning in the pit lake	Social and socio-economic aspects	Decommissioning, Earthworks, Rehabilitation & Post-rehabilitation management & monitoring	• Control through pit access control measures • Ensure the health and safety of all stakeholders as part of the final Mine Closure Plan	• Human access to pen pit deterred with waste rock barriers on the access ramps & security fence around the pit perimeter, with trench & enviroberm around the pit, outside the security fence • Trench and enviroberm functional and stable
Relevant decommissioning activities, as identified in table 5.	Negative social & socio-economic impacts due to further job losses, reduced economic activity, loss of support for mine (CSI & LED) beneficiaries, as well as reduced levels of security and emergency response capacity during the decommissioning and rehabilitation activities	Social and socio-economic aspects	Decommissioning	Control and remedy through social impact management measures • Retrenchment, redeployment & reskilling processes adequately communicated and executed • Minimal negative impacts on the lives of individuals & local communities • Minimal adverse impacts on rights to an adequate standard of living, education, health, etc. • Minimal adverse impacts on local suppliers & service providers • Minimal impacts on CSI/LED & SMME beneficiaries	• Minimal adverse impacts on social fabric and socio-economic conditions as far as reasonably practicable

Activity	Potential impact	Aspects affected	Phase	Mitigation type	Standard to be achieved
				• No unauthorised entry to mine premises and the illegal occupation of mine land, including for illegal mining • Minimal risks of injury & fatalities due to increased road traffic associated with decommissioning	
Relevant earthworks, rehabilitation and post rehabilitation management and monitoring activities, as identified in table 5.	Positive social and socio-economic impacts through the creation of temporary employment opportunities, as well as economic benefits during decommissioning and rehabilitation	Social and socio-economic aspects	Earthworks, Rehabilitation & Post-rehabilitation management & monitoring	Create temporary employment opportunities, as well as economic benefits during decommissioning and rehabilitation	•

f) Impact management actions

(A description of impact management actions, identifying the manner in which the impact management outcomes contemplated in paragraph (e) will be achieved)

Activity	Potential impact	Mitigation type	Implementation time period	Compliance with standards
(Whether listed or not listed, e.g. excavations, blasting, stockpiles, discard dumps or dams, loading, hauling and transport, water supply dams and boreholes, accommodation, offices, ablution, stores, workshops, processing plant, storm water control, berms, roads, pipelines, power lines, conveyors, etc.)	(E.g. dust, noise, drainage surface disturbance, fly rock, surface water contamination, groundwater contamination, air pollution etc.)	(Modify, remedy, control, or stop through, e.g. controlling noise, storm-water & dust, rehabilitation, design measures, avoidance, relocation, etc.) E.g. modify through alternative methods; Implement noise control; control through management and monitoring; or remedy through rehabilitation.	(Describe the time period when the measures in the EMPr must be implemented. Rehabilitation must take place at the earliest opportunity. Therefore state upon cessation of the individual activity, or upon the cessation of mining, bulk sampling or alluvial diamond prospecting, etc.	(A description of how each of the recommendations in 2.11.6 read with 2.12 and 2.15.2 herein will comply with any prescribed environmental management standards or practices that have been identified by Competent Authorities.)
Clear infrastructure from site & dismantle steel structures Demolish & remove structures, walkways & paved areas Remove culvert structures from roads & decommission trenches Remove salvageable equipment & material and mobile buildings Dispose of inert concrete & building rubble in crusher void Shape the area to fill excavations and be free draining Construct waste rock barriers at top of open pit access ramps Erect security fence around open pit outside of indicated ZOR Construct trench & enviroberm around pit outside security fence Reshape steep slopes of WRD, CRD & FRD Cover roads, plant & building footprints & disturbed areas with soil Cover slopes & top areas of MRDs with cover material and soil	Soil compaction due to movement of vehicles & equipment used	• Remedy through rehabilitation actions	• Commence decommissioning as soon as possible after receiving the authorisation, followed by earthworks and rehabilitation, once decommissioning and earthworks have been completed. • Undertake post rehabilitation management and monitoring activities periodically after rehabilitation until mine closure	• Soil compaction alleviated

Activity	Potential impact	Mitigation type	Implementation time period	Compliance with standards
Confirm final alignment & construct water control berms/drains				
Construct crest berm walls & paddocks on MRD facilities				
Construct toe paddocks at seepage points around MRD facilities				
Reinstate surface drainage lines & catchment areas to pans				
Rip roads, plant & building footprint areas to alleviate compaction				
Rip top areas & slopes of MRDs to alleviate compaction				
Clear infrastructure from site & dismantle steel structures Demolish & remove structures, walkways & paved areas Erect security fence around open pit outside of indicated ZOR Construct trench & enviroberm around pit outside security fence Shape the area to fill excavations and be free draining Reshape steep slopes of WRD, CRD & FRD Cover roads, plant & building footprints & disturbed areas with soil Cover slopes & top areas of MRDs with cover material and soil Confirm final alignment & construct water control berms/drains Conduct bio-remediation of hydro carbon contaminated areas Ameliorate growth medium, based on analysis thereof Seed rehabilitated areas Apply follow-up fertiliser where specified Control weeds & invader plants	Soil pollution and contamination due to spillages of hydrocarbons, fertilisers & other contaminants used	• Prevent and minimise through controlling decommissioning & rehabilitation activities • Remedy during rehabilitation	• Commence decommissioning as soon as possible after receiving the authorisation, followed by earthworks and rehabilitation, once decommissioning and earthworks have been completed. • Undertake post rehabilitation management and monitoring activities periodically after rehabilitation until mine closure	• Soil pollution prevented & minimised • Hydrocarbon contaminated soil remediated *in-situ*

Activity	Potential impact	Mitigation type	Implementation time period	Compliance with standards
Maintain & manage all rehabilitated areas				
All activities causing soil compaction, soil pollution and soil loss indicated above & below Ameliorate growth medium, based on analysis thereof Seed rehabilitated areas with indigenous grass and tree seeds Apply follow-up fertiliser on rehabilitated areas where specified Control alien weeds & invader and indigenous encroacher plants Fence rehabilitated areas to control grazing & protect rehabilitation Stimulate vegetation on rehabilitated areas by grazing Create and maintain firebreaks to prevent & control veld fires Maintain & manage all rehabilitated areas	Reduced land use potential due to soil compaction and pollution, as well as loss of topsoil due to soil erosion	• Remedy through rehabilitation actions to replace soil cover where required, alleviate soil compaction & pollution and minimise soil loss	• Commence decommissioning as soon as possible after receiving the authorisation, followed by earthworks and rehabilitation, once decommissioning and earthworks have been completed. • Undertake post rehabilitation management and monitoring activities periodically after rehabilitation until mine closure	• Effective soil cover ensure the agreed land capability • Soil compaction alleviated & soil pollution remedied • Limited erosion that will not deteriorate to large dongas
Reshape steep slopes of WRD, CRD & FRD Cover roads, plant & building footprints & disturbed areas with soil Cover slopes & top areas of MRDs with cover material and soil Fill hollows to make all areas, except the pans, free draining & aligned with natural drainage patterns	Increased surface water run-off due to vegetation clearance and soil disturbance	• Prevent and minimise through restricting soil disturbance & vegetation clearance • Implement storm water control measures	• Commence decommissioning as soon as possible after receiving the authorisation, followed by earthworks and rehabilitation, once decommissioning and	• Water control measures contain run-off on rehabilitated FRD and does not spill more than once in 100 years • Water control measures contain run-off on other

<table>
<tr><th>Activity</th><th>Potential impact</th><th>Mitigation type</th><th>Implementation time period</th><th>Compliance with standards</th></tr>
<tr><td>Construct crest berm walls & paddocks on MRD facilities</td><td rowspan="5"></td><td rowspan="5">• Remedy during rehabilitation</td><td rowspan="5">earthworks have been completed.
• Undertake post rehabilitation management and monitoring activities periodically after rehabilitation until mine closure</td><td rowspan="5">rehabilitated mine residue deposits
• Gabion waterway show no signs of undercutting, excessive sedimentation or subsidence
• Clean runoff volumes to pans are close to original
• Wetland adjacent to mining area reconnected hydraulically to the downstream pan system</td></tr>
<tr><td>Confirm final alignment & construct water control berms/drains</td></tr>
<tr><td>Construct toe paddocks at seepage points around MRD facilities</td></tr>
<tr><td>Reinstate surface drainage lines & catchment areas to pans</td></tr>
<tr><td>Maintain & manage all rehabilitated areas</td></tr>
<tr><td>All activities causing soil compaction & pollution indicated above</td><td rowspan="11">Increased pollutant concentrations and silt in surface water run-off due to the pollutants used, as well as increased soil disturbance, decreased vegetation cover and increased water run-off</td><td rowspan="11">• Prevent and minimise through restricting vegetation clearance & soil disturbance
• Implement storm water control measures
• Remedy during rehabilitation</td><td rowspan="11">• Commence decommissioning as soon as possible after receiving the authorisation, followed by earthworks and rehabilitation, once decommissioning and earthworks have been completed.
• Undertake post rehabilitation management and monitoring activities periodically after rehabilitation until mine closure</td><td rowspan="11">• Water control measures capture and evaporate seepage in toe paddocks
• Sediment transport limited to toe of mine residue deposits and does not reach the northern or southern pans, as well as the wetland adjacent to the mining area</td></tr>
<tr><td>Construct crest berm walls & paddocks on MRD facilities</td></tr>
<tr><td>Confirm final alignment & construct water control berms/drains</td></tr>
<tr><td>Construct toe paddocks at seepage points around MRD facilities</td></tr>
<tr><td>Ameliorate growth medium, based on analysis thereof</td></tr>
<tr><td>Seed rehabilitated areas with indigenous grass and tree seeds</td></tr>
<tr><td>Apply follow-up fertiliser where specified</td></tr>
<tr><td>Control alien weeds & invader and indigenous encroacher plants</td></tr>
<tr><td>Stimulate vegetation on rehabilitated areas by grazing</td></tr>
<tr><td>Create and maintain firebreaks to prevent & control veld fires</td></tr>
<tr><td>Maintain & manage all rehabilitated areas</td></tr>
</table>

Activity	Potential impact	Mitigation type	Implementation time period	Compliance with standards
Disposal of mine residues in mine residue deposits on surface All activities to shape, cover & rehabilitate mine residue deposits Maintain & manage all rehabilitated areas	Potential long term groundwater pollution from unrehabilitated mine residue deposits	Control groundwater pollution & remedy through earthworks & rehabilitation, as well as post-closure pumping and treatment	• Commence decommissioning as soon as possible after receiving the authorisation, followed by earthworks and rehabilitation. • Undertake post rehabilitation management and monitoring activities periodically after rehabilitation until mine closure	• Limited ground water pollution
All activities causing soil compaction & pollution indicated above Ameliorate growth medium, based on analysis thereof Seed rehabilitated areas with indigenous grass & tree seeds Apply follow-up fertiliser where specified Stimulate vegetation on rehabilitated areas by grazing Create and maintain firebreaks to prevent & control veld fires Maintain & manage all rehabilitated areas	Increased generation of dust and fumes from machinery used, as well as increased soil disturbance and reduced vegetation cover	• Prevent and minimise during decommissioning and rehabilitation • Remedy dust generation through rehabilitation actions	• Commence decommissioning as soon as possible after receiving the authorisation, followed by earthworks and rehabilitation. • Undertake post rehabilitation management and monitoring activities periodically after rehabilitation until mine closure	• Limited generation of dust
All activities causing soil compaction & pollution indicated above Ameliorate growth medium, based on analysis thereof Seed rehabilitated areas with indigenous grass & tree seeds Apply follow-up fertiliser where specified Create and maintain firebreaks to prevent & control veld fires Maintain & manage all rehabilitated areas	Noise generated by machinery used	• Prevent and minimise by restricting working hours • Eliminate through decommissioning and rehabilitation actions • Prevent future noise through ongoing management and monitoring	• Commence decommissioning as soon as possible after receiving the authorisation, followed by earthworks and rehabilitation. • Undertake post rehabilitation management and monitoring activities periodically after rehabilitation until mine closure	• No noise after decommissioning and rehabilitation

Activity	Potential impact	Mitigation type	Implementation time period	Compliance with standards
All activities causing soil compaction & pollution indicated above Ameliorate growth medium, based on analysis thereof Seed rehabilitated areas with indigenous grass & tree seeds Apply follow-up fertiliser where specified Control alien weeds & invader and indigenous encroacher plants Stimulate vegetation on rehabilitated areas by grazing Create and maintain firebreaks to prevent & control veld fires Maintain & manage all rehabilitated areas	Reduced vegetation cover and increased competition from weeds and invader plants that establish in disturbed areas	• Prevent and minimise during decommissioning and rehabilitation by restricting vegetation clearance & implementing invader plant control measures • Remedy through rehabilitation actions	• Commence decommissioning as soon as possible after receiving the authorisation, followed by earthworks and rehabilitation, once decommissioning and earthworks have been completed. • Undertake post rehabilitation management and monitoring activities periodically after rehabilitation until mine closure	• Vegetation cover similar to surrounding natural environment • Improved vegetation species composition in wetlands • No tree & weed invasions in pans • Tree & weed invasions controlled so that it does not outcompete the natural grass & tree species • Firebreaks maintained to prevent & control veld fires from destroying the vegetation • Controlled grazing to agreed carrying capacity implemented
All activities causing soil compaction and pollution Construct security fence around pit, outside of indicated ZOR Construct trench & enviroberm around pit outside Ameliorate growth medium, based on analysis thereof Seed rehabilitated areas with indigenous grass & tree seeds Apply follow-up fertiliser where specified Fence the rehabilitated area to control grazing & protect rehabilitation works	• Wildlife displacement due to habitat destruction & transformation, restriction of wildlife movement, and snaring, hunting & killing • Wildlife injury and death	• Prevent and minimise during decommissioning and rehabilitation activities • Remedy through rehabilitation & management actions that recreate and maintain suitable habitats	• Commence decommissioning as soon as possible after receiving the authorisation, followed by earthworks and rehabilitation, once decommissioning and earthworks have been completed. • Undertake post rehabilitation management and monitoring activities periodically after	• Wildlife returned to rehabilitated areas • Increase in wetland faunal species • Wildlife access deterred with security fence, as well as trench & enviroberm around the pit, outside the security fence • Trench and enviroberm functional and stable

Activity	Potential impact	Mitigation type	Implementation time period	Compliance with standards
Control alien weeds & invader and indigenous encroacher plants	caused by sliding/falling down the steep slopes of the mine residue deposits & pit, as well as drowning in the pit lake		rehabilitation until mine closure	
Stimulate vegetation on rehabilitated areas by grazing				
Create and maintain firebreaks to prevent & control veld fires				
Maintain & manage all rehabilitated areas				
All earthworks causing soil compaction, soil pollution and destruction of ecosystem services indicated above	Disruption or destruction of ecosystem services	• Prevent and minimise during decommissioning & rehabilitation • Resume & improve ecosystem services through rehabilitation • Protect rehabilitated ecosystems through ongoing management & monitoring	• Commence decommissioning as soon as possible after receiving the authorisation, followed by earthworks and rehabilitation. • Undertake post rehabilitation management and monitoring activities periodically after rehabilitation until mine closure	• Ecosystem services resumed & improved
All decommissioning activities causing soil compaction & pollution indicated above	Visual impact caused by the clearance of vegetation, as well as construction of ancillary buildings and structures	• Remedy during decommissioning and rehabilitation	• Commence decommissioning as soon as possible after receiving the authorisation, followed by earthworks and rehabilitation. • Undertake post rehabilitation management and monitoring activities periodically after rehabilitation until mine closure	• Visual impacts of mining activities reduced to an acceptable level
All earthworks causing soil compaction and soil pollution indicated above				

Activity	Potential impact	Mitigation type	Implementation time period	Compliance with standards
All decommissioning activities causing soil compaction & pollution indicated above	Social impacts due to human injury and death caused by sliding/falling down the steep slopes of the mine residue deposits & pit, as well as drowning in the pit lake	• Control through pit access control measures	• Commence decommissioning as soon as possible after receiving the authorisation, followed by earthworks and rehabilitation. • Undertake post rehabilitation management and monitoring activities periodically after rehabilitation until mine closure	• Human access to pen pit deterred with waste rock barriers on the access ramps & security fence around the pit perimeter, with trench & enviroberm around the pit, outside the security fence • Trench and enviroberm functional and stable
Construct waste rock barriers / berms at top of remaining pit access ramps				
Erect security fence around open pit outside of indicated ZOR				
Construct trench and enviroberm around open pit outside of security fence				
All decommissioning & rehabilitation activities that result in further job losses, reduced economic activity loss of support for mine beneficiaries (CSI & LED), as well as reduced levels of security and emergency response capacity	Negative social & socio-economic impacts due to further job losses, reduced economic activity, loss of support for mine beneficiaries, as well as reduced levels of security and emergency response capacity	Control and remedy through social impact management measures • Communicate & execute retrenchment, redeployment & reskilling processes in line with SLP commitments • Develop & implement a post retrenchment plan to support employees with the potential impacts on their wellbeing and quality of life post mining • Maintain proportion of procurement from local enterprises & reduce over time as the needs for goods & services decreases	• Implement social impact management measures related to employment, procurement & social support prior to decommissioning & sustain these until mine closure. • Commence decommissioning as soon as possible after receiving the authorisation, followed by earthworks and rehabilitation, once decommissioning and earthworks have been completed. • Undertake post rehabilitation management and monitoring activities periodically after rehabilitation until mine closure	• Minimal adverse impacts on social fabric and socio-economic conditions, as far as reasonably practicable

Activity	Potential impact	Mitigation type	Implementation time period	Compliance with standards
		• Support suppliers & service providers to find opportunities outside the Mine • Assess the financial sustainability of SMMEs that are funded & supported, develop & implement action plans to support those that require further support • Assess impact on CSI/LED beneficiaries, inform them of the Final Mine Closure Plan and develop an exit strategy framework for CSI and LED interventions		
All decommissioning & rehabilitation activities that result in further job losses, reduced economic activity loss of support for mine beneficiaries (CSI & LED), as well as reduced levels of security and emergency response capacity	Negative social & socio-economic impacts due to further job losses, reduced economic activity, loss of support for mine beneficiaries, as well as reduced levels of security and emergency response capacity	• Develop & implement a security plan for decommissioning & rehabilitation and communicate this to neighbouring landowners and stakeholders. • Develop a traffic management plan for decommissioning & implement in collaboration with community	• Implement social impact management measures related to employment, procurement & social support prior to decommissioning & sustain these until mine closure. • Commence decommissioning as soon as possible after receiving the authorisation, followed by earthworks and rehabilitation, once decommissioning and	• Minimal adverse impacts on social fabric and socio-economic conditions, as far as reasonably practicable

Activity	Potential impact	Mitigation type	Implementation time period	Compliance with standards
		stakeholders & law enforcement agencies.	earthworks have been completed. • Undertake post rehabilitation management and monitoring activities periodically after rehabilitation until mine closure	
All decommissioning activities, earthworks, rehabilitation activities and post rehabilitation management and monitoring activities that result in creation of temporary jobs & modified economic activity	Positive social impacts due to job creation etc.	• Create temporary employment opportunities, as well as economic benefits during decommissioning and rehabilitation	• Commence decommissioning as soon as possible after receiving the authorisation, followed by earthworks and rehabilitation. • Undertake post rehabilitation management and monitoring activities periodically after rehabilitation until mine closure	• Optimal positive impacts on social fabric and socio-economic conditions

g) *Financial provision*

1) *Determination of the amount of financial provision*

a) *Describe the closure objectives and the extent to which they have been aligned to the baseline environment described under the Regulation*

The closure vision for Voorspoed Mine is to close the mine in line with the relevant legal requirements, in such a way that the mining area can be utilised in a sustainable manner after closure.

The overarching closure objective is to ensure sustainability beyond mine closure and leaving a positive legacy. This is supported by the following specific objectives:

- Restore as much as possible of the mining area to a condition consistent with the pre-determined post closure land use objectives;
- Ensure that the area is left in a condition that poses an acceptable level of risk to public health and safety; and
- Reduce the need for post closure intervention, either in the form of monitoring or on-going remedial work, as far as is practicably possible.

The Voorspoed Mine Rehabilitation Plan 2019 (Appendix 12) that was developed supports the Voorspoed Mine Final Closure Plan (Appendix 11) and provides details of the actions that will be taken to rehabilitate the footprint of the Voorspoed Mine to a sustainable state, in order to mitigate environmental risks and achieve the predetermined end land use.

The end land use for Voorspoed Mine is to reinstate most of the rehabilitated footprint area back to agricultural land. The aim is to achieve a sustainable land use, comply with the closure vision and match the rehabilitated footprint with the surrounding area as far as reasonably practical.

b) *Confirm specifically that the environmental objectives in relation to closure have been consulted with the landowner and interested and affected parties*

The environmental objectives in relation to closure have been consulted with the landowner and interested and affected parties, through the provision of the Background Information Document, as well as the draft Basic Assessment Report and Environmental Management Programme that was made available to all of the above parties for review and feedback. The environmental objectives in relation to closure was also discussed with interested and affected parties at the public meetings held, as well as during meetings with authorities that regulate aspects of the environment.

c) Provide a rehabilitation plan that describes and shows the scale and aerial extent of the main mining activities, including the anticipated mining area at the time of closure

The final Rehabilitation Plan that supports the final Closure Plan is attached as Appendix 12. The plan describes and shows the scale and aerial extent of the main decommissioning activities at the time of closure.

d) Explain why it can be confirmed that the rehabilitation plan is compatible with the closure objectives

The closure objectives and End Land Use Plan (Appendix 15) are aligned to the baseline environment and the land use in the areas around the mining area. The final Rehabilitation Plan 2019 supports the final Closure Plan and will facilitate the implementation of the closure objectives

The decommissioning and rehabilitation activities will have minimal permanent impacts on the baseline environment, except for the open mine pit and the top of the rehabilitated Fine Residue Deposit, which will remain as areas where access will be restricted, as well as the other rehabilitated Mine Residue Deposits that will be utilised periodically through controlled grazing.

e) Calculate and state the quantum of the financial provision required to manage and rehabilitate the environment in accordance with the applicable guideline

If the preferred decommissioning option is approved, an amount of R 183 233 689 would be required as financial provision to execute the decommissioning and rehabilitation measures indicated in the final Voorspoed Mine Closure Plan (Appendix 11) and associated 2019 Voorspoed Mine Rehabilitation Plan 2019 (Appendix 12). This includes the cost to implement the environmental management, maintenance and monitoring programmes for a period of 10 years post rehabilitation, as indicated in the final Closure Plan.

Furthermore, approximately R150 million would be required to implement the mine closure commitments in the Voorspoed Mine Social and Labour Plan.

f) Confirm that the financial provision will be provided as determined

The decommissioning and closure costs, in terms of the Voorspoed Mine Final Closure Plan and the associated Rehabilitation Plan 2019, is provided for in terms of the Voorspoed Mine financial provision for rehabilitation and closure. Some aspects of the total financial provision for decommissioning and mine closure are provided for in terms of the Social and Labour Plan.

h) Mechanisms for monitoring compliance with and performance assessment against the Environmental Management Programme and reporting thereon, including:

(i) Monitoring of impact management actions;

(ii) Monitoring and reporting frequency;

(iii) Responsible persons;

(iv) Time period for implementing impact management actions; and

(v) Mechanism for monitoring compliance

The following environmental aspects need to be monitored:

- Surface and ground water pollution
- Vegetation impacts
- Soil erosion impacts

A post rehabilitation (and closure) monitoring that addresses the monitoring objectives, scope and frequency is included in the Final Closure Plan and provided below. Where the monitoring frequency has not been specified in specialist reports, specialists contracted to conduct monitoring surveys and analysis should revise and recommend a detailed monitoring plan and frequency, based on results and risk presented by the monitoring data.

Source activity	Impacts requiring monitoring programmes	Functional requirements for monitoring	Roles and responsibilities (for the execution of the monitoring programmes)	Monitoring and reporting frequency
Mine residue deposits, earthworks, rehabilitation & post rehabilitation management activities	Groundwater quality	Monitoring objectives: • Evaluate groundwater pollution levels • Assess compliance with legal conditions, standards & other requirements • Ensure groundwater is fit for current & future land uses, consistent with specified environmental outcomes & standards, i.e. a post closure land use with no long-term liabilities • Evaluate the chemical stability of the MRD facilities to ensure that environmental risks can be controlled by the remediation measures • Refine closure strategies and determine remediation methods, if required	Rehabilitation manager	Monitoring frequency: • Quarterly during the decommissioning-closure phase • Biannually in the post-closure phase
		Monitoring scope: • Water level & water quality from 18 boreholes (13 on the mining area & 5 around the mining are) Physic-chemical parameters (pH, conductivity, Total Dissolved Solids, Total Alkalinity) • Major cations (Ca, Mg, Na, and K) • Major anions (Cl^-, F^-, $SO4^{2-}$ & NO_X) • Metals & trace metals (Fe, Cr, Se, Pb, Mn, Al, Zn • Others determined by ICP-OES • Less parameters in the post-closure phase		Reporting frequency: • Annually

Source activity	Impacts requiring monitoring programmes	Functional requirements for monitoring	Roles and responsibilities (for the execution of the monitoring programmes)	Monitoring and reporting frequency
Mine residue deposits, earthworks, rehabilitation & post rehabilitation activities	Groundwater quality	Initiate a programme to generate hydrological data that will be used as a baseline dataset for future planning and to confirm the numerical modelling and predictions modelled during the mine closure study.	Rehabilitation manager	
		Upgrade the groundwater transport contamination model every 5 years, using the latest monitoring data.		Every 5 years
Mine residue deposits, decommissioning, rehabilitation & post rehabilitation management activities	Surface water control	Monitoring objectives: • Evaluate surface water pollution levels • Assess compliance with legal conditions, standards & other requirements • Ensure surface water is fit for current & future land uses, consistent with specified environmental outcomes & standards, i.e. a post closure land use with no long-term liabilities • Evaluate the chemical stability of the MRD facilities to ensure that environmental risks can be controlled by the remediation measures • Refine closure strategies and determine remediation methods, if required	Rehabilitation manager	Monitoring frequency: • Quarterly during the decommissioning-closure phase • Biannually in the post-closure phase
		Monitoring scope: • Surface water quality from 3 surface water monitoring sites		Reporting frequency: • Annually

Source activity	Impacts requiring monitoring programmes	Functional requirements for monitoring	Roles and responsibilities (for the execution of the monitoring programmes)	Monitoring and reporting frequency
		• Physic-chemical parameters (pH, conductivity, Total Dissolved Solids, Total Alkalinity) • Major cations (Ca, Mg, Na, and K) • Major anions (Cl^-, F^-, $SO4^{2-}$ & NO_X) • Metals & trace metals (Fe, Cr, Se, Pb, Mn, Al, Zn • Others determined by ICP-OES • Less parameters in the post-closure phase		
Mine residue deposits, decommissioning, rehabilitation & post rehabilitation management activities	Surface water control	Monitoring objectives: • Evaluate the structural & ecological stability of the landforms • Evaluate the success of control measures to protect the slopes against erosion	Rehabilitation manager	Monitoring frequency: • Annual monitoring for a 5 year period
		Monitoring scope: • Monitor stability of water control structures for long-term stability, e.g. scouring especially after intense rain events and increased erosion • Monitor & inspect sediment control structures & identify reduced capacities due to sedimentation • Monitor condition of low lying areas constructed on the top of dumps & other flat areas • Identify unwanted concentration of runoff over large areas		Reporting frequency: • Annually

Source activity	Impacts requiring monitoring programmes	Functional requirements for monitoring	Roles and responsibilities (for the execution of the monitoring programmes)	Monitoring and reporting frequency
Earthworks, rehabilitation & post rehabilitation management activities	Rehabilitation/revegetation success	Monitoring objectives: • Evaluate the success of restoring as much as possible of the mining area to a condition consistent with the pre-determined post closure land use & to a final, sustainable end land-use • Assess compliance with legal conditions, standards & other requirements • Evaluate the success of the vegetation to protect the slopes against erosion • Evaluate the achievement of a post closure land use with no long-term liabilities	Rehabilitation manager	Monitoring frequency: • Bi-annual monitoring for a 5 year period
		Monitoring scope: • Monitor vegetation on rehabilitated areas in terms of species diversity, plant density, vegetation structure, species abundance, vegetation cover & dormancy • Monitor soil coverage of vegetation • Monitor extent and severity of erosion • Identify footpath creation during utilisation of area		Reporting frequency: • Annually

Source activity	Impacts requiring monitoring programmes	Functional requirements for monitoring	Roles and responsibilities (for the execution of the monitoring programmes)	Monitoring and reporting frequency
Earthworks, rehabilitation & post rehabilitation management activities	Aquatic ecology	Monitoring objectives: • Assess compliance with legal conditions, standards & other requirements • Evaluate the achievement of a post closure land use with no long-term liabilities	Rehabilitation manager	Monitoring frequency: • Bi-annual monitoring for a 5 year period
		Monitoring scope: • Conduct aquatic biodiversity studies within the pans & wetland adjacent to the mining area to assess the wetland vegetation and animal life		Reporting frequency: • Annually
Earthworks, rehabilitation & post rehabilitation management activities	Alien invasive plant control success	Monitoring objectives: • Assess compliance with legal conditions, standards & other requirements • Evaluate the achievement of a post closure land use with no long-term liabilities	Rehabilitation manager	Monitoring frequency: • Annual monitoring for a 5 year period
		Monitoring scope: • Extent of alien plant invasions across Voorspoed site • Effectiveness of eradication programme • Determination of priority areas		Reporting frequency: • Annually

Source activity	Impacts requiring monitoring programmes	Functional requirements for monitoring	Roles and responsibilities (for the execution of the monitoring programmes)	Monitoring and reporting frequency
Earthworks, rehabilitation & post rehabilitation management activities	Air quality	Monitoring objectives: • Evaluate the success of measures to control dust • Assess compliance with legal conditions, standards & other requirements • Evaluate the achievement of a post closure land use with no long-term liabilities	Rehabilitation manager	Monitoring frequency: • Bi-annual monitoring for a 5 year period
		Monitoring scope: • Continuation of exiting dust monitoring programme to monitor & measure fall-out dust • Existing monitoring programme to be modified as determined by the specialist		Reporting frequency: • Annually
Unstable geology	Open pit stability	Monitoring objectives: • Assess compliance with legal conditions, standards & other requirements • Evaluate the achievement of a post closure land use with no long-term liabilities, i.e. long-term stability of the pit access control measures	Mine closure manager	Monitoring frequency: • Bi-annual monitoring for a 5 year period
		Monitoring scope: • Monitor the open pit ZoR		Reporting frequency: • Annually

Annual monitoring reports will be compiled per topic, indicating the trends of the monitoring results according to the mentioned outcomes and standards and as a minimum include the following topics:

- Introduction with reasons for the report, linked to conditions of approval
- Results of the monitoring programme, with analysis and interpretation of the data, with reference to the outcomes and standards included in the EMPr
- Proposed remedial actions and action plan
- Review of the suitability, adequacy, and effectiveness of the monitoring programme
- Conclusions

EMPr audits, compliant with Regulation 34 of the EIA regulations, published in GN R 982 in terms of the National Environmental Management Act, 2002 (Act No. 107 of 1998) will be conducted by an independent person with the relevant environmental auditing expertise until closure.

The environmental audit report will determine the following:

- the ability of the EMPr, and where applicable the closure plan,
    - to sufficiently provide for the avoidance, management and mitigation of environmental impacts associated with the undertaking of the activity on an ongoing basis
    - to sufficiently provide for the avoidance, management and mitigation of environmental impacts associated with the closure of the facility;
- the level of compliance with the provisions of environmental authorisation, EMPr and where applicable the closure plan

An EMPr and Closure Plan Audit Report will be submitted to the DMR on an annual base. Where the findings of the environmental audit report indicate insufficient mitigation of environmental impacts associated with the undertaking of the activity; or insufficient levels of compliance with the environmental authorisation or EMPr and the closure plan, the applicant will submit recommendations to amend the EMPr or closure plan in order to rectify the shortcomings identified in the environmental audit report, when submitting the environmental audit report to the competent authority, Such recommendations will have been subjected to a public participation process.

Within 7 days of the date of submission of an environmental audit report to DMR, all potential and registered interested and affected parties will be notified of the submission of the report. The report will also be made available to all interested and affected parties on request

i) Indicate the frequency of the submission of the performance assessment / environmental audit report

EMPr and Closure Plan audit reports will be submitted to the DMR annually until mine closure.

j) Environmental awareness plan

1) Manner in which the applicant intends to inform his or her employees of any environmental risk which may result from their work

All contractors and persons that will be involved in the decommissioning and rehabilitation activities will receive basic environmental awareness training, either as induction training or later at a special training session. Different levels of responsibility in relation to worker's potential impact on the environment will be addressed in the training session.

Appropriate training relevant to the implementation of the environmental management programme, as well as the final Closure Plan and associated Rehabilitation Plan 2019 will also be provided to all contractors and persons that will be involved in the decommissioning and rehabilitation activities. Contractors will be required to provide evidence that they have the requisite knowledge and skills to perform the work in an "environmentally responsible manner".

Issues to be considered during training:

- use of chemical toilets
- handling of industrial and domestic waste
- responsible use of water
- responsible handling of topsoil
- prevention of oil/diesel spillages
- prevention of veld fires
- surface run-off control
- rehabilitation

2) Manner in which risks will be dealt with in order to avoid pollution or the degradation of the environment

The following operational procedures will be implemented to avoid environmental pollution or degradation:

Spillage of oil, diesel and other pollutants by vehicles, rehabilitation staff, etc.

- Spillages must be contained at all cost through the best practicable option (bund earth walls). Where necessary, spillages will be remediated *in situ*.
- Leakage from the vehicle, tanker etc, that caused the spillage must be stopped and the vehicle removed to the the laydown area for repairs.
- The Rehabilitation Manager and Contractors are responsible for ensuring that the above actions are implemented.

Fires

- All fires in the veld, buildings, diesel tanks etc. must be prevented where practivcally possible, or extinguished to prevent it from spreading to any other piece of land, building, etc.
- Adequate fire breaks must be prepared and maintained around the mining area.
- Workers involved in the decommissioning and rehabilitation activities must be trained on fire fighting.
- The necessary equipment and protective clothing must be in provided and ready to be used if accidental fires occur.
- The Rehabilitation Manager and Contractors are responsible for ensuring that the above actions are implemented.

Reporting of incidents

- Workers can only report on incidents if they are made aware off the possible environmental risks of their work.
- Every environmental incident that might happen and which the workers become aware of must be reported to the Rehabilitation Manager and Contractor.
- A reporting format will be provided for this purpose.

Environmental complaints procedure

- A formal complaints/concerns reporting system (complaints register) will be established and implemented to address I &AP's interaction with the decommissioning and rehabilitation activities.
- Complaints/concerns will be recorded and appropriately responded to.

k) Specific information required by the Competent Authority

(Among others, confirm that the financial provision will be reviewed annually.)

The financial provision will be reviewed annually in line with the legal requirements in this regard.

2) UNDERTAKING

The EAP herewith confirms

a) The correctness of the information provided in the reports; ☒

b) The inclusion of comments and inputs from stakeholders and interested and affected parties; ☒

c) The inclusion of inputs and recommendations from the specialist reports where relevant; ☒ and

d) That the information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested and affected parties are correctly reflected herein. ☒

Signature of the environmental assessment practitioner:

North-West University, Centre for Environmental Management

Name of company:

26 August 2019

Date:

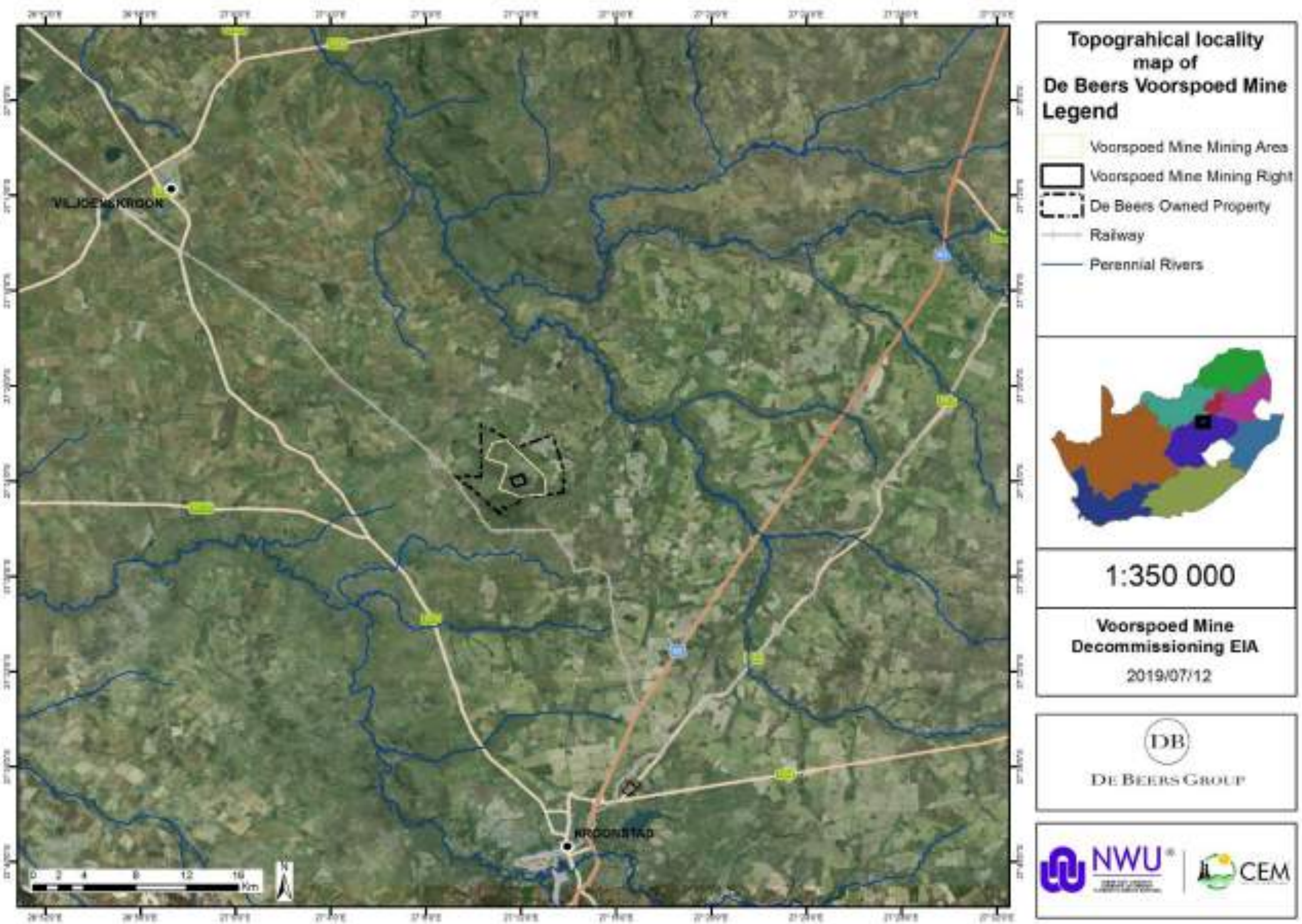
-END-

APPENDICES

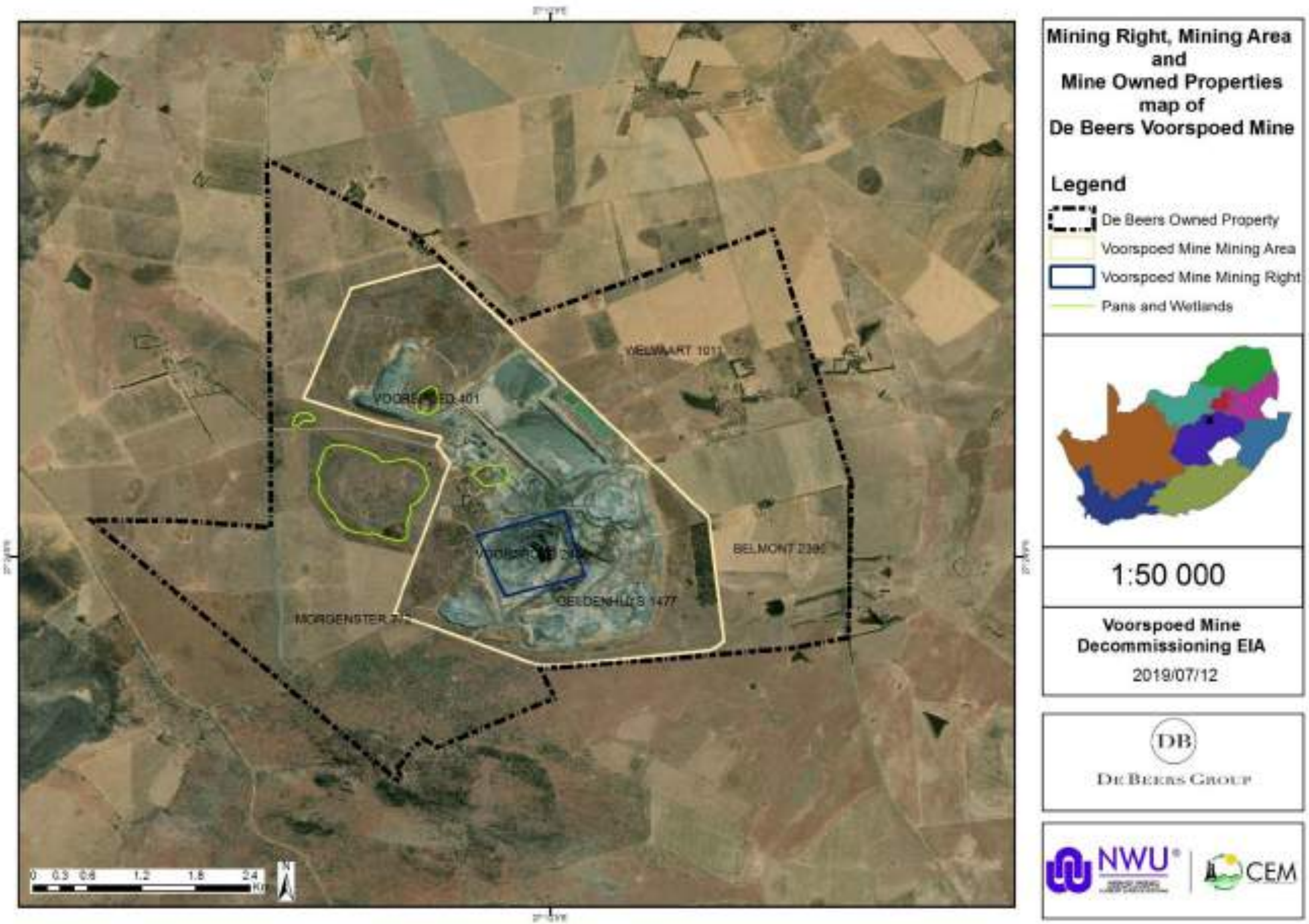
Appendix no.	Description
1	Voorspoed Mine locality map, showing the nearest towns and other infrastructure
2	Voorspoed Mine locality map, showing the mining right, mining area and surrounding mine owned properties
3	Scope of the proposed overall activity, showing the location of all the main and listed activities (facilities) and on-site infrastructure at Voorspoed Mine
4	Scope of the proposed overall activity, showing the location of all the off-site infrastructure at Voorspoed Mine
5	Scope of the proposed overall activity, showing the location of the main closure components at Voorspoed Mine
6	Environmental features and current land use map of Voorspoed Mine, showing all environmental features and current land use activities
7	Assessment of the environmental impacts/risks for the preferred open pit decommissioning and mine closure option
8	Assessment of the environmental impacts/risks for the alternative pit backfill decommissioning and mine closure option
9	Final decommissioning site map, showing the preferred decommissioning option with its associated structures and infrastructure, as well as the environmental sensitivities of the mining area, indicating areas that should be avoided, including buffers
10	Evidence of the EAP's expertise – CV
11	Voorspoed Mine Final Closure Plan, June 2019, Redco & Uvuna Sustainability
12	Voorspoed Mine Rehabilitation Plan 2019, (Annexure A to Final Closure Plan 2019), June 2019, Redco & Uvuna Sustainability
13	Voorspoed Mine – Pit Closure Study, Report E-TEK 10079, 21 June 2016, E-TEK Consulting & Redco
14	Technical Evaluation of the Risks, Impacts and Management Requirements into Pit Backfilling versus Current Mine Plan (Pit Lake), February 2019, Report 1792363-318923-1_Rev1, Golder Associates Africa (Pty) Ltd.
15	Proposed End Land Use Plan for Voorspoed Diamond Mine, not dated, NEKA Sustainability Solutions
16	Socio-economic impact assessment - Voorspoed Mine closure, April 2019, Environmental Resources Management (ERM)

Appendix no.	Description
17	Voorspoed Mine - Summary of surface and groundwater study for mine closure, October 2017 (Golder Associates)
18	Voorspoed Mine's Hydrological Monitoring Program (2018+) - monitoring sites, program and network upgrade
19	Baseline biodiversity assessment at De Beers Voorspoed Mine, October 2010 (Bucandi Environmental Solutions)
20	A Determination of Floristic Biodiversity at De Beers Voorspoed Mine, March 2013 (Bucandi Environmental Solutions)
21	A Wetland Delineation, Management and Rehabilitation Plan for the De Beers Voorspoed Mine, July 2017 (Exigo Sustainability)
22	An Alien Invasive Management Plan for the De Beers Voorspoed Mine, December 2016 (Exigo Sustainability)
23	A Heritage Impact Assessment (HIA) study for an EMP for the Voorspoed Diamond Mine near Kroonstad (J. Pistorius)
24	Correspondence between Voorspoed Mine and the Department of Mineral Resources regarding the section 52 process followed
25	Invitation letter that was circulated to all identified Interested and Affected Parties, inviting them to register and participate in the EIA process
26	Background Information Document with information about the decommissioning and mine closure process, as well as the EIA process and the role of interested and affected parties in the process, with a registration and feedback form that was circulated with the invitation letter to all identified I&APs
27	Evidence of the site notices that were displayed to inform prospective Interested and Affected Parties of the Voorspoed Diamond Mine decommissioning basic environmental impact assessment process
28	Evidence of the newspaper advertisements that were published to inform propspective Interested and Affected Parties of the Voorspoed Diamond Mine decommissioning basic environmental impact assessment process
29	Minutes of the public meeting held in Kroonstad at the Kroonstad Civil Centre on 19 August 2019, including copies of representations and comments received from registered interested and affected parties
30	Minutes of the public meeting held in Parys in the Mosepedi Site Hall, Tumahole, on 20 August 2019, including copies of representations and comments received from registered interested and affected parties

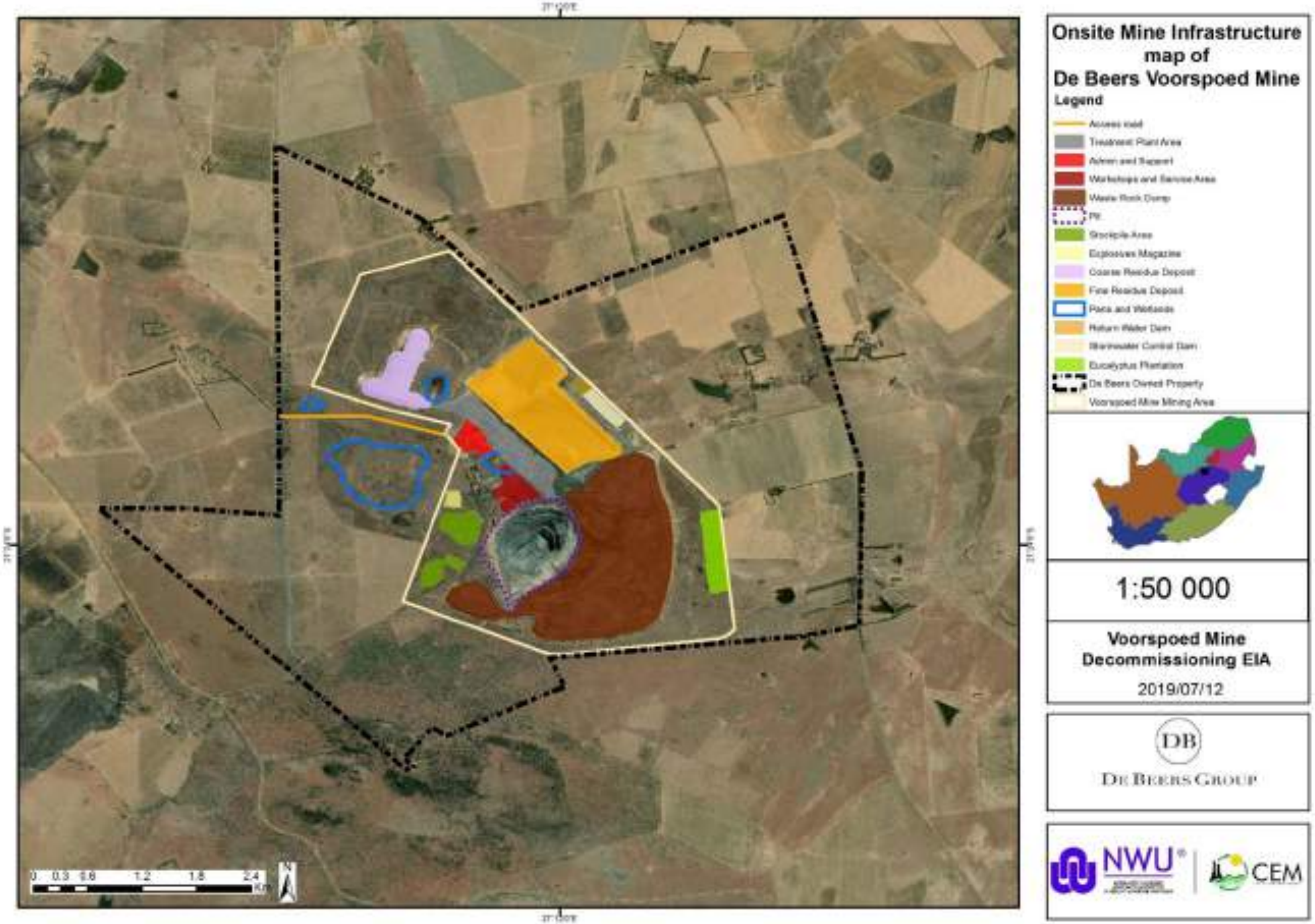
Appendix no.	Description
31	Minutes of a pre-application meeting for the De Beers Voorspoed Mine decommissioning Environmental Authorisation, held with the Department of Mineral Resources on 1 March 2019 at their offices in Welkom
32	Minutes of a meeting for the De Beers Voorspoed Mine decommissioning Environmental Authorisation, held with the Department of Water and Sanitation Regional Office on 3 March 2019 at their offices in Bloemfontein
33	Minutes of a meeting for the De Beers Voorspoed Mine decommissioning Environmental Authorisation, held with the Free State Department of Economic, Small Business, Tourism and Environmental Affairs on 10 April 2019 at their offices in Bloemfontein
34	Minutes of a meeting for the De Beers Voorspoed Mine decommissioning Environmental Authorisation, held with the Department of Rural Development and Land Reform on 10 April 2019 at their offices in Bloemfontein
35	Minutes of a meeting for the De Beers Voorspoed Mine decommissioning Environmental Authorisation, held with the Department of Agriculture, Forestry and Fisheries on 12 April 2019 at Voorspoed Mine
36	Minutes of a meeting for the De Beers Voorspoed Mine decommissioning Environmental Authorisation, held with the Department of Water and Sanitation Head Office on 4 June 2019 at their offices in Pretoria
37	Minutes of a meeting for the De Beers Voorspoed Mine decommissioning Environmental Authorisation, held with the Ngwathe Municipality on 20 August 2019 at their offices in Parys
38	Minutes of a meeting for the De Beers Voorspoed Mine decommissioning Environmental Authorisation, held with the Moqhaka Municipality on 19 August 2019 at their offices in Kroonstad
39	Final comment received from the South African Heritage Resources Agency in terms of Section 38(8) of the National Heritage Resources Act (Act 25 of 1999) on the Voorspoed Mine decommissioning Environmental Authorisation application
40	Comments received from the DWS Chief Director: Water Quality Regulation, Department of Water and Sanitation on the Voorspoed Mine decommissioning Environmental Authorisation application
41	Comments received from the geohydrological specialist, Department of Water and Sanitation on the Voorspoed Mine decommissioning Environmental Authorisation application



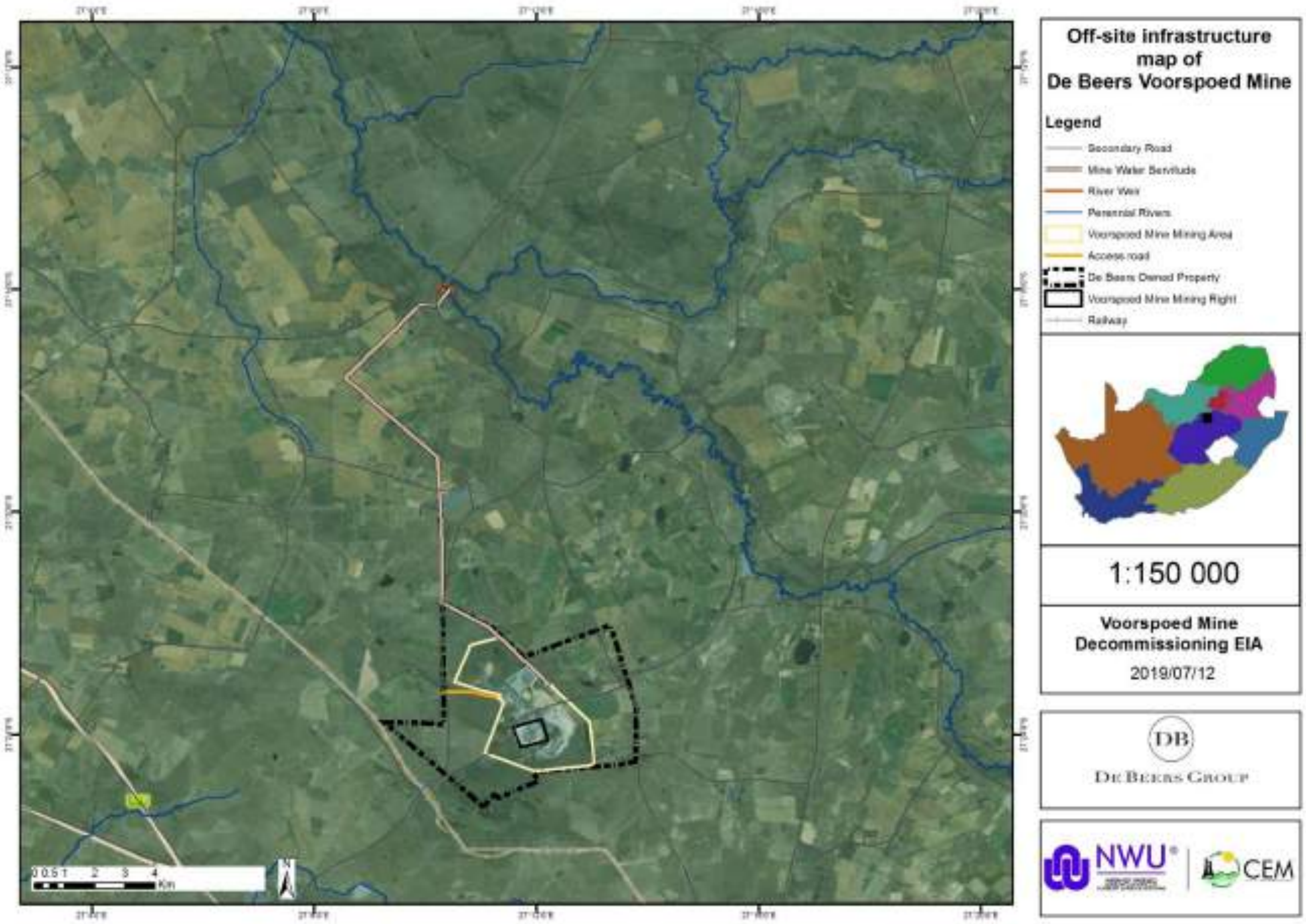
Appendix 1: Voorspoed Mine locality map, showing the nearest towns and other infrastructure



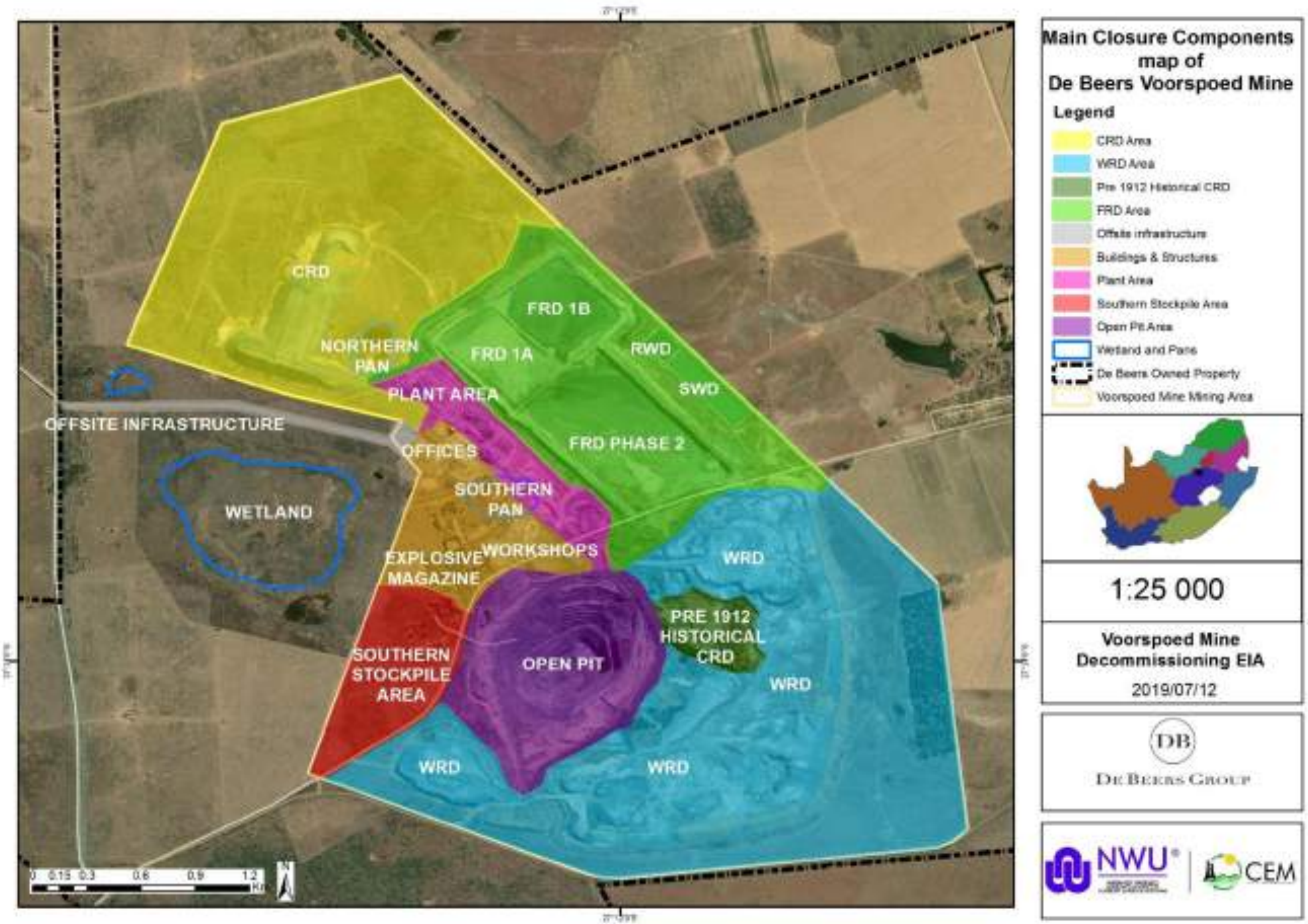
Appendix 2: Voorspoed Mine locality map, showing the mining right, mining area and surrounding mine owned properties



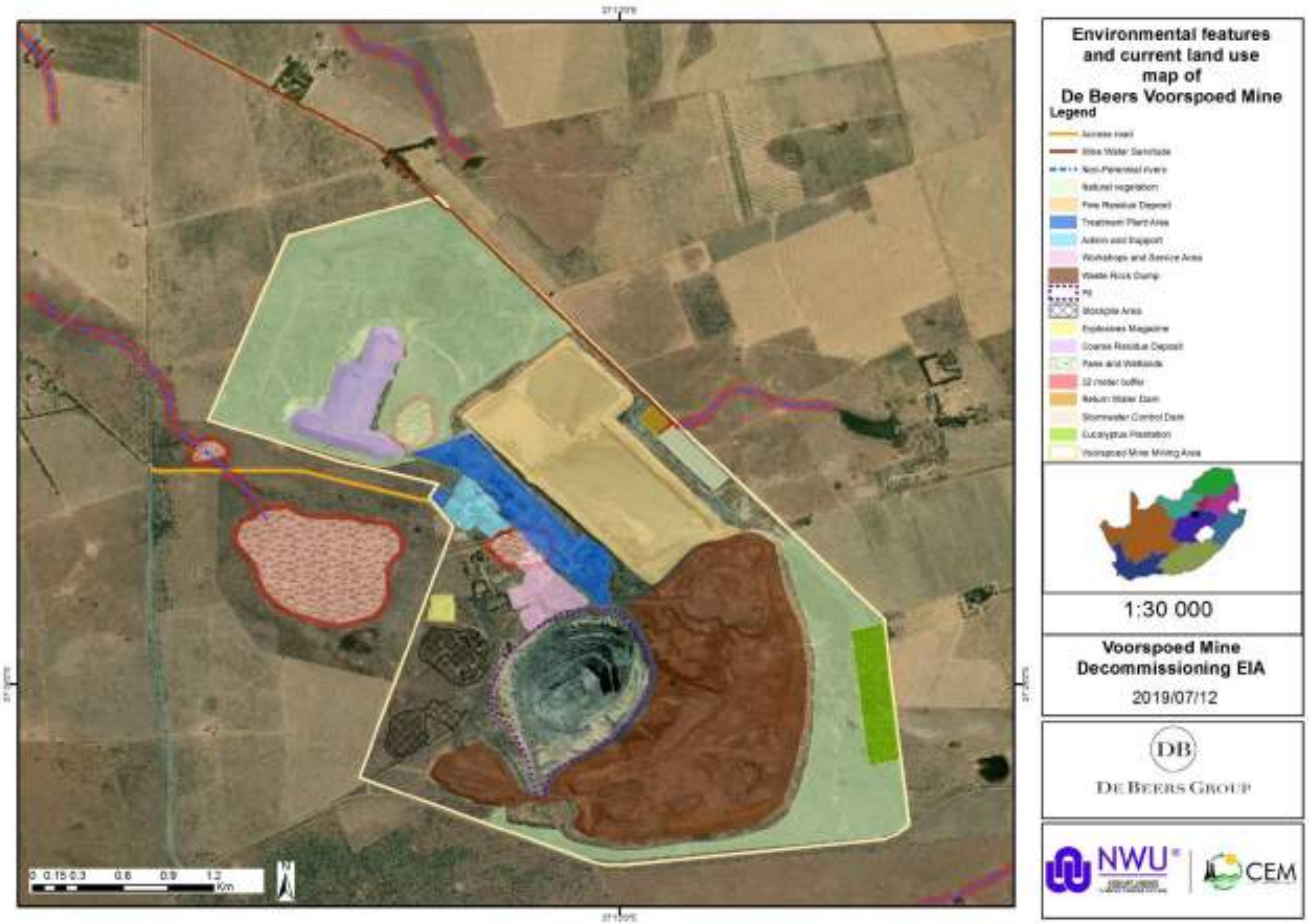
Appendix 3: Scope of the proposed overall activity, showing the location of all the main and listed activities (facilities) and on-site infrastructure



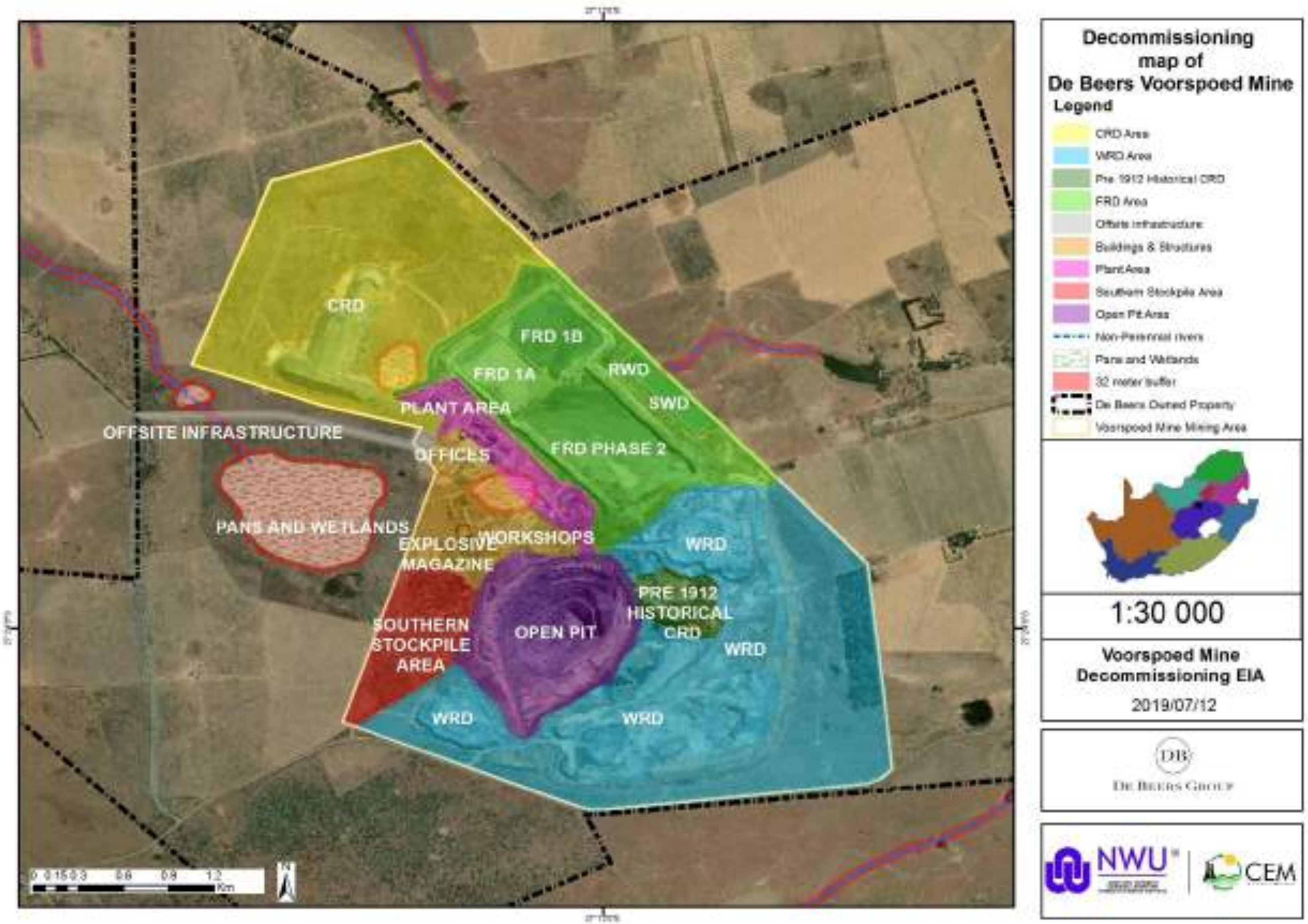
Appendix 4: Scope of the proposed overall activity, showing the location of the off-site infrastructure



Appendix 5: Scope of the proposed overall activity, showing the location of the main closure components at Voorspoed Mine



Appendix 6: Environmental features and current land use map of Voorspoed Mine, showing all environmental features and current land use activities



Appendix 7: Final Voorspoed Mine decommissioning site map, showing the preferred decommissioning option with its associated structures and infrastructure, as well as all environmental sensitivities of the mining area, indicating areas that should be avoided, including buffers

Appendix 8: Assessment of the environmental impacts/risks for the preferred open pit decommissioning and mine closure option

Impact	Pre mitigation impact assessment								Mitigation type	Post mitigation significance
	Extent	Duration	Magnitude	Probability	Reversibility	Extent of avoidance, management, mitigation	Extent of irreplaceable loss of resources	Significance		
Decommissioning activities										
Soil compaction	Site specific	Short	Low	Definite	Moderate	Low	Low	Moderate	Remedy through rehabilitation	Moderate
Soil pollution	Site specific	Short	Low	Moderate	Moderate	Low	Low	Low	Remedy through rehabilitation	Low
Land use/potential	Site specific	Short	Low	Definite	Moderate	Low	Low	Moderate	Remedy through rehabilitation	Moderate
Surface water run-off	Local	Short	Low	Definite	Moderate	Moderate	Low	Low	Control surface water run-off	Low
Surface water pollution	Local	Short	Low	Definite	Moderate	Moderate	Low	Low	Control & remedy through rehabilitation	Low
Generation of dust and fumes	Local	Short	Low	Definite	High	Moderate	Low	Low	Control through management	Low
Noise	Local	Short	Low	Definite	High	Low	Low	Low	Control through management	Low
Vegetation impacts	Site specific	Short	Low	High	Moderate	Moderate	Low	Low	Control through management	Low
Wildlife disturbance and killing/injury	Site specific	Short	Low	High	Moderate	Moderate	Low	Very low	Control through management	Very low
Visual impact	Local	Short	Low	Definite	Low	Low	Low	High		High
Visual impact	Local	Short	Low	Definite				High		High
Social impacts due to human injury & death	Site specific	Medium	Moderate	Definite	Low	Moderate	Low	High	Control through pit access control measures	Moderate
Other social & socio-economic impacts	Regional	Short	Low	Definite	Low	Low	Moderate	Moderate	Manage through social impact management measures	Moderate
Social & socio-economic impacts	Regional	Short	Low	Definite				Moderate		Moderate
Earthworks activities										
Soil compaction	Site specific	Short	Low	Definite	Moderate	Moderate	Low	Moderate	Remedy through rehabilitation	Moderate
Soil pollution	Site specific	Short	Low	Moderate	Moderate	Low	Low	Low	Remedy through rehabilitation	Low
Change in land use/potential	Site specific	Short	Low	Definite	Moderate	Low	Low	Moderate	Remedy through rehabilitation	Moderate
Surface water run-off	Local	Short	Low	Definite	Moderate	Moderate	Low	Low	Control & remedy through rehabilitation	Low
Surface water run-off	Local	Medium	Low	Definite				High		High
Surface water pollution	Local	Medium	Low	Definite	Moderate	Low	Moderate	Moderate	Control & remedy through rehabilitation	Moderate
Surface water pollution	Local	Long	Low	Definite				High		High

Impact	Pre mitigation impact assessment								Mitigation type	Post mitigation significance
	Extent	Duration	Magnitude	Probability	Reversibility	Extent of avoidance, management, mitigation	Extent of irreplaceable loss of resources	Significance		
Groundwater pollution	Local	Medium	Moderate	Moderate	Low	Low	Moderate	High	Control & remedy through rehabilitation	High
Groundwater pollution	Local	Long	Moderate	Very high				Moderate		Moderate
Generation of dust and fumes	Local	Short	Low	Definite	High	Moderate	Low	Low		Low
Noise	Local	Short	Low	Definite	High	Low	Low	Low		Low
Vegetation impacts	Site specific	Short	Low	High	Moderate	Moderate	Low	Low	Remedy through rehabilitation	Low
Wildlife disturbance and killing/injury	Site specific	Short	Low	High	Moderate	Moderate	Low	Very low	Control through management	Very low
Ecosystem services	Local	Short	Low	High	Moderate	Moderate	Low	High	Remedy through rehabilitation	Moderate
Ecosystem services	Local	Short	Low	High				High		High
Visual impact	Local	Short	Low	Definite	Low	Low	Low	High		High
Visual impact	Local	Permanent	Low	Definite				Very high		Very high
Social impacts due to human injury & death	Site specific	Medium	Moderate	Definite	Low	Moderate	Low	High	Control through pit access control measures	Moderate
Social & socio-economic impacts	Regional	Short	Low	Definite				Moderate		Moderate
Rehabilitation activities										
Soil compaction	Site specific	Medium	Low	Definite				Very high		Very high
Soil pollution	Local	Short	Moderate	Definite				High		High
Change in land use/potential	Site specific	Long	Moderate	Definite				Very high		Very high
Surface water run-off	Local	Medium	Moderate	Definite				High		High
Surface water pollution	Local	Medium	Moderate	High	Moderate	Moderate	Low	Moderate	Control & remedy through rehabilitation	Low
Surface water pollution	Local	Medium	Moderate	Definite				High		High
Groundwater pollution	Local	Medium	Moderate	High				High		High
Generation of dust and fumes	Local	Short	Low	Definite	High	Moderate	Low	Low	Control through management	Low
Generation of dust and fumes	Local	Medium	Low	High				High		High
Noise	Local	Short	Low	Definite	High	Low	Low	Very low	Control through management	Very low
Vegetation impacts	Site specific	Medium	Low	High				Moderate		Moderate

Impact	Pre mitigation impact assessment								Mitigation type	Post mitigation significance
	Extent	Duration	Magnitude	Probability	Reversibility	Extent of avoidance, management, mitigation	Extent of irreplaceable loss of resources	Significance		
Wildlife disturbance and killing/injury	Site specific	Short	Low	High	High	High	Low	Low	Control through management	Low
Wildlife disturbance and killing/injury	Site specific	Medium	Low	High				High		High
Ecosystem services	Local	Medium	Moderate	Moderate	Moderate	Moderate	Low	High	Remedy through rehabilitation	Moderate
Ecosystem services	Local	Medium	Moderate	High				Moderate		Moderate
Visual impact	Local	Short	Low	Definite	Low	Low	Low	High		High
Visual impact	Local	Permanent	Low	Definite				Very high		Very high
Social impacts due to human injury & death	Site specific	Medium	Moderate	Definite	Low	Moderate	Low	High	Control through pit access control measures	Moderate
Social & socio-economic impacts	Regional	Short	Low	Definite				Moderate		Moderate
Post rehabilitation management, maintenance and monitoring activities										
Change in land use/potential	Site specific	Long	Low	High				Very high		Very high
Surface water run-off	Local	Long	Low	High				High		High
Surface water pollution	Local	Long	Low	High				High		High
Groundwater pollution	Local	Long	Low	High				Moderate		Moderate
Generation of dust and fumes	Local	Medium	Low	High				Moderate		Moderate
Noise	Local	Permanent	Low	High				Very high		Very high
Vegetation impacts	Site specific	Long	Low	High				High		High
Wildlife disturbance and killing/injury	Site specific	Long	Low	High				High		High
Ecosystem services	Local	Medium	Moderate	Moderate	Moderate	Moderate	Low	High	Remedy through rehabilitation	Moderate
Ecosystem services	Local	Long	Low	High				High		High
Visual impact	Local	Medium	Low	Definite	Low	Low	Low	High		High
Visual impact	Local	Long	Low	High				High		High
Social impacts due to human injury & death	Site specific	Permanent	Moderate	Definite	Low	Moderate	Low	High	Control through pit access control measures	Moderate
Social & socio-economic impacts	Regional	Long	Low	Definite				Moderate		Moderate

Appendix 9: Assessment of the environmental impacts/risks for the alternative pit backfill decommissioning and mine closure option

Impact	Pre mitigation impact assessment								Mitigation type	Post mitigation significance
	Extent	Duration	Magnitude	Probability	Reversibility	Extent of avoidance, management, mitigation	Extent of irreplaceable loss of resources	Significance		
Decommissioning activities										
Soil compaction	Site specific	Short	Low	Definite	Moderate	Low	Low	Moderate	Remedy through rehabilitation	Moderate
Soil pollution	Site specific	Short	Low	Moderate	Moderate	Low	Low	Low	Remedy through rehabilitation	Low
Land use/potential	Site specific	Short	Low	Definite	Moderate	Low	Low	Moderate	Remedy through rehabilitation	Moderate
Surface water run-off	Local	Short	Low	Definite	Moderate	Moderate	Low	Low	Control surface water run-off	Low
Surface water pollution	Local	Short	Low	Definite	Moderate	Moderate	Low	Low	Control surface water pollution	Low
Generation of dust and fumes	Local	Short	Low	Definite	High	Moderate	Low	Low	Control through management	Low
Noise	Local	Short	Low	Definite	High	Low	Low	Low	Control through management	Low
Vegetation impacts	Site specific	Short	Low	High	Moderate	Moderate	Low	Low	Control through management	Low
Wildlife disturbance and killing/injury	Site specific	Short	Low	High	Moderate	Moderate	Low	Very low	Control through management	Very low
Visual impact	Local	Short	Low	Definite	Low	Low	Low	High		High
Visual impact	Local	Short	Low	Definite				High		High
Social impacts due to human injury & death	Site specific	Short	Moderate	Very low	Low	Moderate	Moderate	High		Moderate
Social & socio-economic impacts	Regional	Short	Low	Definite	Low	Low	Moderate	Moderate	Manage through social impact management measures	Moderate
Social & socio-economic impacts	Regional	Short	Low	Definite				Moderate		Moderate
Earthworks activities										
Soil compaction	Site specific	Short	Low	Definite	Moderate	Moderate	Low	Moderate	Remedy through rehabilitation	Moderate
Soil pollution	Site specific	Short	Low	Moderate	Moderate	Low	Low	Low	Remedy through rehabilitation	Low
Change in land use/potential	Site specific	Short	Low	Definite	Moderate	Low	Low	Moderate	Remedy through rehabilitation	Moderate
Surface water run-off	Local	Short	Low	Definite	Moderate	Moderate	Low	Low	Control & remedy through rehabilitation	Low
Surface water run-off	Local	Medium	Low	Definite				High		High
Surface water pollution	Local	Medium	Low	Definite	Moderate	Low	Moderate	Moderate	Control & remedy through rehabilitation	Low
Surface water pollution	Local	Long	Low	Definite				High		High

Impact	Pre mitigation impact assessment								Mitigation type	Post mitigation significance
	Extent	Duration	Magnitude	Probability	Reversibility	Extent of avoidance, management, mitigation	Extent of irreplaceable loss of resources	Significance		
Groundwater pollution	Local	Medium	Moderate	Moderate	Low	Low	Moderate	High	Control & remedy through rehabilitation	Moderate
Groundwater pollution	Local	Long	Moderate	Very high				Moderate		Moderate
Generation of dust and fumes	Local	Short	Low	Definite	High	Moderate	Low	Low		Low
Noise	Local	Short	Low	Definite	High	Low	Low	Low		Low
Vegetation impacts	Site specific	Short	Low	High	Moderate	Moderate	Low	Low	Remedy through rehabilitation	Low
Wildlife disturbance and killing/injury	Site specific	Short	Low	High	Moderate	Moderate	Low	Very low	Control through management	Very low
Ecosystem services	Local	Short	Low	High	Moderate	Moderate	Low	High	Remedy through rehabilitation	Moderate
Ecosystem services	Local	Short	Low	High				High		High
Visual impact	Local	Short	Low	Definite	Low	Low	Low	High		High
Visual impact	Local	Permanent	Low	Definite				Very high		Very high
Social impacts due to human injury & death	Site specific	Short	Moderate	Very low	Low	Moderate	Moderate	High		Moderate
Social & socio-economic impacts	Regional	Short	Low	Definite				Moderate		Moderate
Rehabilitation activities										
Soil compaction	Site specific	Medium	Low	Definite				Very high		Very high
Soil pollution	Local	Short	Moderate	Definite				High		High
Change in land use/potential	Site specific	Long	Moderate	Definite				Very high		Very high
Surface water run-off	Local	Medium	Moderate	Definite				High		High
Surface water pollution	Local	Medium	Moderate	High	Moderate	Moderate	Low	Moderate	Control surface water pollution	Low
Surface water pollution	Local	Medium	Moderate	Definite				High		High
Groundwater pollution	Local	Medium	Moderate	High				High		High
Generation of dust and fumes	Local	Short	Low	Definite	High	Moderate	Low	Low	Control through management	Low
Generation of dust and fumes	Local	Medium	Low	High				High		High
Noise	Local	Short	Low	Definite	High	Low	Low	Very low	Control through management	Very low
Vegetation impacts	Site specific	Medium	Low	High				Moderate		Moderate

Impact	Pre mitigation impact assessment								Mitigation type	Post mitigation significance
	Extent	Duration	Magnitude	Probability	Reversibility	Extent of avoidance, management, mitigation	Extent of irreplaceable loss of resources	Significance		
Wildlife disturbance and killing/injury	Site specific	Short	Low	High	High	High	Low	Low	Control through management	Low
Wildlife disturbance and killing/injury	Site specific	Medium	Low	High				High		High
Ecosystem services	Local	Medium	Moderate	Moderate	Moderate	Moderate	Low	High	Remedy through rehabilitation	Moderate
Ecosystem services	Local	Medium	Moderate	Moderate				Very high		Very high
Visual impact	Local	Short	Low	Definite	Low	Low	Low	High		High
Visual impact	Local	Permanent	Low	Definite				Very high		Very high
Social & socio-economic impacts	Regional	Short	Low	Definite				Moderate		Moderate
Post rehabilitation management, maintenance and monitoring activities										
Change in land use/potential	Site specific	Long	Low	High				Very high		Very high
Surface water run-off	Local	Long	Low	High				High		High
Surface water pollution	Local	Long	Low	High				High		High
Groundwater pollution	Local	Long	Moderate	High	Low	Moderate	Moderate	High	Control through pollution plume borehole capturing system & subsequent storage and/or treatment of polluted water	High
Generation of dust and fumes	Local	Medium	Low	High				Moderate		Moderate
Noise	Local	Permanent	Low	High				Very high		Very high
Vegetation impacts	Site specific	Long	Low	High				High		High
Wildlife disturbance and killing/injury	Site specific	Long	Low	High				High		High
Ecosystem services	Local	Medium	Moderate	Moderate	Moderate	Moderate	Low	High	Remedy through rehabilitation	Moderate
Ecosystem services	Local	Long	Low	High				High		High
Visual impact	Local	Medium	Low	Definite	Low	Low	Low	High		High
Visual impact	Local	Long	Low	High				High		High
Social & socio-economic impacts	Regional	Long	Low	Definite				Moderate		Moderate

Appendix 10: The EAP's CV as evidence of his expertise

TC Meyer
Curriculum Vitae

1. **Surname:** Meyer
2. **First names:** Theunis Christoffel
3. **Date of birth:** 1961-11-29
4. **Nationality:** South African
5. **Marriage status:** Married
6. **Education/qualifications:**

Institution [Date from - Date to]	Qualifications obtained
University of Orange Free State [1982-1992]	B. Sc. Agric, B.Sc. Agric Honours (Pasture Science), M.Sc. Agric (Pasture Science)
University of Pretoria [1987-1987]	B.Sc. Honours (Wildlife Management)
Technikon RSA 1992-1996	National Higher Diploma (Management Practice)
Potchefstroom University 1999-2003	M. (Environmental Management)
Maccauvlei Learning Academy 2010	Assessor Programme Certificate
North West University 2015	Advanced Management Programme Certificate in Strategic Management
Maccauvlei Learning Academy 2017	Moderator Programme Certificate

7. **Language skills:**

Indicate competency on a scale of 1 to 5 (1=excellent; 5=basic)

Language	Reading	Speaking	Writing
Afrikaans	1	1	1
English	1	1	1
German	5	5	

8. **Membership of professional bodies:**

- Registered Professional Natural Scientist – Ecological Science and Environmental Science. (400029/08)
- Certified Senior Environmental Management System Auditor - Southern African Auditor Training and Certification Association (E058)
- International Association for Impact Assessment (South African Chapter)
- Grassland Society of Southern Africa

- Former member of Arid Zone Ecology Forum and Wildlife Management Association of Southern Africa

9. Present position and location:

Chief Subject Specialist, Centre for Environmental Management, North-West University, Potchefstroom

10. Years within the organisation: 18 years

11. Professional experience

11.1 Areas of specialisation

Environmental law, mine closure and rehabilitation, Environmental Impact Assessment, Environmental Management Frameworks, Environmental and Occupational Health and Safety management systems, Environmental Management Systems auditing, environmental legal compliance auditing, municipal environmental management, Green Economy, estate management, invader plant control, biodiversity offsets, karoo, grassland and savannah ecology, wildlife and protected area management, plant-animal interactions.

11.2 Work experience

No	Activity	Key Experience
1.	Project Management	• Managed a number of large, multi-stakeholder projects for public and private sector clients.
2.	Conducting and facilitating Environmental Impact Assessments (EIAs) for clients	• Conducted numerous EIAs throughout South Africa in terms of the Environmental Conservation Act (No. 73 of 1989) (ECA), the National Environmental Management Act (No. 107 of 1998) (NEMA) and the Mineral and Petroleum Resources Development Act (No. 28 of 2002) (MPRDA) for shopping malls, PV solar facilities and mining projects.
3	Development of Environmental Management Frameworks (EMFs) for clients	• Team leader for the development of Environmental Management Frameworks for the Vredefort Dome World Heritage Site, Moqhaka, Ngwathe and Taung Local Municipalities, Mangaung Metropolitan Municipality, as well as Bojanala Platinum District Municipality.
4.	Conducting environmental legal compliance, Environmental Management System (EMS), as well as environmental performance audits	• Conducted numerous environmental legal compliance, EMS and Environmental Performance audits for clients in the mining, energy, chemical, explosives, defence and local government sectors.

No	Activity	Key Experience
5.	Working with local government	• Developed and delivered various environmental management training interventions for local government in the past - Municipalities in Mpumalanga, selected municipalities in SADC, Western Cape and Northern Cape.
6.	Working with communities on issues related to sustainable land management, invader plant control and biodiversity conservation	• Development of an Environmental Sector Master Plan for Metsimaholo Municipality • Development of Invader Plant Control Strategies and Action Plans
7.	Technical • Sustainable agriculture • Veld management • Invader plant control	• Involved in projects to improve/ensure sustainable veld/range management in rural areas –Department of Agriculture & Namibian Department of Nature Conservation • Involved in projects to control alien invasive trees – Department of Agriculture • Involved in veld rehabilitation projects – Department of Agriculture
8.	Training	• Developed and facilitated EIA reviewer training course of 11 competent authorities from 2016 - 2018 • Lecturer, Environmental Management and Environmental Law Masters Programmes - North-West University (2006 – present) • Lecturer, MBA Programmes - School of Business and Governance North-West University (2016 – present) • Lecturer, Environmental management awareness & Environmental Management Systems - North-West University, School of Environmental Sciences and Development, Faculties of Law and Engineering (2002-2005) • Lecturer - Environmental Management module in MBA training programme, Tshwane University of Technology (2012) • External examiner, B. Sc Hons, M. Sc. & M. Sc. Agric programmes – Free State University, North-West University & University of Venda (2001-present) • External moderator, Botany 1 - Technikon of Namibia (1988 – 1989) & Pasture Science II & III - Potchefstroom Agricultural College (1996-2000) • Member of Executive Committee, Environmental Sciences, Environmental Management & Waste Management Standards Generating Body - NSB 10, South African Qualifications Authority (2003-2009) • Lecturer & presenter, formal education & short courses - Grootfontein Agricultural College (1990 – 1994) • Course developer & presenter, short courses - North West

No	Activity	Key Experience
		Department of Agriculture (1994-2001) • Course developer& presenter, Train the trainer: Veld Management - Boskop Training Centre (1995), Train the trainer: Bush control - National Educational Veld Rehabilitation Programme & North West Province Department of Agriculture (1995–2001) • Lecturer, Bush control - Resource Identification and Utilisation Course, North West Province Department of Agriculture (1995–2000) • Course developer & presenter, Train the trainer: Environmental awareness - Impala Platinum Mine (2000), Jwaneng Diamond Mine, Botswana (2001) • Technical course co-ordinator (developer) & presenter: Environmental law, Mine closure and rehabilitation, Environmental Management Systems, Environmental Impact Assessment, Environmental awareness, EMS auditing, Occupational Health and Safety law, Occupational Health and Safety Management Systems, OHSAS 18001 Auditing, Internal SHE Management System Auditing, Handling & Storage of Dangerous Goods - Centre for Environmental Management, North-West University (2001-present) • Programme developer & co-ordinator: Municipal Environmental Management Capacity Building Programmes - Mpumalanga Department of Agriculture and Land Administration, Metsimaholo Local Municipality, Northern Cape Department of Tourism, Environment and Conservation, Ekurhuleni Metropolitan Municipality, Capricorn District Municipality • Programme developer & presenter: Senior management introduction to Environmental and Occupational Health and Safety Management Systems • Programme developer & presenter: Senior management introduction to environmental law and legal liability

11.3 Specific Professional Experience

Dates	Location	Company	Position
2001 – present	Potchefstroom	Centre for Environmental Management, North-West University,	Chief Subject Specialist
Description of experience	• Development, co-ordination and presentation of environmental management and occupational health and safety management, mine closure and rehabilitation, as well as environmental law courses • Conducting and facilitating Environmental Impact Assessments, public participation, integrated Environmental Authorisation and mine closure and rehabilitation processes • Performing environmental legal compliance, environmental performance assessment and environmental management system audits • Development and implementation of ISO 14001 environmental management systems • Providing support to improve the environmental performance of local authorities, as well as public & private sector organisations • Project management • Development of a biodiversity offset proposal and Environmental Management Frameworks • Participation in Standard Generation Body for Environmental Sciences, Environmental Management and Waste Management – also developing standard for post graduate diploma for EAPs • Developing student assessment procedure for CEM Quality Management System • Regular assessment and evaluation of short course training students		
1994 - 2001	Potchefstroom	North West Department of Agriculture	Senior Agricultural scientist
Description of experience	• Planning and execution of research and development projects (grazing capacity, veld management, bush control, veld reclamation) • Development and presentation of training courses on veld management and bush control • Communicating research results through reports, articles and presentations		
1989 - 1994	Middelburg Eastern Cape	Department of Agriculture, Karoo Region	Agricultural scientist
Description of experience	• Planning and execution of research and development projects (grazing capacity, veld management, veld reclamation) • Presentation of training courses on veld management • Formal student training at Grootfontein Agricultural College • Communicating research results through reports, articles and presentations		
1986 – 1989	Windhoek, Namibia	Directorate Nature Conservation, Namibia Government	Nature Conservation Scientist
Description of experience	• Planning and execution of research projects • Development and presentation of training courses on wildlife management • Communicating research results through reports, articles and presentations • Formulation of management recommendations for game reserves		

12 Environmental impact assessment experience

Involved in numerous EIAs throughout South Africa, conducted in terms of the Environmental Conservation Act (No. 73 of 1989) (ECA), the National Environmental Management Act (No. 107 of 1998) (NEMA) and the Mineral and Petroleum Resources Development Act (No. 28 of 2002) (MPRDA). Responsibilities in these EIAs included the facilitation of the EIA and public participation processes, the identification and assessment of environmental impacts and the development of environmental management plans and programmes.

Co-ordinated the EIA reviewer training for competent authorities that was developed and delivered on behalf of the Department of Environmental Affairs and trained nearly 600 EIA reviewers from 11 competent authorities from 2016 to 2018. He also co-ordinated the popular environmental law public short course at the CEM for many years and regularly lectures on the legal EIA requirements to various audiences. These presentations cover the requirements of Section 24 of the NEMA (No. 107 of 1998), the various regulations and listing notices published in terms of the NEMA, as well as the EIA guidelines published by Department of Environmental Affairs (DEA), Gauteng Department of Agriculture and Rural Development (GDARD) and the Western Cape Department of Environmental Affairs and Development Planning (DEADP).

13 Environmental auditing experience

Conducted more than 80 Environmental Management System audits and environmental legal compliance and performance reviews of Mine Environmental Management Programmes, Water Use, Waste and Atmospheric Emissions Licenses, as well as Biodiversity Offsets, spanning more than 150 auditor days on-site for clients in the mining, energy, chemical, explosives, defence and local government sectors.

14 Other relevant information

- **6 Book contributions**

- Hoffman M.T., Cousins B., Meyer T.C., Petersen A. & Hendricks H. 1998. Historical and contemporary agricultural land use and the desertification of the Karoo. In: Dean W.R.J. & Milton S.J. (eds.) The Karoo: ecological patterns and processes. Cambridge University Press.
- Meyer, T.C., Kellner, K. & Viljoen, C. 2002. Land transformation and soil quality (Chapter 9). North West State of the Environment Report, 2002. CD ROM. North West Department of Agriculture, Conservation and Environment, Mmabatho.
- Meyer TC & Le Roux E, 2006. Capacity building for effective municipal environmental management in South Africa. The Sustainable City IV, WIT Press, Southampton, UK.
- Meyer TC & Roos C, 2015. Hazardous Substances Control. In: Du Plessis A (ed.) Environmental Law and Local Government in South Africa, Juta.
- Meyer TC, 2015. Soil and Land Management. In: Du Plessis A (ed.) Environmental Law and Local Government in South Africa, Juta.
- Meyer TC, Verster E, Hattingh A, Snow TV, Olivier NJJ & Du Plessis, W, 2018. Soil, Land and Agriculture. In: King NA, Strydom HA & Retief FP (eds.) Fuggle and Rabie's Environmental Management in South Africa, Juta.

- **11 Semi-scientific publications**

- Meyer T.C. & Immelman W.F. 1993. Botaniese dieetsamestelling van Afrino's op Dorre Karooveld. Karoo Agric 5(2): 5-9
- Hoon J.H. & Meyer, T.C. 1998. Effek van die toediening van 'n kommersiële tannien inhibeerder op die prestasie van Angorabokke op Spekboomveld. Grootfontein Agric 1(1): 8-10

- Meyer T.C., van den Heever J. 1998. Interactions between livestock farming, human needs and the environment in the communal farming sector – perceptions of field workers in the Ganyesa District of the North West Province. Proceedings of a Symposium on Policy-making for the Sustainable Use of southern African Communal Rangelands. University of Fort Hare, Alice, South Africa.
- Meyer T.C., Venter I.S. & Van Zijl I.J.M. 1998. The sustainability of livestock farming in communal rangelands in the North West Province – experience from a long term grazing experiment. Proceedings of a Symposium on Policy-making for the Sustainable Use of southern African Communal Rangelands. University of Fort Hare, Alice, South Africa.
- Meyer T.C., van den Heever J. 1999. Perceptions in Ganyesa on livestock farming. North West Focus, 1999(1): 6-8. Department of Agriculture, North West Province, Potchefstroom.
- Meyer T.C. & Richter C.G.F. 2000. Die Prosopis bedreiging in die ariede gebiede van Suid-Afrika. North West Focus 2000(2). Department of Agriculture, North West Province, Potchefstroom.
- Richter C.G.F. & Meyer T.C. 2000. Die beheer en bestryding van Prosopis. North West Focus 2000(2). Department of Agriculture, North West Province, Potchefstroom.
- Richter C.G.F. & Meyer T.C. 2001. Perspective on bush encroachment in the North West Province. North West Focus 2001(1). Department of Agriculture, North West Province, Potchefstroom.
- Meyer, T.C., C.F.G. Richter & G.N. Smit. 2001. The implications of vegetation dynamics in the Kalahari Thornveld for game ranching. North West Focus 2001(2): 3-10. NW DACE, Potchefstroom.
- Meyer T.C. & Nel J.G. 2002. Towards sustainable development: promoting environmental awareness and training in the mining sector. Proceedings of the First Botswana International Mining Conference, Gaborone, November.
- Meyer T.C. & Le Roux E. 2006. Capacity building for effective municipal environmental management in South Africa. The Sustainable City IV: Urban Regeneration and Sustainability. WITPress, Southampton.
  - Numerous popular publications
  - 39 Presentations at professional congresses/symposia

2019-08-26

Appendix 11: Voorspoed Mine Final Closure Plan, June 2019, Redco & Uvuna Sustainability

Appendix 12: Voorspoed Mine Rehabilitation Plan 2019, (Annexure A to Final Closure Plan 2019), June 2019, Redco & Uvuna Sustainability

Appendix 13: Voorspoed Mine – Pit Closure Study, Report E-TEK 10079, 21 June 2016, E-TEK Consulting & Redco

Appendix 14: Technical Evaluation of the Risks, Impacts and Management Requirements into Pit Backfilling versus Current Mine Plan (Pit Lake), February 2019, Report 1792363-318923-1_Rev1, Golder Associates Africa (Pty) Ltd.

Appendix 15: Proposed End Land Use Plan for Voorspoed Diamond Mine, not dated, NEKA Sustainability Solutions

Appendix 16: Socio-economic impact assessment - Voorspoed Mine closure, April 2019, Environmental Resources Management (ERM)

Appendix 17: Voorspoed Mine - Summary of surface and groundwater study for mine closure, October 2017 (Golder Associates)

Appendix 18: Voorspoed Mine's Hydrological Monitoring Program (2018+) - monitoring sites, program and network upgrade

Appendix 19: Baseline biodiversity assessment at De Beers Voorspoed Mine, October 2010 (Bucandi Environmental Solutions)

Appendix 20: A Determination of Floristic Biodiversity at De Beers Voorspoed Mine, March 2013 (Bucandi Environmental Solutions)

Appendix 21: A Wetland Delineation, Management and Rehabilitation Plan for the De Beers Voorspoed Mine, July 2017 (Exigo Sustainability)

Appendix 22: An Alien Invasive Management Plan for the De Beers Voorspoed Mine, December 2016 (Exigo Sustainability)

Appendix 23: A Heritage Impact Assessment (HIA) study for an EMP for the Voorspoed Diamond Mine near Kroonstad (J. Pistorius)

Appendix 24: Correspondence between Voorspoed Mine and the Department of Mineral Resources regarding the section 52 process followed

DE BEERS GROUP

13 December 2018

The Department of Mineral Resources (the "**DMR**")
Corner Meintjies and Francis Baard Street
Building 2C Trevenna Campus
Pretoria

By email: busi.mlawuli@dmr.gov.za

Dear Mr Smunda Mokoena

UPDATE FOLLOWING THE INVESTIGATION SITE VISIT OF 30 NOVEMBER 2018 REGARDING THE NOTICE IN TERMS OF SECTION 52(1)(b) OF THE MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT 28 OF 2002 ("MPRDA")

1. We refer to the site visit by the Mining Sustainability and Employment Committee ("MSEC") of the Minerals and Petroleum Board on 30 November 2018 and our response letter to the questions raised during the investigation visit submitted to the committee on 4 December 2018. This site visit followed a section 52(1)(b) notice having been lodged with the DMR in respect of Voorspoed mine.

2. In our letter of 4 December 2018, we highlighted that the difference in opinion between De Beers and the NUM was with regards to the ability of the remaining interested bidder, Karabo Ya Phoka Consortium ("Karabo") to purchase Voorspoed Mine and mine it sustainably. We also highlighted that a without prejudice session was being scheduled between De Beers, the NUM, Standard Bank and Karabo to align views regarding their technical and financial ability to mine Voorspoed Mine sustainably.

3. The parties in point 2 above held the said without prejudice session on 10 December 2018 and Karabo was provided an opportunity to present their offer. They highlighted that they now have a new ownership structure, a new technical partner, Consulmet and a new funder, Shabtai Investments. No feasible plan was presented and De Beers agreed to provide Karabo and its new partners a chance to review all the information and prepare a business plan by 15 January 2019.

4. While the technical challenges as presented to MSEC on 30 November 2018 remain, De Beers remains open to considering Karabo's proposal and providing all the necessary information for Karabo to finalise their proposal.

The following update is provided under the auspices of section 29 of the MPRDA (read with section 30 thereof), as such all information provided to the DMR in light with this process is afforded protection in line with section 30 of the MPRDA. A further update will therefore be sent to MSEC following the analysis of Karabo's submission.

Yours sincerely

PHILLIP BARTON
CHIEF EXECUTIVE OFFICER
DE BEERS CONSOLIDATED MINES

De Beers Consolidated Mines Proprietary Limited

Corner Diamond Drive and Crownwood Road Theta Ext 4 Johannesburg 2013 Private Bag X01 Southdale 2135 South Africa
Tel +27 (0)11 374 7000 | Fax +27 (0)11 374 7700 | www.debeersgroup.com
Registered Office: 36 Stockdale Street Kimberley 8301 South Africa | Registration number 1888/000007/07

A member of the Anglo American plc group

[illegible]

DE BEERS GROUP

22 February 2019

The Department of Mineral Resources (the "**DMR**")
Corner Meintjies and Francis Baard Street
Building 2C Trevenna Campus
Pretoria

By email: busi.mlawuli@dmr.gov.za

Dear Mr Simunda Mokoena

UPDATE FOLLOWING OUR LETTER OF 13 DECEMBER 2018 REGARDING THE NOTICE IN TERMS OF SECTION 52(1)(b) OF THE MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT 28 OF 2002 ("MPRDA")

1. We refer to the section 52(1)(b) investigation by the Mining Sustainability and Employment Committee ("MSEC") of the Minerals and Petroleum Board and our last letter to the committee dated 13 December 2018.

2. In our letter of 13 December 2018, we highlighted that Karabo Ya Phoka Resources (Pty) Ltd and its new partners (together "KYPR") had been given an opportunity to review all the information and prepare a business plan for submission by 15 January 2019.

3. KYPR presented its business plan on the 25th of January 2019 and the assessment that was conducted highlighted that there was a lack of understanding of the technical complexities associated with mining the Voorspoed resource and that the plan was estimated to make a R195 million loss over the next five years.

4. A close-out meeting was held with KYPR and the NUM National office on 19 February 2019 to officially provide feedback to all the stakeholders.

5. We have therefore concluded that the mining of the Voorspoed Mine open pit resource is not viable and have consequently closed the disposal process.

We hereby confirm that we have closed all the outstanding next steps from the Committee and hereby request for the Committee to confirm this in writing.

The above update is provided under the auspices of section 29 of the MPRDA (read with section 30 thereof).

Yours sincerely

PHILLIP BARTON
CHIEF EXECUTIVE OFFICER
DE BEERS CONSOLIDATED MINES

De Beers Consolidated Mines Proprietary Limited

[illegible]
[illegible]
[illegible]

A member of the Anglo American plc group

[illegible]

Appendix 25: Invitation letter that was circulated to all identified Interested and Affected Parties, inviting them to register and participate in the EIA process

NWU

Internal Box 150, Private Bag X6001, Potchefstroom, South Africa 2520

Centre for Environmental Management
Tel: +27 (0) 18 299-1467
Fax: + 27 (0) 18 299-4266
Email: theunis.meyer@nwu.ac.za
Web: www.nwu.ac.za/cem

29 July 2019

Land Owners and other Interested and Affected Parties
per mail, e-mail & fax

Sir/Madam

NOTICE OF BASIC ENVIRONMENTAL IMPACT ASSESSMENT AND PUBLIC PARTICIPATION PROCESS WITH LAND OWNERS AND OTHER INTERESTED AND AFFECTED PARTIES IN RESPECT OF THE APPLICATION FOR AN ENVIRONMENTAL AUTHORISATION FOR DECOMMISSIONING AND CLOSURE OF THE VOORSPOED DIAMOND MINE BY THE DE BEERS GROUP (PTY) LTD

Voorspoed Mine is an open pit diamond mine, located approximately 30km north of Kroonstad and 50km south of Vredefort and owned by the De Beers Group. Operation at the mine commenced in 2008 and the mining activities are licenced until October 2023. However, operations at the mine ceased in December 2018 and the mine is currently in the decommissioning and closure phase.

In order to decommission the mine infrastructure as part of the mine closure process, Voorspoed Mine is required to obtain an Environmental Authorisation (EA), prior to commencement of the decommissioning activities. The listed activity that the mine need authorisation for is Activity 22 in Listing Notice 1: The decommissioning of any activity requiring a closure certificate in terms of section 43 of the Mineral and Petroleum Resources Development Act (Act No. 28 of 2002).

The application has been delivered to the Department of Mineral Resources (DMR) on 05 July 2019. In terms of the 2014 EIA regulations, the applicant must give notice to all potential interested and affected parties of an application that is subjected to public participation.

The Centre for Environmental Management (CEM) has been appointed to act as the independent Environmental Assessment Practitioner (EAP) to conduct a basic Environmental Impact Assessment (EIA) and related processes and specialist studies for the purpose of obtaining the environmental authorisation for the decommissioning of the mine. The process is being undertaken in terms of the National Environmental Management Act (No. 107 of 1998) and the 2014 EIA regulations.

One of the most important parts of the environmental authorisation processes is public participation and consultation, which provides Interested and Affected Parties (I&APs) with the opportunity to gain a better understanding of the proposed project and to raise any environmental issues or concerns they may have. You are invited to register as an I&AP in the environmental assessment process of the Voorspoed Mine decommissioning and closure project. Registered I&APs will be able to participate in the EIA process in the following ways:

- Receive information on the project in the Background Information Document (BID), as well as at public meetings;
- Assist in the identification of specific environmental issues and concerns that you must be considered in the EIA, as well as suggestions on how to prevent or mitigate potential environmental impacts;
- Review and comment on the Basic (Environmental Impact) Assessment Report (BAR), Environmental Management Progamme (EMPr) and Closure Plan (CP), before submission to the DMR.

Registration and Background information

You are hereby requested to register as and I&AP and peruse the attached BID. Please complete the feedback form attached to the BID and return it to the EAP, in order to assist in the identification of specific environmental issues and concerns, as well as any suggestions on how to prevent or mitigate potential environmental impacts.

Contact details for the EAP are as follows:

Land-line	018 299 4299	Fax	018 299 4266	Cell phone	078 804 5126
e-mail	Tshepiso.Seobi@nwu.ac.za				

Public meetings

Two public meetings will be held to provide information about the project and allow I&APs to participate. You are invited to attend and participate in the meetings. The details are as follows:

Venue: Kroonstad Town Hall

Date: Monday, 19 August 2019

Time: 16:00

Venue: Parys Town Hall

Date: Tuesday, 20 August 2019

Time: 16:00

Review of the BAR, EMPr and CP before submission

Copies of the BAR, EMPr and CP will be made available by to all registered I&APs in August for review and public comments, before finalisation and submission of the reports to the Department of Mineral Resources for evaluation and decision-making.

Your participation is appreciated.

Yours sincerely

Mr. T.C. Meyer

Environmental Assessment Practitioner, Pri. Sci. Nat

CENTRE FOR ENVIRONMENTAL MANAGEMENT

Appendix 26: Background Information Document with information about the decommissioning and mine closure process, as well as the EIA process and the role of interested and affected parties in the process, with a registration and feedback form that was circulated with the invitation letter to all identified I&APs

Background Information Document for the decommissioning and closure of the Voorspoed Diamond Mine in terms of section 24 of the National Environmental Management Act (107 of 1998) and section 43 of the Minerals and Petroleum Resources Development Act (28 of 2002) by the De Beers Group (Pty) Ltd

Background

Voorspoed Mine is an open pit diamond mine, owned by the De Beers Group. De Beers acquired the mine in 1912, but only established operations between 2006 and 2008. Operation at the mine commenced in 2008 and the mining activities are licenced until October 2023. However, operations at the mine ceased in December 2018 and the mine is currently in the decommissioning and closure phase.

Location of the mine

The mine is located approximately 30km north of Kroonstad and 50km south of Vredefort in the Ngwathe Local Municipality, in the Fezile Dabi District of the Free State (Figure 1).

Figure 1: Locality of the Voorspoed Diamond Mine

Mine environmental impacts and environmental management

Prior to the development of the mine in 2006, the area on which the mine is located was relatively undeveloped and used for agricultural purposes, primarily livestock grazing. Within the vicinity of the current open pit area, remnants from mining activities in the early 1900s were present, including a relatively shallow open pit and a waste (spoil) dump.

During the life of the mine infrastructure was developed on and off the mining area, while various residue deposits were also dumped on the mining area. These created environmental impacts that were managed in terms of the various environmental authorisations issued to the mine, as well as the approved Environmental Management Programme and Integrated Water and Waste Management Plan of the mine.

Description of the decommissioning and mine closure process

Voorspoed Mine's overarching closure objective is to ensure sustainability beyond mine closure and leave a positive legacy. Specific closure objectives are to:

- Restore as much as possible of the mining area to a condition consistent with the pre-determined post closure land use objectives;
- Ensure that the area is left in a condition that poses an acceptable level of risk to public health and safety; and
- Reduce the need for post closure intervention, either in the form of monitoring or on-going remedial work, as far as is practicably possible.

The overall rehabilitation goal is to manage the mine site and implement rehabilitation measures in order to meet the end land use of grazing for livestock and game after closure. This can be achieved by the physical rehabilitation of disturbed areas, by preparing the areas for revegetation, i.e. implement earthworks to create suitable habitats and support the ecological stability (e.g. erosion resistance) of rehabilitated areas. Once this has been done, vegetation will be established that will have the desired stability, species diversity and ecological functioning. In addition, natural water drainage of the rehabilitated site will be re-established where possible, while artificial drainage will be controlled.

Environmental Impact Assessment Process

In order to **decommission** the mine infrastructure as part of the mine closure process, Voorspoed Mine is required to obtain an Environmental Authorisation (EA), prior to commencement of the decommissioning activities. The listed activity that the mine need authorisation for is Activity 22 in Listing Notice 1: The decommissioning of any activity requiring a closure certificate in terms of section 43 of the Mineral and Petroleum Resources Development Act (Act No. 28 of 2002).

The Centre for Environmental Management (CEM) has been appointed to act as the independent Environmental Assessment Practitioner (EAP) to conduct an Environmental Impact Assessment (EIA) and related processes and specialist studies for the purpose of obtaining the required authorisation for the decommissioning of the mine. The process is being undertaken in terms of the National Environmental Management Act (No. 107 of 1998) (NEMA).

Purpose of the EIA process

The 2014 EIA regulations, promulgated in terms of NEMA, prescribe the procedure that must be followed in the EIA process. The regulations aim to provide the competent authority with adequate information to make decisions that will ensure that activities that may have unacceptable negative impacts on the environment are not authorised, and activities that are authorised are undertaken in such a manner that the environmental impacts are managed to acceptable levels.

The aims of environmental impact assessment are to:

- establish the environmental sensitivity of the site;
- determine environmental impacts related to the project;
- identify alternatives to the current proposals;
- inform Interested and Affected Parties (e.g. neighbours & community groups) (I&APs) about the project and provide them the opportunity to identify issues and alternatives;
- assess the proposals and the issues raised.

What type of EIA process will be undertaken?

The 2014 EIA Regulations provide for two types of assessment processes i.e. a Basic (Environmental Impact) Assessment process and a Scoping and Environmental Impact Assessment process.

The EIA process requires that an application for environmental authorisation must be submitted to the Department of Mineral Resources (DMR), supported by specialist reports where required.

The environmental assessment process for this project will involve the following steps:

- Engaging with competent authorities
- Development of Background Information Document, advertisements & site notices
- I&AP registration & circulation of BID
- Conducting of specialist studies
- Drafting of Basic Assessment Report (BAR), Environmental Management Programme (EMPr) and Closure Plan (CP)
- Public participation meeting
- Circulation of draft BAR, EMPr and CP to registered I&APs for review
- Revision of BAR, EMPr and CP, based on I&AP comments
- Submission of final BAR, EMPr and CP to DMR for decision-making
- Informing registered I&APs of the decisions by competent authorities.

Once the DMR has taken a decision on the application, an appeal may be lodged against the decision, if any party involved in the EIA process does not agree with the decision.

What is the role of I&APs in the EIA process?

One of the most important parts of the environmental authorisation processes is public consultation and participation, which provides I&APs with the opportunity to gain a better understanding of the proposed development and to raise any environmental issues or concerns they may have. You are invited to register as an I&AP and participate in the EIA process of the Voorspoed Mine decommissioning and closure project.

How do I register as an I&AP?

Please note that in order to be registered as an I&AP, you must request that your name be added to the registered I&AP list or provide written comments on the proposal or raise issues/concerns that you would like to be addressed in the assessment (see attached form). Future correspondence will only be distributed to registered I&APs.

Details of the EAP

Mr. Theunis Meyer
Telephone: 018 299 1467 Fax: 086 513 7996
E-mail: theunis.meyer@nwu.ac.za

Contact person for I&AP registration and correspondence regarding the EIA process:
Mr. Tshepiso Seobi
Centre for Environmental Management
Private Bag X6001, Potchefstroom, 2520
Telephone: 018 299 4299 or 078 804 5126 **Fax:** 086 513 7996
E-mail: Tshepiso.Seobi@nwu.ac.za

INTERESTED & AFFECTED PARTY (I&AP) REGISTRATION FORM

Application for the decommissioning and closure of the Voorspoed Diamond Mine in terms of the National Environmental Management Act (107 of 1998) and the Minerals and Petroleum Resources Development Act (28 of 2002) by the DeBeersgroup (Pty) Ltd

1. **I, hereby, acknowledge receipt of information regarding the application.**

I wish to register as I&AP and receive further information	
I DO NOT wish to register as I&AP and to receive further information	

2. **Name and surname:**

____

____

3. **Name of business/entity that you represent:**

____

____

4. **Physical Address:**

____

____

5. **Language preference:**

Afrikaans		English		Sesotho	

6. **Communication preference?**

Letter		Fax		E-mail	
WhatsUp		SMS		Please call me	

7. **Postal address:**

____

____

8. Telephone number:		**9. Cell phone number:**	
10. Fax number:		**11. E-mail address:**	

12. **Do you wish to receive future communication?**

Yes		No	

13. **Please indicate any environmental issues of concern regarding the decommissioning and mine closure?**

____

____

____

____

____

14. **Please indicate any suggestions to control identified environmental impacts?**

____

____

____

____

____

15. **Please indicate any suggestions to improve the decommissioning, mine closure and public participation processes?**

____

____

____

____

____

Thank you very much for your participation!

Appendix 27: Evidence of the site notices that were displayed to inform propspective Interested and Affected Parties of the Voorspoed Diamond Mine decommissioning basic environmental impact assessment process

- Turn-off to Voorspoed Diamond Mine from the Kroonstad- Viljoenskroon road

- Turn-off to Voorspoed Diamond Mine from the Kroonstad- Vredefort road

- Voorspoed Diamond Mine entrance

- Municipal offices, Moqhaka Municipality, Kroonstad

- Kroonstad public library

- Viljoenskroon public library

- Municipal offices, Moqhaka Municipality, Viljoenskroon

- Municipal offices, Ngwathe Municipality, Parys

- Parys public library

- Vredefort public library

- Koppies public library

Appendix 28: Evidence of the newspaper advertisements that were published to inform propspective Interested and Affected Parties of the Voorspoed Diamond Mine decommissioning basic environmental impact assessment process

- Business Times, 4 August 2019

120c/kWh

Business
The Big Read

Eskom is running out of daylight

'You've got to address the quantum of the debt that Eskom can sustain on its balance sheet'

Trump campaign idea sucks

MASTER OF MANAGEMENT AND POSTGRADUATE DIPLOMA IN MANAGEMENT IN THE FIELD OF DIGITAL BUSINESS

INFORMATION EVENING

NWU

- Kroonnuus, 6 August 2019

- Parys Gazette, 1 August 2019

DONDERDAG 1 AUGUSTUS 2019 PARYS GAZETTE www.parysgazette.co.za 7

Van die Voorskoolse maats van Parys Voortrekkerkommando wat Woensdag hul broodbydraes gegee het.

Brood vir hulle in nood

Liezl Schepers

[illegible]

Agter die dromme vir Nashville musiekfees

Liezl Schepers

[illegible]

Theuns Botha agter die dromme. Foto: Verskaf

Hulle stap met die louere weg by rolbalkrag-meting

[illegible]

Die wenners van die gemengde driespel was Rudi Jacobs, Sharie Brown en Frik du Preez. Foto: Verskaf

Regs: Toots van der Westhuizen en Raymond Louber wat onderskeidelik die mans- en dameswenners van die rolbalkragmeting was.

NOTIFICATION OF PUBLIC PARTICIPATION PROCESS
DMR Reference Number: FS 30/5/1/2/3/2/1(12) EM

NOTICE OF BASIC ENVIRONMENTAL IMPACT ASSESSMENT, PUBLIC PARTICIPATION AND CONSULTATION PROCESS IN RESPECT OF APPLICATION FOR AN ENVIRONMENTAL AUTHORISATION FOR DECOMMISSIONING OF VOORSPOED DIAMOND MINE IN THE FEZILE DABI DISTRICT, FREE STATE PROVINCE, BY DE BEERS GROUP

Notice is hereby given of a **public participation process in terms of Regulation 41 of the EIA Regulations, published in Government Gazette No. 982 under Section 24(5) and 44 of the National Environmental Management Act (NEMA)**, as part of the application process for an environmental authorisation to undertake the following listed activities:

Activity 22 (GN R. 983 of 2014): The decommissioning of any activity requiring a closure certificate in terms of section 43 of the Mineral and Petroleum Resources Development Act (Act No. 28 of 2002).

Project: Decommissioning of the mine infrastructure as part of the mine closure process. The mine's overarching closure objective is to ensure sustainability beyond mine closure and leave a positive legacy. The overall rehabilitation goal is to manage the mine site and implement rehabilitation measures in order to meet the end land use of grazing for livestock and game after closure.

Location: Mining area on the farms Voorspoed 2480, Voorspoed 401, Geldenhuys 1477 and Morgenster 772, located approximately 30km north of Kroonstad and 50km south of Vredefort in the Ngwathe Local Municipality (27°22.50'S, 27°12.0'E).

Opportunity to register as an Interested and Affected Party: In order to register as an interested and/or affected party, please submit your name, contact information (preferred method of notification, e.g. e-mail address or fax number) and an indication of any direct business, financial, personal or other interest in the matter to the contact person below, by **20 August 2019**.

Public meetings: Monday, 19 August 2019 at 16:00 in Kroonstad Town Hall
Tuesday, 20 August 2019 at 16:00 in Parys Town Hall

For more information contact: Mr. Tshepiso Sedibi, Centre for Environmental Management, Internal Box 150, Private Bag X6001, Potchefstroom, 2520, Tel: (018) 299-4299, Fax: (018) 299-4266,
E-mail: tshepiso.sedibi@nwu.ac.za

TSEBISO EA TSHEBETSO EA HO NKA KAROLO HA SETJHABA
Nomoro ea Boitsebiso ea DMR: FS 30/5/1/2/3/2/1(12) EM

TSEBISO EA TLHAHLOBO EA PHELLO EA TIKOLOHO, TSHEBETSO EA HO NKA KAROLO HA SETJHABA LE HO BUISANA LE SETJHABA MABAPI LE KOPO EA TUMELLO EA TIKOLOHO BAKENG SA HO EMISA HO RAFA KO VOORSPOED DIAMOND MINE MO SETEREKENG SA FEZILE DABI, FREE STATE PROVINCE, KOPO E ETSOA KE DE BEERS GROUP

Ho fanoa ka tsebiso ea tshebetso ea ho nka karolo ha setjhaba ho latela Regulation 41 ea EIA Regulations, e hatisitsoeng mo Government Gazette No. 982 tlasa Section 24(5) le 44 tsa National Environmental Management Act (NEMA), e le karolo ea thulaganyo ea kopo bakeng sa tumello ea tikoloho ea ho etsa mesebetsi (activities) e thathamisitsoeng e latelang:

Activity 22 (GN R. 980 ea 2014): [illegible] section 43 ea Mineral and Petroleum Resources Development Act (Act No. 28 of 2002).

Projeke: [illegible]

Sebaka: Sebaka sa merafo se mapolasing a Voorspoed 2480, Voorspoed 401, Geldenhuys 1477 le Morgenster 772, se le bohole bo ka bang 30km ka leboea ho Kroonstad le 50km ka borwa ho Vredefort mo Masepaleng oa Selehae oa Ngwathe (27°22.50'S, 27°12.0'E).

Monyetla oa ho ngolisa joale ka Leloko le Thahaselang le le Amehileng: [illegible] projekeng ena, ikopanye le motho ka tlase mona ho fihlela ka 20 Phato 2019.

Likopano tsa phatlalatsa:
Mantaha, 19 Phato 2019 ka 16:00 Holong ea Kroonstad
Labobeli, 20 Phato 2019 ka 16:00 Holong ea Parys

Ho fumana malebinyana a eketsehileng ikopanye le: Tshepiso Sedibi, Centre for Environmental Management, Internal Box 150, Private Bag X6001, Potchefstroom, 2520, Tel: (018) 299-4299, Fax: (018) 299-4266.
E-mail: tshepiso.sedibi@nwu.ac.za

- Dumelang News, 2 August 2019

DumelangNews | Junior Bonase Page | Friday 02 August 2019 | NEWS | 5

"Racial spat" at BFN School dismissed as "nothing"

Education Department dismisses the incident as nothing but violence among pupils

Deneysville erupts in protest

Sharp Sharp NEWS

Triple murder shocks Motshabi

NOTIFICATION OF PUBLIC PARTICIPATION PROCESS
DMR Reference Number: FS 30/5/1/2/3/2/1(12) EM

NOTICE OF BASIC ENVIRONMENTAL IMPACT ASSESSMENT, PUBLIC PARTICIPATION AND CONSULTATION PROCESS IN RESPECT OF APPLICATION FOR AN ENVIRONMENTAL AUTHORISATION FOR DECOMMISSIONING OF VOORSPOED DIAMOND MINE IN THE FEZILE DABI DISTRICT, FREE STATE PROVINCE, BY DE BEERS GROUP

Notice is hereby given of a **public participation process in terms of Regulation 41 of the EIA Regulations, published in Government Gazette No. 982** under Section 24(5) and 44 of the National Environmental Management Act (NEMA), as part of the application process for an environmental authorisation to undertake the following listed activities:

Activity 22 (GN R. 983 of 2014): The decommissioning of any activity requiring a closure certificate in terms of section 43 of the Mineral and Petroleum Resources Development Act (Act No. 28 of 2002).

Project: Decommissioning of the mine infrastructure as part of the mine closure process. The mine's overarching closure objective is to ensure sustainability beyond mine closure and leave a positive legacy. The overall rehabilitation goal is to manage the mine site and implement rehabilitation measures in order to meet the end land use of grazing for livestock and game after closure.

Location: Mining area on the farms Voorspoed 2480, Voorspoed 401, Geldenhuys 1477 and Morgenster 772, located approximately 30km north of Kroonstad and 50km south of Vredefort in the Ngwathe Local Municipality (27°22.50"S, 27°12.0"E).

Opportunity to register as an Interested and Affected Party: In order to register as an interested and/or affected party, please submit your name, contact information (preferred method of notification, e.g. e-mail address or fax number) and an indication of any direct business, financial, personal or other interest in the matter to the contact person below, by **20 August 2019.**

Public meetings: Monday, 19 August 2019 at 16:00 in Kroonstad Town Hall
Tuesday, 20 August 2019 at 16:00 in Parys Town Hall

For more information contact: Tshepiso Seobi, Centre for Environmental Management, Internal Box 150, Private Bag X6001, Potchefstroom, 2520, Tel: (018) 299-4299, Fax: (018) 299-4266, E-mail:

TSEBISO EA TSHEBETSO EA HO NKA KAROLO HA SETJHABA
Nomoro ea Boitsebiso ea DMR: FS 30/5/1/2/3/2/1(12) EM

TSEBISO EA TUHALLOSO EA PHELLO EA TIKOLOHO, TSHEBETSO EA HO NKA KAROLO HA SETJHABA LE HO BUISANA LE SETJHABA MABAPI LE KOPO EA TUMELLO EA TIKOLOHO BAKENG SA HO EMISA MO KAPA KO VOORSPOED DIAMOND MINE MO SETEREKENG SA FEZILE DABI, FREE STATE PROVINCE, KOPO E ETSOA KE DE BEERS GROUP

Ho fanoa ka tsebiso ea tshebetso ea ho nka karolo ha setjhaba ho latela **Regulation 41 ea EIA Regulations, e hatisitsoeng mo Government Gazette No. 982 tlasa Section 24(5) le 44 tsa National Environmental Management Act (NEMA)**, e le karolo ea thulaganyo ea kopo bakeng sa tumello ea tikoloho ea ho etso mesebetsi (activities) e thathamisitsoeng e latelang:

Activity 22 (GN R. 983 ea 2014): Ho emisa mosebetsi leha e le ofe o hlokang lengolo la ho koala ka section 43 ea Mineral and Petroleum Resources Development Act (Act No. 28 of 2002).

Projeke: Ho nyetsa meaho ea le lisebelisoa tsa merafo e le karolo ea tsamaiso ea ho koaloa ha merafo. Sepheo sa ho koala merafo se ka holimo tsohle ho netefatsa botsitso ka nqane ho koalo ea merafo le ho siea lefa le khothatsang. Ka kakaretso morero oa tsosoloso ke ho laola setsha sa merafo le ho kenya tshebetsong mehato ea tsosoloso e le hore qetellong naha eo e sebelisetsoe ho fula ha liphoofolo tse ruiloeng le liphoofolo tsa papali ka mor'a ho koaloa.

Sebaka: Setsha sa merafo se mapolasing a Voorspoed 2480, Voorspoed 401, Geldenhuys 1477 le Morgenster 772, se le bohole bo ka bang 30km ka leboea ho Kroonstad le 50km ka boroa ho Vredefort mo Masepaleng oa Selehae oa Ngwathe (27°22.50"S, 27°12.0"E).

Monyetla oa ho ngolisa joalo ka Leloko le Thahasellang le le Amehileng: Hore o ingolise joalo ka leloko le thahasellang le/kapa le amehileng, ka kopo ingolise ka ho romela lebitso la hao, lintlha tsa ho ikopanya le oena (tsebetsa mokhoa oa tsebiso, mohlala, aterese ea e-mail kapa nomoro ea fax) le litshupo tsa thahasello ea khoebo e tobileng, ea lichelete, ea hao kapa efe kapa efe mo projekeng ena, ikopanye le motho ka tlaase mona ho fihlela ka 20 Phato 2019.
Likopano tsa phatlalatsa: Mantaha, 19 Phato 2019 ka 16:00 Holong ea Kroonstad

Labobeli, 20 Phato 2019 ka 16:00 Holong ea Parys
Ho fumana maseliyana a eketsehileng ikopanye le: Tshepiso Seobi, Centre for Environmental Management, Internal Box 150, Private Bag X6001, Potchefstroom, 2520, Tel: (018) 299-4299, Fax: (018) 299-4266, E-mail

Appendix 29: Minutes of the public meeting held in Kroonstad at the Kroonstad Civil Centre on 19 August 2019, including copies of representations and comments received from registered interested and affected parties

Private Bag X6001, Potchefstroom
South Africa 2520

Tel: 018 299-1111/2222
Web: http://www.nwu.ac.za

Centre for Environmental Management

Internal box 150, Private Bag X6001, Potchefstroom, South Africa, 2520

Tel: 018 299 1467
Fax: 018 299 4266
Email: theunis.meyer@nwu.ac.za

Web: https://cem-nwu.co.za/

Minutes of the Public Meeting for the Application for Environmental Authorisation for the Proposed Decommissioning of the Voorspoed Diamond Mine, in the Ngwathe Local Municipality, Free State held on 19 August 2019 in the Allen Rautenbach Hall, Hill Street, Kroonstad

1. **Welcome**

   Mr Tshepiso Seobi welcomed all attendees to the meeting and briefly explained the purpose of the meeting.

2. **Attendance**

   The meeting was attended by the North-West University project team, ten representatives from Voorspoed Mine and ten members of the public. See attendance register, attached as Appendix A.

3. **Safety moment**

   Mr Andrew Moremi from Voorspoed Diamond Mine shared a safety moment with the public meeting attendees. The topic of the moment was on the hazards associated with the use of many extension cords in the venue were the meeting was being held. Meeting attendees were cautioned to take care when moving around in the venue.

4. **Public meeting presentation**

   The meeting was held, using a PowerPoint presentation, which is attached as Appendix B.

5. **Introduction to the facilitator, Environmental Assessment Practitioner and project team**

   The meeting was facilitated by Prof Johan Nel from the North-West University's (NWU) Centre for Environmental Management (CEM). The Environmental Assessment Practitioner (EAP) for the Environmental Impact Assessment is Mr Theunis Meyer, also from the NWU, CEM. Mr Tshepiso Seobi, who assists with the Public Participation (PP) component of the project, and Mrs Simoné van Rooyen (who recorded the minutes of the meeting) also forms part of the NWU CEM project team.

   Voorspoed Diamond Mine was represented by Mr Petrus Jordaan (Closure Manager), Mr Andrew Moremi (Public Relations Manager) and Mr Hans Kgasago (Rehabilitation Manager). Mr DP van der Merwe, a mine rehabilitation specialist from Redco, is one of the specialists that assisted with the development of the mine closure plan that also attended the meeting.

6. Meeting format

Prof Johan Nel explained the format of the meeting, i.e. a presentation will be presented by the project team, after which all attendees will be invited to participate in a question and answer session. After this session, the road ahead will be explained.

7. Introduction

7.1 Understanding the legal requirements for decommissioning and mine closure

The legal requirements for decommissioning and mine closure was explained by the Mr Theunis Meyer (see slides 8 to 17 of Appendix B). Reference was made to some requirements of the Mineral and Petroleum Resources Development Act 28 of 2002 and the National Environmental Management Act 107 of 1998 (NEMA).

7.2 Understanding the Environmental Impact Assessment process

The Environmental Impact Assessment (EIA) process that is required by the NEMA was also explained by Mr Theunis Meyer (see slides 18 to 26). A process flow displayed the generic EIA process.

7.3 Understanding the Public Participation process

The PP process that is required as part of the EIA process was also explained by Mr Theunis Meyer (see slides 27 to 36). The aim of the PP process was explained using a figure.

7.4 Introduction to the Voorspoed Diamond Mine decommissioning and closure process

The Voorspoed Diamond Mine decommissioning and closure process was explained by Mr Petrus Jordaan (see slides 37 to 47). The location, the current mine infrastructure and status of the mining pit were also displayed using maps.

7.5 Community benefits

The benefits to the community was explained by Mr Andrew Moremi (see slides 48 to 56). Contents from the Socio-economic Impact Assessment and Social Labour Plan were presented to explain the way in which the community benefitted during the operational phase of the mine, as well as those that will be continuing until mine closure.

8. Voorspoed Diamond Mine closure plan

8.1 Alternatives considered

The alternatives considered was explained by Mr Hans Kgasago (see slides 57 to 68). Various alternatives as well as the preferred option were described.

8.2 End land use

The end land use (ELU) was also explained by Mr Hans Kgasago (see slides 69 to 78). Content from the ELU Plan was presented. The ELU, farms or areas included in the ELU Plan, the current land use and soil and land capability were also displayed using maps.

8.3 Decommissioning and rehabilitation actions

The decommissioning and rehabilitation actions were also explained by Mr Hans Kgasago (see slides 79 to 94). Updates on rehabilitation for the periods 2014 to 2018 and 2019 were displayed using numerous photographs.

9. PP process followed to date

The PP process followed to date was explained by Mr Tshepiso Seobi (see slides 95 to 106). Reference was made to the publication of newspaper advertisements as well as the placement of site notices.

10. Identification of environmental issues and mitigation measures related to the decommissioning and mine closure process

10.1 Identification of environmental issues identified by the EAP and the specialists

The environmental issues identified was discussed by Mr Theunis Meyer (see slides 107 to 110). Soil compaction and pollution, surface water run-off, groundwater quality deteriorating etc., were identified as issues.

10.2 Facilitation of process to identify additional environmental issues by Interested and Affected Parties

The facilitator, Prof Johan Nel, facilitated a session in which the Interested and Affected Parties (I&APs) could raise additional environmental issues of concern (see slides 111 to 113 of the presentation). A number of comments and questions were raised by participants (attached as Appendix C) and responded to by the EAP and representatives of Voorspoed Mine (attached as Appendix D).

10.3 Identification of rehabilitation actions and mitigation measures identified by the EAP and the specialists

The rehabilitation actions identified to address the environmental impacts caused by the mining activities and to reinstate most of the rehabilitated footprint area back to agricultural land was discussed by Mr Theunis Meyer (see slides 114 to 116). These included decommissioning existing structures and infrastructure, ripping areas with compacted soil, bio-remediating hydrocarbon polluted soils, reshaping steep slopes of mine residue deposits and reinstating surface water drainage lines on-site, to mention a few.

10.4 Facilitation of process to identify additional rehabilitation actions and mitigation measures by Interested and Affected Parties

The facilitator facilitated a session in which the I&APs were invited to raise additional rehabilitation actions and mitigation measures (see slides 117 to 118). No comments or questions were received from the participants.

11. General question and answer session

The facilitator invited the participants to raise any other issues related to the decommissioning and closure of the mine not yet discussed during the meeting (see slide 119). No additional issues were raised by any participant.

12. The road ahead

The EAP, Mr Meyer, explained the road ahead for the EIA process (see slides 120 to 121). It includes, amongst others, the finalisation of the draft Basic Assessment Report (BAR), Environmental Management Programme (EMPr) and Closure Plan (CP) and the reviewing of and commenting on the BAR, EMPr and CP by I&APs.

NWU® | CEM

13. Closure

The facilitator closed the public meeting by thanking all for their attendance and providing the contact details of Messrs Theunis Meyer and Tshepiso Seobi for further engagement (see slides 122 to 123).

Appendix A: Attendance register

DE BEERS GROUP | NWU | CEM

ATTENDANCE REGISTER

Project: EIA for Decommissioning of De Beer Voorspoed Mine
Event: Public Meeting
Locality: Allen Rautenbach Hall, Hill Street, Kroonstad
Date and Time: Monday 19 August 2019 at 16h00

Title, Name and Surname	Affiliation (Organisation) and Designation or Nature of involvement	Cell and / or Telephone Number(s)	E-mail/Postal Address(es)	Signature
Mr N. Pacwa	Raucom Business Chamber	082 397 0652	[illegible]	
[illegible]	[illegible]	082 410 3674	[illegible].co.za	
[illegible]	[illegible]	[illegible]	[illegible]	

Voorspoed Mine Attendance Register Public Meeting — Rev 2019-07 — Page 1 of 8

Title, Name and Surname	Affiliation (Organisation) and Designation or Nature of involvement	Cell and / or Telephone Number(s)	E-mail/Postal Address(es)	Signature
Joseph [illegible]	DE BEERS	0824873693		
[illegible]	De Beers	076 010 8019		
F.P. [illegible]	"	056 2162542		
Mr [illegible]	"	073 533 1421		
Mr [illegible]	De Beers	0820178384 056 216 8414		

Voorspoed Mine Attendance Register Public Meeting — Rev 2019-08 — Page 2 of 8

NWU | CEM

Title, Name and Surname	Affiliation (Organisation) and Designation or Nature of involvement	Cell and / or Telephone Number(s)	E-mail/Postal Address(es)	Signature
WINDY SENOGE	Public Participation Office	072 595 5946	1347 Kockoe Village Kroonstad	W Senoge
MFAKA STEPHEN SEPHUME	PUBLIC PARTICIPANT	0849960991	7 Stolier Str Snideand Kroonstad 9499	[illegible]
Reboile Kgaba	DEBEERS	056 2168500	[illegible] @debeersgroup.com	[illegible]
Thandi Tlhabile	De Beers Environmental Officer	056 2168530	[illegible] @debeersgroup.com	[illegible]
Mojabeng Ruiname	De Beers Corporate Affairs	056 216 8537	[illegible] @debeersgroup.com	[illegible]

Title, Name and Surname	Affiliation (Organisation) and Designation or Nature of involvement	Cell and / or Telephone Number(s)	E-mail/Postal Address(es)	Signature
Ms Sarah Letsapa	Sign Language Interpreter	0731918084	[illegible] @gmail.com	[illegible]
Mr Tuisetso Mangena	Public	082 936 7631	[illegible]	[illegible]
Tshepiso Sedibe	North-West Univ. Centre for Env. Management	018 2999 297 077 509 5176	Tshepiso.Sedibe@nwu.ac.za	[illegible]
[illegible]	NWU CEM	[illegible]	[illegible]	[illegible]
Johan Nel	NWU CEM	0832637082	johan.nel@nwu.ac.za	[illegible]

NWU® | CEM Centre for Environmental Management

Title, Name and Surname	Affiliation (Organisation) and Designation or Nature of involvement	Cell and / or Telephone Number(s)	E-mail/Postal Address(es)	Signature
DP vd Merwe	REDCO	082 903 1528	dp@redcoservices.co.za	
PS Jordaan	De Beers	056 - 216 8966	petrus.jordaan@debeersgroup.com	
Hans Kgasago	DE Beers	056 216 8605	hans.kgasago@debeersgroup.com	
Tsuentsweu	Tshel. long Trading	0736780847	Gkhablongoga@kgmail	
Patiso Moreken & Dike G.C.	Patiso Arts and gadgets(Pty)Ltd / Borleds	073 186 5296 / 0760811363	mpatiso@yahoo.com	

Appendix B: PowerPoint presentation that was used during the meeting


Why are we here? (1)


Why are we here? (2)


Why are we here? (3)


Why are we here? (4)


Why are we here? (5)


Why are we here? (6)


Why are we here? (7)


Why are we here? (8)


Why are we here? (3)
Why are we here?
Understanding the EIA process
EIA process (1)
EIA process (2)
Generic EIA Process
EIA process (3)
EIA Role players
EIA process (4)
EIA Role players
EIA process (5)


EIA process (6)


EIA process (7)


Why are we here?
Understanding the Public Participation process


Public participation process (1)


Public participation process (2)


Public participation process (3)


Public participation process (4)


Public participation process (5)


Public participation process (6)


Public participation process (7)


Public participation process (8)


Aim of Public Participation Process


Introduction to the Voorspoed Mine decommissioning & closure process


Locality map


Historical background (1)


Historical background (2)


Current mine infrastructure


Status of mining pit


Voorspoed Mine Closure Process (1)


Voorspoed Mine Closure Process (2)


Voorspoed Mine Closure Process (3)


Proposed Voorspoed decommissioning & closure (1)


Proposed Voorspoed decommissioning & closure (2)

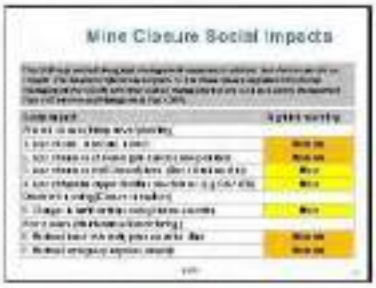

Community Benefits


Host & Labour-sending Area


Updated SEIA report


Overall SEIA outcome


Community visibility outcome


Mine Closure Social Impacts


SLP 3: 2017 – 2021 Progress & Outcomes

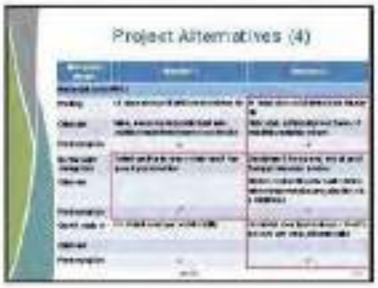

SLP 2: 2012 – 2016 Progress & Outcomes


SLP 1: 2007 – 2011 Progress & Outcomes


Voorspoed Mine Closure Plan –
alternatives considered

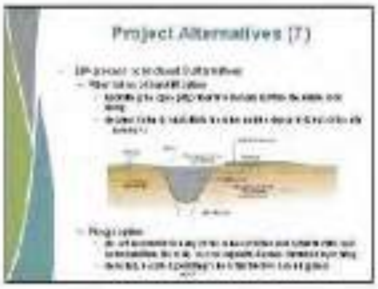
Project Alternatives (1)

Project Alternatives (2)


Project Alternatives (3)

Project Alternatives (4)

Project Alternatives (5)

Project Alternatives (6)


Project Alternatives (7)


Alternatives comparison


Preferred open pit
decommissioning option


Picture of preferred option

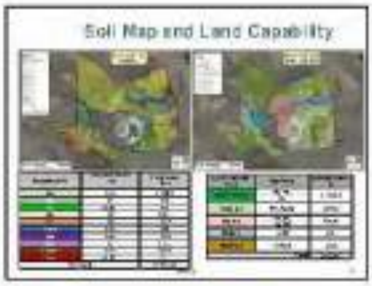

Voorspoed Mine Closure Plan –
end land use


End land use plan (1)


End land use map


Voorspoed End Land Use Plan –
Scope
Land available for ELUP
Workshop
Results


Farms/areas included in ELUP


Soil Map and Land Capability


Potential ELU Options – Added to during workshop


Financial modelling
- primary scenarios – results

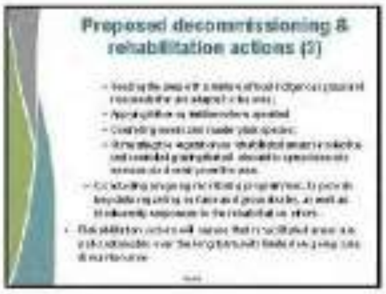

Voorspoed Mine Closure Plan – decommissioning & rehabilitation actions


Mine closure components


Decommissioning & mine closure


Proposed decommissioning & rehabilitation actions (1)


Proposed decommissioning &
rehabilitation actions (2)


Proposed decommissioning &
rehabilitation actions (3)


Rehabilitation Update: 2014 - 2018


Waste Rock Dump – Progress
(Reshaped, Topsoiled & Vegetated)


Waste Rock Dump – Successful Rehabilitation
(Reshaped, Topsoiled & Vegetated)


Rehabilitation Update - 2019


Waste Rock Dump – Progress
(Reshaped, Topsoiled & Vegetated)


Rehabilitation Activities –
Planned VS completed


Waste Rock Dump – 2019 Rehab Progress


Waste Rock Dump – 2019 Rehab Progress


Southern Pan – Bluegum Trees Eradication


Northern Pan – Slangbos Eradication


Public Consultation Process followed to date


I&AP Identification


Public participation process followed (1)


Newspaper Advertisements (1)
Business Times, 4 August 2019


Newspaper Advertisements (2)


Newspaper Advertisements (3)


Newspaper Advertisements (4)


Voorspoed Mine site notices

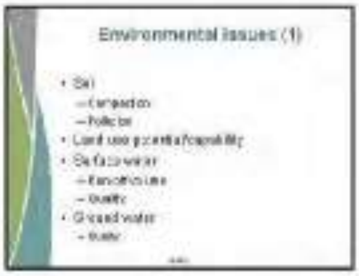

Kroonstad site notices


Parys site notices


Viljoenskroon site notices


Vredefort & Koppies site notices


Identification of
Environmental issues

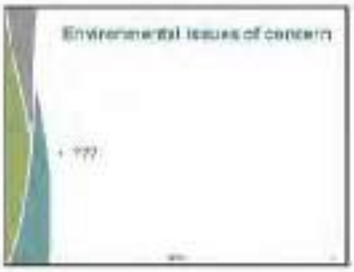

Environmental issues (1)


Environmental issues (2)


Environmental issues (3)


Facilitation of issues
raised by I&APs


Rules for facilitation


Environmental issues of concern
• ???


Identification of
rehabilitation actions


Rehabilitation actions identified (1)


Rehabilitation actions identified (2)


Facilitation of mitigation measures raised by I&APs


Proposed mitigation measures
• ???


Other issues
• ???


The Road Ahead


What next?
• Appeal process


Closure


Contact us:
NWU

Appendix C: Issues and comments raised by the participants

Voorspoed Mine Decommissioning Basic Environmental Impact Assessment: Public Participation Process

ISSUES / COMMENTS / CONCERNS

Title: Mr. Initials: N. Surname: Palm

Organisation / Firm (if applicable): RavCom Business Chamber.

Position / Nature of involvement. E.g. property owner: Chairperson.

Street address: Reitz Street Viljoenskroon.

Postal address:

Tel and area code: (Work) 0562 3970652 (Home)

(Cell) 0562 3970652 (Fax)

E-mail: info@ravcomchamber.com.
skr101@mweb.co.za

Please state your issues / comments / concerns:

1. How to protect against Zama-Zama activities

2. Possible use of rocks/aggregates for brick making or alike.

3. Possible solar plant development. Yes or NO.

RavCom Business Chamber

NICO PALM

Cell +27 (0)82 397 0652
Fax +27 (0)86 609 0408

Email info@ravcomchamber.com
Web www.ravcomchamber.com

Voorspoed Mine Decommissioning Basic Environmental Impact Assessment: Public Participation Process

ISSUES / COMMENTS / CONCERNS

Title: MR Initials M.S. Surname: SEHUME

Organisation / Firm (if applicable): PUBLIC PARTICIPANT

Position / Nature of involvement. E.g. property owner:

Street address: 7 STRAINER STR

Postal address: SUIDRAND KROONSTAD 9499

Tel and area code: (Work) 0562169235 (Home)

(Cell) 0834994099 1 (Fax)

E-mail: moatsstephen@gmail.

Please state your issues / comments / concerns:

- My concern is the way the De Beers Consolidated distributed opportunities both social and employment because children of surrounding farm labourers were never considered for anything for economic development.
- The re-establishment of mining operations at Voorspoed brought more distress and misery to already economically depressed farm labourers families.

Voorspoed Mine Decommissioning Basic Environmental Impact Assessment: Public Participation Process

ISSUES / COMMENTS / CONCERNS

Title: ms Initials: Ronel Surname: Leonard

Organisation / Firm (if applicable): C+R Leonard Pty Ltd

Position / Nature of involvement. E.g. property owner: Director of store

Street address: Farm Belmont

Postal address: PO Box 4164 Kroonstad 9501

Tel and area code: (Work) 0823575486 (Home)

(Cell) 0827852326 (Fax)

E-mail: george-1@mweb.co.za

Please state your issues / comments / concerns:

using the old mine heap and mine on siding on another adjacent farm is there and will there be a proper EAP before giving the ok to mine that heap

Voorspoed Mine Decommissioning Basic Environmental Impact Assessment: Public Participation Process

ISSUES / COMMENTS / CONCERNS

Title: Mr Initials: EP Surname: Mofokeng

Organisation / Firm (if applicable): Patiso Tech and Gadgets

Position / Nature of involvement. E.g. property owner:

Street address: 310 BRAND STREET KROONSTAD

Postal address: SAME AS ABOVE.

Tel and area code: (Work) (Home)

(Cell) 073 186 5896 (Fax)

E-mail: m.patiso@yahoo.com

Please state your issues / comments / concerns:

- Exhibition museum at the pit.
- Tendering process so far for the mine closure.
-

Appendix D: Issues and response table with a summary of the issues raised by the public and the responses provided by the EAP and mine representatives at the meeting

Interested and affected parties	Issues raised	EAP's response to issues as mandated by the applicant
Ronel Leonard	Heard rumours that a party is busy moving some of the historic mine dump from the Mine's premises to another site where it is being re-mined for diamonds	*Response by PJ Jordaan (on behalf of the Mine):* One party was interested in re-mining the historic dump. The Mine requested that this party must first conform to all of the regulatory requirements to proceed with this activity. The party has to date not conformed to the requirements, thus the dump is currently not being reworked.
Ronel Leonard	Suggested that Renosterkop be transformed into a conservation area as an alternative mitigation/rehabilitation measure	*Response by PJ Jordaan (on behalf of the Mine) and by Theunis Meyer, the EAP:* The Renosterkop area referred to is situated outside the mining area and was not negatively impacted by the Mine. Strictly speaking, it does not fall within the ambit of the decommissioning scope of the EIA. The conservation proposal, previously made by the adjacent land owners, was not pursued by the Mine, due to constraints the Mine faced at the time. Land owners are requested to submit a new proposal for consideration.
Mpaka Stephen Sehume	Why has the surrounding farm labourers never benefited economically and socially from the Mine's activities, i.e. employments, education etc.	*Response by PJ Jordaan, Andrew Moremi, Lungile Zimu, Rebotile Kgaka and Mojabeng Pinkoane (on behalf of the Mine):* The Mine did not directly/specifically target the surrounding farm labourers as beneficiaries. Neither did the Mine directly/specifically exclude the surrounding farm labourers as beneficiaries. The corporate social responsibility programmes of the Mine are administered through the Moqhaka and Ngwathe Local Municipalities and other stakeholders, such as the Department of Labour. These parties were tasked to identify beneficiaries that meet the specifications of the projects, i.e. equipment, level of education needs etc. Thus, the surrounding farm labourers need to meet these needs to be eligible beneficiaries, e.g. currently five people from the surrounding communities are employed by the Mine, of which two work in the Supply Chain Department.

Interested and affected parties	Issues raised	EAP's response to issues as mandated by the applicant
Nico Palm	Does the Mine have a plan in place to deal with illegal Miners (Zama-Zamas)?	*Response by PJ Jordaan (on behalf of the Mine):* The Mine recognises the potential threat that illegal Miners may pose and has thus made provision for this in the closure plan in the following manners: 1. All diamonds have been mined from the pit, thus there are no reason/incentive to enter the pit; 2. The access ramps to the pit have already failed and can not be used to access the pit; 3. The pit will be filled with water; 4. The pit will be fenced with a ClearVu security fence restricting access; and 4. Security guards will monitor access to the pit until the rehabilitation plan is implemented. Thereafter, security cameras and alarms will be installed to notify the Mine of any trespassers in future.
Nico Palm	Can the aggregate be used to make bricks?	*Response by PJ Jordaan (on behalf of the Mine):* The Mine has previously explored the option of making bricks from the aggregate. It was found to be an unsuccessful endeavour, since the bricks deteriorate over time. The untreated aggregate is thus not suitable for brickmaking.
Nico Palm	How economically viable is the option of constructing a solar farm on the disturbed mining area as an alternative end land use?	*Response by PJ Jordaan (on behalf of the Mine) and Theunis Meyer, the EAP:* The construction of a solar farm is not currently considered as an economically viable alternative end land use for this site. This option is however still being explored and if it is found to be viable, the correct process will be followed in terms of this application to amend the documentation and inform interested and affected parties accordingly.
Pakiso Mofokeng	Is there a possibility, post closure, to create an educational tourism facility, i.e. a museum and pit view point, similar to the one in Kimberley?	*Response by PJ Jordaan (on behalf of the Mine):* This is not possible, since the geology around the pit is too unstable to allow for the construction of a ramp for a view point. In addition, access to the pit will be restricted by means of a security fence. Therefore, it will not be possible to see the open pit after decommissioning. Creating an educational tourism opportunity

Interested and affected parties	Issues raised	EAP's response to issues as mandated by the applicant
		during the decommissioning and closure process, based on responsible mine closure is a more viable option, thus teaching students about mine rehabilitation.
Pakiso Mofokeng	Pakiso Tech and Gadgets submitted a tender for the rehabilitation of the Mine. Has the tender been awarded to anyone yet?	*Response by PJ Jordaan (on behalf of the Mine):* The 2019 tender for rehabilitation has not been awarded yet.
Pakiso Mofokeng	Will the public participation slide deck displayed today be made available to the public?	*Response by Theunis Meyer, the EAP:* Yes, all documents relating to this application for decommission will be made available in both hard copy ad electronic format. Interested and affected parties will be notified of the when and where the copies are available.

Appendix 30: Minutes of the public meeting held in Parys in the Mosepedi Site Hall, Tumahole, on 20 August 2019, including copies of representations and comments received from registered interested and affected parties

Private Bag X6001, Potchefstroom
South Africa 2520

Tel. 018 299-1111/2222
Web: http://www.nwu.ac.za

Centre for Environmental Management

Internal box 150, Private Bag X6001, Potchefstroom, South Africa, 2520

Tel: 018 299 1467
Fax: 018 299 4266
Email: theunis.meyer@nwu.ac.za

Web: https://cem-nwu.co.za/

Minutes of the Public Meeting for the Application for Environmental Authorisation for the Proposed Decommissioning of the Voorspoed Diamond Mine, in the Ngwathe Local Municipality, Free State held on 20 August 2019 in the Mosepedi Site Hall, Tumahole, Parys

1. Welcome

Mr Tshepiso Seobi welcomed all attendees to the meeting and briefly explained the purpose of the meeting.

2. Attendance

The meeting was attended by the North-West University project team, four representatives from Voorspoed Mine and 34 members of the public. See attendance register, attached as Appendix A.

3. Safety moment

Mr Andrew Moremi from Voorspoed Diamond Mine shared a safety moment with the public meeting attendees. The topic of the moment was on the hazards associated with the use of many extension cords in the venue were the meeting was being held. Meeting attendees were cautioned to take care when moving around in the venue.

4. Public meeting presentation

The meeting was held, using a PowerPoint presentation, which is attached as Appendix B.

5. Introduction to the facilitator, Environmental Assessment Practitioner and project team

The meeting was facilitated by Prof Johan Nel from the North-West University's (NWU) Centre for Environmental Management (CEM). The Environmental Assessment Practitioner (EAP) for the Environmental Impact Assessment is Mr Theunis Meyer, also from the NWU, CEM. Mr Tshepiso Seobi, who assists with the Public Participation (PP) component of the project, and Mrs Simoné van Rooyen (who recorded the minutes of the meeting) also forms part of the NWU CEM project team.

Voorspoed Diamond Mine was represented by Mr Petrus Jordaan (Closure Manager), Mr Andrew Moremi (Public Relations Manager) and Mr Hans Kgasago (Rehabilitation Manager). Mr DP van der Merwe, a mine rehabilitation specialist from Redco, one of the specialists that assisted with the development of the mine closure plan, also attended the meeting.

6. Meeting format

Prof Johan Nel explained the format of the meeting, i.e. a presentation will be presented by the project team, after which all attendees will be invited to participate in a question and answer session. After this session, the road ahead will be explained.

7. Introduction

7.1 Understanding the legal requirements for decommissioning and mine closure

The legal requirements for decommissioning and mine closure was explained by the Mr Theunis Meyer (see slides 8 to 17 of Appendix B). Reference was made to some requirements of the Mineral and Petroleum Resources Development Act 28 of 2002 and the National Environmental Management Act 107 of 1998 (NEMA).

7.2 Understanding the Environmental Impact Assessment process

The Environmental Impact Assessment (EIA) process that is required by the NEMA was also explained by Mr Theunis Meyer (see slides 18 to 26). A process flow displayed the generic EIA process.

7.3 Understanding the Public Participation process

The PP process that is required as part of the EIA process was also explained by Mr Theunis Meyer (see slides 27 to 36). The aim of the PP process was explained using a figure.

7.4 Introduction to the Voorspoed Diamond Mine decommissioning and closure process

The Voorspoed Diamond Mine decommissioning and closure process was explained by Mr Petrus Jordaan (see slides 37 to 47). The location, the current mine infrastructure and status of the mining pit were also displayed using maps.

7.5 Community benefits

The benefits to the community was explained by Mr Andrew Moremi (see slides 48 to 56). Contents from the Socio-economic Impact Assessment and Social Labour Plan were presented to explain the way in which the community benefitted during the operational phase of the mine, as well as those that will be continuing until mine closure.

8. Voorspoed Diamond Mine closure plan

8.1 Alternatives considered

The alternatives considered was explained by Mr Hans Kgasago (see slides 57 to 68). Various alternatives as well as the preferred option were described.

8.2 End land use

The end land use (ELU) was also explained by Mr Hans Kgasago (see slides 69 to 78). Content from the ELU Plan was presented. The ELU, farms or areas included in the ELU Plan, the current land use and soil and land capability were also displayed using maps.

8.3 Decommissioning and rehabilitation actions

The decommissioning and rehabilitation actions were also explained by Mr Hans Kgasago (see slides 79 to 94). Updates on rehabilitation for the periods 2014 to 2018 and 2019 were displayed using numerous photographs.

9. PP process followed to date

The PP process followed to date was explained by Mr Tshepiso Seobi (see slides 95 to 106). Reference was made to the publication of newspaper advertisements as well as the placement of site notices.

10. Identification of environmental issues and mitigation measures related to the decommissioning and mine closure process

10.1 Identification of environmental issues identified by the EAP and the specialists

The environmental issues identified was discussed by Mr Theunis Meyer (see slides 107 to 110). Soil compaction and pollution, surface water run-off, groundwater quality deteriorating etc., were identified as issues.

10.2 Facilitation of process to identify additional environmental issues by Interested and Affected Parties

The facilitator, Prof Johan Nel, facilitated a session in which the Interested and Affected Parties (I&APs) could raise additional environmental issues of concern (see slides 111 to 113 of the presentation). A number of comments and questions were raised by participants (attached as Appendix C) and responded to by the EAP and representatives of Voorspoed Mine (attached as Appendix D).

10.3 Identification of rehabilitation actions and mitigation measures identified by the EAP and the specialists

The rehabilitation actions identified to address the environmental impacts caused by the mining activities and to reinstate most of the rehabilitated footprint area back to agricultural land was discussed by Mr Theunis Meyer (see slides 114 to 116). These included decommissioning existing structures and infrastructure, ripping areas with compacted soil, bio-remediating hydrocarbon polluted soils, reshaping steep slopes of mine residue deposits and reinstating surface water drainage lines on-site, to mention a few.

10.4 Facilitation of process to identify additional rehabilitation actions and mitigation measures by Interested and Affected Parties

The facilitator facilitated a session in which the I&APs were invited to raise additional rehabilitation actions and mitigation measures (see slides 117 to 118). No comments or questions were received from the participants.

11. General question and answer session

The facilitator invited the participants to raise any other issues related to the decommissioning and closure of the mine not yet discussed during the meeting (see slide 119). No additional issues were raised by any participant.

12. The road ahead

The EAP, Mr Meyer, explained the road ahead for the EIA process (see slides 120 to 121). It includes, amongst others, the finalisation of the draft Basic Assessment Report (BAR), Environmental Management Programme (EMPr) and Closure Plan (CP) and the reviewing of and commenting on the BAR, EMPr and CP by I&APs.

NWU® | CEM Centre for Environmental Management

13. Closure

The facilitator closed the public meeting by thanking all for their attendance and providing the contact details of Messrs Theunis Meyer and Tshepiso Seobi for further engagement (see slides 122 to 123).

Appendix A: Attendance register

DE BEERS GROUP

NWU® | CEM

ATTENDANCE REGISTER

Project: EIA for Decommissioning of De Beer Voorspoed Mine
Event: Public Meeting
Locality: [illegible] Site Hall, Rampa Street, Tumahole, Parys
Date and Time: Tuesday 20 August 2019 at 16h00

Title, Name and Surname	Affiliation (Organisation) and Designation or Nature of Involvement	Cell and / or Telephone Number(s)	E-mail/Postal Address(es)	Signature
[illegible]	[illegible]	[illegible]		
[illegible]	[illegible] Catering	[illegible]	[illegible]	
Yolan Sochiva	Sedi La ka Catering	[illegible]		

Title, Name and Surname	Affiliation (Organisation) and Designation or Nature of Involvement	Cell and / or Telephone Number(s)	E-mail/Postal Address(es)	Signature
[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]		
[illegible] Freddy	[illegible]	[illegible]		
[illegible]	[illegible]	073 758 [illegible]		
[illegible]	Jordan	084 [illegible]		

NWU® | CEM

Title, Name and Surname	Affiliation (Organisation) and Designation or Nature of Involvement	Cell and / or Telephone Number(s)	E-mail/Postal Address(es)	Signature
Thabo [illegible]		0834360874	[illegible]	[illegible]
[illegible]		0837710641	[illegible]	[illegible]
M. Gouese Kosa	LEARN	083 946 9768	[illegible]	[illegible]
So Jinamartesh		0837619566	nambutelo	mantesho
Mr M.M [illegible]		076 582 1793	[illegible]	[illegible]

Voorspoed Mine Attendance Register Public Meeting — Rev [illegible] — Page 3 of 8

Title, Name and Surname	Affiliation (Organisation) and Designation or Nature of Involvement	Cell and / or Telephone Number(s)	E-mail/Postal Address(es)	Signature
[illegible]		0717076519		[illegible]
[illegible]		0657017772		[illegible]
[illegible] MOBALA		060 478 5579		[illegible]
Christa [illegible]		079 3077 816		[illegible]
Daniel [illegible]		079 05 130 22	[illegible]@gmail.com	[illegible]

Voorspoed Mine Attendance Register Public Meeting — Rev [illegible] — Page 4 of 8

Title, Name and Surname	Affiliation (Organisation) and Designation or Nature of involvement	Cell and / or Telephone Number(s)	E-mail/Postal Address(es)	Signature
Papi Mope		0719093510		[illegible]
Alehandry Chymoua		067 2421 855		[illegible]
Mrs Maraeshe		082 483 3984		[illegible]
MR Samuel Kolobe		078 735 4437		[illegible]
Majnel January		067 165 2193		[illegible]

Voorspoed Mine Attendance Register Public Meeting   Rev 2019-08   Page 5 of 5

DE BEERS GROUP

NWU®

CEM Centre for Environmental Management

ATTENDANCE REGISTER

Project: EIA for Decommissioning of De Beer Voorspoed Mine
Event: Public Meeting
Locality: Mosepedi Site Hall, Rampa Street, Tumahole, Parys
Date and Time: Tuesday 20 August 2019 at 15h00

Title, Name and Surname	Affiliation (Organisation) and Designation or Nature of involvement	Cell and / or Telephone Number(s)	E-mail/Postal Address(es)	Signature
Mr Tusetso Nyamsusa	Public	063 9367531	[illegible]	[illegible]
Mr Sylvester Motlolometsi	Public	073 52 200 23	m-tlolmetsise@gmail	[illegible]
Mr Barnyboy Gaebor	Public	0789585205	None	[illegible]

Voorspoed Mine Attendance Register Public Meeting   Rev 2019-08   Page 1 of 5

NWU® | CEM Centre for Environmental Management

Title, Name and Surname	Affiliation (Organisation) and Designation or Nature of Involvement	Cell and / or Telephone Number(s)	E-mail/Postal Address(es)	Signature
Kebonyetswe Mogoleng	Public	0630364823	None	
Mosen Lekere	De Beer	073 5354431		
David Serame	Hale Emalane Basadi Training Services	0630239422	[illegible]@gmail.com	
Reitumetse Mogorera	Public	060 754 1315	[illegible]@gmail.com	
Eunice Makhokolo	Public	073 307 4150	[illegible]@gmail.com	

Title, Name and Surname	Affiliation (Organisation) and Designation or Nature of Involvement	Cell and / or Telephone Number(s)	E-mail/Postal Address(es)	Signature
Lerato Moiapi	Public	0730987222	[illegible]@gmail.com	
Sonwabo Tlhompho	Public	060 [illegible]	[illegible]@gmail	
Serato Lehana	Sew Lane Enterprise	0731918064	[illegible]@gmail.com	
Tshepiso Seoti	North-West Univ. Centre for Env. Management	0182994299 0788045726	Tshepiso.Seoti@nwu.ac.za	
PJ Jordan	De Beers	056 2168466	Petrus.jordan@debeersgroup.com	

NWU® | CEM Centre for Environmental Management

Title, Name and Surname	Affiliation (Organisation) and Designation or Nature of involvement	Cell and / or Telephone Number(s)	E-mail/Postal Address(es)	Signature
Pastor Mphe Lucbea	Tamahole Religious Amalgated Forum	072 492 1617	mplebloa H @ gmail. com	
[illegible]	CEM/NWU	0836[illegible]	[illegible]	
TC MEYER	NWU - CEM	018 299 1467	THEUNIS. MEYER@ NWU. AC. ZA	
[illegible]	NWU CEM [illegible]	018 299 4663	[illegible] NWU. AC. ZA	
ANDREW MERENY	De Beers	056 216 8474	andrew.meremi@ debeersgroup. com	

Voorspoed Mine Attendance Register Public Meeting | Rev [illegible] | Page [illegible]

Title, Name and Surname	Affiliation (Organisation) and Designation or Nature of involvement	Cell and/ or Telephone Number(s)	E-mail/Postal Address(es)	Signature
[illegible] Thibile	De Beers Environmental Officer	056 216 5535	[illegible] debeersgroup. com	

Voorspoed Mine Attendance Register Public Meeting | Rev [illegible] | Page [illegible]

Appendix B: PowerPoint presentation that was used during the meeting


Why are we here? (1)


Why are we here? (2)


Why are we here? (3)


Why are we here? (4)


Why are we here? (5)


Why are we here? (6)


Why are we here? (7)


Why are we here? (8)


Why are we here? (3)


Why are we here?
Understanding the EIA process


EIA process (1)


EIA process (2)


Generic EIA Process


EIA process (3)


EIA process (4)
EIA Role players


EIA process (5)


EIA process (6)
The basic EIA process for the project involve the following steps:
Public meeting


EIA process (7)


Why are we here?
Understanding the Public Participation process


Public participation process (1)


Public participation process (2)
The NEMA requires a public participation process for all EA processes


Public participation process (3)


Public participation process (4)
Must include consultation with:


Public participation process (5)
Must include consultation with:


Public participation process (6)


Public participation process (7)


Public participation process (8)


Aim of Public Participation Process


Introduction to the Voorspoed Mine decommissioning & closure process


Locality map


Historical background (1)


Historical background (2)


Current mine infrastructure


Status of mining pit


Voorspoed Mine Closure Process (1)


Voorspoed Mine Closure Process (2)


Voorspoed Mine Closure Process (3)


Proposed Voorspoed decommissioning & closure (1)


Proposed Voorspoed decommissioning & closure (2)


Community Benefits


Host & Labour-sending Area


Updated SEIA report


Overall SEIA outcome


Community visibility outcome


Mine Closure Social Impacts


SLP 3: 2017 – 2021 Progress & Outcomes


SLP 2: 2012 – 2016 Progress & Outcomes

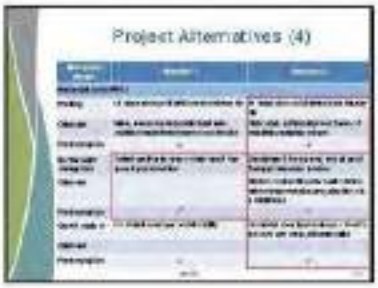

SLP 1: 2007 – 2011 Progress & Outcomes


Voorspoed Mine Closure Plan – alternatives considered


Project Alternatives (1)

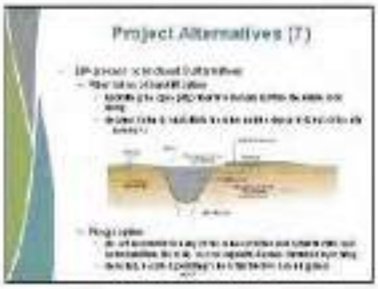

Project Alternatives (2)


Project Alternatives (3)


Project Alternatives (4)


Project Alternatives (5)


Project Alternatives (6)


Project Alternatives (7)


Alternatives comparison


Preferred open pit decommissioning option


Picture of preferred option

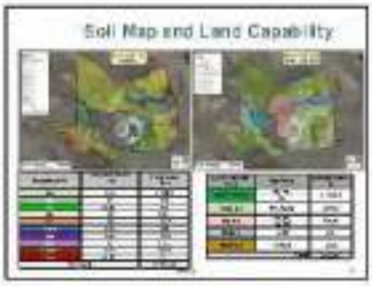

Voorspoed Mine Closure Plan – end land use


End land use plan (1)


End land use map


Voorspoed End Land Use Plan – Scope
Current land use
Land available for ELUP
Potential ELU Options - Added to during Workshop
Results


Farms/areas included in ELUP


Soil Map and Land Capability


Potential ELU Options – Added to during workshop


Financial modelling
- primary scenarios – results

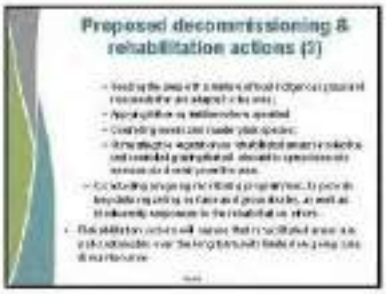

Voorspoed Mine Closure Plan – decommissioning & rehabilitation actions


Mine closure components


Decommissioning & mine closure


Proposed decommissioning & rehabilitation actions (1)


Proposed decommissioning &
rehabilitation actions (2)


Proposed decommissioning &
rehabilitation actions (3)


Rehabilitation Update: 2014 - 2018


Waste Rock Dump – Progress
(Reshaped, Topsoiled & Vegetated)


Waste Rock Dump – Successful Rehabilitation
(Reshaped, Topsoiled & Vegetated)


Rehabilitation Update - 2019


Waste Rock Dump – Progress
(Reshaped, Topsoiled & Vegetated)


Rehabilitation Activities –
Planned VS completed


Waste Rock Dump – 2019 Rehab Progress


Waste Rock Dump – 2019 Rehab Progress


Southern Pan – Bluegum Trees Eradication


Northern Pan – Slangbos Eradication


Public Consultation Process followed to date


I&AP Identification


Public participation process followed (1)


Newspaper Advertisements (1)
• Business Times, 4 August 2019


Newspaper Advertisements (2)


Newspaper Advertisements (3)


Newspaper Advertisements (4)


Voorspoed Mine site notices

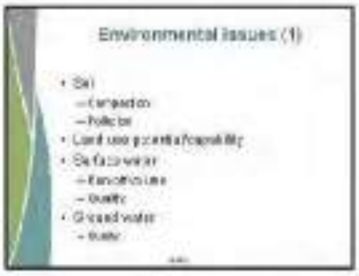

Kroonstad site notices


Parys site notices


Viljoenskroon site notices


Vredefort & Koppies site notices


Identification of
Environmental issues

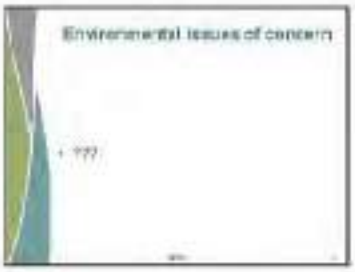

Environmental issues (1)
Soil
Land use potential/capability
Surface water
Ground water


Environmental issues (2)
Vegetation
Visual impact


Environmental issues (3)
Social & socio-economic


Facilitation of issues
raised by I&APs


Rules for facilitation


Environmental issues of concern
???


Identification of
rehabilitation actions

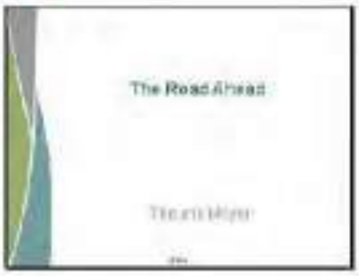

Rehabilitation actions identified (1)


Rehabilitation actions identified (2)


Facilitation of mitigation measures raised by I&APs


Proposed mitigation measures
• ???


Other issues
• ???


The Road Ahead


What next?


Closure


Contact us:
NWU

Appendix C: Issues and comments raised by the participants

Voorspoed Mine Decommissioning Basic Environmental Impact Assessment: Public Participation Process

ISSUES / COMMENTS / CONCERNS

Title: MALE Initials M.G Surname: KOBA

Organisation / Firm (if applicable): NON

Position / Nature of involvement. E.g. property owner: WANNER BE

Street address: 5253 Zone 6 Tumahole

Postal address: 9585

Tel and area code: (Work) ______ (Home) ______

(Cell) 083 966 9748 (Fax) ______

E-mail: ______

Please state your issues / comments / concerns:

INVITATION TO SIGN

WHATS COMMIE HAPPENING TO THE HOLE

Is it possible for the whole to separate the water for us, as we don't have clean water?

Does the water clean for us like transport the the water like rain!

Voorspoed Mine Decommissioning Basic Environmental Impact Assessment: Public Participation Process

ISSUES / COMMENTS / CONCERNS

Title: Pastor Initials: M Surname: Leboa

Organisation / Firm (if applicable): Tumahole Religious Ministers Forum

Position / Nature of involvement. E.g. property owner: ______

Street address: 8824 Mandelaville, Parys 9585

Postal address: P.O. Box 1170, PARYS 9585

Tel and area code: (Work) ______ (Home) ______

(Cell) 0724921617 (Fax) ______

E-mail: mpholeboa61@gmail.com

Please state your issues / comments / concerns:

In terms of the after effects of the Mine closure, as a layman, I may not be in a position to know and approve of what should or should not happen. This goes with the community as well.

Usually, should it go to a plopush, we witness reaction by way of protests etc. How best can we ensure to avoid that by acting "proffessionally"?

2. During the Mine operation, other than the recent Ratang Maghekeng House, what other socio-economic contribution has the mine offered.

Mpho Leboa [signature] 20.08.2019

Voorspoed Mine Decommissioning Basic Environmental Impact Assessment: Public Participation Process

ISSUES / COMMENTS / CONCERNS

Title: Pastor Initials: M Surname: Leboa

Organisation / Firm (if applicable): Tumahole Religious Ministers Forum

Position / Nature of involvement. E.g. property owner: Chairperson

Street address: 8824 Mandelaville, Tumahole, Parys 9585

Postal address: PO Box 1170 PARYS 9585

Tel and area code: (Work) ______ (Home) ______

(Cell) 0724921617 (Fax) ______

E-mail: mpholeboa61@gmail.com

Please state your issues / comments / concerns:

Since the community of Tumahole and Parys are part of the closing process, would it be possible for interested individuals to go view the area, and make sure they also know atleast what they agree or disagree about.

Mpho Leboa [signature]

Voorspoed Mine Decommissioning Basic Environmental Impact Assessment: Public Participation Process

ISSUES / COMMENTS / CONCERNS

Title: Mr Initials: S Surname: MOTLOLAMETSI

Organisation / Firm (if applicable):

Position / Nature of involvement. E.g. property owner: Community

Street address: 1037 MOORELOA STR TUMAHOLE PARYS

Postal address:

Tel and area code: (Work) (Home)

(Cell) 073 55 20023 (Fax)

E-mail: motldomotsis9@gmail.com

Please state your issues / comments / concerns:

I wanted to understand in terms of De Beers financial support in assisting in building schools and facilities that have to support the community, who is going to be responsible for the managing & sustaing of the facilities? and who is going to be responsible for the acquisition of personnel to be employed?

Voorspoed Mine Decommissioning Basic Environmental Impact Assessment: Public Participation Process

ISSUES / COMMENTS / CONCERNS

Title: MR Initials: Y.D Surname: Sookiva

Organisation / Firm (if applicable): affected

Position / Nature of involvement. E.g. property owner:

Street address: 1084 Deliver Street

Postal address:

Tel and area code: (Work) (Home)

(Cell) 0609406176 (Fax)

E-mail:

Please state your issues / comments / concerns:

I am so concerned about the closer of the

NWU® | CEM Centre for Environmental Management

Xalani, Sochiva

I am so concerned about the closer of the Mine. While I am busy hustling for job and the Government must try to help alot of People are going to lose job. If our government aint helping us to keep the Mine for our Province And the Free State Premier should Make Sure we keep our Mine for the Youth to Countinue Working Please.

DE BEERS GROUP

Appendix D: Issues and response table with a summary of the issues raised by the public and the responses provided by the EAP and mine representatives at the meeting

Interested and affected parties	Issues raised	EAP's response to issues as mandated by the applicant
Mpho Leboa	Mine closure is a very technical process. Not everyone from the community understands this process. Thus, if any unexpected impacts result from this process, the community may be angered and express this anger by way of protests. How best can the Mine involve the community in this process to avoid these unwanted protests?	*Response by PJ Jordaan (on behalf of the Mine):* The Mine will, outside the scope of this mine closure process, arrange another engagement to inform the community in layman's terms of the closure process and its implications.
Mpho Leboa and Sylvester Motlolometsi	The Mine has contributed significantly to the community in terms of education, employment, providing facilities etc. How will the, for example, Ratang Maqheku Centre for the Aged in Parys, be sustained post mine closure?	*Response by Andrew Moremi (on behalf of the Mine):* The Mine's current Social and Labour Plan is effective from 2017 – 2021. Thus the Mine is committed to supporting all of its social commitments until 2021. The Mine is also in communication with the Department of Social Development to revise the grants to, for example, Ratang Maqheku, to be more inclusive for the Centre to be sustained.
Xolani Sochiva	The mine should not close. It should remain open to create job opportunities for the youth in the Free State Province that is poverty-stricken.	*Response by PJ Jordaan (on behalf of the Mine):* Unfortunately there is no other option, but to close the mine. There are no more diamonds to mine and as a result no more job opportunities. The Mine had to get approval from the Minister for closure. Thus, the decision to close was not taken lightly.
M George Koba	Who is going to be responsible for the risks in the mining area post mine closure? The government did not create the mining area and thus do not know all the risks. De Beers created it, they understand the risks and how to manage it and should remain liable.	*Response by PJ Jordaan (on behalf of the Mine):* The Mine will be responsible for rehabilitating the mining area until approximately 2028. Thus the Mine will manage and mitigate all risks. The mining area will be monitored post rehabilitation to ascertain that no risks remain before the government gives the mine the authority to walk close the mining area. The government will thus not issue a closure certificate, if any risks still remain.

NWU® | CEM Centre for Environmental Management

Interested and affected parties	Issues raised	EAP's response to issues as mandated by the applicant
M George Koba	Will the community be informed of the progress made with rehabilitation?	*Response by Theunis Meyer, the EAP:* The environmental authorisation or permission that the government (DMR) will give to the Mine to decommission and rehabilitate will contain monitoring and auditing requirements. Monitoring and auditing will be done on an annual basis and the audit report will be made publically available. Thus the community can access the report for a progress update on the rehabilitation commitments made by the Mine.
Mpho Leboa	Can the community visit the Mine during the decommissioning, rehabilitation and closure phases to view progress made against the commitments communicated in the presentation tonight?	*Response by PJ Jordaan (on behalf of the Mine):* The Mine invites and will be happy to welcome all visitors. Andrew Moremi from the Mine will facilitate the visits.
M George Koba	Can the pit water be provided to the community as a sustainable water source?	*Response by PJ Jordaan (on behalf of the Mine):* Unfortunately it is not safe to access the water, the pit walls have already failed. Also, the quality of water in the pit is not good. Furthermore, the water level in the pit will never reach above a certain point, since the evaporation rate is much higher than the water inflow rate. It is thus not a sustainable water source.
M George Koba	The mine pit is unsafe for people and animals. How will access into the pit be prevented?	*Response by PJ Jordaan (on behalf of the Mine):* Several mitigation measures are in place to prevent access into the mine pit, i.e. there is no road leading into the pit, since the pit walls have already failed; a high quality fence will be put up around the pit; a berm and trench will be constructed outside the fence to prevent accidental driving to the pit; an outside perimeter fence will also be put up; and security guards are currently monitoring the pit area. In future, cameras and alarms will monitor the area for movement.

Appendix 31: Minutes of a pre-application meeting for the De Beers Voorspoed Mine decommissioning Environmental Authorisation, held with the Department of Mineral Resources on 1 March 2019 at their offices in Welkom

Private Bag X6001, Potchefstroom
South Africa 2520

Tel: 018 299-1111/2222
Web: http://www.nwu.ac.za

Centre for Environmental Management

Internal box 150, Private Bag X6001, Potchefstroom, South Africa, 2520

Tel: 018 299 1590 / 2734
Fax: 018 299 4266 / 2726
Email: cemprojects@nwu.ac.za / ceminfo@nwu.ac.za

Web: http://www.nwu.ac.za/cem

2019/03/01

MINUTES OF PRE-APPLICATION MEETING FOR THE DE BEERS VOORSPOED MINE DECOMMISSIONING ENVIRONMENTAL AUTHORISATION

Date of meeting:	**Friday, 1 March 2019**
Time of meeting:	**09:00**
Venue:	**DMR offices, Welkom**

1. Attendance:

Name	Title	Organisation	Contact details
Malcolm Hendrickse	General Manager	DBCM Voorspoed Mine	056 216 8867 Malcolm.hendrickse@debeersgroup.com
Hans Kgasago	Rehabilitation Manager	DBCM Voorspoed Mine	056 216 8605 Hans.kgasago@debeersgroup.com
Theunis Meyer	Environmental Assessment Practitioner	NWU-CEM	018 299 1467 Theunis.meyer@nwu.ac.za
Reece Alberts	Environmental Assessment Practitioner	NWU-CEM	018 299 6267 12991805@nwu.ac.za
MG (Machudu) Mulaudzi	ASD: MEM	DMR	057 391 1386 Machudu.mulaudzi@dmr.gov.za
NC (Cedric) Fhedzicani	DD: Environment	DMR	057 391 1308 Cedrick.fhedzicani@dmr.gov.za
KC Mphapuli	ASD: Mine economics	DMR	057 391 1306 Khangwelo.mphaluli@dmr.gov.za

Attendance register attached (Appendix A).

Powerpoint slide deck used during the meeting attached (Appendix B).

2. Opening & welcome

DMR welcomes the visitors to the meeting.

Voorspoed Mine indicates that the purpose of the meeting is formally inform the DMR that Voorspoed Mine will be closing and to discuss the application for decommissioning that will be submitted to DMR during the first quarter of 2019.

The Environmental Assessment Practitioner (EAP), Mr Meyer, also emphasized that the meeting is also considered as a pre-application meeting for the application for environmental authorisation for the decommissioning of Voorspoed Mine.

3. Historical background to Voorpoed Mine Decommissioning and closure process

The Voorspoed Mine General Manager provide an overview about the mine's history. The current mining right was granted in 2006 and the mine official opened on 4 November 2008 as a marginal mine that largely exploits an inferred resource. It consists of an open pit operation that mined to an approximate depth of 214m and recovered 6 Mct of diamonds.

The life of mine was envisaged until 2022; however, operational challenges due to a pit slope failure prompted the DBCM board to take a decision in July 2018 to proceed with the cessation of mining activities by the end of 2018 and proceed with responsible closure of the mine.

Following an extensive, disposal process, the company could not find a suitable operator to acquire and operate Voorspoed Mine in a sustainable manner and started the section 52 process. The DMR, however, requested extension of the sale process to Aug 2018 to allow other interested parties to be considered. One remaining interested party participated up to the end of January 2019 and the process was concluded on 19 February 2019. No viable option was identified to continue with the Voorspoed Mine. The DBCM informed board to close the mine and informed the Section 52 board accordingly.

Discussion:

DMR comment/response	Voorspoed EAP comment/response
DMR requests a copy of the formal communication regarding the mine closure to the Section 52 board.	A copy of the formal communication will be provided by Voorspoed Mine.
	Downscaling is being negotiated and the approved SLP is being implemented towards mine closure.

4. Legal framework for decommissioning and mine closure

The EAP indicated that one of the important objectives of this meeting is to discuss and reach agreement on the closure process, as well as identify specific process requirements.

4.1. Overview

The EAP provided a brief overview of the understanding of the legal framework for decommissioning and mine closure.

NWU | CEM

Prior to December 2018, Voorspoed Mine had an approved EMPr (in terms of the Minerals and Petroleum Resources Development (MPRDA) and National Environmental Management Acts (NEMA)), as well as a Water Use license and Integrated Water and Waste Managemenrt Plan (in terms of the National Water Act (NWA)). In terms of the Financial Provison regulations published under the NEMA, the mine also had a final Rehabilitation and Closure Plan, an annual Rehabilitation Plan and an Environmental Risk Assessment. In addition, it also had a number of other documents, including an approved Social and Labour Plan, as well as a number of environmental specialist studies.

The decision to proceed with decommissioning and mine closure requires the mine to apply for an environmental authorisation (EA) for decommissioning, as defined, and undertake a basic environmental impact assessment (BA) process in terms of the 2014 Environmental Impact Assessment (EIA) regulations. This will result in the drafting of an Environmental Management Programme (EMPr), and a Closure Plan (CP).

Once the EA has been issued, the EMPr & CP has to be implemented in preparation for mine closure. The mine closure application will be submitted somewhere in the future, after the completion of the approved closure plan.

Discussion:

DMR comment/response	Voorspoed EAP comment/response
DMR agrees that the application can be submitted on completion of the approved CP.	What is DMR's view on the submission of the section 43 mine closure application?
DMR indicated that decommissioning cannot proceed without the necessary EA. The partial/temporary removal of some of the valuable components of the processing plant is debated, with the caution to not take the plant out of active service permanently.	Voorspoed Mine indicated that they will selectively remove some of the valuable components of the processing plant for maintenance and security purposes. They will, however, not take the plant out of active service permanently.

4.2. NEMA BA process

The Basic Assessment process will follow the legislated 197 day process and will be triggered by the submission of the application for the decommissioning EA application. The drafting of the BA report, EMPr and CP has to be completed 50 days after the submission of the EA application, followed by a 30-day public review and commenting period, with a final 10 day period for consideration and incorporation of the comments. The revised documents will be submitted to DMR 90 days after the submission of the EA application.

Discussion:

DMR comment/response	Voorspoed EAP comment/response
DMR indicated that the official BA application template on the SAMRAD platform needs to be used for the application. The undertook to enquire as to the possible existence of a dedicated application form for a decommissioning BA and to provide feedback	If there is another BA application form that could be used, information in this regard will be appreciated, as the official template is difficult to use. EAP to follow up with DMR.

DMR comment/response	Voorspoed EAP comment/response
DMR indicated that 3 hard copies of all documentation needs to be submitted in addition to the electronic SAMRAD submission.	This will be done.
This will assist in facilitating an effective decision-making process.	EAP undertakes to arrange a meeting with the case officer prior to the submission of the draft/final documents to brief him/her on the content of the documents.
DMR indicates that it will fast track the EIA decision-making process as they acknowledge the safety and security risks associated with a delayed EA application process.	How can the EAP assist the DMR to ensure an efficient EIA decision-making process?

5. BA process plan

5.1. Pre-application meetings

Pre-application meetings will be held, not only with the DMR, but also other key stakeholders to inform them of the decommissioning EA application process and discuss the application process and reach agreement in this regard, as well as to identify specific process requirements that they may have.

A meeting has already been scheduled with the Department of Water and Sanitation (DWS), while other key stakeholders include the provincial department of environmental affairs (DESTEA), as well as the departments of agriculture and rural development.

Discussion:

DMR comment/response	Voorspoed EAP comment/response
DMR reminded the applicant and EAP to also involve the Chief-Director mine safety in the decommissioning process.	This will be done, as the Chief-Director is an important stakeholder in the decommissioning and mine closure process. Contact details for the relevant person needs to be sourced
Engage with the provincial department of agriculture for their views on the involvement of the national department.	Should the engagement be with the provincial or national offices of the department of Agriculture?
Yes, engage with the provincial office.	Should the stakeholder engagement also include the Department of Rural Development?
DMR is comfortable with the engagement process with key stakeholders, provided that proof of such engagement is provided with the application.	Will be done.
DMR requests that the other key stakeholders should be informed of the details of the DMR case officer, to facilitate	Will be done.

DMR comment/response	Voorspoed EAP comment/response
effective public participation and authority inut.	

5.2. BA process

The BA process, as prescribed by the 2014 EIA regulations will be followed. This will include the following activities:

- Descriptions of
  - Existing mine processes and infrastructure
  - Post closure natural and socio-economic environments, as well as land use
  - Mine closure process – closure objective
  - Mine closure alternatives
  - Environmental impacts/risks
  - Residual and latent environmental impacts/risks
  - Environmental prevention and mitigation measures
- Drafting, review and approval of
  - BA report
  - EMPr & Closure Plan

A number of the existing documents will be used as specialist inputs into the process.

5.3. Public participation process

The prescribed public participation process will be followed. The existing Voorspoed Mine stakeholder register has already been sourced and will form the basis of the Interested and Affected Parties (I&APs), together with the legally mandated I&APs. Commenting authorities will be engaged as discussed above.

The process will include the drafting and circulation of a background information document with response sheet, while site notices will be displayed at the site, as well as other identified publicly accessible localities.

Newspaper advertisements will be published in a number of local newspapers, while local radiostations will also be requested to inform the community about the public participation process.

One public meeting will be held in the Kroonstad civic centre, while dedicated meetings will also be held with commenting authorities, prior to the document review process.

Draft documents will be made available electronically on a publicly accessible website, while hard copies will be made available at Voorspoed Mine, the Moqhaka and Ngwather local municipality offices, the Fezile Dabi disctrict municipality offices, as well as at public libraries in Kroonstad and Parys.

Discussion:

DMR comment/response	Voorspoed EAP comment/response
DMR indicated that the newspaper advertisement must also be published in one national newspaper.	This will be done.

5.4. Project timeframes

The proposed project timeline is as follows:

- Pre-application meetings – March 2019
- Start of the BA process – April 2019
- Submission of the EA application – 23 April 2019
- Drafting of the BAR, EMPr & CP – April & May 2019
- Authority meetings – last week of May 2019
- Public meeting – 4 June 2019
- Circulate BAR, EMPr & CP for public comment – 10 June 2019
- Submit final BAR, EMPr & CP for decision-making – 22 July 2019
- DMR decision on the application – 6 Noveber 2019
- Conclusion of the submission of appeals – before 15 December 2019

6. General

DMR notices that this will be the first decommissioning and mine closure process for a big mine that they will be involved in. Everybody agrees with this statement.

7. Way Forward and Closure

Everybody agrees to support each other in order to ensure a successful decommisoning EA application.

The meeting ends at 11:45.

Appendix A: Attendance register

ATTENDANCE REGISTER

MEETING BETWEEN DMR AND DE BEERS (VOORSPOED MINE)

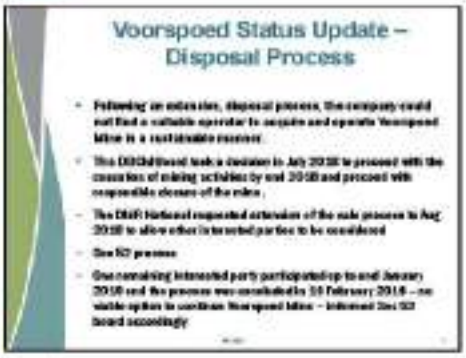
Date: 01 MARCH 2019

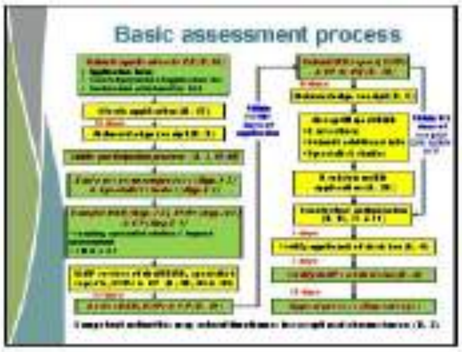
Time: 09:00

LOCATION: 2[ND] FLOOR BOARDROOM

SEQ NO	NAME AND SURNAME	ORGANISATION	DESIGNATION	CONTACT NUMBERS	EMAIL	GENDER	SIGNATURE
1	Malcom Hendricks	De Beers	EM	[illegible]	[illegible]	M	[signature]
2	Hans Kgasago	DE Beers	REHAB MANAGER	[illegible]	[illegible]	M	[signature]
3	R Abrahams	NWU	EAP	[illegible]	[illegible]	M	[signature]
4	TC MEYER	NWU-CEM	EAP	[illegible]	[illegible]	M	[signature]
5	NC Fhedzisani	DMR	DD: Environment	[illegible]	[illegible]	M	[signature]
6	KC Mphaphuli	DMR	ASD: Mine Economics	[illegible]	[illegible]	M	[signature]
7	MG Mulaudzi	DMR	ASD: MEM	[illegible]	[illegible]	M	[signature]
8							
9							
10							
11							

Appendix B: Powerpoint presentation that was used during the meeting




Basic assessment process

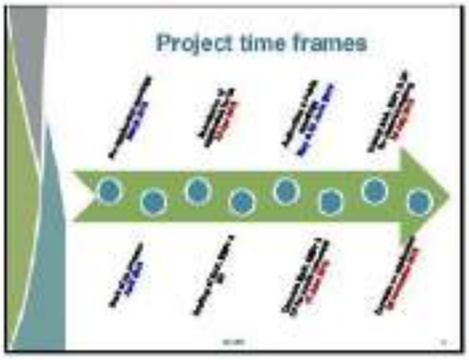

BA process plan


Pre-application meetings
Separate meetings with:
DWS – 7 March 2016
Others???
Objective:
To discuss and reach agreement on the closure process
To identify specific process requirements


Basic Environmental Impact Assessment
Undertaking of Basic EIA
Descriptions of
Existing mine processes and infrastructure
Mine closure process – closure objective
Mine closure alternatives
Environmental impacts/risks
Residual and latent environmental impacts/risks
Environmental prevention and mitigation measures
Drafting, review and approval of
BA report
EMPr & Closure Plan


Public Participation Process (1)
Stakeholder identification
Existing Voorspoed Mine I&APs
Mandated I&APs
Background Information Document
Newspaper Advertisements
Kroonnuus & Parys Gazette
Moqhaka News, Ngwathe News & Dumelang News
Radio stations???


Public Participation Process (2)
Meetings
1 Public meeting in Kroonstad (Moqhaka LM)
Meetings with other key government stakeholders
Availability of draft documents
Voorspoed Mine
Kroonstad & Parys public libraries


Project time frames


Thank you
Thank you

NWU® | CEM


Contact us:
Centre for Environmental Management

Appendix 32: Minutes of a meeting for the De Beers Voorspoed Mine decommissioning Environmental Authorisation, held with the Department of Water and Sanitation Regional Office on 3 March 2019 at their offices in Bloemfontein

Private Bag X6001, Potchefstroom
South Africa 2520
Tel: 018 299-1111/2222
Web: http://www.nwu.ac.za

Centre for Environmental Management

Internal box 150, Private Bag X6001, Potchefstroom, South Africa, 2520

Tel: 018 299 1580 / 2724
Fax: 018 299 4266 / 2726
Email: cemprojects@nwu.ac.za / ceminfo@nwu.ac.za

Web: http://www.nwu.ac.za/cem

2019/03/07

MINUTES OF PRE-APPLICATION MEETING FOR THE DE BEERS VOORSPOED MINE DECOMMISSIONING ENVIRONMENTAL AUTHORISATION

Date of meeting:	**Thursday, 7 March 2019**
Time of meeting:	**10:00**
Venue:	**DWS offices, Bloemfontein**

1. Attendance:

Name	Title	Organisation	Contact details
Hans Kgasago	Rehabilitation Manager	DBCM Voorspoed Mine	056 216 8605 Hans.kgasago@debeersgroup.com
Theunis Meyer	Environmental Assessment Practitioner	NWU-CEM	018 299 1467 Theunis.meyer@nwu.ac.za
Reece Alberts	Environmental Assessment Practitioner	NWU-CEM	018 299 6267 12991806@nwu.ac.za
Melato Boitumelo (Mrs)		DWS: FS	051 405 9000 082 556 3497 melatobe@dws.gov.za
G (George) Nel	DD: WU	DWS: FS	051 405 9000 082 878 5707 Nelg@dws.gov.za
W (Willem) Grobler	DD: CME	DWS: FS	Apology
		DWS: HQ	Apology

Attendance register attached (Appendix A).

Powerpoint slide deck used during the meeting attached (Appendix B).

2. Opening & welcome

DWS welcomes the visitors to the meeting. Apologies were made for Mr Willem Grobler that is not available, as well as DWS Head Office staff that could not attend.

Voorspoed Mine indicates that the purpose of the meeting is to formally inform the DWS that Voorspoed Mine will be closing and to discuss the application for decommissioning that will be submitted to DMR during the first quarter of 2019.

3. Historical background to Voorpoed Mine Decommissioning and closure process

The Voorspoed Mine Rehabilitation Manager, Mr Kasago, provides an overview about the mine's recent history. The current mining right was granted in 2006 and the mine official opened on 4 November 2008 as a marginal mine that largely exploits an inferred resource. It consists of an open pit operation that mined to an approximate depth of 214m and recovered 6 Mct of diamonds.

The life of mine was envisaged until 2022; however, operational challenges due to a pit slope failure prompted the DBCM board to take a decision in July 2018 to proceed with the cessation of mining activities by the end of 2018 and proceed with responsible closure of the mine.

Following an extensive, disposal process, the company could not find a suitable operator to acquire and operate Voorspoed Mine in a sustainable manner and started the section 52 process. The DMR, however, requested extension of the sale process to Aug 2018 to allow other interested parties to be considered. One remaining interested party participated up to the end of January 2019 and the process was concluded on 19 February 2019. No viable option was identified to continue with the Voorspoed Mine. The DBCM informed board to close the mine and informed the Section 52 board accordingly.

At present, the remaining interested party is still considering options for remining the historical residue stockpiles. Voorspoed Mine is awaiting a proposal in this regard. Such activity will, however, have significant implications for the decommissioning and mine closure process.

4. Legal framework for decommissioning and mine closure

The EAP, Mr Meyer, indicates that one of the important objectives of this meeting is to discuss and reach agreement on the closure process, as well as to identify specific process requirements that DWS may have in this regard.

4.1. Overview

The EAP provided a brief overview of the understanding of the legal framework for decommissioning and mine closure.

Prior to December 2018, Voorspoed Mine had an approved EMPr (in terms of the Minerals and Petroleum Resources Development (MPRDA) and National Environmental Management Acts (NEMA)), as well as a Water Use license and Integrated Water and Waste Managemenrt Plan (in terms of the National Water Act (NWA)). In terms of the Financial Provison regulations published under the NEMA, the mine also had a final Rehabilitation and Closure Plan, an annual Rehabilitation Plan and an Environmental Risk Assessment. In addition, it also had a number of other documents, including an approved Social and Labour Plan, as well as a number of environmental specialist studies.

NWU® | CEM

The decision to proceed with decommissioning and mine closure requires the mine to apply for an environmental authorisation (EA) for decommissioning, as defined, and undertake a basic environmental impact assessment (BA) process in terms of the 2014 Environmental Impact Assessment (EIA) regulations. This will result in the drafting of an Environmental Management Programme (EMPr), and a Closure Plan (CP).

Once the EA has been issued, the EMPr & CP has to be implemented in preparation for mine closure. The mine closure application will be submitted somewhere in the future, after the completion of the approved closure plan.

Discussion:

DWS comment/response	Voorspoed EAP comment/response
The current water license will remain in place until DWS is notified that a water use have changed. If any water use is transferred to another party, DWS must be informed immediately, so that the license can be revised accordingly. Some water uses will remain until the closure certificate is issued.	How will the current water use license be affected?
This can be done, as the rehabilitation is still related to the mining activity, although it is during the decommissioning and closure phase.	Enquired as to whether some water abstracted for mining may be used to support rehabilitation processes during dry periods.

4.2. NEMA BA process

The Basic Assesssment process will follow the legislated 197 day process and will be triggered by the submission of the application for the decommissioning EA application. The drafting of the BA report, EMPr and CP has to be completed 50 days after the submission of the EA application, followed by a 30-day public review and commenting period, with a final 10 day period for consideration and incorporation of the comments. The revised documents will be submitted to DMR 90 days after the submission of the EA application.

Discussion:

DWS comment/response	Voorspoed EAP comment/response
DWS indicated that apart from the FS provincial office, separate units at DWS HQ will also be involved in the decommissioning application and review of the decommissioning documentation, including dam safety, resource protection and waste, as well as mining.	This is noted.
DWS requested that a hard copy of all documents be submitted to the DWS: FS office, with an electronic copy. The FS office will circulate the documents to the other units and submit a consolidated response.	This will be done.

DWS comment/response	Voorspoed EAP comment/response
This will assist in facilitating an effective decision-making process. DWS requests that notification about any proposed meeting should be circulated well in advance in order to secure the dates and approval to attend.	EAP undertakes to arrange a meeting with the relevant officer prior to the submission of the draft/final documents to brief him/her on the content of the documents. If required, this could also be done for the people at DWS:HQ in Pretoria. A combined meeting for all DWS officials could also be arranged in Potchefstroom or Kroonstad.

5. Water management issues in the mine decommissioning and closure process

5.1. Water management related studies

The EAP mentions that various water related studies have been done in the past that will be considered into the decommissioning application where relevant. These include the following:

- Geohydrological specialist investigation at the De Beers Voorspoed Diamond Mine – Metago Environmental Engineers, 2004
- Voorspoed Mine water balance investigation report – Jones & Wagener, 2012
- Predicted groundwater conditions at Voorspoed Mine - Itasca Denver, Inc., Colorado, 2014
- An assessment of the pollution potential from mine waste residues for Voorspoed Diamond Mine - Metago Environmental Engineers, 2005
- Inorganic geochemical environmental evaluation of Kimberlite Tailings – NWU Geology Department, 2014
- Hydrological & geochemistry studies, Golder & Associates, 2017
  - Review and assessment of the existing hydrogeological and hydrogeochemical data (previous studies and update).
  - Geochemical characterisation (waste assessment and waste classification of tailing deposits and waste rock dump;
  - Development of a numerical groundwater flow model and contaminated transport model.
  - Addressing data/information gaps related to optimise the mine site hydrological and geochemical monitoring aspects
  - Preparing a post mining monitoring programme mine closure requirements (Water and Sanitation (DWS) and Mineral resources).
  - Flood line assessment as per the WUL requirements
  - Long term dynamic water balance
  - Salt balance
- Dam Safety Inspection Report for the Renoster Weir – SRK Consulting, 2006
- Review of storm water entering the Voorspoed Mine open cast pit, storm water management and recommended storm water control measures – KLM Consulting Services, 2004
- Wetland delineation, management and rehabilitation plan for the De Beers Voorspoed Mine, Free State Province, Excigo Sustainability, 2017.

5.2. Current status and DWS expectations with regard to the BPG documents

The current status of the following two existing Best Practice Guidelines, published by DWS, is discussed:

- BPG G5: G5: Water Management Aspects for Mine Closure
- BPG G5: G4: Impact Prediction

While BPG G5 specifies a number of water related requirements for mine closure, it also specifies that the BPG G4 requirements must be complied with.

Discussion:

DWS comment/response	Voorspoed EAP comment/response
DWS undertakes to seek clarity on the matter and provide feedback to the EAP.	What is the current status of these two guidelines. Does DWS expects compliance with all the requirements specified?
DWS undertakes to seek clarity on the matter and provide feedback to the EAP.	BPG G4 emphasises the role of an independent reviewer in any impactprediction process, which ideally should occur over an extended period. Will this requirement be enforced or is DWS in a position to consider the documentation without the independent review report?

6. BA process plan

6.1. Pre-application meetings

Pre-application meetings will be held with key stakeholders such as DWS to inform them of the decommissioning EA application process and discuss the application process and reach agreement in this regard, as well as to identify specific process requirements that they may have.

Discussion:

DWS comment/response	Voorspoed EAP comment/response
Requests a copy of the presentation that was used at the meeting.	The EAP undertakes to circulate a copy of the presentation, together with minutes of the meeting.

6.2. BA process

The BA process, as prescribed by the 2014 EIA regulations will be followed. This will include the following activities:

- Descriptions of
  - Existing mine processes and infrastructure
  - Post closure natural and socio-economic environments, as well as land use
  - Mine closure process – closure objective
  - Mine closure alternatives

  - Environmental impacts/risks
  - Residual and latent environmental impacts/risks
  - Environmental prevention and mitigation measures
- Drafting, review and approval of
  - BA report
  - EMPr & Closure Plan

A number of the existing documents will be used as specialist inputs into the process, especially all the water related specialist studies.

6.3. Public participation process

The prescribed public participation process will be followed. The existing Voorspoed Mine stakeholder register has already been sourced and will form the basis of the Interested and Affected Parties (I&APs), together with the legally mandated I&APs. Commenting authorities will be engaged as discussed above.

The process will include the drafting and circulation of a background information document with response sheet, while site notices will be displayed at the site, as well as other identified publicly accessible localities.

Newspaper advertisements will be published in a number of local newspapers, as well as a national newspaper. Local radiostations will also be requested to inform the community about the public participation process.

One public meeting will be held in the Kroonstad civic centre, while dedicated meetings will also be held with commenting authorities, prior to the document review process.

Draft documents will be made available electronically on a publicly accessible website, while hard copies will be made available at Voorspoed Mine, the Moqhaka and Ngwather local municipality offices, the Fezile Dabi disctrict municipality offices, as well as at public libraries in Kroonstad and Parys.

Copies of the documents will be hand delivered to DWS: FS office, as well as DWS: HO, if required.

Discussion:

DWS comment/response	Voorspoed EAP comment/response
DWS will confirm the requirement for the delivery of documents.	

6.4. Project timeframes

The proposed project timeline is as follows:

- Pre-application meetings – March 2019
- Start of the BA process – April 2019
- Submission of the EA application – 23 April 2019
- Drafting of the BAR, EMPr & CP – April & May 2019
- Authority meetings – last week of May 2019

- Public meeting – 4 June 2019
- Circulate BAR, EMPr & CP for public comment – 10 June 2019
- Submit final BAR, EMPr & CP for decision-making – 22 July 2019
- DMR decision on the application – 6 Noveber 2019
- Conclusion of the submission of appeals – before 15 December 2019

7. General

DWS notices that this will be the first decommissioning and mine closure process for a big mine that they will be involved in. Everybody agrees with this statement.

8. Way Forward and Closure

Everybody agrees to support each other in order to ensure a successful decommisoning EA application.

The meeting ends at 11:45.

Appendix A: Attendance register

water & sanitation
Department: Water and Sanitation
REPUBLIC OF SOUTH AFRICA

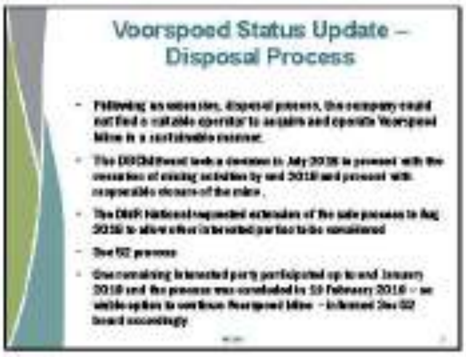
ATTENDANCE REGISTER

Meeting: DWS and Voorspoed	Date: 07 March 2019
	Place: Bloemfontein DWS office

Name	Organisation	Contact Numbers	Email	Signature
HANS KGETAPO	VOORSPOED MINE	Cell: 072 07 30 126 Phone: 056 216 9601 Fax:	hans.kgatapo@debeersgroup.com	[signature]
R ALBERTS	NWU	Cell: Phone: 018 2992267 Fax: 018 2992266	12991805@nwu.ac.za	[signature]
Boitumelo Meleto	DWS:FS	Cell: 082 556 3097 Phone: 051 405 9000 Fax:	meletob@dws.gov.za	[signature]
G. NEL	DWS: FS	Cell: 082 8786 707 Phone: 051 405 9000 Fax:	NELG@DWS.GOV.ZA	[signature]
TL MEYER	NWU-CEM	Cell: 084 627 0237 Phone: 018 299 1467 Fax: 086 573 7996	Theunis.Meyer@nwu.ac.za	[signature]
		Cell: Phone: Fax:		

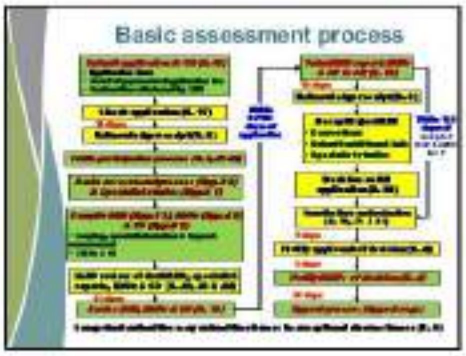
NWU® | CEM Centre for Environmental Management

Appendix B: Powerpoint presentation that was used during the meeting

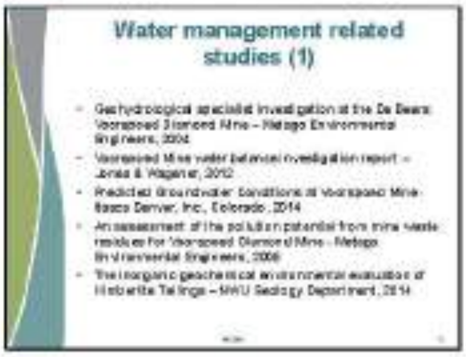


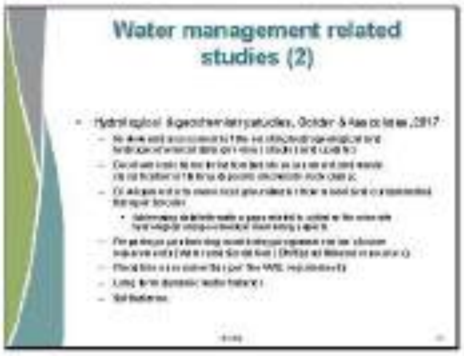
Page 9 of 11

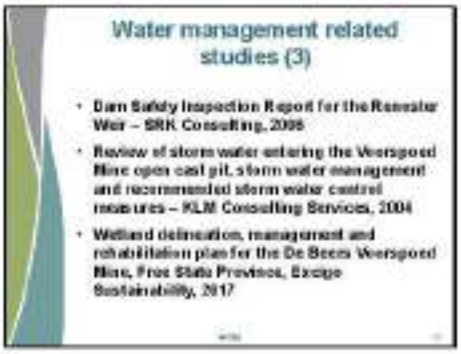
NWU® | CEM


Basic assessment process


Water management issues


Water management related studies (1)
Geohydrological specialist investigation at the De Beers Voorspoed Diamond Mine – Metago Environmental Engineers, 2004
Voorspoed Mine water balance investigation report – Jones & Wagener, 2012
Predicted Groundwater Conditions at Voorspoed Mine- Basco Denver, Inc., Colorado, 2014
An assessment of the pollution potential from mine waste residues for Voorspoed Diamond Mine - Metago Environmental Engineers, 2006
The inorganic geochemical environmental evaluation of Kimberlite Tailings – NWU Geology Department, 2014


Water management related studies (2)
Long term dynamic water balance


Water management related studies (3)
Dam Safety Inspection Report for the Renoster Weir – SRK Consulting, 2006
Review of storm water entering the Voorspoed Mine open cast pit, storm water management and recommended storm water control measures – KLM Consulting Services, 2004
Wetland delineation, management and rehabilitation plan for the De Beers Voorspoed Mine, Free State Province, Exigo Sustainability, 2017


Water related mine closure requirements
Status of BPGs
Best Practice Guideline G5: Water Management Aspects for Mine Closure
Best Practice Guideline G4: Impact Prediction
Independent reviewer?

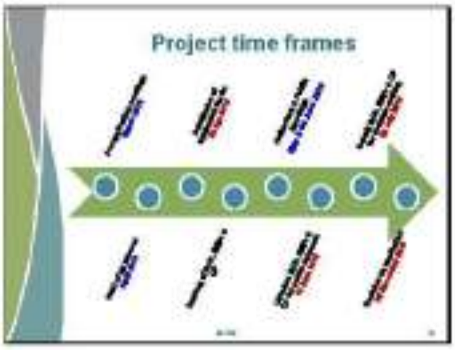

BA process plan


Pre-application meetings
Separate meetings with:
DMR – 1 March 2019
DWS – 7 March 2019
FS DESTEA
DAFF – Province & National
DRDLR
Objective:
To discuss and reach agreement on the closure process
To identify specific process requirements


Basic Environmental Impact Assessment
Undertaking of Basic EIA
Descriptions of
Drafting, review and approval of


Public Participation Process (1)
Stakeholder identification
Existing Voorspoed Mine I&APs
Mandated I&APs
Background Information Document
Newspaper Advertisements
1 National newspaper
Moqhaka News, Ngwathe News & Dumelang News
Local radio stations


Public Participation Process (2)
Meetings
1 Public meeting in Kroonstad (Moqhaka LM)
Meetings with other key government stakeholders
Availability of draft documents
Voorspoed Mine
Moqhaka & Ngwathe LM Muncipal offices
Kroonstad & Parys public libraries


Project time frames


Thank you
Thank you


Contact us:
NWU
CEM

Appendix 33: Minutes of a meeting for the De Beers Voorspoed Mine decommissioning Environmental Authorisation, held with the Free State Department of Economic, Small Business, Tourism and Environmental Affairs on 10 April 2019 at their offices in Bloemfontein

Private Bag X6001, Potchefstroom
South Africa 2520

Tel: 018 299-1111/2222
Web: http://www.nwu.ac.za

Centre for Environmental Management

Internal box 150, Private Bag X6001, Potchefstroom, South Africa, 2520

Tel: 018 299 1590 / 2724
Fax: 018 299 4266 / 2726
Email: cemprojects@nwu.ac.za / ceminfo@nwu.ac.za

Web: http:www.nwu.ac.za/cem

2019/04/17

De Beers Voorspoed Diamond Mine Decommisioning Environmental Impact Assessment and Mine Closure Process Public Participation Process: Meeting with the Free State Department of Economic, Small Business Development, Tourism & Environmental Affairs, held on 10 April 2019 at their offices in Bloemfontein

Minutes of meeting

1. Attendance

Name	Position	Organisation
Grace Mkhosana	Director: Environment	FS DESTEA
Daniel Mofokeng	Deputy-director: Air quality	FS DESTEA
Hans Kgasago	Rehabilitation Manager	De Beers Voorspoed Mine
Theunis Meyer	Environmental Assesment Practitioner	North-West University, Centre for Environmental Management

2. Purpose of the meeting

Mr Kgasago explained that De Beers Voorspoed Diamond Mine has reached the end of the life of the mine and is in the process of closing. Mr Meyer further explained that an application will be lodged for an environmental authorisation (EA) for the decommissioning of the mining activities. FS DESTEA has been identified as one of the organs of state that may have jurisdiction over any aspect of the operation or activity and has to be included in the public participation process.

The purpose of the meeting is twofold:

- to inform FS DESTEA about the decommissioning and mine closure process; and
- to engage with them to understand their expectations about the process to be followed and environmental issues or concerns to be addressed in the EIA process.

3. Notes on the discussions

3.1 The role of DESTEA

Ms Mkhosana indicated that the DMR is the competent authority responsible for considering the EA application and taking the decision on whether to authorise the decommissioning of the mining activities or not. FS DESTEA is only a commenting authority in the EIA process and need not be involved in the EIA process. It only needs to be provided with the draft reports for their consideration and inputs during the public participation process.

3.2 EIA process

Mr Meyer indicated that a hard copy of the draft report will be delivered by hand to DESTEA, while the DMR will be informed of this.

After a discussion, it was agreed that the EAP may arrange a meeting with the DESTEA case officer to coincide with the submission of the Draft Basic Assessment report and associated documents, to provide an overview of the report, or submit a presentation with the overview with the draft documents.

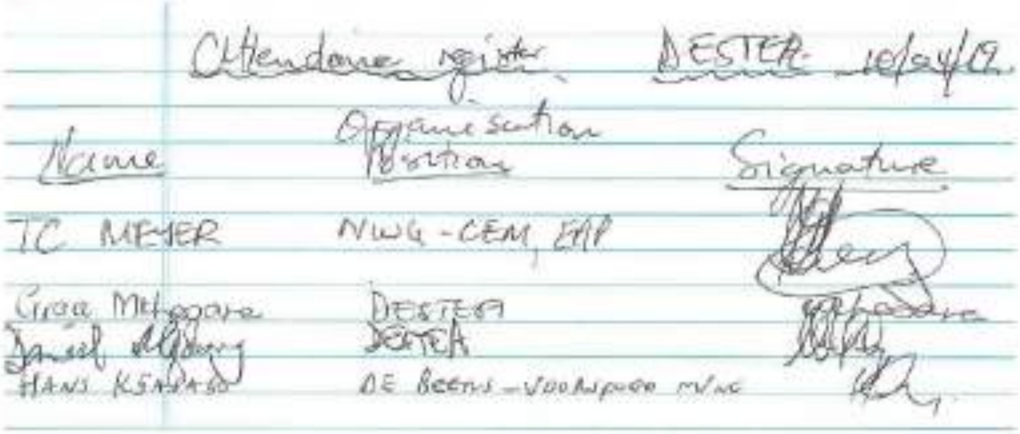
3.3 Notification in terms of the National Environmental Management: Air Quality Act

After a discussion of the need to submit a notification to the Minister of Environmental Affairs in terms of section 33 of the NEM:AQA, Mr Mofokeng indicated that such notification has to be submitted to the Air Quality officer at the Fezile Dabi District Municipality.

4. Closing

The meeting was adjourned at 10:45.

Attendance register


Attendance register DESTEA 10/4/19.

Name	Organisation Position	Signature
TC MEYER	NWU-CEM, EAP	[signature]
Greg Mkhosana	DESTEA	[signature]
Daniel [illegible]	DESTEA	[signature]
HANS [illegible]	DE BEERS – VOORSPOED MINE	[signature]

Page 2 of 2

Appendix 34: Minutes of a meeting for the De Beers Voorspoed Mine decommissioning Environmental Authorisation, held with the Department of Rural Development and Land Affairs on 10 April 2019 at their offices in Bloemfontein

Private Bag X6001, Potchefstroom
South Africa 2520

Tel: 018 299-1111/2222
Web: http://www.nwu.ac.za

Centre for Environmental Management

Internal box 150, Private Bag X6001, Potchefstroom, South Africa, 2520

Tel: 018 299 1590 / 2724
Fax: 018 299 4266 / 2726
Email: cemprojects@nwu.ac.za / ceminfo@nwu.ac.za

Web: http:www.nwu.ac.za/cem

2019/04/17

De Beers Voorspoed Diamond Mine Decommisioning Environmental Impact Assessment and Mine Closure Process Public Participation Process: Meeting with the Free State Department of Economic, Small Business Development, Tourism & Environmental Affairs, held on 10 April 2019 at their offices in Bloemfontein

Minutes of meeting

1. Attendance

Name	Position	Organisation
Grace Mkhosana	Director: Environment	FS DESTEA
Daniel Mofokeng	Deputy-director: Air quality	FS DESTEA
Hans Kgasago	Rehabilitation Manager	De Beers Voorspoed Mine
Theunis Meyer	Environmental Assesment Practitioner	North-West University, Centre for Environmental Management

2. Purpose of the meeting

Mr Kgasago explained that De Beers Voorspoed Diamond Mine has reached the end of the life of the mine and is in the process of closing. Mr Meyer further explained that an application will be lodged for an environmental authorisation (EA) for the decommissioning of the mining activities. FS DESTEA has been identified as one of the organs of state that may have jurisdiction over any aspect of the operation or activity and has to be included in the public participation process.

The purpose of the meeting is twofold:

- to inform FS DESTEA about the decommissioning and mine closure process; and
- to engage with them to understand their expectations about the process to be followed and environmental issues or concerns to be addressed in the EIA process.

3. Notes on the discussions

3.1 The role of DESTEA

Ms Mkhosana indicated that the DMR is the competent authority responsible for considering the EA application and taking the decision on whether to authorise the decommissioning of the mining activities or not. FS DESTEA is only a commenting authority in the EIA process and need not be involved in the EIA process. It only needs to be provided with the draft reports for their consideration and inputs during the public participation process.

3.2 EIA process

Mr Meyer indicated that a hard copy of the draft report will be delivered by hand to DESTEA, while the DMR will be informed of this.

After a discussion, it was agreed that the EAP may arrange a meeting with the DESTEA case officer to coincide with the submission of the Draft Basic Assessment report and associated documents, to provide an overview of the report, or submit a presentation with the overview with the draft documents.

3.3 Notification in terms of the National Environmental Management: Air Quality Act

After a discussion of the need to submit a notification to the Minister of Environmental Affairs in terms of section 33 of the NEM:AQA, Mr Mofokeng indicated that such notification has to be submitted to the Air Quality officer at the Fezile Dabi District Municipality.

4. Closing

The meeting was adjourned at 10:45.

Attendance register

Attendance register DESTEA 10/04/19.

Name	Organisation Position	Signature
JC MEYER	NWU-CEM, EAP	[illegible]
Grace Mkhosana	DESTEA	[illegible]
Daniel Mofokeng	DESTEA	[illegible]
HANS KSANTASO	DE BEERS - VOORSPOED MINE	[illegible]

Page 2 of 2

Appendix 35: Minutes of a meeting for the De Beers Voorspoed Mine decommissioning Environmental Authorisation, held with the Department of Agriculture, Forestry and Fisheries on 12 April 2019 at Voorspoed Mine

NWU®

Private Bag X6001, Potchefstroom
South Africa 2520

Tel: 018 299-1111/2222
Web: http://www.nwu.ac.za

Centre for Environmental Management

Internal box 150, Private Bag X6001, Potchefstroom, South Africa, 2520

Tel: 018 299 1590 / 2734
Fax: 018 299 4266 / 2726
Email: cemprojects@nwu.ac.za / ceminfo@nwu.ac.za

Web: http://www.nwu.ac.za/cem

2019/04/17

De Beers Voorspoed Diamond Mine Decommisioning Environmental Impact Assessment and Mine Closure Process Public Participation Process: Meeting with the Free State Department of Agriculture, held at 12:00 on 12 April 2019 at Voorspoed Diamond Mine, Kroonstad District

Minutes of meeting

1. Attendance

Name	Position	Organisation
Lekgau Mahlatji	Regional Manager	DAFF
Hans Kgasago	Rehabilitation Manager	De Beers Voorspoed Mine
Theunis Meyer	Environmental Assesment Practitioner	North-West University, Centre for Environmental Management

2. Purpose of the meeting

Mr Kgasago explained that De Beers Voorspoed Diamond Mine has reached the end of the life of the mine and is in the process of closing. Mr Meyer further explained that an application will be lodged for an environmental authorisation (EA) for the decommissioning of the mining activities. DAFF has been identified as one of the organs of state that may have jurisdiction over any aspect of the operation or activity and has to be included in the public participation process.

The purpose of the meeting is twofold:

- to inform DAFF about the decommissioning and mine closure process; and
- to engage with them to understand their expectations about the process to be followed and environmental issues or concerns to be addressed in the EIA process.

NWU® | CEM Centre for Environmental Management

3. Notes on the discussions

3.1 The role of DAFF

Mr Mahlatji indicated that the DAFF is a commenting authority in the EIA process will review and comment on the draft reports during the public participation process.

They are primarily concerned about the post rehabilitation and closure land use of the mining area.

3.2 EIA process

Mr Meyer indicated that a hard copy of the draft report will be delivered by hand to DAFF, while the DMR will be informed of this.

After a discussion, the EAP offered to arrange a meeting with the relevant DAFF official to coincide with the submission of the Draft Basic Assessment report and associated documents, to provide an overview of the report, in order to facilitate the review and commenting process.

3.3 DAFF inputs into the EIA process

Mr Mahlatji indicated that the DAFF is concerned about the following matters:

- Before the mining activities commenced, the land had been farming land and therefore needs to go back to farming land that could be used for agricultural production.
- The slope of the remaining rehabilitated residue deposits should facilitate farming activities. A question was asked as to whether it would be possible to cut and bale the grass on the rehabilitated areas mechanically?
- The depth of the soil cover on the rehabilitated residue deposits. If the soil cover is only 200 mm deep, it must not compromise the ability of the land to be used for agricultural production and compromise the ability of the vegetation to reach a stable state.
- During and after the mine rehabilitation and closure process, the area may be susceptible to invasion by alien invader plants. Measures need to be implemented to control such plants during the rehabilitation and closure process until a stable vegetation cover has been achieved.
- Some parts of the mining land is currently covered by the indigenous encroacher plant, commonly known as Bankrupt Bush or Slangbos. Measures must be implemented to control these plants during the rehabilitation and closure process.

4. Closing

The meeting was adjourned at 14:30.

De Beers Voorspoed Mine Decommissioning application

Date: 13 April 2018

Time: 12:00

Venue: Voorspoed Mine

Attendance register

Name	Organisation and designation	Contact number	Email	Signature
Mr Theunis Meyer	NWU-CEM: EAP	018 299 1467	Theunis.Meyer@nwu.ac.za	[illegible]
Mr Hans Hgapago	Voorspoed Mine Rehabilitation Manager	056 216 8605	[illegible]	[illegible]
Leksana Mahlatse	DAFF Regional Manager	051-4097417 060 973717	[illegible]	[illegible]

Appendix 36: Minutes of a meeting for the De Beers Voorspoed Mine decommissioning Environmental Authorisation, held with the Department of Water and Sanitation Head Office on 4 June 2019 at their offices in Pretoria

NWU®
NORTH-WEST UNIVERSITY
YUNIBESITI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT

Private Bag X6001, Potchefstroom
South Africa 2520

Tel: 018 299-1111/2222
Web: http://www.nwu.ac.za

Centre for Environmental Management

Internal box 150, Private Bag X6001, Potchefstroom, South Africa, 2520

Tel: 018 299 1590 / 2724
Fax: 018 299 4266 / 2726
Email: cemprojects@nwu.ac.za / ceminfo@nwu.ac.za

Web: http:www.nwu.ac.za/cem

2019/06/04

MINUTES OF PRE-APPLICATION MEETING FOR THE DE BEERS VOORSPOED MINE DECOMMISSIONING ENVIRONMENTAL AUTHORISATION

Date of meeting:	**Tuesday, 4 June 2019**
Time of meeting:	**08:30**
Venue:	**DWS Head Office, Pretoria**

1. Attendance:

Name	Title	Organisation	Contact details
Hans Kgasago	Rehabilitation Manager	DBCM Voorspoed Mine	056 216 8605 Hans.kgasago@debeersgroup.com
Theunis Meyer	Environmental Assessment Practitioner	NWU-CEM	018 299 1467 Theunis.meyer@nwu.ac.za
Reece Alberts	Environmental Assessment Practitioner	NWU-CEM	018 299 6267 12991805@nwu.ac.za
Dikeledi Baloyi	??	DWS RPW (Resource Protection & Waste)	012 336 8863 baloyidb@dws.gov.za
Makhura Maile	??	DWS: RPW	012 336 8920 makhuram@dws.gov.za
Meso Kama	??	DWS: RPW	012 336 6806 mesok@dws.gov.za
Candace Enoch	??	DWS MWM (Mine Water Management)	083 409 4539 enochc@dws.gov.za
Kgotso Mahlahlane	??	DWS: RPW	012 336 7777 mahlahlanek@dws.gov.za
Thivha Nemataleni	??	DWS: RPW	082 886 0570 nematalenit@dws.gov.za

Name	Title	Organisation	Contact details
Zimbini Mazula	??	DWS: MWM	072 317 4522 mazulaz@dws.gov.za
Desmond Mutshaive	??	DWS: MWM	012 336 7193 mutshaivel@dws.gov.za
Bashan Govender	??	DWS: MWM	082 895 0327 govenderb@dws.gov.za

Attendance register attached (Appendix A).

Powerpoint slide deck used during the meeting attached (Appendix B).

2. Opening & welcome

DWS welcomes the visitors to the meeting. All attendees are given the opportunity to introfuce themselves.

Voorspoed Mine indicates that the purpose of the meeting is to formally inform the DWS that Voorspoed Mine will be closing and to discuss the application for decommissioning that will be submitted to DMR during the second quarter of 2019.

3. Historical background to Voorpoed Mine Decommissioning and closure process

The Voorspoed Mine Rehabilitation Manager, Mr Kasago, provides an overview about the mine's recent history. The current mining right was granted in 2006 and the mine official opened on 4 November 2008 as a marginal mine that largely exploits an inferred resource. It consists of an open pit operation that mined to an approximate depth of 214m and recovered 6 Mct of diamonds.

The life of mine was envisaged until 2022, however, operational challenges due to a pit slope failure prompted the DBCM board to take a decision in July 2018 to proceed with the cessation of mining activities by the end of 2018 and proceed with responsible closure of the mine.

Following an extensive, disposal process, the company could not find a suitable operator to acquire and operate Voorspoed Mine in a sustainable manner and started the section 52 process. The DMR, however, requested extension of the sale process to Aug 2018 to allow other interested parties to be considered. One remaining interested party participated up to the end of January 2019 and the process was concluded on 19 February 2019. No viable option was identified to continue with the Voorspoed Mine. The DBCM informed board to close the mine and informed the Section 52 board accordingly.

At present, the remaining interested party is still considering options for remining the historical residue stockpiles. Voorspoed Mine is awaiting a proposal in this regard. Such activity will, however, have significant implications for the decommissioning and mine closure process.

4. Legal framework for decommissioning and mine closure

The EAP, Mr Meyer, indicates that one of the important objectives of this meeting is to discuss and reach agreement on the closure process, as well as to identify specific process requirements that DWS may have in this regard.

Similar meegtings were also held with the Department of Minetal Resources - Free State Regional Office, DWS Free State Regional Office, Free State Departments of Economic and Small Business development, Tourism and Environmental Affairs, Agriculture and Rural Development and Land Reform.

4.1. Overview

The EAP provided a brief overview of the understanding of the legal framework for decommissioning and mine closure.

Prior to December 2018, Voorspoed Mine had an approved EMPr (in terms of the Minerals and Petroleum Resources Development (MPRDA) and National Environmental Management Acts (NEMA)), as well as a Water Use license and Integrated Water and Waste Managemenrt Plan (in terms of the National Water Act (NWA)). In terms of the Financial Provison regulations published under the NEMA, the mine also had a final Rehabilitation and Closure Plan, an annual Rehabilitation Plan and an Environmental Risk Assessment. In addition, it also had a number of other documents, including an approved Social and Labour Plan, as well as a number of environmental specialist studies.

The decision to proceed with decommissioning and mine closure requires the mine to apply for an environmental authorisation (EA) for decommissioning, as defined, and undertake a basic environmental impact assessment (BA) process in terms of the 2014 Environmental Impact Assessment (EIA) regulations. This will result in the drafting of an Environmental Management Programme (EMPr), and a Closure Plan (CP).

Once the EA has been issued, the EMPr & CP has to be implemented in preparation for mine closure. The mine closure application will be submitted somewhere in the future, after the completion of the approved closure plan.

Discussion:

DWS comment/response	Voorspoed EAP comment/response
What water uses are taking place at Voorspoed Mine?	Voorspoed mine engages in abstraction (21(a)), storage (21(b)), disposal of waste (21(g)) and dewatering (21(j)). All of these are authorised in Water Use License No. 9/C70H/ABGJ/1031 that was issued to De Beers Consolidated Mines Limited on 20 June 2011 and amended on 04 February 2013, except for abstraction of water from a borehole on-site, which has already been reduced and will end upon mine closure. In addition, the mining activities have modified a small water course that originates on the site, without a modification (21(c) & (i)) water use.

Why are some of the water uses not authorised?	All the illegal water uses had been identified and communicated in the IWWMP that was submitted to DWS in 2014. Voorspoed Mine was in the process to apply for the amendment of the WUL to include these water uses, when the mine was forced into pre-mature closure.

4.2. NEMA BA process

The Basic Assessment process will follow the legislated 197 day process and will be triggered by the submission of the application for the decommissioning EA application. The drafting of the BA report, EMPr and CP has to be completed 50 days after the submission of the EA application, followed by a 30-day public review and commenting period, with a final 10 day period for consideration and incorporation of the comments. The revised documents will be submitted to DMR 90 days after the submission of the EA application.

Discussion:

DWS comment/response	Voorspoed EAP comment/response
DWS indicated that staff from the mine water management and resource protection and waste sections at DWS HQ will also be involved in the decommissioning application and review of the decommissioning documentation, in addition to the staff from the FS provincial office. Staff from the dam safety section may also be involved.	This is noted.
DWS indicated that all documents must be submitted to the DWS: FS office, who will circulate the documents to the other units and submit a consolidated response.	This will be discussed with the DWS:FS Office. If submitting copies to DWS HQ directly will facilitate the review process, the EAP offers to submit copies of the reports directly to DWS HQ.
This will assist in facilitating an effective decision-making process.	EAP offers to arrange a meeting with the relevant officers prior to the submission of the draft/final documents to brief him/her on the content of the documents.

5. Water management issues in the mine decommissioning and closure process

5.1. Water related issues at Voorspoed Mine

The EAP indicates that the following water related infrastructure and facilities exist currently at Voorspoed Mine:

- Open pit
- Kimberlite Processing Plant.
- Waste Rock Dump, Coarse Residue Deposit & Fine Residue Deposit
- Return Water Dam and the Storm Water Control Dam
- Storm water control infrastructure such as channels and berms

- Water pipeline from weir on the Renoster River to Voorspoed Mine
- Various abstraction and monitoring boreholes
- Two Sewage Treatment Plants
- Waste storage area
- Other infrastructure
  - Offices, stores, training centres and change houses
  - Workshops, vehicle wash bays, vehicle refuelling bays and fuel and lube storage tanks
  - Power line & Eskom Sub-station.
  - Explosives Magazine

Since the mine planning started, numerous specialist studies were done. Ground and surface water monitoring was also undertaken regularly.

During the decommissioning and mine closure process, the open pit will not be backfilled, but will remain, with a pit lake.

Discussion:

DWS comment/response	Voorspoed EAP comment/response
DWS enquired as to what options were considered in deciding on the pit lake option.	Mr Kgasago indicated that a range of specialist studies were undertaken and 8 pit closure options were investigated. The final option was selected on the basis of BPEO, as well as BATNEEC, which are both referenced in a number of DWS BPGs.
What will the impact be of the preferred pit closure option and the formation of the pit lake?	Specialist studies have shown that the pit lake will form very slowly and the surface will always remain way (approximately 40-75 m) below the ground level and never decant into the receiving environment. The quality of the pit water has elevated TDS levels, which is expected to increase over time. No acid drainage will be generated. Specialist studies have also indicated that if the pit is back-filled, it could create a matrix of soil and rock that could facilitate the upward mobility of the polluted water and result in the decanting thereof into the receiving environment.

5.2. Water management related studies

The water related specialist studies include the following:

- Geohydrological specialist investigation at the De Beers Voorspoed Diamond Mine – Metago Environmental Engineers, 2004
- Voorspoed Mine water balance investigation report – Jones & Wagener, 2012
- Predicted groundwater conditions at Voorspoed Mine - Itasca Denver, Inc., Colorado, 2014

- An assessment of the pollution potential from mine waste residues for Voorspoed Diamond Mine - Metago Environmental Engineers, 2005
- Inorganic geochemical environmental evaluation of Kimberlite Tailings – NWU Geology Department, 2014
- Voorspoed Mine – Pit Closure Study, E-Tek Consulting & Redco, 2017
- Voorspoed Diamond Mine Water and Salt Balance Report, Golder & Associates, 2017
- Geochemical Assessment Report, Golder & Associates, 2017
- Summary of Surface and Groundwater Study for Mine Closure, Golder & Associates, 2017
- Voorspoed Mine Hydrological Monitoring Program (2018+), Golder & Associates, 2019
- Dam Safety Inspection Report for the Renoster Weir – SRK Consulting, 2006
- Review of storm water entering the Voorspoed Mine open cast pit, storm water management and recommended storm water control measures – KLM Consulting Services, 2004
- Wetland delineation, management and rehabilitation plan for the De Beers Voorspoed Mine, Free State Province, Excigo Sustainability, 2017.

5.3. Current status and DWS expectations with regard to the BPG documents

After the previous engagement with the DWS: Free State office, confirmation has been received that consideration of the following two existing Best Practice Guidelines, published by DWS, is still required in the mine decommissioning and closure process:

- BPG G5: G5: Water Management Aspects for Mine Closure
- BPG G5: G4: Impact Prediction

Consequently, an independent water specialist consultant team has been appointed to independently review the key water specialist studies undertaken to date.

6. BA process plan

6.1. Pre-application meetings

Pre-application meetings have been held with key stakeholders to inform them of the decommissioning EA application process and discuss the application process and reach agreement in this regard, as well as to identify specific process requirements that they may have.

6.2. BA process

The BA process, as prescribed by the 2014 EIA regulations will be followed. This will include the following activities:

- Descriptions of
  - Existing mine processes and infrastructure
  - Post closure natural and socio-economic environments, as well as land use
  - Mine closure process – closure objective
  - Mine closure alternatives
  - Environmental impacts/risks
  - Residual and latent environmental impacts/risks

  - Environmental prevention and mitigation measures
- Drafting, review and approval of
  - BA report
  - EMPr & Closure Plan

A number of the existing documents will be used as specialist inputs into the process, especially all the water related specialist studies.

6.3. Public participation process

The prescribed public participation process will be followed. The existing Voorspoed Mine stakeholder register has already been sourced and will form the basis of the Interested and Affected Parties (I&APs), together with the legally mandated I&APs. Commenting authorities will be engaged as discussed above.

The process will include the drafting and circulation of a background information document with response sheet, while site notices will be displayed at the site, as well as other identified publicly accessible localities.

Newspaper advertisements will be published in a number of local newspapers, as well as a national newspaper. Local radiostations will also be requested to inform the community about the public participation process.

Two public meetings will be held in the Kroonstad and Parys civic centres, while dedicated meetings will also be heldwith commenting authorities, prior to the document review process.

Draft documents will be made available electronically on a publicly accessible website, while hard copies will be made available at Voorspoed Mine, the Moqhaka and Ngwather local municipality offices, the Fezile Dabi disctrict municipality offices, as well as at public libraries in Kroonstad and Parys.

Copies of the documents will be hand delivered to DWS: FS office, as well as DWS: HO, if required.

Discussion:

DWS comment/response	Voorspoed EAP comment/response
See 4.2	

6.4. Project timeframes

The proposed project timeline is as follows:

- Pre-application meetings – March to June 2019
- Start of the BA process – June 2019
- Submission of the EA application – 24 June 2019
- Drafting of the BAR, EMPr & CP –May & June 2019
- Authority meetings – last week of May 2019
- Public meeting – 20 & 21 August 2019
- Circulate BAR, EMPr & CP for public comment – 22 July 2019
- Submit final BAR, EMPr & CP for decision-making – 30 August 2019

- DMR decision on the application – 18 December 2019
- Conclusion of the submission of appeals – 27 January 2020

7. Way Forward and Closure

DWS requests that a site visit be arranged so that the officials could familiarise themselves with the mine site. Voorspoed Mine will arrange the site visit with the assistance of the EAP.

Everybody agrees to support each other in order to ensure a successful decommisoning EA application.

The meeting ends at 10:00.

Appendix A: Attendance register

CEM

ATTENDANCE REGISTER

Project: Voorspoed Diamond Mine Decommissioning and Closure
Event: Department of Water and Sanitation Meeting
Locality: DWS Head Office, Pretoria
Date and Time: Tuesday, 14 June, 2016, 08h30

Name and Surname:	Organisation:	Contact Number(s):	E-mail Address(es):	Signature:
Deeran Basu	DWS : RPM	012 336 8758 [illegible]	Basu@dws.gov.za	
Marlene Meyer	DWS: RPM	012 336 8920	[illegible]@dws.gov.za	
Meso Kama	DWS: RPW	012 336 [illegible]	[illegible]@dws.gov.za	
Candice Erasmus	DWS: NWM	083 469 4539	ErasmusC@dws.gov.za	
Kgotso Mahlahlane	DWS: RPW	012 336 7777 073 537 9352	MahlahlaneK@dws.gov.za	
Thomas Meyer	NWU - CEM	018 299 4467 083 627 0637	Thomas.Meyer@nwu.ac.za	
E Alberts	NWU - CEM	018 2[illegible]	12[illegible]@nwu.ac.za	

Attendance Register Project Close-Out Meeting Rev 2015-03 | Page 1 of 2

Name and Surname:	Organisation:	Contact Number(s):	E-mail Address(es):	Signature:
Hans Kgasago	De Beers	056 716 8600	[illegible].Kgasago@debeersgroup.com	
Tlou Nemakhavhani	DWS : RPW	082 895 0570	NemakhavhaniT@dws.gov.za	
Zintle Mazula	DWS : NWRP	072 374 5[illegible]	MazulaZ@dws.gov.za	
Desmond Mathebula	DWS: NWRP	012 336 7193	MathebulaD@dws.gov.za	
[illegible]	DWS : [illegible]	082 195 [illegible]	[illegible]@dws.gov.za	

Attendance Register Project Close-Out Meeting Rev 2015-03 | Page 2 of 2

Appendix B: Powerpoint presentation that was used during the meeting

Appendix 37: Minutes of a meeting for the De Beers Voorspoed Mine decommissioning Environmental Authorisation, held with the Ngwathe Municipality on 20 August 2019 at their offices in Parys

NWU®
NORTH-WEST UNIVERSITY
YUNIBESITI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT

Private Bag X6001, Potchefstroom
South Africa 2520

Tel: 018 299-1111/2222
Web: http://www.nwu.ac.za

Centre for Environmental Management

Internal box 150, Private Bag X6001, Potchefstroom, South Africa, 2520

Tel: 018 299 1590 / 2724
Fax: 018 299 4266 / 2726
Email: cemprojects@nwu.ac.za / ceminfo@nwu.ac.za

Web: http://www.nwu.ac.za/cem

2019/06/04

MINUTES OF PRE-APPLICATION MEETING FOR THE DE BEERS VOORSPOED MINE DECOMMISSIONING ENVIRONMENTAL AUTHORISATION

Date of meeting:	**Tuesday, 4 June 2019**
Time of meeting:	**08:30**
Venue:	**DWS Head Office, Pretoria**

1. Attendance:

Name	Title	Organisation	Contact details
Hans Kgasago	Rehabilitation Manager	DBCM Voorspoed Mine	056 216 8605 Hans.kgasago@debeersgroup.com
Theunis Meyer	Environmental Assessment Practitioner	NWU-CEM	018 299 1467 Theunis.meyer@nwu.ac.za
Reece Alberts	Environmental Assessment Practitioner	NWU-CEM	018 299 6267 12991805@nwu.ac.za
Dikeledi Baloyi	??	DWS RPW (Resource Protection & Waste)	012 336 8863 baloyidb@dws.gov.za
Makhura Maile	??	DWS: RPW	012 336 8920 makhuram@dws.gov.za
Meso Kama	??	DWS: RPW	012 336 6806 mesok@dws.gov.za
Candace Enoch	??	DWS MWM (Mine Water Management)	083 409 4539 enochc@dws.gov.za
Kgotso Mahlahlane	??	DWS: RPW	012 336 7777 mahlahlanek@dws.gov.za
Thivha Nemataleni	??	DWS: RPW	082 895 0570 nematalenit@dws.gov.za

Name	Title	Organisation	Contact details
Zimbini Mazula	??	DWS: MWM	072 317 4522 mazulaz@dws.gov.za
Desmond Mutshaive	??	DWS: MWM	012 336 7193 mutshaivel@dws.gov.za
Bashan Govender	??	DWS: MWM	082 895 0327 govenderb@dws.gov.za

Attendance register attached (Appendix A).

Powerpoint slide deck used during the meeting attached (Appendix B).

2. Opening & welcome

DWS welcomes the visitors to the meeting. All attendees are given the opportunity to introfuce themselves.

Voorspoed Mine indicates that the purpose of the meeting is to formally inform the DWS that Voorspoed Mine will be closing and to discuss the application for decommissioning that will be submitted to DMR during the second quarter of 2019.

3. Historical background to Voorpoed Mine Decommissioning and closure process

The Voorspoed Mine Rehabilitation Manager, Mr Kasago, provides an overview about the mine's recent history. The current mining right was granted in 2006 and the mine official opened on 4 November 2008 as a marginal mine that largely exploits an inferred resource. It consists of an open pit operation that mined to an approximate depth of 214m and recovered 6 Mct of diamonds.

The life of mine was envisaged until 2022, however, operational challenges due to a pit slope failure prompted the DBCM board to take a decision in July 2018 to proceed with the cessation of mining activities by the end of 2018 and proceed with responsible closure of the mine.

Following an extensive, disposal process, the company could not find a suitable operator to acquire and operate Voorspoed Mine in a sustainable manner and started the section 52 process. The DMR, however, requested extension of the sale process to Aug 2018 to allow other interested parties to be considered. One remaining interested party participated up to the end of January 2019 and the process was concluded on 19 February 2019. No viable option was identified to continue with the Voorspoed Mine. The DBCM informed board to close the mine and informed the Section 52 board accordingly.

At present, the remaining interested party is still considering options for remining the historical residue stockpiles. Voorspoed Mine is awaiting a proposal in this regard. Such activity will, however, have significant implications for the decommissioning and mine closure process.

NWU® | CEM

4. Legal framework for decommissioning and mine closure

The EAP, Mr Meyer, indicates that one of the important objectives of this meeting is to discuss and reach agreement on the closure process, as well as to identify specific process requirements that DWS may have in this regard.

Similar meegtings were also held with the Department of Minetal Resources - Free State Regional Office, DWS Free State Regional Office, Free State Departments of Economic and Small Business development, Tourism and Environmental Affairs, Agriculture and Rural Development and Land Reform.

4.1. Overview

The EAP provided a brief overview of the understanding of the legal framework for decommissioning and mine closure.

Prior to December 2018, Voorspoed Mine had an approved EMPr (in terms of the Minerals and Petroleum Resources Development (MPRDA) and National Environmental Management Acts (NEMA)), as well as a Water Use license and Integrated Water and Waste Managemenrt Plan (in terms of the National Water Act (NWA)). In terms of the Financial Provison regulations published under the NEMA, the mine also had a final Rehabilitation and Closure Plan, an annual Rehabilitation Plan and an Environmental Risk Assessment. In addition, it also had a number of other documents, including an approved Social and Labour Plan, as well as a number of environmental specialist studies.

The decision to proceed with decommissioning and mine closure requires the mine to apply for an environmental authorisation (EA) for decommissioning, as defined, and undertake a basic environmental impact assessment (BA) process in terms of the 2014 Environmental Impact Assessment (EIA) regulations. This will result in the drafting of an Environmental Management Programme (EMPr), and a Closure Plan (CP).

Once the EA has been issued, the EMPr & CP has to be implemented in preparation for mine closure. The mine closure application will be submitted somewhere in the future, after the completion of the approved closure plan.

Discussion:

DWS comment/response	Voorspoed EAP comment/response
What water uses are taking place at Voorspoed Mine?	Voorspoed mine engages in abstraction (21(a)), storage (21(b)), disposal of waste (21(g)) and dewatering (21(j)). All of these are authorised in Water Use License No. 9/C70H/ABGJ/1031 that was issued to De Beers Consolidated Mines Limited on 20 June 2011 and amended on 04 February 2013, except for abstraction of water from a borehole on-site, which has already been reduced and will end upon mine closure. In addition, the mining activities have modified a small water course that originates on the site, without a modification (21(c) & (i)) water use.

Why are some of the water uses not authorised?	All the illegal water uses had been identified and communicated in the IWWMP that was submitted to DWS in 2014. Voorspoed Mine was in the process to apply for the amendment of the WUL to include these water uses, when the mine was forced into pre-mature closure.

4.2. NEMA BA process

The Basic Assessment process will follow the legislated 197 day process and will be triggered by the submission of the application for the decommissioning EA application. The drafting of the BA report, EMPr and CP has to be completed 50 days after the submission of the EA application, followed by a 30-day public review and commenting period, with a final 10 day period for consideration and incorporation of the comments. The revised documents will be submitted to DMR 90 days after the submission of the EA application.

Discussion:

DWS comment/response	Voorspoed EAP comment/response
DWS indicated that staff from the mine water management and resource protection and waste sections at DWS HQ will also be involved in the decommissioning application and review of the decommissioning documentation, in addition to the staff from the FS provincial office. Staff from the dam safety section may also be involved.	This is noted.
DWS indicated that all documents must be submitted to the DWS: FS office, who will circulate the documents to the other units and submit a consolidated response.	This will be discussed with the DWS:FS Office. If submitting copies to DWS HQ directly will facilitate the review process, the EAP offers to submit copies of the reports directly to DWS HQ.
This will assist in facilitating an effective decision-making process.	EAP offers to arrange a meeting with the relevant officers prior to the submission of the draft/final documents to brief him/her on the content of the documents.

5. Water management issues in the mine decommissioning and closure process

5.1. Water related issues at Voorspoed Mine

The EAP indicates that the following water related infrastructure and facilities exist currently at Voorspoed Mine:

- Open pit
- Kimberlite Processing Plant.
- Waste Rock Dump, Coarse Residue Deposit & Fine Residue Deposit
- Return Water Dam and the Storm Water Control Dam
- Storm water control infrastructure such as channels and berms

- Water pipeline from weir on the Renoster River to Voorspoed Mine
- Various abstraction and monitoring boreholes
- Two Sewage Treatment Plants
- Waste storage area
- Other infrastructure
  - Offices, stores, training centres and change houses
  - Workshops, vehicle wash bays, vehicle refuelling bays and fuel and lube storage tanks
  - Power line & Eskom Sub-station.
  - Explosives Magazine

Since the mine planning started, numerous specialist studies were done. Ground and surface water monitoring was also undertaken regularly.

During the decommissioning and mine closure process, the open pit will not be backfilled, but will remain, with a pit lake.

Discussion:

DWS comment/response	Voorspoed EAP comment/response
DWS enquired as to what options were considered in deciding on the pit lake option.	Mr Kgasago indicated that a range of specialist studies were undertaken and 8 pit closure options were investigated. The final option was selected on the basis of BPEO, as well as BATNEEC, which are both referenced in a number of DWS BPGs.
What will the impact be of the preferred pit closure option and the formation of the pit lake?	Specialist studies have shown that the pit lake will form very slowly and the surface will always remain way (approximately 40-75 m) below the ground level and never decant into the receiving environment. The quality of the pit water has elevated TDS levels, which is expected to increase over time. No acid drainage will be generated. Specialist studies have also indicated that if the pit is back-filled, it could create a matrix of soil and rock that could facilitate the upward mobility of the polluted water and result in the decanting thereof into the receiving environment.

5.2. Water management related studies

The water related specialist studies include the following:

- Geohydrological specialist investigation at the De Beers Voorspoed Diamond Mine – Metago Environmental Engineers, 2004
- Voorspoed Mine water balance investigation report – Jones & Wagener, 2012
- Predicted groundwater conditions at Voorspoed Mine - Itasca Denver, Inc., Colorado, 2014

- An assessment of the pollution potential from mine waste residues for Voorspoed Diamond Mine - Metago Environmental Engineers, 2005
- Inorganic geochemical environmental evaluation of Kimberlite Tailings – NWU Geology Department, 2014
- Voorspoed Mine – Pit Closure Study, E-Tek Consulting & Redco, 2017
- Voorspoed Diamond Mine Water and Salt Balance Report, Golder & Associates, 2017
- Geochemical Assessment Report, Golder & Associates, 2017
- Summary of Surface and Groundwater Study for Mine Closure, Golder & Associates, 2017
- Voorspoed Mine Hydrological Monitoring Program (2018+), Golder & Associates, 2019
- Dam Safety Inspection Report for the Renoster Weir – SRK Consulting, 2006
- Review of storm water entering the Voorspoed Mine open cast pit, storm water management and recommended storm water control measures – KLM Consulting Services, 2004
- Wetland delineation, management and rehabilitation plan for the De Beers Voorspoed Mine, Free State Province, Excigo Sustainability, 2017.

5.3. Current status and DWS expectations with regard to the BPG documents

After the previous engagement with the DWS: Free State office, confirmation has been received that consideration of the following two existing Best Practice Guidelines, published by DWS, is still required in the mine decommissioning and closure process:

- BPG G5: G5: Water Management Aspects for Mine Closure
- BPG G5: G4: Impact Prediction

Consequently, an independent water specialist consultant team has been appointed to independently review the key water specialist studies undertaken to date.

6. BA process plan

6.1. Pre-application meetings

Pre-application meetings have been held with key stakeholders to inform them of the decommissioning EA application process and discuss the application process and reach agreement in this regard, as well as to identify specific process requirements that they may have.

6.2. BA process

The BA process, as prescribed by the 2014 EIA regulations will be followed. This will include the following activities:

- Descriptions of
  - Existing mine processes and infrastructure
  - Post closure natural and socio-economic environments, as well as land use
  - Mine closure process – closure objective
  - Mine closure alternatives
  - Environmental impacts/risks
  - Residual and latent environmental impacts/risks

- Environmental prevention and mitigation measures
- Drafting, review and approval of
  - BA report
  - EMPr & Closure Plan

A number of the existing documents will be used as specialist inputs into the process, especially all the water related specialist studies.

6.3. Public participation process

The prescribed public participation process will be followed. The existing Voorspoed Mine stakeholder register has already been sourced and will form the basis of the Interested and Affected Parties (I&APs), together with the legally mandated I&APs. Commenting authorities will be engaged as discussed above.

The process will include the drafting and circulation of a background information document with response sheet, while site notices will be displayed at the site, as well as other identified publicly accessible localities.

Newspaper advertisements will be published in a number of local newspapers, as well as a national newspaper. Local radiostations will also be requested to inform the community about the public participation process.

Two public meetings will be held in the Kroonstad and Parys civic centres, while dedicated meetings will also be heldwith commenting authorities, prior to the document review process.

Draft documents will be made available electronically on a publicly accessible website, while hard copies will be made available at Voorspoed Mine, the Moqhaka and Ngwather local municipality offices, the Fezile Dabi disctrict municipality offices, as well as at public libraries in Kroonstad and Parys.

Copies of the documents will be hand delivered to DWS: FS office, as well as DWS: HO, if required.

Discussion:

DWS comment/response	Voorspoed EAP comment/response
See 4.2	

6.4. Project timeframes

The proposed project timeline is as follows:

- Pre-application meetings – March to June 2019
- Start of the BA process – June 2019
- Submission of the EA application – 24 June 2019
- Drafting of the BAR, EMPr & CP –May & June 2019
- Authority meetings – last week of May 2019
- Public meeting – 20 & 21 August 2019
- Circulate BAR, EMPr & CP for public comment – 22 July 2019
- Submit final BAR, EMPr & CP for decision-making – 30 August 2019

- DMR decision on the application – 18 December 2019
- Conclusion of the submission of appeals – 27 January 2020

7. Way Forward and Closure

DWS requests that a site visit be arranged so that the officials could familiarise themselves with the mine site. Voorspoed Mine will arrange the site visit with the assistance of the EAP.

Everybody agrees to support each other in order to ensure a successful decommisoning EA application.

The meeting ends at 10:00.

Appendix A: Attendance register

CEM

ATTENDANCE REGISTER

Project: Voorspoed Diamond Mine Decommissioning and Closure
Event: Department of Water and Sanitation Meeting
Locality: DWS Head Office, Pretoria
Date and Time: Tuesday, 14 June, 2016, 08h30

Name and Surname:	Organisation:	Contact Number(s):	E-mail Address(es):	Signature:
Dennis Baye	DWS : RPM	012 880 5758 [illegible]	[illegible]@dws.gov.za	[illegible]
Moleluma Mese	DWS: RPM	012 336 8920	[illegible]@dws.gov.za	[illegible]
Meso Kana	DWS: RPW	012 336 [illegible]	[illegible]@dws.gov.za	[illegible]
Candice Erasmus	DWS: NWM	083 [illegible] 4539	ErasmusC@dws.gov.za	[illegible]
Kgotso Mahlatsane	DWS: RPM	012 336 7777 0735579952	MahlatsaneK@dws.gov.za	[illegible]
Thomas Meyer	NWU - CEM	018 299 [illegible] 083 627 0637	Thomas.Meyer@nwu.ac.za	[illegible]
E Alberts	NWU - CEM	018 299 [illegible]	[illegible]@nwu.ac.za	[illegible]

Attendance Register Project Close-Out Meeting Rev 2015-00 Page 1 of 2

Name and Surname:	Organisation:	Contact Number(s):	E-mail Address(es):	Signature:
Hans Kgasago	De Beers	056 716 8601	[illegible].kgasago@debeersgroup.com	[illegible]
Tilda Nenwisheni	DWS : RPW	082 8950570	NenwisheniT@dws.gov.za	[illegible]
Zintombi Maduna	DWS : NWRIM	012 336 [illegible]	[illegible]@dws.gov.za	[illegible]
Desmond Mathebula	DWS : NWRM	012 336 7193	MathebulaD@dws.gov.za	[illegible]
Gihan [illegible]	DWS : Water Resource [illegible]	012 [illegible]	[illegible]@dws.gov.za	[illegible]

Attendance Register Project Close-Out Meeting Rev 2015-00 Page 2 of 2

NWU® | CEM Centre for Environmental Management

Appendix B: Powerpoint presentation that was used during the meeting

Appendix 38: Minutes of a meeting for the De Beers Voorspoed Mine decommissioning Environmental Authorisation, held with the Moqhaka Municipality on 19 August 2019 at their offices in Kroonstad

Although the meeting was arranged with the municipality for 14:00 on Monday, 19 August 2019, the meeting was not held due to the unavailability of the relevant officials and councillors.

Appendix 39: Final comment received from the South African Heritage Resources Agency in terms of Section 38(8) of the National Heritage Resources Act (Act 25 of 1999) on the Voorspoed Mine decommissioning Environmental Authorisation application

Voorspoed Mine decommissioning

Our Ref:

an agency of the
Department of Arts and Culture

T: +27 21 462 4502 | F: +27 21 462 4509 | E: info@sahra.org.za
South African Heritage Resources Agency | 111 Harrington Street | Cape Town
P.O. Box 4637 | Cape Town | 8001
www.sahra.org.za

Enquiries: Ragna Redelstorff
Tel: +27 (0)21 202 8651
Email: rredelstorff@sahra.org.za
CaseID: 14265

Date: Wednesday September 25, 2019
Page No: 1

Final Comment

In terms of Section 38(8) of the National Heritage Resources Act (Act 25 of 1999)

Attention: De Beers Group Voorspoed Mine

Proposed decommissioning and mine closure, Voorspoed Mine, Ngwathe Municipality, Free State

The proposed project entails the decommissioning and mine closure of the Voorspoed Mine, an open pit diamond mine for which operations ceased in December 2018. The mine is located on the farms Voorspoed 2480 (consolidation of subdivision 1 of the Farm Voorspoed 401, Subdivision 1 of the Farm Geldenhuys 1477, Subdivision 2 of the Farm Morgenster 772), Voorspoed 2480, Geldenhuys 1477, Morgenster 772, within Fezile Dabi Magisterial District, Ngwathe Municipality, Free State Province. The BAR and EMPr and 2005 HIA were submitted with the application.

Final comment

As this is a decommissioning application of an existing mine the SAHRA Archaeology, Palaeontology and Meteorites (APM) Unit has no objection against the activities subject to the following conditions that must be adhered to:

1. Should any objects of archaeological or palaeontological remains be found during construction activities, work must immediately stop in that area and the Environmental Control Officer (ECO) must be informed.

2. The ECO must inform the South African Heritage Recourse Agency (SAHRA) and contact an archaeologist and/or palaeontologist, depending on the nature of the find, to assess the importance and rescue them if necessary (with the relevant SAHRA permit). No work may be resumed in this area without the permission from the ECO and SAHRA.

3. If the newly discovered heritage resource is considered significant a Phase 2 assessment may be required. A permit from the responsible heritage authority will be needed.

Should you have any further queries, please contact the designated official using the case number quoted

Voorspoed Mine decommissioning

Our Ref:

an agency of the
Department of Arts and Culture

T: +27 21 462 4502 | F: +27 21 462 4509 | E: info@sahra.org.za
South African Heritage Resources Agency | 111 Harrington Street | Cape Town
P.O. Box 4637 | Cape Town | 8001
www.sahra.org.za

Enquiries: Ragna Redelstorff
Tel: +27 (0)21 202 8651
Email: rredelstorff@sahra.org.za
CaseID: 14265

Date: Wednesday September 25, 2019
Page No: 2

above in the case header.

Yours faithfully

Ragna Redelstorff
Heritage Officer
South African Heritage Resources Agency

ADMIN:
Direct URL to case: http://www.sahra.org.za/node/527873
(, Ref: FS 30/5/1/2/3/2/1(12) EM)

Terms & Conditions:

1. This approval does not exonerate the applicant from obtaining local authority approval or any other necessary approval for proposed work.
2. If any heritage resources, including graves or human remains, are encountered they must be reported to SAHRA immediately.
3. SAHRA reserves the right to request additional information as required.

Appendix 40: Comments received from the DWS Chief Director: Water Quality Regulation, Department of Water and Sanitation on the Voorspoed Mine decommissioning Environmental Authorisation application

water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

Private Bag X313, Pretoria, 0001, 185 Francis Baard Street Tel: (012) 336 7898
Enq: Ms C. Enoch
Tel: 012 336 7898

By email: MelatoB@dws.gov.za
Department of Water and Sanitation
Free State Region

Dear Ms Melato Boitumelo

COMMENTS ON THE BASIC ASSESSMENT AND ENVIRONMENTAL MANAGEMENT PROGRAMME FOR THE DECOMMISSIONING OF VOORSPOED MINE, KROONSTAD AREA, FREE STATE PROVINCE

Voorspoed Mine (owned by the De Beers Group) is an open cast diamond mine with a depth of 214 m, located approximately 30km from Kroonstad in the Free State province. The mine began operating in November 2008. The life of mine was until 2021. Due to the instability of the pit, the mine is currently in the process of closure and decommissioning. The operations ceased in December 2018.

Mine residue facilities include a Waste Rock Dump (WRD), a Coarse Residue Deposit (CRD), a Fine Residue Deposit (FRD) and topsoil stockpiles. The mining area also includes two pans, namely the northern pan and the southern pan, and a wetland situated adjacent to the mining area. Rehabilitation of the mine residue deposits will involve reshaping of steep slopes and the covering of the slopes with 200m soil to form a growth material together with underlying material.

The pit will be left to fill by direct rainfall recharge and local runoff from the pit footprint area. Human and animal access to the pit will be restricted by the construction of waste rock barriers/berms at the top of the remaining access ramps since access ramps lower down in the pit have already failed naturally.

The intention of the mine is to allow the pit to recharge with direct rainfall and become a lake - like structure. A security fence will be erected around the open pit. The most appropriate end land use of the decommissioned site is agricultural land use including the production of selected crops (maize and sunflower), domestic livestock farming (cattle and sheep) and game farming.

FINDINGS

- The current Pit water is characterised as neutral mine drainage which is alkaline and brackish (high TDS) and exceeds several parameters in the South African Water Quality Guidelines for domestic, livestock and irrigation water use.
- The water was characterised by alkaline pH (8.2-9.5) and elevated concentrations of TDS (769-1318 mg/l), sodium (213-375mg/l), sulphate (173-370 mg/l), nitrate (30-120mg/l) and fluoride (1.28-1.95 mg/l) that exceeds the Guidelines for domestic, irrigation and livestock use.

Page 1 of 2

- The groundwater from boreholes close to the WRD was characterised by a pH of 6.8-8.7 pH units. The concentrations of TDS (236-666 mg/l), calcium (12-73 mg/l) and sodium (51-237 mg/l) has exceeded the Guidelines for domestic use.
- Classifications of acid rock drainage potential show that all the coarse residue, fine residue and waste rock samples are not potentially acid generating.
- The conducted short term leaching tests measured readily soluble components of geological materials and does not predict the long term water quality impacts.
- Based on Acid Base Accounting (ABA), the total sulphur (0.04 - 0.11%), sulphide (0.01 - 0.03%) and sulphate (0.001 – 0.16%) content of all mine residue materials was very low. This is an indication that the mine residue material is unlikely to produce acid mine water.

RECOMMENDATIONS

- Use of the pit water for irrigation is not supported since the pit water exceeds the South African Water Quality Guidelines for domestic, irrigation and livestock use.
- A model that describes the current and post closure pit water quality must be developed.
- A geotechnical study must be conducted to determine the stability of the pit wall. This is necessary in order to identify the potential impacts on the land adjacent to the pit. It is also important in determining how the eroded side-wall material may contribute to further deterioration of the pit water quality. Further collapse of the pit side-walls may lead to the collapse of the fencing surrounding the pit, which poses a risk to public safety and animals.
- According to the EMPr, backfilling was a requirement for the mine. However, it has been indicated that the mine is not in a position to backfill the pit due to unforeseen circumstances. An impact prediction model must therefore be developed in terms of the Department of Water Affairs and Forestry (DWAF) Best Practice Guidelines (BPG) G4 (Impact Prediction) to indicate the potential groundwater pollution impacts should the pit be backfilled.
- Groundwater monitoring must be conducted on a quarterly basis and reported on an annual basis. Baseline groundwater quality data must be provided and groundwater monitoring must be undertaken for five years after cessation of mining operations.
- All comments received from the public participation process must be taken into consideration.

Taking into consideration the gaps in information identified, the Chief Directorate: Water Quality Regulation does not support closure of the mine, as proposed.

Yours faithfully

CHIEF DIRECTOR: WATER QUALITY REGULATION

DATE: 02/10/2019

PS: PLEASE NOTE THAT THIS LETTER IS DIRECTED AT THE RELEVANT REGIONAL OFFICE OR CMA AND SHOULD NOT BE DISTRIBUTED TO THE APPLICANT AS THIS WILL BE IN VIOLATION OF THE WUA REGULATIONS.

MINE WATER MANAGEMENT CANNOT TAKE RESPONSIBILITY FOR INCOMPLETE APPLICATIONS OR GAPS IN INFORMATION AS ALL THE REQUIREMENTS ARE CONTAINED IN THE WUA REGULATIONS AND APPENDIXES.

Page 2 of 2

Appendix 41: Comments received from the geohydrological specialist, Department of Water and Sanitation on the Voorspoed Mine decommissioning Environmental Authorisation application

water & sanitation
Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

Enquiries: Mofokeng S
Reference: 27/2/1/DBCM-VoorspoedMine
Telephone: 051 405 9173

Attention: Ms. Melato B

REQUEST FOR GEOHYDROLOGICAL EVALUATION AND RECOMMENDATION FOR: De BEERS CONSOLIDATED MINES (Pty) LIMITED- VOORSPOED MINES.

Your request for comment/recommendation regarding the following reports submitted to the Department:

a. **Summary of Surface and Groundwater Study for Mine Closure. Dated October 2017, prepared by Golder Associates (Pty) Ltd (Golder, 2017).**
b. **Voorspoed Mine's Hydrological Monitoring Program (2018+), Monitoring Sites Program and Network Upgrade. Dated August 2018, prepared by Golder Associate (Pty) Ltd (Golder, 2018).**

1. Background

1.1 De Beers Consolidated Mines (Pty) Ltd's Voorspoed Diamond mine is situated in the north-eastern part of Free State Province of South Africa and the mine is approaching its mining operations closure phase, in approximately 4 years.

1.2 According to Golder (2017), the mine is located on property farm Voorspoed 401, portion 0, however, a GIS search shows that the mine is on four properties, portion 0 of farm Voorspoed 401, portion 0 of farm Voorspoed 2480, portion 0 of farm Geldenhuys 1477 as well as a portion of portion 0 of farm Morgenstern 772.

1.2 A surface and groundwater study of the mine had to be done covering the following aspects: (a) Geohydrological assessment, including a conceptual, numerical flow and transport model, (b) Geochemistry study assessment, (c) Dynamic water balance model and, (d) Hydrological assessment of potential flood line risks.

1.3 The mine area is situated within quaternary catchment C70H in the Middle Vaal water Management Area, located in the central part of South Africa in the Free State Province. The site is drained by tributaries of the Heuningspruit running in a north-westerly direction where it joins the Renoster River about 15 km to the north of the site.

2. Geology

2.1 The reports submitted didn't give information regarding the geology of the area, however GIS and the information from The Geology of South Africa (Johnson *et al.*, 2006) was used to obtained as much information as possible of the geology of the area.

2.2 Based on information obtained from GIS, the mine area is characterized by the rocks belonging to the Volksrust Formation of the Ecca group of the Karoo Supergroup. The Volksrust Fm is predominantly argillaceous unit which interfingers with the overlying Beaufort Group and underlying Vryheid Fm.

2.3 The Voorspoed mine area comprises of shales and mudstones of Volksrust Fm.

2.4 The strata is has been intruded by dolerite dykes and sills with three major sills identified to intersect the pit.

2.5 Johnson *et al* (2006), states that the formation consists of grey to black silty shale with thin, usually bioturbated, siltstone or sandstone lenses and beds, particularly towards its upper and lower boundaries

3. Geohydrology

3.1 The rocks/aquifers in the Ecca Group are anisotropic meaning their properties differ in direction.

3.2 According to Vivier (1996), the geometry of Ecca group is not only anisotropic but the aquifers are also complicated by the migration of the braided and meandering streams, this will imply that the sandstone and mudstones of Ecca group have significantly low to virtually absent primary porosity and permeability.

3.3 Woodford and Chevallier (2002) has stated that the main reason for the low permiabilities could be due to sandstone being generally poorly sorted and that their primary porosities have lowered by diagenesis.

3.4 The hydrogeological map of Kroonstad (DWAF, 2000) indicates that the project area falls within the intergranular and fractured aquifer type with an expected borehole yields of 0.1-0.5 l/s, however higher yields can occasionally be obtained by targeting folds, faults and joints structures where favourable recharge conditions exist.

3.5 According to the Aquifer Classification Map of South Africa (CSIR, 1999 and DWA, 2012) the area of application is situated in a minor aquifer system with an average yield estimated at 2 l/s.

3.6 The aquifer vulnerability in the study area is classified as moderately vulnerable region which is vulnerable to some pollutants, but only when continuously discharged or leached (CSIR, 1999 and DWA, 2013).

4. GEOHYDROLOGICAL ASSESSMENT OF THE WATER USE ACTIVITY/IMPACT

4.1 Geohydrological assessment and surface water assessment was conducted in order to determine the extent of groundwater usage in the study area, the geological structures that could potentially act as preferential pathways for groundwater movement and contamination transport as well as surface water resources that could have been impacted by the mining processes.

4.2 A hydrocensus was conducted in April 2017 for about 3 to 5 km radius of the mine. A total of at least twelve (12) boreholes and four (4) surface water bodies were located. A total of sixteen (16) water samples were collected during hydrocensus survey and the samples were sent to a laboratory in South Africa and the other one in United Kingdom for analysis (Golder, 2017).

4.3 Additional seven (7) boreholes were drilled in 2018; this was in order upgrade the groundwater monitoring coverage. Six (6) of the boreholes were to monitor the shallow aquifer, while the remaining borehole was located in order to be able to monitor the deeper aquifer (Golder, 2018). Majority of the existing boreholes from Golder (2017) are deep hence these additional boreholes were drilled to provide information pertaining to shallow aquifer.

4.4 In order to be able to site the additional boreholes, a geophysical survey had to be conducted to investigate the geological features that could assist with the position of these boreholes. Four (4) magnetic traverses were surveyed and brought about drilling of seven additional boreholes stated on point 4.3 above.

4.5 The numerical model for the assessment of the contaminant transport as performed from data collected in 2017 indicates that contamination from WRD is rainfall driven as the behaviour of the plume varies seasonally.

4.6 200 year simulation of the plume from the waste rock facility is unlikely to exceed the sulphate limits on the farms neighbouring the mine.

4.7 The CRD with its highest source concentrations does not appear to impact on the nearby boreholes; either the seepage from this site is not entering groundwater system or the boreholes installed do not suitably representing the upper fractured aquifer.

5. GROUNDWATER MONITORING PROGRAM

5.1 From Golder (2017), there were a total of sixteen water samples collected, the sample were a representative of both surface and groundwater from the Open Pit, Waste Rock Dump (WRD), Coarse Residue Dump (CRD), Fine Residue Dump (FRD) and ROM Stockpile.

5.2 Pit Water sample indicates a Na-SO_4 water quality, water samples from CRD and FRD indicates Na-Cl water type this could be due to natural source of sodium chloride from the Kimberlite pipe.

5.3 In general the Piper Diagrams shown in the reports illustrate the natural groundwater quality evaluation from the recently recharged waters characterised by Ca/Mg-HCO3 as a representative of dynamic flow. Gradually towards a typical deep Karoo water quality.

5.4 Some groundwater samples had elevated levels of chloride and sulphate; this could be due to the impact by industrial or mining activities.

5.5 The shallow monitoring boreholes samples (Golder, 2018) shows three different water types, recharge/fresh water (Ca/Mg-HCO_3), natural aquifer water (Na-Cl) and typical polluted industrial/mine/waste water with elevated levels of SO_4.

5.6 Borehole VDBH06S, VDBH06D and VDBH04 indicates fresh water quality based on their representation on the piper diagram, with VDBH06D&S this classification makes sense because they're located on the north-western side of the mine area where there are no facilities that could impact negatively on the groundwater resource, but borehole VDBH04 is located at the edge of the WRD therefore it is expected that the water quality from this borehole will show the impact by the WRD.

5.7 The other boreholes and their water quality results are understandable based on their location and what they are expected to be monitoring.

6. COMMENTS

6.1 SECTIONS

6.1.2. In terms of the Geohydrological Study

The studies are acceptable as they have gone into details regarding the geohydrological status of the mine and also looked at possible impacts on the resource as well as providing the mitigation measures to all the anticipated impacts.

The impact to the groundwater resource is mostly from the dump sites as indicated on the geochemical analyses diagrams; however the contaminant transport model indicates that contamination will not exceed the sulphate limits on the farms neighbouring the mine post mine closure.

6.1.3. In terms of the Monitoring Plan

In 2017 the mine had sixteen (16) monitoring sites and this was increased by a further eight boreholes in 2018 to monitor shallow aquifer as the previous boreholes were mainly for monitoring of deep aquifer. The groundwater monitoring program is adequate and acceptable. The Department also supports the recommendation of the report to develop three (3) surface water monitoring sites.

7. RECOMMENDATIONS

Based on the contents of both reports, Golder, 2017 and Golder 2018 the following is recommended:

- Groundwater levels should be monitored on a monthly basis during the Life of Mine and Decommissioning-Closure Phase and biannually in the post-closure phase.
- Groundwater quality should be sampled and analysed by an accredited laboratory quarterly during Life of Mine and Decommissioning-closure phases and therefore be sampled and analysed by an accredited laboratory biannually during Post-closure phase.
- Groundwater sampling and analyses mentioned above should include major cations (i.e.: Ca, Mg, Na and K), major anion (i.e. Cl, F, and SO_4), Physic-chemical determinants (i.e. pH, conductivity, TDS, and Total Alkalinity), and metals and Trace metals (i.e. Fe, Cr, Se, Pb, Mn, Al and Zn).
- The mine should adhere to the correct scientific methods during groundwater sampling to avoid alien contamination and cross contamination from one borehole to another, such work should be executed by a qualified scientist. The samples should be sent to the accredited laboratory for analysis
- A program should also be initiated by the mine to generate hydrological data that will be used as a baseline dataset for future planning and to confirm the numerical

De Beers Consolidated Mines- Voorspoed Mine, Kroonstad, Free State, South Africa.

modelling and predictions modelled during the mine closure study (Golder, 2017) and Monitoring Sites Program (Golder, 2018).

- With the new data compilation, a transport contamination model should be upgraded at least every 5 years.
- Should the mine see the need to drill more monitoring boreholes beyond the already existing boreholes, then care should be taken that these boreholes are not drilled into the determine geological structures that may act as preferential flow path for groundwater.

Please do not hesitate to contact us should any other query arise concerning the above-mentioned development.

Yours sincerely

CANDIDATE SCIENTIST:
Mofokeng Setjhaba (Pr.Nat.Sci)
DATE: 26/09/2019

APPENDIX H

Formal Correspondence to Regulators from GCS: Pitlakes as a Coal Mine Closure Option - Summary of Current Position, Engagement and Legislative Process

The Minister of Human Settlements, Water and Sanitation
The Minister of Mineral Recourses and Energy
The Minister of Agriculture, Land Reform and Rural Development
Director Generals
State Law Advisor
Law Working Groups

17 April 2020

<u>Pitlakes as a Coal Mine Closure Option - Summary of Current Position, Engagement and Legislative Process</u>

1. Background

1.1. With a mining legacy of over 150 years and being host to some of the richest deposits of coal, diamonds, gold and platinum in the world, South Africa is grappling with the issue of sustainable mine closure. The re-use of open pits posts closure of coal mines is one of the key issues related to ensuring sustainable mine closure and, in this regard, pitlakes can play a positive role in achieving sustainable mine closure.

1.2. GCS Water and Environment (Pty) Ltd ("**GCS**") have undertaken significant research in the field of pitlakes as a coal mine closure option, the most recent of which was completed in partnership with the Water Research Commission ("**WRC**").

1.3. GCS has been requested by Coaltech to engage with the authorities and interested and affected parties in order to clarify the technical merits of pitlakes as a mine closure option and, given that pitlakes as a closure option is scientifically defendable, to agree on the technical aspects and legal requirements.

2. Technical Introduction

2.1. Pitlakes form when groundwater levels rebound in the final void of an open cast coal mining operation. In South Africa, pitlakes are perceived negatively as, in certain circumstances, they may have poor water quality and, if not designed and managed properly, they may lead to discharge of affected mine water into surrounding terrestrial and aquatic resources. However, this is not true for all pitlakes and depends on the chemical characterisation of the backfill material, design of the final void, and management of surrounding land.

2.2. The use of pitlakes as a mine closure and rehabilitation method is a relatively new concept in South Africa, with recent studies showing that there may well be viable long-term solutions.

This is particularly true in the case of coal mine pits, with over 110 open pits currently in existence in South Africa.[1]

2.3. There is much literature aimed at directing mining activities towards contributing to sustainable development. Despite this, achieving sustainable mine closure remains a huge issue for South Africa and numerous other countries around the world. Mines in South Africa continuously fall short of addressing even predictable closure impacts. Approximately 6000 ownerless and abandoned mines litter South Africa's landscape, with further mines under so-called 'care and maintenance', in response to the struggle to secure closure certificates.[2] There is a clear disconnect between policy and practice surrounding mine closure in South Africa.

2.4. Recognising correctly designed pitlakes as a legal coal mine closure option may thus contribute to sustainable mine closure and will likely prove to be a cost-effective method of sustainably closing coal mines, such that the national environmental management principles enshrined in the Constitution of the Republic of South Africa 1996, and in chapter 2 of the National Environmental Management Act 107 of 1998 ("**NEMA**") are given effect to. Correctly designed pitlakes offer a passive water treatment option. This is important as mines that use active water treatment are energy intensive, using energy (mostly from the national grid) which could be used more effectively elsewhere in South Africa. Where water quality is suitable, pitlakes can be used as a water resource to supply communities after the closure of a coal mine, such as for community agriculture projects.

3. <u>The Scientific Viability of Pitlakes</u>

3.1. Recently, GCS authored a scientific study that was commissioned by the WRC to investigate whether pitlakes are an environmentally sustainable closure option for open cast coal mines. The sustainability of pitlakes is a function of the mining method employed during operations and the relative size of the pitlake in comparison to the disturbed area. The study is entitled "*An Investigation to Determine if South African Coal Mine Pitlakes are a Viable Closure Option"* and is dated August 2019 ("**the WRC 2019 Pitlakes Study**").

3.2. The WRC 2019 Pitlakes Study concludes as follows:

"The study concludes that pitlakes can be environmentally sustainable if they are designed correctly and that the surface discharge of water into the catchment area is managed. The organic and inorganic water quality in the pitlakes showed that the pitlakes are alkaline and have elevated total dissolved solid contents (mainly sodium sulphate) when compared to the natural surface and groundwater in the catchment. These water bodies can support life in terms of chlorophyll-a, phytoplankton and microbiology (bacteria).

The surface area of a pitlake is vitally important to maximise evaporation which directly affects the water balance. In addition, surface runoff should be controlled to avoid excess runoff into the pitlake during storm events that may lead to a temporary positive water

---

1 "Coal mine pit lakes: a viable mine closure option?" *Mining Review Africa, Issue 6 (2018).*

2 Olalde M "IN DEPTH: Cleaning up the mining mess" *Fin24* (https://www.fin24.com/Companies/Mining/in-depth-cleaning-up-the-mining-mess-20180712)

balance and uncontrolled discharge into the catchment. Should the pitlake be suitably designed, it forms a water sink to prevent uncontrolled discharge from the mining operations. A fundamental change in thinking and legislative requirement is required to view pitlakes as an environmentally sustainable solution to prevent uncontrolled discharge from open cast mining operations to avoid the expense of ongoing water treatment. Correctly designed pitlakes offer an environmentally sustainable closure option for open cast coal mines in South Africa.

Enough data was collected in the study to allow for the development of a guideline for the design of coal mine pitlakes in the South African coal fields. The design manual considered the water balances of the pitlakes and the biological and chemical process that drive the water quality of pitlakes."

3.3. The WRC 2019 Pitlakes Study clearly concludes that pitlakes are an environmentally sustainable mine closure solution, provided they are correctly designed and that certain other requirements and standards are met. The WRC 2019 Pitlakes Study suggests numerous design options to enhance water quality and ensure minimal environmental degradation, if any. Considering the above, the existing legislation surrounding mine closure is examined below, with a view to suggesting possible amendments or other avenues to explore. The objective is to ensure that pitlakes contribute to sustainable mine closure.

4. <u>International Norms and Standards</u>

4.1. Numerous international studies have been conducted regarding the viability of pitlakes as a mine closure option. An article in the journal "*Minerals*" explores the various uses that pitlakes have the potential to fulfil, by looking at existing uses around the world.[3]

4.2. This study highlights that the risks surrounding pitlakes can be mitigated by proper closure planning and associated technical measures during mining and closure or following relinquishment, the article notes that the following end uses have been realised in various locations around the world:

"Passive and active recreation, nature conservation, fishery and aquaculture, drinking and industrial water storage, greenhouse carbon fixation, flood protection and waterway remediation, disposal of mine and other waste, mine water treatment and containment, and education and research."

4.3. The International Council on Mining & Metals ("**IMMC**") published the *"Integrated Mine Closure Good Practice Guide, 2nd Edition"* ("**Good Practice Guide**") in 2019[4], which echoes the sentiments of the above article. The Good Practice Guide further states that, while pitlakes may present residual certain risks at closure, they also offer substantial benefits (unlike many other mine closure options which ultimately sterilize the mining area). If proper management relating to the change in land type from terrestrial (pre-mining) to aquatic (post-mining), pitlakes can present numerous beneficial opportunities post-closure. By integrating social,

---

3 McCollough CD, Schultze M, Van den Berg J "Realizing Beneficial End Uses from Abandoned Pit Mine Lakes" *Minerals* (2020).

4 IMMC "Integrated Mine Closure Good Practice Guide" *2nd Edition* (2019).

environmental and economic viewpoints and factors, pitlakes can be used in a variety of activities, including the irrigation of agricultural land. Water management will need to be determined according to the characteristics of the pitlake and the surrounding area, in line with the over-arching notion of sustainability.

4.4. Pitlakes are commonly used in Australia, Canada, and several other countries, largely due to the growth in open cut mining over the last few decades. In the countries, they are often perceived as beneficial, depending on the quality of the water in the pitlake.[5] Significant effort has thus been expended on investigating and examining these pitlakes and their water quality, thereby promoting effective management.

4.5. In the Czech Republic, pitlakes are used for a variety of post-closure purposes, including agricultural production, recreational and sports activities, industrial production, nature conservation and water retention. The water from such lakes is sometimes used as a cooling medium for thermal power plants, fish breeding, irrigation of agricultural land in areas with a rainfall deficit, and fresh water reservoirs for cattle (depending on water quality).[6]

4.6. Ultimately, and in line with the WRC 2019 Pitlakes Study (which is in the process of being published), the use of pitlakes as a mine closure solution has been found to be scientifically defendable. However, South Africa's mining laws do not specifically recognise pitlakes as a sustainable closure option.

5. South African Legislation

5.1. Mine closure in South Africa is governed principally by the Mineral and Petroleum Resources Development Act 28 of 2002 ("**MPRDA**"), the NEMA and The National Water Act 36 of 1998 ("**NWA**"), as well as subordinate legislation.

5.2. The MPRDA and Regulations ("**MPRDA Regulations**")

5.2.1. Under section 43 of the MRPDA, holders of a prospecting right, mining right, retention permit or mining permit are responsible for environmental liability, amongst other consequences of mining activities.

5.2.2. An environmental management programme ("**EMPr**"), as per section 51 of the MPRDA Regulations, must include a description of the environmental objectives and specific goals for, *inter alia*, mine closure and the management of identified environmental impacts emanating from the proposed mining operation. Under section 52, an environmental management plan ("**EMP**") must include closure and environmental objectives.

5.2.3. Section 55 requires that, as part of the EMPr and EMP, a holder of a permit or right must conduct monitoring continuously, as well as conduct annual performance assessments of the EMPr and EMP and submit the performance assessment to the Minister within

5 Kumar R *et al* "Water Resources in Australian Mine Pit Lakes" *Water in Mining Conference* (2009).

6 Hrdinka T "Typology and potential utilization of anthropogenic lakes in mining pits in the Czech Republic" *Limnological Review* (2007).

specified time frames. When the holder of a right or permit intends closing an operation, a final performance assessment must be conducted and a report submitted to the Minister to ensure, *inter alia*, that the closure objectives as described in the EMPr or EMP have been met.

5.2.4. Accordingly, it is envisioned that the use of pitlakes will be included in an EMPr, EMP and performance assessments, thereby ensuring the holder of a mining right or permit remains responsible for environmental liability for the duration of the mining operation, up until such time as a closure certificate is obtained. Where pitlakes may be viable closure options for existing operations, existing environmental authorisations, EMPr's, EMP's and performance assessments would need to be amended to include pitlakes as part of the closure plan.

5.2.5. Regulation 56 under the MPRDA Regulations outlines the principles for mine closure, with Regulation 56(e) being the most pertinent to this brief.

"In accordance with applicable legislative requirements for mine closure, the holder of a prospecting right, mining right, retention permit or mining permit must ensure that –

(e) the land is rehabilitated, as far as is practicable, to its natural state, or to a predetermined and agreed standard or land use which conforms with the concept of sustainable development."

5.2.6. Considering Regulation 56(e) above, pitlakes are required to be recognised to form part of the "*predetermined and agreed standard or land use which conforms with the concept of sustainable development*".

5.3. Regulations Pertaining to the Financial Provision for Prospecting, Exploration, Mining or Production Operations ("**the Financial Provision Regulations**")

5.3.1. Regulation 5 is relevant as it obliges an applicant or the holder of a right or permit to make financial provision for, *inter alia*, decommissioning and closure activities. By reflecting pitlakes in the EMPr, EMP and performance assessments as a valid closure option, an applicant or holder of a mining right or permit –will be able to adequately determine the financial provision required to sustainably use pitlakes as a mine closure option.

5.3.2. Regulation 6 sets out how the financial provision must be determined, with specific reference made to mine closure plans. It is envisioned that pitlakes are likely to form an integral part of these closure plans should the requisite legislation be amended, or the required declaration(s) made, allowing them to be recognised as a legal and viable mine closure option.

5.4. NEMA

5.4.1. Regarding mine closure, NEMA states the following under section 24 (Environmental Authorisations):

"(5) The minister, or an MEC with the concurrence of the Minister, may make regulations consistent with subsection (4) –

…

(b)laying down the procedure to be followed in respect of-

….

(viii)mine closure requirements and procedures, the apportionment of liability for mine closure and the sustainable closure of mines with an interconnected or integrated impact resulting in a cumulative impact."

5.4.2. Section 44 of NEMA grants the Minister wide powers to promulgate regulations dealing with any matter under NEMA. An example of regulations made under the above sections, amongst others, is Government Notice R1147 (the Financial Provisioning Regulations, 2015).

5.5. The National Water Act

5.5.1. The National Water Act, under section 21, lists the water uses for which a water use license is required. Sections 21(e) and 31(1)(e) are relevant here and read as follows:

"21. For purposes of this Act, water use includes –

…

(e) engaging in a controlled activity identified as such in section 37(1) or declared under section 38(1)."

5.5.2. Section 37 lists controlled activities, in terms of subsection (e) stating the following:

"31. (1) The following are controlled activities:

(e) an activity which has been declared as such under section 38."

5.5.3. Section 38 of the National Water Act states that the Minister may, by notice in the Gazette, **in general** or specifically, declare an activity to be a controlled activity. Before making such a declaration, the Minister must be satisfied that the activity in question is **likely to impact detrimentally on a water resource**. The procedure to be followed by the Minister is laid out further in section 38, summarised as follows.

5.5.4. The Minister must publish a notice in the Gazette setting out the category of activities proposed to be declared, inviting written comments to be submitted on the proposed declaration, and thereafter consider all comments received. Each notice published must contain a schedule that must list all controlled activities set out in section 37(1)(a) to (d) and those which have, up to the date of the notice, been declared to be controlled activities. Declaring an activity, a controlled activity is a subjective test, and the Minister must only be satisfied that the activity is likely to impact detrimentally on a water resource. The National Water Act does not state when an activity is likely to impact detrimentally on a water resource. Although the water quality in a pitlake is generally acceptable for agricultural or industrial purposes, it will ordinarily not meet the catchment standards- thus could be seen to qualify as a controlled activity.

5.5.5. A general declaration under section 38, declaring pitlakes a "controlled activity", will empower the Minister to, at his/her discretion, determine the viability of any given application for a water use license for a pitlake. As pitlakes are not suited to every situation, this discretion and the design considerations of the pitlake are important.

5.5.6. It is suggested that, after consultation with all relevant stakeholders and authorities, an application be made to the Minister to declare the use of pitlakes as a mine closure option a "controlled activity", such that it is recognised under the National Water Act. This will allow a water use license to be obtained by a mine wishing to use pitlakes upon its decommissioning and closure. In this way it will not be necessary to change other legislation.

5.6. <u>The National Environmental Management Laws Amendment Bill ("**NEMLA IV**")</u>

5.6.1. It is important to mention NEMLA IV, as it pertains to the issue at hand. NEMLA IV was passed by the National Assembly on 27 November 2018 and is currently with the National Council of Provinces for concurrence. If enacted as is, the Minister (or a Member of the Executive Committee) may prescribe additional activities for which financial provisioning must be provided.

5.6.2. Any application for an environmental authorisation for these additional activities would be required to make financial provision for progressive rehabilitation, decommissioning and closure and post closure activities. This would ensure that mitigation, rehabilitation and remediation of the environmental impacts, including latent and residual impacts extending to the pumping and treatment of extraneous and polluted water. This could well include pitlakes, should they be approved as a viable coal mine closure option.

5.6.3. By not impacting on any zoning or planning regulations or conditions (assuming that mines applying to use pitlakes as a closure option have applied for and obtained all the requisite documentation and authorisations), mines can be rehabilitated and relinquished to the government or alternative next land user, with the pitlakes on such land classified and regulated as a controlled activity under a registered water use licence. In this way the mine can be relinquished, a final closure certificate issued, and responsibility for the land can be taken over by the next land user.

6. Conclusion

6.1. It is thus envisioned that application will be made under the National Water Act to have pitlakes declared a "controlled activity" under section 38.

6.2. As pitlakes have been proven to contribute positively to sustainable mine closure in terms of the scientific studies undertaken and are also used worldwide, such a declaration will give effect to the environmental management principles in chapter 2 of NEMA (including sustainability), as well as Regulation 56 under the MPRDA Regulations (i.e. that "*the land is rehabilitated, as far as is practicable, to its natural state, or to a predetermined and agreed standard or land use which conforms with the concept of sustainable development.").* This will form part of a coal mine meeting its closure obligations and commitments, allowing relinquishment to occur and a closure certificate to be issued.

6.3. Accordingly, bearing in mind the over-arching notion of sustainability that is inherent in NEMA, the NWA and the MPRDA, this brief is intended to result in engagement with the Department of Mineral Resources and other relevant stakeholders and interested and affected parties, such that pitlakes will fall under rehabilitating land *"to a predetermined and agreed standard or land use*", regulated under the NWA and in terms of a water use license.

Yours faithfully

____

GCS Water & Environment (Pty) Ltd
Per: Andrew Johnstone

Yours faithfully

____

Gunn Attorneys
Per: Adam Gunn

APPENDIX I

Confirmation letter from DMRE of receipt of EMPR amendment application

mineral resources
Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

Private Bag X33, Welkom, 9460, Tel: 057 391 1385, Fax: 057 357 6003
The Strip Building, 314 Stateway Street, Welkom, 9459

Enquiries: Mr. T.P Monyai **E-Mail:** Tuwani Monyai@dmr.gov.za
Sub-Directorate: Mine Environmental Management **Ref No.:** FS 30/5/1/2/3/2/1 (012) EM

The Directors
De Beers Consolidated Mines (Pty) Ltd
P O Box 1964
Kroonstad
9500

Attention: Mr. P.E. Jordaan
e-mail: petrus.jordaan@debeersgroup.com
cc: sharonm@gcs-sa.biz

ACKNOWLEDGEMENT OF RECEIPT OF AN APPLICATION FOR AN AMENDMENT OF THE 2010 ENVIRONMENTAL MANAGEMENT PROGRAMME CONDITIONS OF APPROVAL FOR DE BEERS CONSOLIDATED MINES (PTY) LTD OPERATION LODGED IN TERMS OF REGULATION 31 OF THE ENVIRONMENTAL IMPACT ASSESMENT REGULATIONS, 2014 (HEREIN REFERRED TO AS THE "EIA REGULATIONS") IN RESPECT OF FARM VOORSPOED 2480 (CONSOLIDATION OF SUBDIVISION 1 OF THE FARM VOORSPOED 401, SUBDIVISON 1 OF THE FARM GELDENHUYS 1477 AND SUBDIVISION 2 OF THE FARM MORGENSTER 772), VOORSPOED 401, GELDENHUYS 1477 AND MORGENSTER 772, SITUATED MAGISTERIAL DISTRICT OF KROONSTAD: FREE STATE REGION.

1. The abovementioned application received by this Department on **10 March 2020** refers.
2. The Department hereby acknowledges receipt of an application for **an amendment of the 2010 Environmental Management Programme Conditions of Approval De Beers Consolidated Mines (Pty) Ltd** in terms of regulation 3(6) of the EIA Regulations.
3. Your application will be checked as required in terms of regulation 17 of the EIA Regulations and should there be any issues of concern, you will be informed in writing so that such issues can be addressed.
4. Kindly note that the acknowledgement of your application does not suspend the 2010 approved EMPr and its conditions of approval. Your application will be processed and a recommendation on granting or refusal of an environmental authorisation will be forwarded to the Minister or his delegate for consideration, and the decision will be communicated as stipulated in regulation 4(1) of the EIA Regulations.

5. Further note that in terms of regulation 45 of the EIA Regulations, your failure to submit the documents or meet any timeframes prescribed in terms of the said Regulations will result in your application deemed to have lapsed.

Yours faithfully

pp..................................

REGIONAL MANAGER: MINERAL REGULATION

FREE STATE REGION

DATE..16.03.2020

Please quote this office file number as reference for any correspondence regarding this application.

APPENDIX J

Curriculum Vitae of EAP

MAGNUS VAN ROOYEN
Technical Director

CORE SKILLS

- Environmental Impact Assessments
- Scoping Reports
- Preliminary Environmental Assessment
- Mining Right and Applications
- Environmental Management Programmes
- Strategic Environmental Assessments
- Wildlife Management Plans

DETAILS

Qualifications

- BSc – Botany & Zoology
- B.SC Honours - Botany
- Specialist Student
- Post Graduate Diploma in Teaching
- Masters Degree: Environmental Management

Memberships

- SACNASP
- International Association of Impact Assessors

Languages

- English - fluent
- Afrikaans- fluent
- German – fair
- Dutch – fair
- Zulu - adequate

PROFILE

In addition to holding a Masters Degree: Environmental Management, Magnus also holds a BSc degree in Botany and Zoology, an Honours Degree in Botany and a Post Graduate Certificate in Education.

Magnus has 13 years' experience in projects involving Environmental Impact Assessments in various developmental sectors (Mining and Agricultural Sector, National Roads, Pipelines, Dams, and Residential Developments), conducting of Specialist Biodiversity Assessments associated with Environmental Impact Assessments and Project Feasibility Studies. He has experience in the compilation of Resettlement Policy Framework Plans associated with infrastructure development projects.
Magnus has experience in working on various private and public sectors as well as rural and urban environments in various countries.
His expertise lies within the mining sector where he has gained extensive exposure to all the aspects of mining projects from the pre-feasibility, prospecting, environmental impact assessment

Magnus has experience in the following areas:

- Environmental Impact Assessments
- Scoping Reports
- Preliminary Environmental Assessment
- Mining Right and Permit Applications
- Environmental Management Programmes
- Strategic Environmental Assessments
- Wildlife Management Plans

WORK EXPERIENCE

Year	Employer	Position	Role and Responsibility
2007 – 2020	JG Afrika (Pty) Ltd	Executive Associate	Project Management of an environmental contingent of 4 people and conducting Environmental Impact Assessments
2006 – 2007	JG Afrika (Pty) Ltd	Environmental Scientist	Conducted a wide range of infrastructure related Environmental Impact Assessments
2002 – 2005	Department of Conservation Ecology, University of Stellenbosch	Biodiversity Researcher	Conducted field work, sampling, laboratory work and logistics associated with two projects within the Conservation Ecology Department
2002 – 2005	Department of Botany and Zoology, University of Stellenbosch	Junior Lecturer in Botany	Lectured Botany practical component of the first-year Natural Science Degree
2001 – 2002	Paul Roos Gymnasium	Biology Teacher	Teaching the South African Biology curriculum to high school students

Biodiversity Assessment Projects	<u>**Biodiversity Assessment Projects**</u> **Mamatwan Tailings Facility** Biodiversity and Wetland Assessment for the site to be used for the establishment of the new tailings facility on the South32 Mamatwan Manganese Mine near Hotazel. **Hillside Aluminum Desalination Plant** Biodiversity Screening Assessment for the infrastructure network associated with the South32 Hillside Aluminum Desalination Plant in Richards Bay. **Lichtenburg Siding Expansion** Biodiversity Assessment for the proposed expansion of the Lichtenburg Cement Siding, North West Province. **Nacala Dam Project** Riparian Vegetation Study for the Ecological Reserve Determination Specialist Study for the Environmental Impact Assessment for the Nacala Dam Project in Mozambique. **National Route N8** Vegetation Specialist Study for the Environmental Impact Assessment for the National Route N8. National Route N2 uMgeni Interchange ImprovementsEnvironmental Impact Assessment for proposed improvements to the uMgeni Road Interchange and the National Route N2. The project included an extensive public participation process within the city of Durban, KwaZulu-Natal during the process. **Qudeni Link Road** Vegetation Specialist Study for the Environmental Impact Assessment for the Qudeni Rural Link Road. **Municipal Landfill Site Identification** Negative mapping and ground truthing for the options analysis for the identification of a District Municipality Landfill Site.
Port Related Projects	**Pier 1 Phase 2 expansion** Environmental Impact Assessment for proposed expansions to Pier 1 within the Durban Harbour. Locomotive Turning Table in the Port of Richards Bay Environmental Impact Assessment for proposed Locomotive Turn Table in within the Port of Richards Bay. **Rail line construction in the Port of Richards Bay** Environmental Impact Assessment for proposed additional rail line into the Richards Bay Coal Terminal in the Port of Richards Bay.

	Environmental Monitoring – RME Projects Durban Harbour Environmental Monitoring Duties for all the RME construction projects within the Durban harbour. **Ore Loading Facility at Kalia in Guinea** Environmental Impact Assessment for the proposed Ore Loading Facility in Kalia in Guinea, West.
Roads Projects	**National Route N2 uMgeni Interchange Improvements** Environmental Impact Assessment for proposed improvements to the uMgeni Road Interchange and the National Route N2. The project included an extensive public participation process with a range of public and private sector stakeholders. **National Route N11 upgrade** Environmental Impact Assessment for proposed upgrade of the National Route N11. The project included a public participation process with a range of public and private sector stakeholders as well as specialist studies associated with the river crossings. **National Route N2 improvement and upgrade** Environmental Impact Assessment for proposed upgrade of the National Route N2. The project included a public participation process with a range of public and private sector stakeholders as well as specialist studies associated with the river crossings. **National Route N3 Chota Motala Interchange Environmental Audits** Environmental Monitoring for the construction of the Chota Motala Interchange on the National Route N3. N**ational Route R30 Environmental Audits** Environmental Monitoring for the construction of the National Route R30.
Agricultural Projects	**uMngano Community Dairy Development Project** Environmental and Social Impact Assessment for the Development of a 200ha dairy for the uMngano Community in KwaZulu-Natal, South Africa. **uMngano Community Vegetable Project** Environmental and Social Impact Assessment for the Development of a 180ha vegetable growing project for the uMngano Community in KwaZulu-Natal, South Africa. **Sundays River Citrus Project** Environmental and Social Impact Assessment for the Development of a 100ha citrus project in the Sundays River Valley in the Eastern Cape, South Africa.
Water Projects	**Nacala Dam project in Mozambique for the Millennium Challenge Corporation** Environmental and Social Impact Assessment for the Nacala Dam project in Nacala, Mozambique. The study included the management of a range of specialist studies which included; biodiversity (fauna and flora) assessments, health impact assessments, social impact assessments, a hydrocensus, geotechnical investigation and an ecological flow requirement assessment. The project was conducted under the auspices

	of the Millennium Challenge Corporation. **Mpofana Bulk Water Supply Scheme Environmental Impact Assessment for the Bulk Water Supply Scheme** which included an extensive public facilitation process with affected landowners and other specialist studies. **KwaHlokohloko Rural Water Supply Scheme Environmental Impact Assessment for the Rural Water Supply** Scheme which included an extensive public facilitation process with the rural landowners and tribal leaders. **Conservation Management Plans** **Ndumo Game Reserve Management Plan** Compilation of the Management Plan for the KwaZulu-Natal Wildlife Ndumo Game Reserve in northern KwaZulu-Natal. The compilation was conducted in accordance to the National Environmental Management: Protected Areas Act (No 57 of 2003).
Mining Projects	Uithoek Colliery for Miranda Mineral Holdings Environmental Impact Assessment for the establishment of the Uithoek Colliery including the management of a range of specialist studies which included a hydrological and geohydrological assessment, a biodiversity assessment, a social and heritage assessment and a repatriation plan for residents on the site. **Burnside Colliery for Miranda Mineral Holdings** Environmental Impact Assessment for the establishment of the Burnside Colliery including the management of a range of specialist studies which included a hydrological and geohydrological assessment, a biodiversity assessment, a social and heritage assessment and a repatriation plan for residents on the site. **Ultimate Goal Colliery for Corobrik (Pty) Ltd** Environmental Impact Assessment for the establishment of the Ultimate Goal Colliery including the management of a range of specialist studies which included a hydrological and geohydrological assessment, a biodiversity assessment, a social and heritage assessment and a repatriation plan for residents on the site. **Klipwaal Gold Mine for Miranda Mineral Holdings** Environmental Due Diligence assessment on the Klipwaal Gold Mine which included an assessment of completed and required rehabilitation, a contaminated land liability assessment and an evaluation of the structure and the possible impact of the slurry dams. **Afrimat Quarries Compliance Audits** Compliance audits and Due Diligence assessments of the Afrimat Quarry operations in South Africa. These audits are conducted on a two yearly basis. **Private and Public Sector Development Projects** Provincial Legislature Precinct Environmental and Social Impact Assessment for the proposed Provincial Legislature Precinct. This study consisted of a large public facilitation component and extensive engagement with private and public sector stakeholders.

	Camps Drift Canal Mixed Use Development Environmental Impact Assessment for proposed improvements to the uMgeni Road Interchange and the National Route N2. The project included an extensive public participation process within the city of Durban, KwaZulu-Natal during the process. **Tiger Lodge Development** Environmental Impact Assessment for the proposed Tiger Lodge Tourism Development. **Paradise Lodge Development** Environmental Impact Assessment for the proposed Paradise Lodge Tourism Development.

DECLARATION

I, Magnus Van Rooyen hereby declare that the details furnished above are true and correct to the best of my knowledge and belief and I undertake to inform you of any changes therein, immediately. In case any of the above information is found to be false or untrue or misleading or misrepresenting, I am aware that I may be held liable for it.

Signature: **Date: 27/02/2021**

0058905

UNIVERSITY OF STELLENBOSCH

This is to certify that whereas

MAGNUS VAN ROOYEN

had complied with all the conditions prescribed in the Act, Statute and Rules of the University, the degree

MASTER OF PHILOSOPHY

(MPhil)

(Environmental Management)

with all the rights and privileges pertaining thereto was conferred on him at a congregation of the University in December 2004.

RECTOR AND VICE CHANCELLOR

DEAN

Endorsement: This is a duplicate of the original certificate, which was lost or destroyed as far as can be determined by the University.

REGISTRAR

21 November 2006

This certificate was issued in both Afrikaans and English. In the unlikely event of an inconsistency in the wording, the Afrikaans text shall have precedence.

THE SOUTH AFRICAN COUNCIL
FOR
NATURAL SCIENTIFIC PROFESSIONS

herewith certifies that

Magnus van Rooyen
Registration number: 400335/11

is registered as a

Professional Natural Scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)
in the following field(s) of practice
(Schedule I of the Act)

Environmental Science **31 August 2011**

31 August 2011
Pretoria

President

Chief Executive Officer

Janice Callaghan

Junior Environmental Consultant

CORE SKILLS

- Water Use Licensing
- EIAs and BARs
- Section 24G reports
- RSIP reports
- Auditing
- Annual Decommissioning, Rehabilitation and Closure Updates

DETAILS

Qualifications

- BSc (Hons) Environmental Science
- Certificate from UCT in Occupational Health and Safety
- Certificate from University of British Columbia in Ecodesign for Cities and Suburbs

Membership

- Society of South African Geographers
- IAIAsa
- EAPASA (registration in progress)
- Cand.Sci.Nat

Languages

- English – fluent
- Afrikaans - fluent

Countries Worked In

- South Africa

PROFILE

Janice is a Junior Environmental Consultant at GCS Water and Environmental since April 2018 with 3 years' experience. She forms part of the Durban Environmental Unit and has undertaken various applications including Water Use License Applications, Integrated Water and Waste Management Plans, Environmental Impact Assessments and Environmental Management Programmes.

She pays great attention to detail and is a self-motivated individual, who is passionate about the environment with a particular interest in biogeography and conservation. Janice is both team player and able to work independently and is always keen to learn. Her methodical and organized approach will benefit her in the workplace when meeting deadlines.

Professional Affiliations:

- SACNASP (Cand.Sci.Nat)
- IAIAsa
- SSAG

Areas of Expertise:

- Reviewing specialist studies and compiling reports;
- Database compilation and management;
- Compiling environmental authorisation applications for various mining projects in terms of NEMA, NEM:WA and NWA;
- Undertaking environmental audits;
- Compiling Annual Financial Provisioning Updates;
- Rehabilitation Strategy Implementation Plan;
- Report writing;
- Compilation of tender documents;
- Writing proposals;
- Assisting with information material and report compilation.

Work Experience

Period	Employer	Position	Role/ Responsibility
March 2020 to present	GCS	Junior Environmental Consultant	- Undertaking environmental authorization processes - Mine closure and financial provisioning - Environmental Officer assistance to Buffalo Coal - Client liaison - Project management
April 2018 to March 2020	GCS	Intern	- Assisting environmental consultants with environmental applications

Year	Client	Project Description	Role/Responsibility
		RSIPs	
2019	Buffalo Coal	Magdalena Colliery RSIP Update	Updating the RSIP undertaken in 2014 prior to the commencement of S24G activities
2020	Exxaro	Rietkuil RSIP	Compiling a RSIP for the Rietkuil Siding in compliance with their IWUL
2020	Exxaro	Belfast RSIP Update	Finalising the document with client comments
2020	Marula Platinum	RSIP update	Undertaking the annual update of the RSIP in compliance with the IWUL
2020	Anglo American	Mafube Coal RSIP update	Undertaking the annual update of the RSIPs in compliance with the IWUL
2020	Tharisa Minerals	RSIP update	Internal review of the update compiled by GCS prior to sending to the client for review.
		Audits	
2019	Buffalo Coal	Annual EMPr and WUL audits for Coalfields, Aviemore and Magdalena operations	Assisting the lead auditor in site work and compilation of the audit reports.
2020	Buffalo Coal	Annual EMPr and WUL audits for Coalfields, Aviemore and Magdalena operations	Assisting the lead auditor in site work and compilation of the audit reports.
2020	Samancor	Annual audits for 6 operations	Assisting with compilation and internal review of the documents prior to sending for client review.
2020	Eskom	Legal compliance audit for Majuba power station	Assisting the lead auditor in site work and compilation of the audit reports.
2020	Eskom	Biennial PCB Audit	Assisting the lead auditor in site work and compilation of the audit reports.
2021	ZAC	Annual IWUL Audit	Lead auditor undertaking the site audit and compilation of report.
		IWULAs	
2018	Frame Knitting Manufacturers	WULA for borehole	Report writing and compilation, license application forms, public participation and follow-ups with DWS.
2018 - 2020	Buffalo Coal	Magdalena IWULA Amendment	Report writing and compilation, and data analysis
2018 - 2019	Tendele Coal	Somkhele IWULA Amendment	Public participation and associated report writing
2018 - 2020	South 32	Roypoint IWULA	Data management, public participation
2018 - 2019	Buffalo Coal	Aviemore New Adit and Access Road WULA	Data management, report compilation and submission

2020 - present	Buffalo Coal	Coalfields IWULA Finalisation	Uploading of documents to e-WULAAS portal, client liaison
Environmental Authorisations			
2018 – 2019	Buffalo Coal	Coalfields Calcine Plant BA	Report writing and compilation, public participation
2018 – 2019	Buffalo Coal	Aviemore New Adit and Access Road EA	Data management, report compilation and submission
2018 - 2020	ZAC	ZAC New Adit and Opencast Mining Operations	Report writing and compilation of BARs, public participation
2018 - 2019	Buffalo Coal	Magdalena S24G application	Writing and compiling Section 24G EIA, and EMPr, and public participation
2019 - present	Buffalo Coal	Magdalena Waste Management License	Report writing, public participation
2020	Phumaf Engineering	Gauteng Rapid Land Release Environmental Assessments	Compilation of Scoping Report and Basic Assessment Reports, public participation
2020-present	Welgedacht/Kangra	Application for Environmental Authorisaton for Aasvoelkrans, Umgala and Zimbutu Dump	Report writing and compilation, public participatio
Mine Closure and Financial Provisioning			
2019	Buffalo Coal	Annual Financial Provisioning Update in terms of GNR 1147 for Magdalena, Aviemore and Wesselsnek	Updating closure costing; annual rehabilitation plan; final rehabilitation, decommissioning and closure plan; and environmental risk assessment for each site.
2020	Buffalo Coal	Annual Financial Provisioning Update in terms of GNR 1147 for Magdalena, Aviemore and Wesselsnek	Updating closure costing; annual rehabilitation plan; final rehabilitation, decommissioning and closure plan; and environmental risk assessment for each site.
2020 - present	Corobrik/Investec	Application for mine closure for the Corobrik Avoca site for a development to be undertaken	Mine closure application process.
Environmental Officer			
2019 - present	Buffalo Coal	Ad hoc work as required	Environmental Officer assistance to Buffalo Coal
Other			
2018 - present	Exxaro	Belfast RAP	LRP analysis and RAP compilation
2018	Airports Company South Africa	KSIA Storm Water Monitoring	Sorting of monitoring data
2018	CIG	Standerton SIA	Database compilation and management, data analysis, assisting with report writing
2018 - present	CIG	Standerton Oil Mill Phase 2	Data management, stakeholder engagement

2020	Tendele Coal	Somkhele Health Impact Assessment	Undertake an environmental Health Impact Assessment under the guidance of an external reviewer, in terms of the IFC and South African Department of Health Guidelines for undertaking such an assessment.

DECLARATION

I, Janice Callaghan, hereby declare that the details furnished above are true and correct to the best of my knowledge and belief and I undertake to inform you of any changes therein, immediately. In case any of the above information is found to be false or untrue or misleading or misrepresenting, I am aware that I may be held liable for it.

Signature:  Date: 08 February 2021