APPENDIX W

Decommissioning, Rehabilitation and Mine Closure Plan, Environmental Risk Assessment and Annual Rehabilitation Plan

REPORT

EXXARO RESOURCES LIMITED

Turfvlakte Final Decommissioning, Rehabilitation and Mine Closure Plan, Environmental Risk Assessment Report and Annual Rehabilitation Plan in terms of GN R. 1147

Submitted to:

Exxaro Resources Limited

Submitted by:

Golder Associates Africa (Pty) Ltd.

Podium at Menlyn, Second Floor, 43 Ingersol Road, Menlyn, Pretoria, 0181, South Africa

P O Box 6001, Halfway House, 1685

+27 11 254 4800

1784950-330233-13

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Distribution List

1 eCopy to Exxaro Resources Limited

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1.0 INTRODUCTION

1.1 Project overview

Exxaro Coal (Pty) Ltd is proposing to expand its Grootegeluk Coal Mine (Grootegeluk) within its current approved mining rights area through the opening of two additional opencast pits on the farm Turfvlakte.463 LQ, directly south of the Grootegeluk operations, near Lephalale in the Limpopo Province. The Turfvlakte coal reserves and proposed open pits are located within the existing Grootegeluk mining right area.

Golder Associates (Golder), an independent environmental and engineering company, was appointed by Exxaro to conduct the required environmental authorisation and licensing processes for the proposed Turfvlakte project.

Exxaro has applied for environmental authorisation for the proposed Turfvlakte project. Listed activities related to the opencast mining require environmental authorisation in terms of the EIA Regulations GN R. 324, 325, 326 and 327 that commenced on 7 April 2017. Exxaro must submit an application for Environmental Authorisation (EA) to the Department of Mineral Resources (DMR), undertake an EIA and submit an Environmental Impact Assessment Report (EIAR) and an Environmental Management Programme (EMPr), describing how the environmental impacts of the proposed mining operations will be managed and mitigated, to the DMR.

Exxaro must develop the closure planning and costs as part of the authorisation process for the proposed project. The planning will guide the final decommissioning, rehabilitation and closure of the mining site at the end of operations. Mine closure planning in South Africa is governed by the requirements of the Financial Provisioning Regulations (GN R. 1147 – as amended) promulgated under the National Environmental Management Act (Act No. 107 of 1998) (NEMA). This report documents the closure planning and costing for the proposed Turfvlakte project aligned to GN R. 1147.

At present, two different project scenarios are being contemplated for Turfvlakte and relates to the sequencing of the mining activities, namely:

- Mining Pit 2 and then Pit 1 (preferred alternative); and
- Mining Pit 1 and then Pit 2.

The preferred alternative is mainly based on financial considerations as mining the Pit 2 coal seam first is beneficial from a cashflow perspective. However, the two project alternatives have only marginal implications on the closure planning and costs and are therefore applicable to both scenarios, unless specifically indicated otherwise.

1.2 Site locality and description

The Turfvlakte project is situated approximately 30 km north-west of Lephalale in the Waterberg region (which forms part of the Bushveld region) of the Limpopo Province of South Africa (Figure 1).

The proposed mining expansion will consist of two pits, namely Pit 1 and Pit 2. Pit 2 will be located directly south of Grootegeluk Dump 6 and the transport of coal to the strategic stockpiles will be around the dump (Figure 2). Pit 2 is located to the south of Pit 1, with an associated topsoil/material stockpiling area as well as a temporary infrastructure servitude located between the two pits.

A property border that separates Exxaro-owned land from Eskom-owned land is located directly south of Pit 1. A provincial road close to this boundary traverses the Eskom property in an east-west direction. Some infrastructure is directly south of the south-eastern point of the pit and currently falls within the blasting radius of 500 metres.

2.0 APPROACH

The approach followed to compile the necessary closure planning documentation, including determining the closure costs estimate, is as follows:

- Source information regarding the nature and extent of the operations and related activities from Exxaro, including closure planning and costs already conducted by Golder for Grootegeluk;
- Review available information at desktop level to compile a knowledge base to inform the closure planning process;
- Establish the closure scenario and next land uses in collaboration with the Golder technical team involved in the rehabilitation planning for Grootegeluk, and formulate suitable closure measures within the context of the devised closure scenario;
- Determine the volumes and quantities for the foreseen earthworks and open pit rehabilitation as well as other related activities;
- Devise site-specific unit rates for the rehabilitation of disturbed surface areas and for earthworks (dozing and load and haul) utilising bulk machinery/equipment based on the existing Grootegeluk closure costs;
- Populate the latest Golder costing model, which meets the GN R. 1147 requirements, with the determined quantities and rates. The model includes 'yes/no' buttons for the toggling of cost items as well as narratives reflecting the assumptions/qualifications made with respect to these cost item;
- Submit the devised closure scenario to the Exxaro project team for input and sign-off; and
- Compile a Final Rehabilitation, Decommissioning and Mine Closure Plan and associated Environmental Risk Assessment (this report) describing the site-specific assumptions and considerations that were adopted to determine the closure costs estimate.

3.0 AVAILABLE INFORMATION

The new information that was available to inform the closure costs are listed in Table 1:

Table 1: Key background information

Title	Author	Date
1784950 Exxaro Resources: Turfvlakte Coal Mine Closure Costs, as at August 2019 [Draft]	Golder	2019
Draft Scoping Report: Application for EA and WUL for the proposed Turfvlakte Open Pit Mine Project at Grootegeluk Coal Mine near Lephalale, Limpopo Province	Golder	2019
Annual Rehabilitation Plan for Grootegeluk Coal Mine	Golder	2019
Lephalale LM IDP 2018-2019	Lephalale Local Municipality	2018
https://en.wikipedia.org/wiki/Medupi_Power_Station	N/A	Accessed October 2019

4.0 LEGAL AND GOVERNMENT FRAMEWORK

The current Financial Provisioning Regulations (GN R. 1147, Regulations Pertaining to the Financial Provision for Prospecting, Exploration, Mining or Production Operations), promulgated under the NEMA on 20 November 2015 and as amended, provide the regulatory requirements for the closure planning and cost determination for existing and planned mines.

GN R. 1147 is planned to be repealed and superseded by revised regulations, with several versions of the proposed amendments to these regulations having been made available for public and industry comment over the course of the last two years. At present it is unclear when the revised regulations will be promulgated. The contents of this document are closely aligned with the requirements of GN R. 1147, and it is unlikely that the next amendment to the regulations will require significant changes to the closure planning for Turfvlakte. Changes should be addressed as and when the new regulations are promulgated, as part of the routine closure planning and costs updates for the mining operation.

Apart from the requirements of GN R. 1147, summarised at the beginning of each Part of this document, mine closure planning is also required to be compliant with additional legislation, summarised in APPENDIX B.

5.0 PROJECT DESCRIPTION

5.1 Location and layout

The location of the proposed development is shown in Figure 1. The project components are described in the sections below and the site layout of the project is presented in Figure 2.

5.2 Mining operations

Exxaro is proposing to expand their existing mining operations by extending the opencast mining operation to Turfvlakte. The opencast operations will consist of two pits, namely Pit 1 and Pit 2. Pit 1 will be 158 ha in size and will be 88 m deep, while Pit 2 will be 64 ha and 109 m deep.

Sufficient coal reserves have been proven to support opencast mining. Due to faulting in the area, most of the benching will be at relatively shallow depths, resulting in high-quality coal that can be mined at a favourable stripping ratio.

The interburden and coal mined from Pit 1 and Pit 2 will be transported to and handled at the existing Grootegeluk Coal Mine plants. The mining operations will be undertaken 24 hrs a day and six days a week.

Exxaro is considering two options for the mining of Pit 1 and Pit 2. The preferred option is to mine Pit 1 and then Pit 2 to produce 1.5 million tonnes per annum run of mine (ROM) coal over a period of twelve (12) years.

The alternative option is to mine both pits simultaneously, to produce 3 million tonnes per annum ROM coal over a period of seven (7) years. The preferred and alternative project options are illustrated by Figure 3 and Figure 4 respectively.

5.3 Other infrastructure

The proposed infrastructure to be established at surface in support of the coal mining operation includes haul roads connecting the proposed pits to the existing Grootegeluk Coal Mine operations, laydown area for the mine equipment and offices, water management infrastructure (sumps and pipelines), waste management area (waste skips) and a sub-station.

Haul roads

The proposed haul roads will be constructed to tie into the existing Grootegeluk Coal Mine haul roads. The haul roads will connect the Turfvlakte Pit 1, Pit 2, and the infrastructure laydown area with the Grootegeluk Coal Mine Dump 6 and the rest of the Grootegeluk Coal Mine operational areas.

The haul roads have been designed to accommodate large off-highway haul trucks and will be dual carriageway with engineered gravel surfaces. The haul roads will be 38.2 m wide, allowing for 11 m lane widths and 5.4 m wide earth berms on the side and in the centre of the road.

Access roads

Access to the Turfvlakte mining area will be via the existing Grootegeluk Coal Mine access gate. The proposed new access roads will be constructed to tie into the existing Grootegeluk Coal Mine access roads. The access roads will provide access to all the infrastructure areas.

The access roads have been designed to accommodate light vehicles and will be dual directional roads with gravel surfaces and will be 10 m wide.

Infrastructure laydown area

The infrastructure laydown area will cover 18 ha and will provide areas for safe parking, offices and equipment storage.

Storm water management

The storm water management infrastructure will be designed as per the requirements of Regulation 704 under the National Water Act to ensure separation of clean and dirty water catchments.

Cut-off berms and earth canals will be located upstream of the infrastructure areas to divert the clean water run-off around the dirty infrastructure areas. These canals will integrate into the existing Grootegeluk Coal Mine storm water management system.

The contaminated run-off will be collected in concrete-lined channels that will connect with the existing Grootegeluk Coal Mine storm water management system.

Utilities

Potable water

A potable water tank, with a capacity of 25 m^3, will be constructed to supply potable water for the mining operations. The potable water will be pumped from the existing Grootegeluk Coal Mine potable water system.

Fire water

A fire water tank, with a capacity of 25 m^3, will be constructed to supply fire water for the mining operations. The fire water will be pumped from the existing Grootegeluk Coal Mine fire water system.

Sanitation

Sewage from the Turfvlakte operations will be transferred to the existing Grootegeluk Coal Mine for treatment at the existing sewage treatment facilities.

Electricity supply

A substation will be constructed inside the infrastructure laydown area to supply electricity to the mining operations. The substation will be fed from the future Grootegeluk Coal Mine GG1/GG2 33 kV switching station as well as directly from the main Eskom 132/33 kV substation.

5.4 Materials and waste management

The following types of mining related materials and wastes will be handled because of the proposed mining activities:

Overburden

The overburden (material that lies above the coal, such as the hards and softs) generated during the creation of the box cuts (first cut into the overburden to access the coal and interburden) will be stockpiled on the existing Grootegeluk Coal Mine Dump 6.

Interburden

The interburden (material that separates the coal seams within strata) will be transported with the coal to the existing Grootegeluk Coal Mine plants for further beneficiation.

Plant discard

Discharge from the Grootegeluk beneficiation process will report to a common discard conveyor, which will also include the fines discard, from where it will be conveyed to backfill the existing Grootegeluk Coal Mine pit.

Hydrocarbon and hazardous waste

Small amounts of hydrocarbon waste, that includes solid and liquid waste of a petrochemical nature (fuel, grease, oil, etc.) as well as other hazardous waste, will be stored in designated skips or drums for recycling or disposal at a licenced hazardous waste facility in accordance with existing hazardous waste management procedures implemented at Grootegeluk Coal Mine.

General waste

General waste that includes paper, plastic, glass, etc. will be stored in designated containers for disposal in accordance with the Grootegeluk Coal Mine waste management procedures.

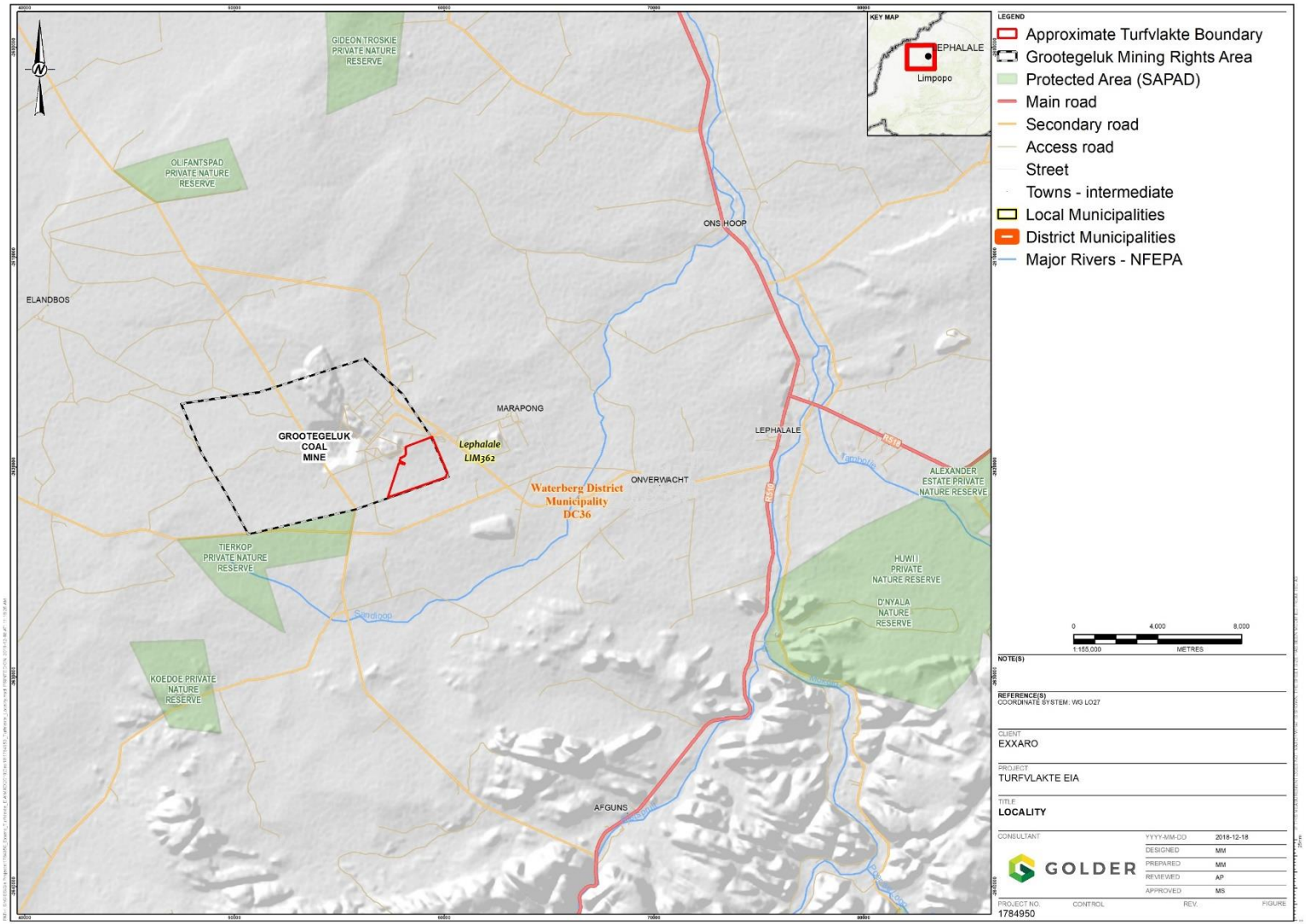

Figure 1: Turfvlakte project site location

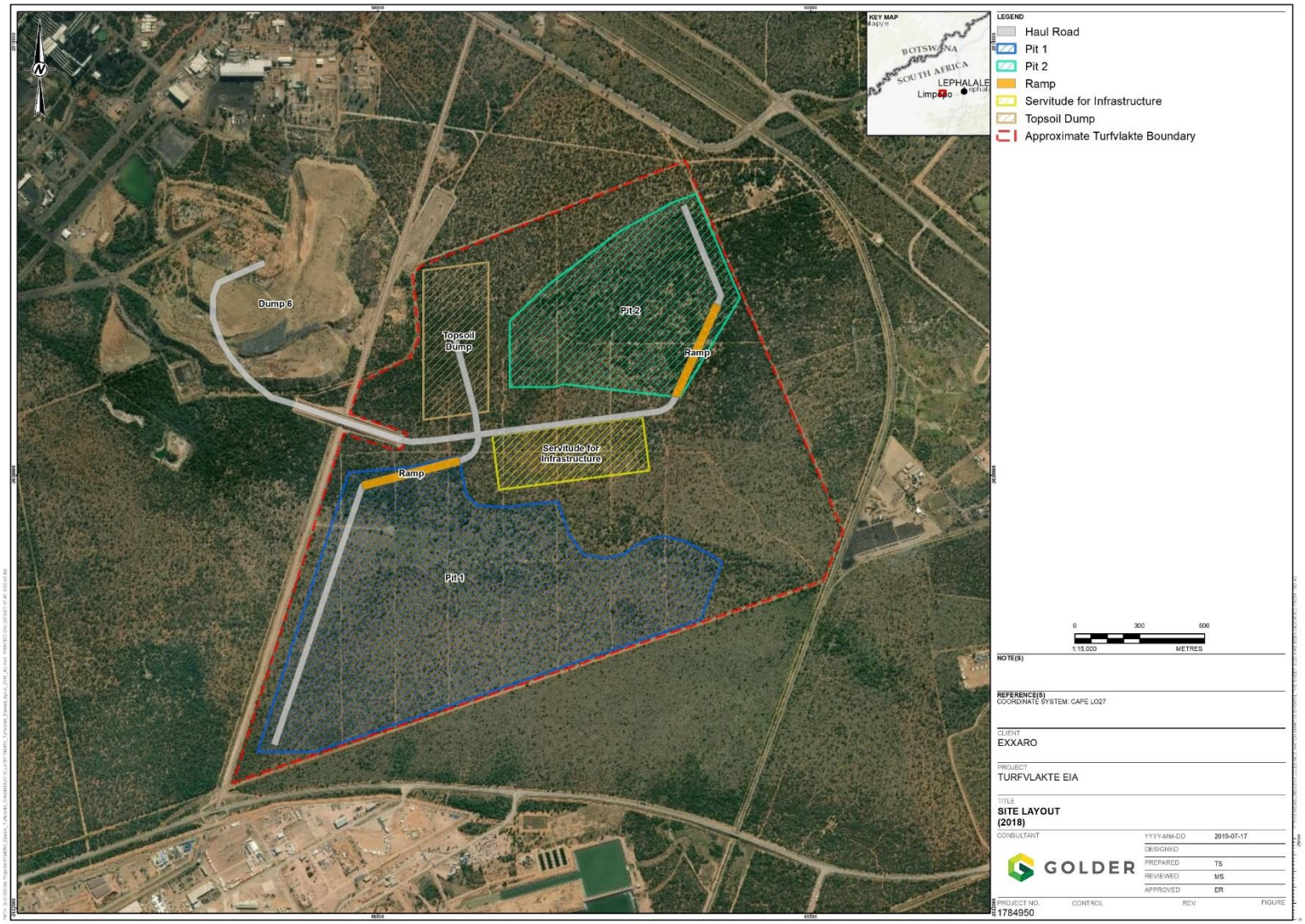

Figure 2: Infrastructure layout of the proposed Turfvlakte Project

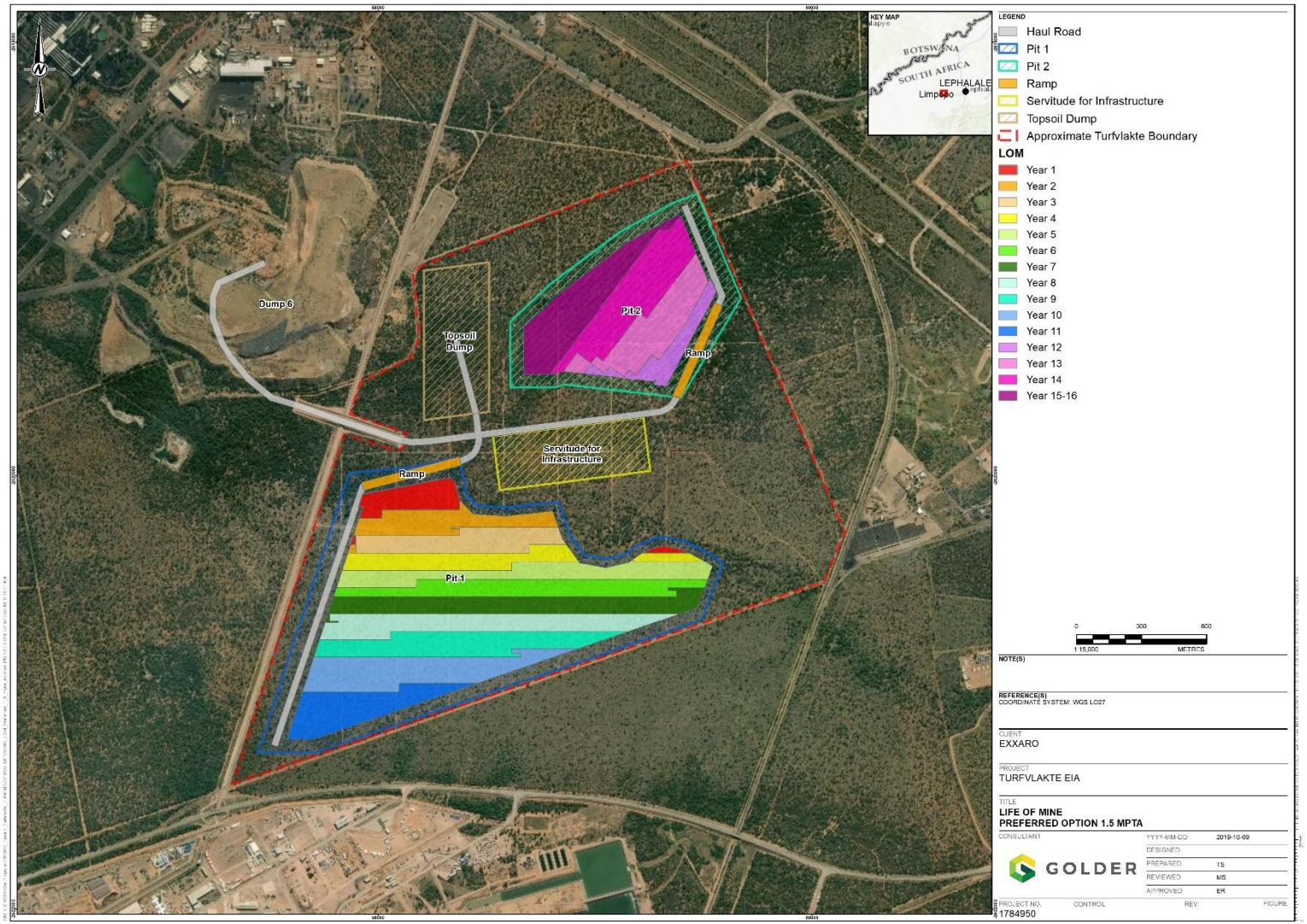

Figure 3: Preferred mining sequence option for Turfvlakte

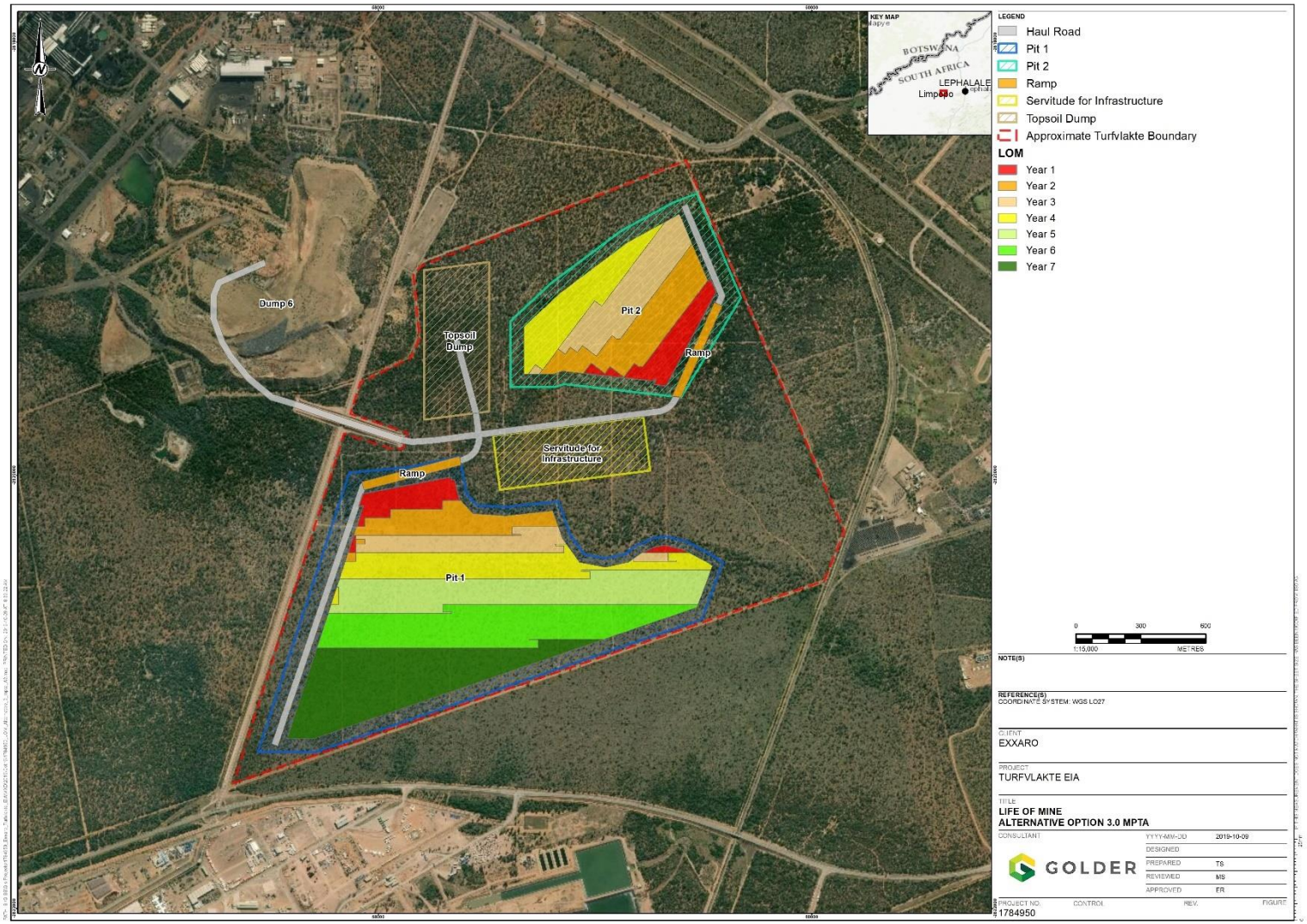

Figure 4: Alternative mining sequence option for Turfvlakte

PART A: CLOSURE PLANNING CONTEXT

6.0 RELEVANT NEMA REGULATIONS (GN R. 1147: APPENDIX 4)

The required content of the Final Rehabilitation, Decommissioning and Mine Closure Plan is detailed in Table 2, which also provides cross references to the relevant sections of the plan where these requirements are addressed.

Table 2: Content of mine closure plan (GN R. 1147: Appendix 4)

Content of rehabilitation, decommissioning and mine closure plan	Reference to section
The Final Rehabilitation, Decommissioning and Mine Closure Plan must be measurable and auditable and must include-	
a) Details of- (i) The person or persons that prepared the plan (i) The professional registrations and experience of the preparers	Included under project information (i.e. Page 1 of this report)
b) The context of the project, including- (i) Material information and issues that have guided the development of the plan	The information used to compile this closure plan is included in Sections 3.0
(ii) An overview of- (aa) The environmental context, including but not limited to air quality, quantity and quality of surface and groundwater, land, soils and biodiversity (bb) The social context that may influence closure activities and post-mining land use or be influenced by closure activities and post-mining land use	Refer to Section 7.0 as well as the main Environmental Authorisation submission for environmental and social context
(iii) Stakeholder issues and comments that have informed the plan	No stakeholder engagement was undertaken as part of this closure plan, as this aspect is addressed as part of the overall Environmental Authorisation process
(iv) The mine plan and schedule for the full approved operations, must include- (aa) Appropriate description of the mine plan (bb) Drawings and figures to indicate how the mine develops; (cc) What areas are disturbed (dd) How infrastructure and structures (including ponds, residue stockpiles etc.) develops during operations	Refer to Sections 1.1 and 5.1

Content of rehabilitation, decommissioning and mine closure plan	Reference to section
c) Findings of an environmental risk assessment leading to the most appropriate closure strategy, including- (i) A description of the risk assessment methodology, including risk identification and quantification, to be undertaken for all areas of infrastructure or activity or aspects for which a holder of a right or permit has a responsibility to mitigate an impact or risk at closure (ii) An identification of indicators that are most sensitive to potential risks and the monitoring of such risks with a view to informing rehabilitation and remediation activities (iii) An identification of conceptual closure strategies to avoid, manage and mitigate the impacts and risks (iv) A reassessment of the risks to determine whether, after the implementation of the closure strategy, the residual risk has been avoided and / or how it has resulted in avoidance, rehabilitation and management of impacts and whether this is acceptable to the mining operation and stakeholders (v) An explanation of changes to the risk assessment results, as applicable in annual updates to the plan	Refer to Sections 8.0 and 21.0
d) Design principles, including- (i) The legal and governance framework and interpretation of these requirements for the closure design principles	Refer to Section 4.0 for legal and government framework guiding compilation of this closure plan
(ii) Closure vision, objectives and targets, which objectives and targets must reflect the local environmental and socio-economic context and reflect regulatory and corporate requirements and stakeholder expectations	Refer to Sections 10.0 and 11.0 for the closure vision, target and objectives
(iii) A description and evaluation of alternative closure and post closure options where these exist that are practicable within the socio-economic and environmental opportunities and constraints in which the operation is located	Refer to Section 13.0
(iv) A motivation for the preferred closure action within the context of the risks and impacts that are being mitigated	Refer to Section 13.0
(v) A definition and motivation of the closure and post closure period, taking cognisance of the probable need to implement post closure monitoring and maintenance for a period sufficient to demonstrate that relinquishment criteria have been achieved	Refer to Section 15.3 for the description of the closure and post closure period

Content of rehabilitation, decommissioning and mine closure plan	Reference to section
(vi) Details associated with any on-going research on closure options	Refer to Section 0 for a list on matters requiring further attention to inform future updates of the closure plan, including closure option refinement
(vii) A detailed description of the assumptions made to develop closure actions in the absence of detailed knowledge on site conditions, potential impacts, material availability, stakeholder requirements and other factors for which information is lacking	A detailed description of the assumptions made to develop the closure plan is included in Section 19.3
e) A planned final post-mining land use which is appropriate, feasible and possible of implementation, including- (i) Descriptions of appropriate and feasible final post-mining land use for the overall project and per infrastructure or activity and a description of the methodology used to identify final post-mining land use, including the requirements of the operations stakeholders (ii) A map of the planned final post-mining land use	Refer to Section 12.2 for planned next land use
f) Closure actions, including- (i) The development and documenting of a description of specific technical solutions related to infrastructure and facilities for the preferred closure option or options, which must include all areas, infrastructure, activities and aspects both within the mine lease area and off of the mine lease area associated with mining for which the mine has the responsibility to implement closure actions	Refer to Sections 14.1 and 15.0 for technical inputs and closure measures
(ii) The development and maintenance of a list and assessment of threats and opportunities and any uncertainties associated with the preferred closure option, which list will be used to identify and define any additional work that is needed to reduce the level of uncertainty	Refer to Sections 8.0 and 13.0
g) A schedule of actions for final rehabilitation, decommissioning and closure which will ensure avoidance, rehabilitation, management of impacts including pumping and treatment of extraneous water- (i) Linked to the mine works programme, if green fields, or to the current mine plan, if brownfields (ii) Including assumptions and schedule drivers (iii) Including a spatial map or schedule, showing planned spatial progression throughout operations	Refer to Section 15.0 relating to mitigation measures and Section 5.0; and Figure 3 and Figure 4 for mine planning. that concurrent rehabilitation will follow the mining sequence as areas

Content of rehabilitation, decommissioning and mine closure plan	Reference to section
	become available for rehab. The detailed scheduling will be set out in the ARP once rehabilitation commences.
h) An indication of the organisational capacity that will be put in place to implement the plan, including- (i) Organisational structure as it pertains to the plan; (ii) Responsibilities (iii) Training and capacity building that may be required to build closure competence	Refer to Section 18.0 for organisational capacity
i) An indication of gaps in the plan, including an auditable action plan and schedule to address the gaps	Refer to Section 0 for identified knowledge gaps
j) Relinquishment criteria for each activity or infrastructure in relation to environmental aspects with auditable indicators	Refer to Table 11
k) Closure cost estimation procedure, which ensures that identified rehabilitation, decommissioning, closure and post-closure costs, whether on-going or once-off, are realistically estimated and incorporated into the estimate, on condition that- (i) Cost estimates for operations, or components of operations that are more than 30 years from closure will be prepared as conceptual estimates with an accuracy of ± 50 per cent. Cost estimates will have an accuracy of ± 70 per cent for operations, or components of operations, 30 or less years (but more than ten years) from closure and ± 80 per cent for operations, or components of operations ten or less years (but more than five years) from closure. Operations with 5 or less years will have an accuracy of ± 90 per cent. Motivation must be provided to indicate the accuracy in the reported number and as accuracy improves, what actions resulted in an improvement in accuracy (ii) The closure costs estimation must include— (aa) An explanation of the closure cost methodology (bb) Auditable calculations of costs per activity or infrastructure (cc) Cost assumptions (iii) The closure costs must be updated annually during the operation's life to reflect known developments, including changes from the annual review of the closure strategy assumptions and inputs, scope changes, the effect of a further year's inflation, new regulatory requirements and any other material developments	Refer to Section 19.0 for the closure costing and methodology undertaken to determine the closure costs

Content of rehabilitation, decommissioning and mine closure plan	Reference to section
l) Monitoring, auditing and reporting requirements which relate to the risk assessment, legal requirements and knowledge gaps as a minimum and must include- (i) A schedule outlining internal, external and legislated audits of the plan for the year, including- (aa) The person responsible for undertaking the audit(s) (bb) The planned date of audit and frequency of audit (cc) An explanation of the approach that will be taken to address and close out audit results and schedule (ii) schedule of reporting requirements providing an outline of internal and external reporting, including disclosure of updates of the plan to stakeholders	Refer to Section 17.0
(iii) A monitoring plan which outlines- (aa) Parameters to be monitored, frequency of monitoring and period of monitoring (bb) An explanation of the approach that will be taken to analyse monitoring results and how these results will be used to inform adaptive or corrective management and/or risk reduction activities	Refer to Section 17.0
m) Motivations for any amendments made to the final rehabilitation, decommissioning and mine closure plan, given the monitoring results in the previous auditing period and the identification of gaps as per 2(i)	Currently not applicable as this is the first version of the Turfvlakte closure planning, however, to be addressed with subsequent closure plan updates

7.0 KNOWLEDGE BASELINE

The following sections summarise the most important physical, biological and socio-economic (environmental) baseline aspects as it pertains to the closure of the Turfvlakte mining site and is therefore not comprehensive. For more information refer to the Draft Scoping Report (Golder, 2019), or the respective specialist studies listed therein.

7.1 Local geology

- The Turfvlakte project area is dominated by the geology of three major Karoo Super Group Formations, namely the Volksrust, Vryheid and Clarence Formations. The general stratigraphy consists of weathered formation which is approximately 25 to 30 m thick and is made up of topsoil, calcrete, minor ferricrete, a sandy alluvium, weathered shale, clay and non-reactive carbonaceous material.
- The project area is situated in a narrow corridor that is bounded by two regional faults namely the Daarby and Eenzaamheid Faults, with a number of smaller, sympathetic faults associated with them. These faults are expected to play an important role in the long-term recharge patterns and timeframes of the final mining voids that will remain after closure.

Closure implications:

- The long-term stability / break-back line of the final voids side walls must be taken into consideration when planning for closure, to ensure human and animal safety.
- The implications of the various faults and local geological fractures on recharge of the final pit voids must be determined, to understand the likely implications on the re-watering of the pits as well as their potential use as a post-closure water source.

7.2 Climate

- The proposed Turfvlakte project area is located in the Waterberg region of South Africa which falls within the subtropical high-pressure belt. Average temperatures in the region range from a minimum of approximately 5°C in June and July, to a maximum of approximately 33°C in January and December.
- Rainfall in the vicinity of Turfvlakte is mainly in the form of thundershowers or short downpours and has historically been around 495 mm/annum, although simulated precipitation taking into consideration climate change trends is around 581 mm/annum. The wet season occurring from October to March and the dry season from April to September. The average annual evaporation is approximately 1 844 mm/annum. The area is mainly frost free and hail seldom occurs.

Closure implications:

- The intermittent high-intensity downpours that are often preceded and followed by long dry and hot periods may impede sustained long-term vegetation establishment. Heavy rainfall can also lead to localised erosion of rehabilitated footprint areas, although the flat slopes found across the entire site will likely favour ponding and associated recharge of the backfilled pit areas, and controlled runoff management over these areas must therefore be ensured.
- The very high evaporation to precipitation ratio (nearly 4:1) may prevent sustained pit lakes as a useable water source from forming in the final voids. The high evaporation rate will also prove challenging in terms of vegetation establishment.

7.3 Air quality

- The Turfvlakte project area is located within the Waterberg-Bojanala Priority Area (WBPA) which places a number of restrictions on allowable air emissions from different development sectors, as well as target air quality values.
- The most important sources of atmospheric emissions in the area are Grootegeluk Coal Mine and the neighbouring Medupi and Matimba Eskom power stations, with informal settlements, agriculture and other uses contributing to air emissions to a lesser extent.
- Receptors in the vicinity include dispersed farmhouses, lodges, towns (notably Marapong and Onverwacht), a number of schools and hospitals as well as natural reserves, with the Manketti Lodge being the nearest sensitive receptor to the proposed Turfvlakte mining area.

Closure implications:

- The main sources of air pollution resulting from rehabilitation of the Turfvlakte open pit mining activities will be airborne dust and associated fallout on surrounding areas, as well as emissions from mining machinery and equipment. These impacts will be similar to those caused during operations, but will be much shorter in duration, and should be managed and mitigated in the same manner as during operations.

- Rehabilitation of the backfilled open pits and other areas disturbed by mining areas must ensure that dust entrainment is controlled in the long term, and that undue dust fallout on surrounding areas does not occur during initial rehabilitation activities or after closure.

7.4 Topography

- The general topography of the Turfvlakte site and vicinity is very flat, with slopes varying between 0 and 3%. The site is generally featureless with elevations varying from 900 to 922 m above sea level, with the more prominent features occurring to the north i.e. Nelsonskop (922 m), and the Waterberg range (3 600 m) in the south.
- Due to the flat topography, highly permeable sands and the absence of any surface water drainage courses, the mine has no direct impact on the surface hydrology of the Mogol Catchment.

Closure implications:

- A significant materials deficit will exist at closure, meaning that neither of the open pits will be fully backfilled, leaving two large permanent voids which will significantly alter the topographical character of the project site after mine closure.
- The steep side walls of the permanent mining voids pose a potential safety threat to humans and animals entering the rehabilitated mining site, and measures must therefore be put in place to deter entry into potentially unsafe areas.
- The rehabilitated opencast areas and voids will also impact surface runoff patterns on site and increased volumes of poorer quality mine-impacted water. The backfilled pit areas must therefore be rehabilitated in such a manner that recharge into the spoils is reduced as far as possible, and surface runoff from surrounding areas must be directed around these areas to improve the in-pit water quality.

7.5 Soil, land capability and land use

- Approximately 84% of the Turfvlakte site comprises the Ae252 land type, which consists of 79% of Hutton soils and 21% of the Mispah soils. The remaining 16% of the site consists of land type Ah85 which comprises of 46% of Hutton, 43% Clovelly, 5% Fernwood, 4% Avalon and 2% of the Mispah soil forms, respectively. The entire site is classified as Class V, typifying non-arable land that is only suitable for limited pastoral or forestry use, if sufficient rainfall is received.
- Given the above land capability limitations, the majority of the region is characterised by natural bushveld and protected natural reserves, with small plots of cultivated land and farming activities mainly localised around the Mogol River and associated irrigation areas.

Closure implications:

- The post-closure land of the site will largely be a function of the regional land use, and land capability of the rehabilitated mining areas. The parts of the site that are not affected by mining will therefore continue to play a local ecological habitat provision function supporting the Manketti game reserve, whereas the habitat support potential of the rehabilitated pit areas will be determined by the extent to which vegetation cover of sufficient species diversity can be established and maintained in the long run.
- The permanent pit voids will either be managed as “no-go” / access restricted areas, or may form a potential source of usable water, depending on the ability of sustainable pit lake/s to form and the in-pit water quality.

7.6 Ecology

- The Turfvlakte project area is located in the Limpopo Sweet Bushveld (ref. SVcb19) vegetation type of the savanna biome, characterised by a dominant grass layer and a discontinuous, yet distinct woody plant component. The savanna vegetation species composition is primarily a function of climate and soil characteristics, as well as regulation function of fire and browsing and grazing by large herbivores.
- The project site and region as a whole is characterised by a mixture of fine-leafed savannas (occurring on more nutrient rich soils and dominated by microphyllous woody species of the Mimosaceae family, most commonly *Vachellia* and *Senegalia* spp.); and broad-leafed savannas (occurring on nutrient poorer soils dominated by macrophyllous woody species from the Combretaceae family, common genera: *Combretum* and *Terminalia*).
- The site is located in an Ecological Support Area according to the Limpopo Conservation Plan's mapping of critical biodiversity areas (CBA). A number of statutorily declared nature reserves as well as informal conservation areas are present in the vicinity of Turfvlakte, including Marakele National Park, D'Nyala Nature Reserve, Welgevonden Private Nature Reserve, Hans Strijdom Nature Reserve and the neighbouring Tierkop Private Nature Reserve. The Waterberg Biosphere Reserve located to the south is recognised by UNESCO, and the entire Waterberg plateau located to the southeast is also designated as an Important Bird Area (IBA).

Closure implications:

- The Turfvlakte site is located between the much larger existing Grootegeluk mine and Matimba and Medupi power stations and is cut off from surrounding untransformed areas by roads, railway lines and conveyors. Grootegeluk will also continue to operate for several decades after the Turfvlakte mining area has been rehabilitated, and in the short run will therefore play an ecological support role as habitat provision for bird species and small vertebrates. In the longer run the rehabilitated site can however play a more important ecological role once integrated with the rehabilitated Grootegeluk mine site. Locally occurring plant species should therefore be selected for rehabilitation purposes, based on their ability to integrate with and match the surrounding species composition in the long run.
- Establishing "tree pockets" consisting of clumps of larger, more mature trees over the rehabilitated areas will help to expedite soil attenuation, increased soil nutrient and organic matter content and habitat re-establishment and a dedicated nursery should therefore be established during operations for this purpose.

7.7 Surface water

- The Grootegeluk Coal Mine and Turfvlakte project area is situated in the A42J quaternary catchment of the Limpopo Water Management Area (WMA). The main surface water resource in the quaternary catchment is the Sandloopspruit, which flows east-northeast to join the Mokolo River approximately 40 km south of the Limpopo River.
- Drainage is generally east-northeast towards the Mogol River; however, no natural drainage channels occur on the Turfvlakte site, with runoff in the area mainly concentrating in dry sandy gullies such as the Sandloopspruit, which passes approximately five kilometres to the south of the site. The only surface water resources in the study area are a number of smallish ephemeral pans dotting the central section of the site.
- The main water users in the local area are domestic water users form the Town of Lephalale and the Marapong Village, east of the Turfvlakte project area in the Southern Regions of the Lephalale Local Municipality. These areas receive water from the Mokolo Dam via the Wolfenfontein storage dam.

Closure implications:

- The surface runoff characteristics of the site will be vastly different after closure compared to the pre-mining situation, owing to the presence of the two substantial permanent voids. Stormwater management measures implemented at closure must prevent surface runoff from entering the pits, as well as ensure that undue surface ponding does not occur.

7.8 Groundwater

- The Turfvlakte Project site is located in an area classified as a minor aquifer system, as defined by Hydrogeological Map Series published by DWAF (1996) with the majority of the site classified as intergranular and fractured.
- Water strikes depths encountered during the Exxaro Drilling Programme (2017-2018) range from 20 to 39 mbgl with and average strike depth of 28.7 mbgl. Blow yield measured during the drilling programme ranges from 0.13 to 3.49 l/s with an average yield of 0.68 l/s. From the published hydrogeological maps (DWAF 1996) the average recharge of the greater northern part of Turfvlakte study area is shown as between 5 and 10 mm per annum, whereas the southern part is shown as between 10 and 15 mm per annum.

Closure implications:

- The variable recharge from the surrounding in-situ geology into the open pit due to the fractured nature of the surrounding substrate as well as recharge rate through the backfilled spoils will play a determining role in whether in-pit lakes will be sustained in the long run and must be monitored and modelled during operations.
- Recharge through the backfilled overburden will be notably higher than the natural recharge rates, however waste loading to the pit water from this material is expected to be limited as the discard and interburden material will be deposited in the Grootegeluk pit.

7.9 Visual aspect

- The wider study area is characterised by a mixture of completely transformed and developed land associated with the adjacent Grootegeluk Coal Mine, Eskom Power Stations, the Marapong residential area as well as large tracts of undeveloped natural bushveld, under either game or livestock management.

Closure implications:

- The presence of two permanent voids after closure will have a pronounced impact on the visual character of the site and visual mitigation must be implemented where feasible to soften these changes. Concurrent rehabilitation must be done where feasible to ensure that the visual impact is progressively mitigated throughout operations and not deferred to closure.
- Ongoing monitoring and aftercare of rehabilitated areas will be required to ensure that long-term vegetation reestablishment is successful and that the visual character of the site does not deteriorate over time.

7.10 Socio-economic

- The Grootegeluk and proposed Turfvlakte mining complex is located in Ward 2 of the Lephalale Local Municipality (LLM), in the Waterberg District Municipality (WDM) of the Limpopo Province. Geographically, WDM is the largest District Municipality in the province, but it has the smallest population as it consists mainly of commercial farms, game farms, smaller rural settlements and a few small towns. LLM is situated in the north-western part of the WDM, with its north-western border forming part of the

international border between South Africa and Botswana. It is the largest local municipality in the province, with a surface area of about 1.4 million ha.

- The Province as a whole and WDM are popular tourism destinations, owing to attractions such as the Makapans Valley and Marekele National Park. The Matimba and Medupi Power Stations located south of Grootegeluk and Turfvlakte are of significance to the national economy, by helping to secure the long-term power supply of the country.
- The population of LLM has increased significantly from 115 767 in 2001, to 140 240 in 2016, which is likely due to the construction of Medupi Power Station which commenced in 2008. The local economy is currently dominated by Grootegeluk Mine and the aforementioned power stations. The contribution of mining to the LLM's GDP is significant, at 59.21%. Other important economic sectors in both the LLM and WDM include:
  - agriculture, forestry and fishing
  - electricity, gas and water
  - wholesale and retail trade, catering and accommodation
  - transport, storage and communication
  - finance, insurance, real estate and business services, and
  - general government.
- LLM has a 44% employment rate, with 42% being economically inactive and 12% unemployed.

Closure implications:

- Operations at Grootegeluk will extend several decades beyond that of Turfvlakte, and both will have the same staff compliment, hence closure of the Turfvlakte operations will not impact the mine employees. Depending on the eventual life of mine and operational planning for the planned Thabametsi operations, Exxaro may also investigate the opportunity of moving some of the Grootegeluk staff to thus operation, to potentially reduce the impact on individuals affected by the eventual Grootegeluk mine closure.
- Re-skilling and skills development of Grootegeluk/Turfvlakte staff that cannot be transferred to other Exxaro operations, should as part of the Grootegeluk closure plan focus on the other main economic sectors in the area, based on an assessment of the current prevailing growth trends and skills requirement at that time.

8.0 ENVIRONMENTAL RISK ASSESSMENT

8.1 Screening level risk assessment

A screening level Environmental Risk Assessment (ERA) was undertaken as part of the closure plan compilation for the Turfvlakte project, especially aimed at informing the likely closure measures to ensure a meaningful and sustainable post closure situation (summarised in Table 3). Available information was reviewed, and key risks were identified based on this information.

The risk assessment process followed is described below:

- For each risk identified, a pre-mitigation (maximum foreseeable loss - MFL) risk rating and post-mitigation risk rating was determined. The MFL risk rating presumed a worst-case scenario where all active/current risk controls were assumed to be ineffective when considering the likelihood and consequence of each risk; and

- Measures to mitigate the pre-mitigation risks were then developed to reduce the probability and/or consequence of the risk driver. The risk was then reassessed with the proposed mitigation measures in place and the post-mitigation or residual risk (RR) determined, assuming reasonable effectiveness of the conceptualised mitigation measures.

The probability and consequence tables as well as the ERA can be found in APPENDIX C.

8.2 Key environmental risks and mitigation measures

The significant environmental risks identified in the screening level risk assessment, are outlined in Section 21.0. These risks have been ranked from the highest pre-mitigation risk score to lowest, per category. It is noted that residual risks are addressed in Part B of this report and are not addressed in this section.

Table 3: Turfvlakte screening level risk assessment

RISK ID*	Category	RISK NAME	RISK DESCRIPTION	CAUSES	IMPACTS/EFFECTS	TREATMENT PLAN
WQ-01	Geochemical	AMD (Acid Mine Drainage)	Generation of AMD in pyrite bearing exposed coal face	Chemical and biological oxidation of pyritic materials under conditions where soil covering does not adequately reduce the ingress of water and air into the reactive materials resulting in the production of AMD (where materials are Potentially Acid Forming (PAG))	AMD seepage affects groundwater and water quality of the in-pit lakes should these form	Implement measures to reduce oxidation potential of PAG materials remaining in pit at closure, including covering exposed seam faces with suitable material Compile post closure integrated water management plan including comprehensive geochemical characterisation and integrate with same for Grootegeluk as relevant Climate change over the Life of Mine (LoM) is likely to have an impact on the water balance and research should be done on this topic to indicate how this will impact the water balance model
WQ-02	Groundwater	Groundwater contamination	Presence of contaminants of concern above agreed criteria within groundwater table	Groundwater contamination due to hydrocarbon spillages and salt leach, exacerbated due to poor management practices during the operational period Presence at closure of contaminant plume/s (hydrocarbons, leached salts etc.) generated during operations a key risk at closure being inadequate containment of the contaminant plume(s)	Prevention of beneficial groundwater use Downstream impacts to receptors (human and environmental health)	Surface water and groundwater monitoring will be conducted Rehabilitating all haul roads and parking/laydown areas, including associated coal veneers, fugitive coal and potential hydrocarbon spillages, thus removing potential contamination to surface and groundwater. Compile post closure integrated water management plan including comprehensive geochemical characterisation At present it is deemed unlikely that groundwater abstraction, treatment and/or management will be required, however conduct operational water quality monitoring for a predetermined period (pre site relinquishment, and extended post closure in the case of unscheduled closure) to verify whether this will be required
WQ-03	Groundwater	Reduced groundwater availability	Reduced groundwater availability	Open pits will create a drawdown cone that might affect availability of groundwater within the dewatering cone of depression	Long term prolonged groundwater drawdown effecting water resource yield to the west of the pit	Continue with ground water quality and elevation monitoring during and after closure, and determine whether in-pit water quality after closure will be suitable to support target next land uses
WQ-04	Groundwater	Pit lake water quality	Poor pit lake water quality	Contamination of pit lake water as the rebounding water table floods remaining exposed coal seams in the pit	Contaminated pit water renders this unfit for use (wildlife and stock watering), as well as potentially contaminating the surrounding aquifers if pit lake is not a sink (influent system)	Limit final void water make to regional groundwater recharge and direct rainfall Consider the need for on-going dewatering Compile post closure integrated water management plan including comprehensive geochemical characterisation to confirm technical studies to date - see note

RISK ID*	Category	RISK NAME	RISK DESCRIPTION	CAUSES	IMPACTS/EFFECTS	TREATMENT PLAN
WQ-05	Surface water	Waterlogging of final landforms	Insufficient draining of final landforms, particularly planned backfilled pit	Rehabilitated areas have not been backfilled and recontoured to be free-draining, resulting in waterlogging of flat areas or depressions	Waterlogging results in: Death of vegetation Capillary rise of salts into the surface soils affecting soil texture and plant growth Trapping of livestock	Compile detailed postmining landform and cover design based on a volumetric assessment, and undertake trial to confirm success prior to final implementation Manage the backfilling operations to achieve the design elevations and continually calibrate the life of mine materials balance Reinstate surface drainage lines aligned to existing surface macro-topography and to ensure free drainage Routing clean runoff to local / natural drainage lines as far as possible Ensuring that the drainage lines created on the rehabilitated surfaces will not scour and become sources of erosion
WQ-06	Surface water	Erosion	Erosion of rehabilitated areas	Inappropriate side slopes of the backfilled pit low wall and side walls Post mining landform not designed to cater for significant rainfall intensity Vegetation failure on rehabilitated areas	Soil, surface water and groundwater contamination Further vegetation failure, loss of biodiversity Impacted landscape visual appeal Reduced post mining landform viability and loss of growth medium	Design and construct surface water rerouting measures around the pit appropriately to prevent overtopping and associated erosion Design and construct physically stable and sustainable landforms Conduct rehabilitation trials to determine most appropriate / sustainable profile, cover design and revegetation strategy Determine appropriate cover designs (based on findings of rehabilitation trials) of remnant residue with "clean" material of an appropriate thickness to capacitate vegetation establishment; thus preventing mobilisation of mine residue
LU-PS-01	Geotechnical	Erosion of landforms	Instability of constructed landforms as a result of erosion of cover materials	Landform features (rehabilitated open pit areas) designed with slopes that are too steep and on which the energy of runoff water is not properly controlled. Landforms do not have the desired vegetation cover that persists in the long term (i.e. in adequate soil fertility and improper selection of suitable grasses and other vegetation)	Unsustainable vegetation covers on rehabilitated landforms with steep slopes of especially the pit low wall results in soil loss and exposure of underlying reactive materials (with attendant environmental impacts) Unnecessary cost to repair Deposition of material into downstream environment (e.g. drainage lines) and subsequent alteration of established hydrological processes	Slopes on backfilled pit areas will be shaped to be free draining and no steeper than 1:3 Design and construct free draining landforms based on landform modelling informed by suitable erosion modelling and LoM volumetric assessment Rehabilitation monitoring and care and maintenance to ensure achievement of performance objectives and site relinquishment criteria to be well established prior to scheduled closure, and to be extended post closure to confirm success

RISK ID*	Category	RISK NAME	RISK DESCRIPTION	CAUSES	IMPACTS/EFFECTS	TREATMENT PLAN
LU-PS-02	Geotechnical	Pit wall failure	Pit wall failure due to loss of geotechnical integrity	Inappropriate highwall design for closure, weathering of exposed strata in highwall, and wetting of highwall with pit lake formation	Injury to humans and / or fauna Exposure of materials prone to spontaneous combustion	The benches of the pit will be blasted to a gradient of 1:3 or flatter (required angle to be determined), combining the benches into one uniform slope “Push-up” berm(s) will be created at the base of the uniform slope A dished corridor will be created outside the safe 100 year break back line with a environ bund created with the material 20 m back from the break back line with a height of 3 m and slope angle of 1:2 Allowing spalling and sloughing to proceed naturally to “create” stable long-term pit shell slopes Rock engineering study: primary objective included in the study is to determine the slope stability of the pit wall in the areas that may be affected by the proposed water management and dump rehabilitation strategy Rehabilitation monitoring and care and maintenance to ensure achievement of performance objectives and site relinquishment criteria to be well established prior to scheduled closure, and to be extended post closure to confirm success Include potential climate change scenarios (e.g. severe storm / rainfall events) to the study assumptions Expand rock engineering studies during the operational period to determine the slope stability of the pit wall in the areas that may be affected by water management and dump rehabilitation strategy - thus establishing baseline data from which to extend / augment future studies
LU-R-01	Geochemical	Spontaneous combustion (Sponcom)	Spontaneous combustion of exposed coal on remaining mining benches	Chemical and biological oxidation of exposed pyrite in coal resulting in spontaneous combustion, in the absence of a suitable (soil or water) cover	Sponcom of exposed coal poses health and safety risks for humans (closure contractors and end land users) and wildlife Hot spots close to the final rehabilitated surface can affect revegetation success, thus resulting in failure of cover and surface erosion	Concurrent rehabilitation of open pits: - Maintaining a sufficient advance rate of materials placement thereby limiting the time of exposure to the atmosphere - Sealing the backfill in compartments at various intervals as backfilling takes place with available overburden material - The interburden material will be backfilled according to the Grootegeluk Standards in compartments to prevent spontaneous combustion Learn from and adjust rehabilitation measures as per findings of dump rehabilitation trials Undertake rehabilitation monitoring and care and maintenance to ensure achievement of performance objectives and site

RISK ID*	Category	RISK NAME	RISK DESCRIPTION	CAUSES	IMPACTS/EFFECTS	TREATMENT PLAN
						relinquishment criteria to be well established prior to scheduled closure, and to be extended post closure to confirm success
LU-R-02	Surface water / biodiversity	Endorheic pans	Inability to recreate endorheic pans (pan fields) as unique habitat for biodiversity conservation on rehabilitated areas	Construction of pans requires a trail so as to prove the viability of the concept. This will require careful planning and execution, requiring different approaches than current rehabilitation practice at Grootegeluk Design challenges and solutions current not fully understood Lack of integration / alignment between mine environmental team and operational team on requirement and practicalities of recreating pans	Loss of pan habitat and associated biodiversity / eco-services	Use outcome of proof of concept to inform best construction practice and successful outcomes, so as not to influence the required site relinquishment criteria / performance objectives associated to final rehabilitation of the open pit (i.e. free draining, limiting water ingress, etc.) Should proof of concept be indicated to be viable, undertake appropriate planning and placement of pans according to final land use plan and site wide rehabilitation plan
LU-R-03	Rehabilitation	Inability to establish and sustain native vegetation	Inability to establish and sustain native vegetation and therefore meet closure objectives	Unsustainable vegetation cover caused by: - Soil cover material with suboptimal depth, texture and / or fertility - Inappropriate selection of species for the rehabilitated landforms - Lack of appropriate and timely weed control - Prolonged droughts/climate change impacts - Overstocking and overgrazing - Lack of available seed	Loss of vegetation cover resulting in: - Loss of veld carrying capacity - Increased soil loss by water erosion - Landform instability - Increased wind borne dust - Loss of faunal habitat - Weed infestation and loss of recovering biodiversity - Imbalance in local and regional ecosystems	Selection of low intensity post-closure land use Dedicated vegetation assessment to determine key species growing within the naturally occurring area towards defining a species mix that uses pioneer species to achieve priority rehabilitation objectives (erosion prevention) towards establishing ecologically functional climax conditions (endemic, hardy and drought resistance species) Establishing or allowing for the natural establishment, as applicable, of viable self-sustaining vegetation communities (keystone pioneer vegetation species), and thus the preparation of ecosystem processes, productivity and services via natural succession Ensuring that the rehabilitated mine site is free draining and that disturbed areas are suitably prepared for the natural establishment of vegetation (where planned for); however

RISK ID*	Category	RISK NAME	RISK DESCRIPTION	CAUSES	IMPACTS/EFFECTS	TREATMENT PLAN
					- Increased rework costs - Delayed closure	ensuring that the drainage lines created on the rehabilitated surfaces will not scour and be sources of head cuts Develop and implement effective soil management strategies and maintain a LoM topsoil/growth medium balance ensuring sufficient growth medium quantities and quality available for rehabilitation Ensuring that the growth medium has the required organic content and the potential to sustain microbial activity to ensure infiltration, limit runoff and improved soil stability Using shrub and forb species create micro-climates to cool the upper surfaces to encourage grass germinations Implement rehabilitation measures, according to rehabilitation plan, progressively and adjust measures based on monitoring and learnings to improve, as necessary Undertake rehabilitation monitoring and care and maintenance to ensure achievement of performance objectives and site relinquishment criteria to be well established prior to scheduled closure, and to be extended post closure to confirm success Monitor and suitably eradicate invasive alien vegetation that hinders the success of indigenous vegetation establishment deters from the environmental quality of the rehabilitated site
LU-R-04	Rehabilitation	Failure to establish native fauna habitat	Failure to establish native fauna habitat overall biodiversity targets	Inadequate habitat within final landform for fauna recolonisation Loss of unique habitats due to the location of a number of seasonal pans within the approved mine plan and mining right area	Inability to meet proposed biodiversity and end land use objectives	Assess whether the rehabilitated areas, with limited intervention and change, could be adapted to provide suitable habitats for small mammals, improving the overall biodiversity, while also identifying those aspects / obstacles once site rehabilitation has been completed which could inhibit and/or deter animal life from returning to the rehabilitated project sites Utilise woody debris as a valuable rehabilitation material that provides several benefits, including habitat creation Create an environment where as wide as possible diversity of species would be tolerant and form a stable and sustainable environment, rather than creating different habitats for specific species

RISK ID*	Category	RISK NAME	RISK DESCRIPTION	CAUSES	IMPACTS/EFFECTS	TREATMENT PLAN
LU-R-05	Rehabilitation	Post-closure land use limitations	Post-closure land use limitations due to rehabilitation process	Backlogs in concurrent rehabilitation roll-out may hinder envisaged end land use(s) from being realised	Limits the extent to which the site is re-integrated into the surrounding landscape and also the range of potential and planned end or next land uses	Progressive rehabilitation plan which considers short term and medium term rehabilitation goals Short term: annual, 12-month period Medium term: 5-year period Undertake dedicated / committed operational implementation, with adjustment of measures based on learnings Undertake rehabilitation monitoring and care and maintenance to ensure achievement of performance objectives and site relinquishment criteria to be well established prior to scheduled closure, and to be extended post closure to confirm success
LU-R-06	Rehabilitation	Open pit cover resources / material availability	Insufficient cover resources / materials insufficient to meet closure requirements	Incorrect cover configuration with available soil resources Inadequate stripping and stockpiling of usable soils ahead of mining and soils lost by not being placed according to soil placement plan	Achieved land capabilities on rehabilitated land suboptimal and not supporting sustainable planned next land uses	Evaluate cover soil depths criteria of cover material by means of auger observations on a 50 x 50 m grid basis (by a soil specialist). Spatial maps to provide by soil specialist to indicate cover soil depth and non-compliant sections Compile succinct and focused topsoil management plan which is aligned to mine and other operational planning, based on technical / specialist studies including but not limited to: stripping plan/methodology, stockpiling methodology, placement delineation/methodology and management of the LoM growth medium balance Ensure effective implementation, measurement and sign off and dedicated progressive implementation of this plan Undertake rehabilitation monitoring and care and maintenance to ensure achievement of performance objectives and site relinquishment criteria to be well established prior to scheduled closure, and to be extended post closure to confirm success
LU-R-07	Climate	Climate change impacts	Closure design does not sufficiently account for potential climate change impacts Climate change impacts on vegetation, rehabilitated land and structures designed for current climate norms	Closure design utilised historical climate data only, without consideration of potential future variability Failure to evaluate the effects of climate change for the area on vegetation sustainability and the adequacy of stormwater management structures	Failure of agreed post-closure criteria to be met	Use outcome of future Grootegeluk climate change impact study, to ensure long term post closure view, with review of existing planned rehabilitation and closure measures in light of the findings of the climate change study, and adjustment of measures as necessary

RISK ID*	Category	RISK NAME	RISK DESCRIPTION	CAUSES	IMPACTS/EFFECTS	TREATMENT PLAN
SE-01	Safety	Unauthorised site access	Safety concerns due to access and exposure to vertical faces and drops	Unauthorised / uncontrolled access to vertical faces	Personal injury or death	Pit will be blasted to a gradient of 1:3, combining the benches into one uniform slope “Push-up” berm(s) will be created at the base of the uniform slope A dished corridor will be created outside the predicted pit wall break back line with a environ bund created with the material 20 m back from the break back line with a height of 3 m and slope angle of 1:2 Allowing spalling and sloughing to proceed naturally to “create” stable long-term pit shell slopes
SE-02	Air quality	Dust generation	Dust generation from post-closure landforms	Disturbance of materials during land forming, strong wind events, drying of materials Spontaneous combustion products could be a long-term air quality issue if all remaining exposed in-situ carbonaceous material in pit is not covered / flooded	Visual amenity, respiratory problems, contamination to surrounding areas if dust contains elevated metals	Ongoing / concurrent rehabilitation of available disturbed areas as per GN R. 1147 requirements - including establishment of vegetation to curb dust generation Undertake air quality monitoring, rehabilitation monitoring and care and maintenance to ensure achievement of performance objectives and site relinquishment criteria to be well established prior to scheduled closure, and to be extended post closure to confirm success
SE-04	Geomorphologi-cal	Compromised visual amenity Compromised landform stability and viability	Compromised visual amenity as perceived by relevant stakeholders Compromised land capability	Deviation from expected / desired / anticipated outcome	Inability to meet desired relinquishment criteria and timeframes Negative reputation	Re-establishing vegetation on rehabilitated areas, as required, to be aesthetically pleasing, aligned to surrounding natural vegetation cover Develop a post mining landform design based on geomorphological principles and informed by hydrological calculations and erosion modelling. Manage accurate implementation and calibrate the model based on actual volumes and bulking factors determined during operations Shaping and levelling rehabilitated areas to create landforms that emulate the surroundings and to facilitate drainage Establish realistic and achievable site relinquishment criteria with respect to visual amenity Undertake stakeholder engagement during authorisation processes for the rehabilitation of remnant mine residue facilities (configuration and cover) to obtain and address concerns as far as possible, as well as to demonstrate design feasibility and responsiveness to environmental considerations Undertake continued engagement during the closure planning process, particularly with respect to inputs into post closure

RISK ID*	Category	RISK NAME	RISK DESCRIPTION	CAUSES	IMPACTS/EFFECTS	TREATMENT PLAN
						land use and visual amenity
SE-05	Socio-economic	Local and regional economic impacts	Unfavourable socio-economic impacts upon local community and industry upon mine closure	Large number of local community employed by the mine Local businesses supply the mine and are largely dependent upon it Closure of the mine will remove this demand Mine workers, many of their family members and suppliers to the mine are financially largely dependent upon the mine (and indirectly the employees of the existing Matimba and future Medupi power station, as both will likely close once both greater Grootegeluk (including Turfvlakte) and Thabametsi mines close), which would impact upon their livelihoods at closure	Local increase in un-employment, movement of communities to other areas in search of work Closure of local businesses	Align social and labour plan projects and strategies to post closure land use and alternative livelihood planning Undertake comprehensive, ongoing, focused and industry-wide stakeholder engagement, particularly with provincial and regional players on enabling of replacement industries / livelihood opportunities Undertake training and awareness creation to empower the community to effectively manage the financial and / or commercial resources transferred from the mine prior to hand over
SE-06	Socio-economic	Lack of viable post closure land use	Absence of potentially self-sustaining industry following mine closure limiting the post-closure land use options of the mine	Post-closure land use options for the mine unlikely to be as economically favourable for local businesses	Loss of businesses and reduced employment opportunities within the local community Limited opportunities for post-closure land uses which incorporate business, as these would require some sort of third-party management	Align social and labour plan projects and strategies to post closure land use and alternative livelihood planning Undertake comprehensive, ongoing, focused and industry-wide stakeholder engagement, particularly with provincial and regional players on enabling of replacement industries / livelihood opportunities Ensure third party agreements are concluded that effective hand-over of pre-determined mining-related surface infrastructure / equipment for future use by other parties takes place Undertake training and awareness creation to empower the community to effectively manage the financial and / or

RISK ID*	Category	RISK NAME	RISK DESCRIPTION	CAUSES	IMPACTS/EFFECTS	TREATMENT PLAN
						commercial resources transferred from the mine prior to hand over
SE-07	Socio-economic	Lack of stakeholder engagement	Insufficient stakeholder engagement resulting in stakeholder and community dissatisfaction	Lack of engagement with relevant stakeholders Perceived inability to address concerns or adopt thinking Misaligned planning and not addressing stakeholder requirements throughout the operational period, leading up to mine decommissioning and closure	Community outrage Lack of support from the community for closure Staff losses, with staff seeking new permanent employment Failure to agree on relinquishment criteria	Develop rehabilitation and closure focused stakeholder engagement plan with intensity ramping up as the LoM nears Ensure that stakeholder engagement has clear outcomes to be addressed in closure planning process, particularly with respect to performance objectives and site relinquishment criteria
SE-08	Socio-economic	Unfulfilled operational commitments	EMP, SLP and closure-related commitments remaining unfulfilled at closure during operations	SLP not implemented or updated during operations to reflect true status of engagement SLP projects not budgeted during operations	The need for financial resources to address commitments post-operation which have not been considered in the cost estimate	Track / monitor socio-economic mitigation measures to confirm success post implementation of SLP projects, to inform development of appropriate and sustainable measures to mitigate anticipated impacts at closure Integrate SLP and closure planning, based on findings / outcomes of stakeholder engagement (particularly with respect to performance objectives and relinquishment criteria), and commence with the implementation of social readiness planning for closure (similar to annual progressive / concurrent rehabilitation planning and associated implementation), ramping up as the LoM nears
LC-01	Legal	Failure to obtain regulator acceptance	Not obtaining regulatory approval closure plan and associated site relinquishment criteria	Failure to engage relevant stakeholders regarding closure of the site Misalignment between closure study and regulatory expectations Regulatory changes	Delay in commencement of closure execution and eventual site relinquishment, with continued / prolonged liability	Stakeholder engagement with key regulatory stakeholders Obtain written approval from regulatory decision makers on rehabilitation performance objectives and site relinquishment criteria

RISK ID*	Category	RISK NAME	RISK DESCRIPTION	CAUSES	IMPACTS/EFFECTS	TREATMENT PLAN
LC-02	Legal	Insufficient financial provisioning	Failure to adequately account for the true cost of closure in financial provisions	Insufficient technical investigations and engineering design at required estimate accuracy level, insufficient quantification of residual risks Failure to define the scope of closure and associated assumptions Failure to understand the full risk profile of the project	Inability to set realistic performance objectives and measures to achieve these Increased cost to close, or ongoing financial liabilities to implement additional closure interventions	Closure cost estimate prepared and regularly updated - aligned to requirements of GN R. 1147 (regulations entail external audit of annual closure cost determinations) Concurrent / progressive rehabilitation, also aligned to GN R. 1147 will be undertaken, thus minimising eventual closure liability Estimate includes contingencies Nearing LoM, according to detailed closure planning schedule, undertake more detailed technical investigations / post closure predictions to confirm assumptions made in closure cost determinations, particularly those related to residual risk, and adjust closure measures and associated financial provisioning, as necessary Obtain specialist demolition and rehabilitation practitioner quotations to confirm closure allowances

PART B: REHABILITATION, DECOMMISSIONING AND MINE CLOSURE PLAN

9.0 BROAD ASSUMPTIONS FOR CLOSURE PLANNING

The following assumptions have been made with the compilation of this closure plan:

- This plan is based on existing available information. No additional technical work was done to support the compilation of the plan, however going forward closure-related knowledge gaps will be addressed based on priority; and
- This plan has been compiled without input from external stakeholders. Stakeholder consultation will be undertaken by Exxaro prior to final closure of the site to obtain stakeholder views and opinions, and these will be incorporated/considered in the final version of this closure plan.

10.0 CLOSURE VISION

To establish a safe, stable and non-polluting post-mining landscape that is sustainable over the long term while supporting and integrating with the desired game-farming end land use.

11.0 CLOSURE OBJECTIVES

The above overall closure vision is underpinned by the more specific closure objectives 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, in general, is not only neat and tidy, giving an acceptable overall aesthetic appearance, but which in terms of this attribute is also aligned to the planned final land use;
- **Biodiversity:** To encourage, where appropriate, the re-establishment of indigenous vegetation on the rehabilitated mine sites such that the terrestrial biodiversity is largely re-instated over time; and
- **Social:** To ensure that the transfer of any infrastructure to third parties, if applicable, contributes to the long-term socio-economic benefit of the local communities, and that these benefits are lasting and sustainable.

12.0 NEXT LAND USE PLANNING

12.1 Current land use

The current Turfvlakte mining right area is relatively undisturbed with no formal land uses occurring at present, other than forming part of the Manketti game reserve that surrounds much of Grootegeluk. A number of grid-pattern gravel roads were established during prospecting, and a wide haul truck access bridge that crosses the existing conveyor along the western boundary of the mining rights area has been constructed.

Existing land uses in the immediate vicinity of the Turfvlakte site include the expansive Grootegeluk surface mining operations to the northeast, the Eskom Mathimba power station to the east and Medupi station to the southwest, and the Marapong township further to the east. Asphalt roads transect the areas directly northeast and south of the site, and the existing Grootegeluk railway line also passes to the east of the site.

Lephalale is located approximately 20 km to the east of the site, and the greater region is extensively used for game farming and related tourism, with irrigated agriculture occurring along the Mogol River.

12.2 Next land use

The target next land use for the rehabilitated Turfvlakte and Grootegeluk mining areas is mainly wilderness supporting the Manketti game reserve and surrounding game farming activities, albeit that expensive areas of both closed mining areas will consist of rehabilitated mining voids, which will not be backfilled due to the material deficits of both operations.

13.0 CONSIDERATION OF CLOSURE ALTERNATIVES

Closure-related alternatives for the Turfvlakte project are limited given the relatively simplistic nature of the project, in that no permanent mining-related infrastructure will be constructed and operational aspects are limited to the two open pits and a topsoil stockpiling area. Consequently, the following closure alternatives were considered and assessed.

13.1 Open pit mining areas

- Completely backfill open pits after roll-over mining has concluded: This alternative would require that suitable material be sourced from an off-site source (the nearest potential source being Grootegeluk Dump 6), as a pronounced materials deficit for this purpose would exist at closure as all the interburden and discard will be backfilled into the Grootegeluk open pit during operations. For this reason, this alternative is considered non-feasible, as the cost of trucking backfill material from Dump 6 into the pit voids that will remain at closure would be prohibitively expensive.
- Make safe the remaining open pit voids at closure and allow to re-water in a controlled manner (preferred alternative): The expectation is that the pit water quality after closure will be relatively good, given that the majority of potential contaminating material, namely the discard and interburden, will be used as backfill at Grootegeluk. If additional measures are taken to limit the rate of oxidation of the remaining potential acid-forming material, such as lining the pit shell and walls above the exposed coal seams, this water could potentially be beneficially used for post-closure uses, or to support ecological processes and/or aquatic habitat provision.

13.2 Supporting infrastructure

All coal mined at Turfvlakte will be taken to the Grootegeluk plant for processing, Turfvlakte operations will entail limited temporary support infrastructure such as offices, haul and other roads and water provision. This infrastructure will have no further use after mining and will therefore be decommissioned and removed from

site and/or rehabilitated once the Turfvlakte mining operations have concluded. No specific alternatives for closure were identified in this regard.

14.0 CLOSURE SCENARIO

The closure scenario as reflected in this report provides context for the closure cost determination. The scenario has been defined for four distinct time periods/slots within the overall mine life cycle, namely:

- During operations: Key operational rehabilitation actions that will take place during this period;
- Last day of operations: The expected state of the mine at this time;
- Final mine decommissioning, rehabilitation and closure: Key actions that will take place over this time period; and
- Post mine closure: On-going monitoring and aftercare to reflect performance of the implemented closure measures as stipulated in the final mine closure plan towards eventual site relinquishment, also addressing residual impacts and latent risks.

Table 4: Closure scenario defined for Turfvlakte

Operational rehabilitation to be implemented during operations	Description of the state of the mine on the last day of operations (Closure scenario at scheduled closure)	Key actions during final decommissioning, rehabilitation and closure period	Key post closure actions
Surface infrastructure			
■ Limited infrastructure will be erected as part of the project and it is therefore not anticipated that any infrastructure will become redundant and be dismantled and demolished during operations ■ Roads potentially no longer required during the operational period will be rehabilitated	The following infrastructural aspects are expected to be present at the end of operations: **Process related infrastructure** ■ Crushing and other related infrastructure ■ Product handling infrastructure ■ In-pit backfilling infrastructure, including in–pit crushing stations and materials handling infrastructure ■ Pipelines and linear infrastructure. **Ancillary infrastructure** ■ Minimal supporting infrastructure including temporary / container administration and office complex ■ Access and security infrastructure **Services infrastructure** ■ Tele-communications, potable water, electricity and sewage networks	■ All potentially contaminated infrastructure will be washed down prior to demolition, and contaminated runoff collected for safe disposal ■ In-pit crushing infrastructure will be dismantled and removed off-site ■ Security fencing and other limited steel demolition material will be taken to a central location and salvaged ■ Inert concrete and general demolition waste will be suitably disposed ■ Most of the haul roads and access roads, except for those required for post closure activities, will be rehabilitated, aligned to the end land use plan	■ Air quality, groundwater and rehabilitation monitoring will take place to confirm success of closure measures implemented, until performance objectives and abandonment criteria are met ■ Care and maintenance will take place, and will be focused on establishing / maintaining vegetation on disturbed areas until it becomes self-sustaining ■ The monitoring roads will be rehabilitated once post closure monitoring and associated care and maintenance is no longer required ■ Site relinquishment will take place upon receipt of a closure certificate

Operational rehabilitation to be implemented during operations	Description of the state of the mine on the last day of operations (Closure scenario at scheduled closure)	Key actions during final decommissioning, rehabilitation and closure period	Key post closure actions
	■ Access roads to the mine and on the mining property, including gravel/dirt and potentially asphalt roads		
Open pit mining area			
■ Pre-stripping of soil will be done prior to mining and will be stockpiled, for future placement on backfilled sections of the pit ■ Stripping and appropriate stockpiling of available Glenrosa soils for the on-going creation of tree stations and other rehabilitation purposes will be done ■ Concurrent operational backfilling of the Turfvlakte open pit areas so that no backfilling or rehabilitation backlog occurs at closure, beyond the “active area” that will remain at closure. Backfilling will be conducted to NGL and the surface shaped to create a “fan” configuration that facilitates upper surface drainage from the backfilled area to the	■ A substantial section of open pit will remain, as a percentage of the material to be backfilled will remain on the last day of operations. The preceding backfilled portions of the open pits will be filled to pre-determined elevations and drainage profiles implemented during operations ■ At the last day of operations surface shaping and rehabilitation of the active area will be outstanding ■ The exposed pit shell and floor may in some areas have the propensity for sponcom, depending on the amount of oxygen-exposed seam remaining	■ Surface shaping of the active area will be done to facilitate surface runoff drainage to the surrounding NGL, aligned with the final surface runoff management plan ■ Tree stations will be established at the active area. Potential soil amelioration to enhance plant growth will be implemented if required ■ The pit floor will be designed to be continuously flooded by a shallow water body, thereby preventing the risk of sponcom of the pit floor ■ The exposed coal seams on the benches will be covered with overburden to prevent sponcom of the pit shell	■ Air quality, groundwater and rehabilitation monitoring will take place to confirm success of closure measures implemented, until performance objectives and abandonment criteria are met ■ Initial differential settlement on the backfilled sections of the open pit will be addressed, should this manifest. Corrective re-profiling will be done where possible differential settlement or erosion/wash-out occurs ■ Care and maintenance will take place and will be focused on establishing / maintaining the tree stations and vegetation on vacant and disturbed areas until it becomes self-sustaining. Care and maintenance must also

Operational rehabilitation to be implemented during operations	Description of the state of the mine on the last day of operations (Closure scenario at scheduled closure)	Key actions during final decommissioning, rehabilitation and closure period	Key post closure actions
surrounding topography and allows for differential settlement without significant impediments to surface drainage ■ Backfill of the “active area” of the open pit to the uppermost sealing layer over the exposed carbonaceous material ■ Corrective re-profiling will be done where possible differential settlement or erosion/wash-out occurred during operations	■ After pit dewatering ceases, the groundwater will begin to rebound into the pit	■ The access ramp will be protected against unwanted access and severe erosion by the installation of cross walls and drainage ■ A pronounced trench/dished corridor will be created outside the safe 100-year break-back line ■ An enviro-bund will be created preferably with open waste rock, or alternatively with the excavated material ■ Indigenous thorny/spiny vegetation will be established within the dished corridor, on the enviro-bund and between the enviro-bund and the pit lip. Aligned with the wilderness area / game farm next land use, a security or stock fence will be erected outside the enviro-bund to prevent access by game animals	maintain the on-going functionality of the enviro-bund ■ The monitoring roads will be rehabilitated once post closure monitoring and associated care and maintenance is no longer required ■ Site relinquishment will take place upon receipt of a closure certificate

Operational rehabilitation to be implemented during operations	Description of the state of the mine on the last day of operations (Closure scenario at scheduled closure)	Key actions during final decommissioning, rehabilitation and closure period	Key post closure actions
Soil stockpile area			
At present, soil stockpile areas are not envisaged as part of the project, as roll-over mining and backfilling of the open pits will be done. However, in the event that areas for live backfill placement in the open pit should not be available for whatever reason, the following will apply for potential temporary stockpile areas: ■ Stripped topsoil and other non-carbonaceous material will be continuously stripped and temporarily stored on the non-lined soil stockpile areas, prior to being placed on the backfilled open pit areas for rehabilitation	■ The rate of topsoil stripping to live placement is expected to remain more-or-less constant during operations, and a comparable volume to during operations will therefore still be stored at closure, to be used for rehabilitation, as described for the open pits above	■ Contaminated veneer will be disposed in the pit and covered as required ■ The disturbed topsoil stockpile and infrastructure servitude footprint areas will be suitably rehabilitated and vegetated to achieve a succession trajectory that will eventually result in the agreed end use and desired ecological state	■ Rehabilitation, groundwater monitoring will take place to confirm success of closure measures implemented, until performance objectives and abandonment criteria are met ■ Care and maintenance will take place, based on monitoring results ■ The monitoring roads will be rehabilitated once post closure monitoring and associated care and maintenance is no longer required ■ Site relinquishment will take place upon receipt of a closure certificate
Dams and impoundments			
■ No dams or impoundments will be created as part of the project	N/A	N/A	N/A

Operational rehabilitation to be implemented during operations	Description of the state of the mine on the last day of operations (Closure scenario at scheduled closure)	Key actions during final decommissioning, rehabilitation and closure period	Key post closure actions
Next land use			
■ For the duration of the operational phase the primary land uses will be mining-related, with untransformed areas effectively being retained as wilderness for eventual re-integration with the surrounding game farming areas	■ At the cessation of mining the partially rehabilitated open pit areas will have started to revert to wilderness, with the remaining areas dominating by mining-related uses	■ The land cover of the Turfvlakte site will gradually be returned to a natural wilderness state as the mining infrastructure is demolished, and disturbed areas are rehabilitated. However, formal use of the land will not take place during this phase, to afford rehabilitated areas the opportunity to adequately re-establish	■ The rehabilitated and closed Turfvlakte site will eventually be reintegrated with the adjacent Manketi game reserve area and used for game farming-related uses, based on the final carrying capacity achieved. The remaining Pit 1 final void will be closed off with a rock embankment (“enviro-bund”), and may potentially provide controlled access for game watering, depending on whether ponding water of acceptable quality is available for this purpose

14.1 Open pit technical planning input

This section provides more detailed technical planning inputs to the rehabilitation of the open pits, based on the above assumptions and aligned to the parallel closure planning that is being conducted for Grootegeluk. It is noted that these inputs are still conceptual in nature and have been applied for Turfvlakte where deemed appropriate but will likely be adapted in future as site-specific and operational considerations are better understood.

14.1.1 Open pit

At the end of pit mining, a notable portion of both pits would have been infilled to a predetermined elevation, followed by a final cover to render the infilled portions of the pit free draining. The final cover would be profiled in a “waving pattern” to provide preferential pathways for surface drainage to minimise infiltration, as well as to address likely secondary settlement over parts of the infilled pit areas (Figure 5).

For the purpose of the closure cost determination it was assumed that that pit infilling and final cover profiling would be conducted progressively during operations to the extent possible, so that only the portion of the open pit that will still be backfilled at cessation of mining, would require application of waving material as part of closure.

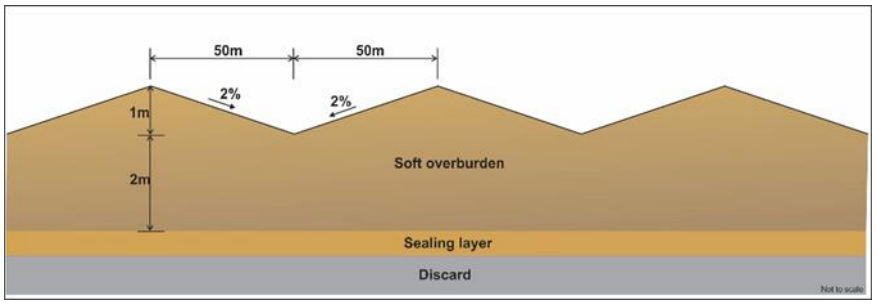

Figure 5: Conceptual side section through backfilled pit and associated overburden "waving" pattern

Given the high propensity for possible spontaneous combustion of the remaining carbonaceous material along the exposed pit floor, allowance was also made for the construction of embankments along the pit floor, to facilitated covering/inundating the exposed pit floor with the rebounding groundwater.

Potential spontaneous combustion of exposed coal seams on the pit benches will also be addressed by dressing these with overburden, obtained by cutting from the bench and dozing it onto the side walls at a suitable gradient to be determined.

An envirobund would be constructed around the final exposed pit perimeter to prevented unwanted access to the pit. Erosion of the pit ramps will be controlled by the creation of dedicated cross walls at a predetermined spacing to retard and direct runoff along the remaining ramps

14.1.2 Tree stations

Tree stations are required to be established over the backfilled portions of the open pit, to ensure that an appropriate vegetation community is established in the long term (Figure 6). Topsoil stockpiled for rehabilitations purposes will be applied with the establishment of tree stations (tree cavity 1.5 m x 1.5 m x 1.5 m) at locations and species to be determined by a rehabilitation ecologist and confirmed by trials conducted for Grootegeluk.

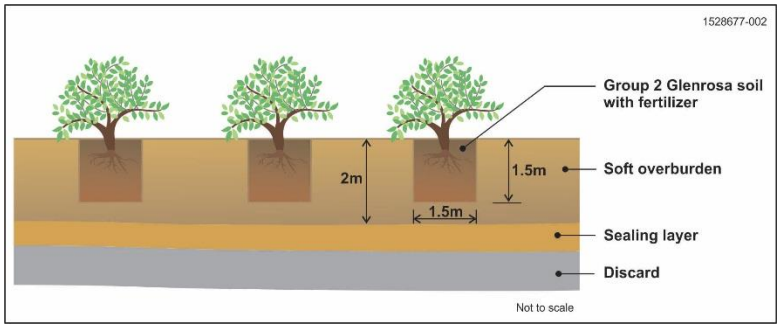

Figure 6: Schematic section of tree station

As mentioned above it is assumed the pits will be infilled and the final waving pattern applied as part of concurrent rehabilitation throughout operations. However, backfilling operations will likely result in a notable amount of dust generation, and the backfilled pits may also settle to varying degrees requiring final profiling. For this reason, it was conservatively assumed that the tree stations over all backfilled sections of the open pits will only occur at closure, although the feasibility of establishing them during the latter stages of operations should be investigated. The tree stations can also be applied to other disturbed areas becoming apparent at the time of closure.

Establishing of tree stations during operations will require a notable volume of Glenrosa soil. Careful scheduling and stockpiling of this resource, is needed during operations to ensure availability for the intended purpose.

The vast numbers of indigenous trees/saplings required to establish the tree stations and augment the biodiversity of the greater Ferroland Manketti game reserve, warrants the consideration of an on-site nursery. The proposed nursery could be combined with that of Grootegeluk. Consideration could also be given to make this a communal project.

The tree stations can also be combined to form larger “islands” as directed by a rehabilitation ecologist. Trials are recommended to confirm the most optimal spacing and configuration of tree stations, with rehabilitation performance monitored throughout operations.

15.0 CLOSURE MEASURES

The following closure measures have been identified for the respective infrastructure, mining and routine surface rehabilitation. The monitoring and aftercare-related and additional allowance requirements are also documented and form the basis for the closure costing (refer to APPENDIX A).

15.1 Infrastructural areas

Table 5: Infrastructural areas closure measures

Aspect / component	Scheduled closure measures
Supporting and civil service infrastructure	■ Remove all assets/equipment that can be profitably reused (temporary container buildings, crusher plant, etc.), and demolish the limited remaining infrastructure (fences, access control, pipelines) for salvage or resale ■ Demolish and excavate concrete foundations and structures (mainly associated with fence post footings) to 1 m below ground level ■ Rip tracks along the fences and allow for natural re-vegetation

Aspect / component	Scheduled closure measures
	■ Transport crushed concrete to Grootegeluk Dump 6 general waste site for disposal, or alternatively as backfill material in nearest section of Turfvlakte open pit, if suitable for this purpose ■ Remove contamination/spillages from all vehicle/machinery parking areas and bays and coal veneers from haul road fringes and dispose at Grootegeluk in accordance with existing operational site management procedures
Access roads	■ Rehabilitate all engineered and other gravel roads (if any), except for those required for post-closure monitoring and those as agreed to be taken over by a third party, as aligned to the agreed next land use ■ Bury engineered layers in a trenched system next to the roads ■ Re-establish natural drainage, including the removal of culverts and/or trenching ■ Shape and profile to match surrounding topography and to be free draining ■ Rip to a depth of 500 mm to alleviate compaction ■ Seed/vegetate with indigenous vegetation as determined by specialist
Haul roads	■ Excavate haul road access bridge ramps and embankment material and transport to nearest Turfvlakte open pit section for backfilling ■ Demolish haul road access bridge concrete structure and crush concrete ■ Transport crushed concrete to Grootegeluk Dump 6 general waste site for disposal, or alternatively as backfill material in nearest section of Turfvlakte open pit, if suitable for this purpose ■ Remove remaining carbonaceous veneer (hardstands) and fugitive material along the haul roads and deposit safely into the Grootegeluk open pit ■ Re-establish natural drainage, including the removal of culverts and/or trenching ■ Shape and profile to match surrounding topography and to be free draining ■ Rip to a depth of 1 m to alleviate compaction ■ Seed/vegetate with indigenous vegetation as determined by specialist

15.2 Mining areas

Table 6: Mining areas closure measures

Aspect / component	Scheduled closure measures
Final pit infilling and voids	**Backfilled areas** ■ Conduct profiling and shaping of the backfilled areas to create the surface waving pattern and associated drainage indicated in Figure 5; ■ Excavate/establish tree stations of 1.5 m x 1.5 m, locations and species to be determined by a rehabilitation ecologist. Backfill the excavated hollows with stockpiled Glenrosa soils stripped and stockpiled ahead of the mining face(s). Conduct soil fertility testing of the stockpiled soil and ameliorate as required to sustain the desired vegetation. Where practical, consolidate tree stations to

Aspect / component	Scheduled closure measures
	create larger clumps that will be more conducive to ecological functioning than small isolated tree stations. **Final voids** ■ Remove all service infrastructure (electricity supply, in-pit dewatering pumps and piping, etc.) and other equipment in the pit ■ Protect the pit access road against severe erosion and unwanted access by providing 2 m high waste rock cross walls and drainage; ■ Dress/cover exposed pit floor (in situ carbonaceous material) with a 300 mm layer overburden or material from dump 6 to prevent spontaneous combustion ■ Cover exposed coal seams within pit shell to prevent spontaneous combustion by dozing material from the pit bench to cover the coal seam, and compact as needed **Pit lip and fringe** ■ Determine and take into consideration (with enviro bund placement) the 100-year break-back line around the open pits (anticipated to be 50 m from pit lip) to allow spalling and sloughing to proceed naturally to create stable long-term pit shell slopes; ■ Excavate a dished corridor outside the safe break back line that the inner toe of the environ bund created with the material from the corridor is 20 m back from the break back line; ■ Construct an open waste rock environ bund between the dished corridor and the safe break back line around the full perimeter of the pit with a height of 3 m and slopes no flatter than 1:2, but no greater than the angle of repose; ■ Establish indigenous thorny/spiny vegetation in the dished corridor, on the enviro-bund and in the area around the pit lip; ■ Erect a game fence (2.2 to 2.4 m height) on the outer side of the envirobund. The fence will be maintained as part of the overall game park management.

15.2.1 General surface rehabilitation

Table 7: General surface rehabilitation measures

Aspect / component	Scheduled closure measures
Shaping and levelling of footprint areas	■ Fill excavations through cut to fill and or infilling with available suitable material ■ Shape and profile disturbed surface areas to be free draining and emulating the natural surface topography as far as possible ■ Stabilise disturbed areas to prevent erosion and sediment mobilisation in the short to medium term until a suitable vegetation cover has been established
Ripping	■ Rip disturbed footprint to a depth of approximately 500 mm with suitable agricultural equipment to alleviate compaction

Aspect / component	Scheduled closure measures
	■ For areas that are heavily compacted (hard stands, haul roads), rip with construction equipment to a depth of at least 1 m, and over-rip with agricultural equipment in order to create suitable conditions for vegetation establishment
Vegetation establishment	■ Seed/vegetate with indigenous vegetation as determined by specialist
Invasive vegetation	■ Apply one or a combination of the following basic methods of control, according to species of concern: ■ Physical (mechanical) consisting of – ▪ Uprooting (hand pulling) ▪ Cutting back ▪ Hand pulling, chopping, slashing and felling ▪ Ring-barking (girdling) ■ Chemical by means of herbicides as follows: ▪ Foliar application ▪ Stem notching and application ▪ Stump treatment ▪ Soil treatment ■ Biological, which involves the use of host-specific natural enemies of weeds or invaders from the plant's country of origin, to either kill or remove the invasive potential of these plants
Hardstands, compacted areas, storage yards/areas, etc. (not within plant area with pseudo terrace).	■ Remove fugitive rubble and remnant scrap, tyres, etc. and dispose of appropriately ■ Remove fugitive contamination and coal veneers ■ Shape and profile to match surrounding topography and to be free draining ■ Rip compacted areas to a depth of 1 m ■ Seed/vegetate with indigenous vegetation as determined by specialist

15.2.2 Water management

Table 8: Water management measures

Aspect / component	Scheduled closure measures
Surface water management.	■ Identify possible obstructions/impediments to surface water flows and correct to be free-draining ■ Identify possible interception and/or ponding areas of surface water flows. Shape these areas to be free-draining and if not possible isolate these areas from drainage paths by routing surface water flow past these areas (i.e. borrow pits, deep dams/ponds to become watering holes with development of game farming end land use) ■ Link the induced/constructed site drainage routes/lines to the natural drainage corridors

Aspect / component	Scheduled closure measures
	■ Limit and clean-up possible soil/sediment contamination ■ Check on possible groundwater contamination and subsequent surface water contamination

15.3 Post closure aspects

15.3.1 Care and maintenance

Table 9: Care and maintenance measures

Aspect / component	Scheduled closure measures
Monitoring	
Surface water monitoring (10 years post closure / implementation of measures)	■ Not applicable as there are no surface water features within the proposed mining area
Groundwater monitoring (10 years post closure / implementation of measures).	■ Undertake groundwater monitoring for 10 years post closure at 8 monitoring boreholes to ensure that potential contaminant plumes are receding appropriately (according to abandonment criteria)
Rehabilitation monitoring (10 years post closure / implementation of measures)	■ Undertake site-wide general rehabilitation monitoring of rehabilitated areas to ensure that the rehabilitation and closure measures implemented are successful and to define further aftercare requirements
Care and maintenance	
Care and maintenance (10 years post closure / implementation of measures)	■ Undertake care and maintenance as required at the above rehabilitated areas, for at least ten years post closure or until abandonment criteria are met, specifically in terms of the following: ▪ General site status ▪ Open pit ▪ Vegetation establishment ▪ Surface water flow ▪ Invasive alien species ▪ Contaminant plumes ■ On-going hand pulling of trees and saplings and localised application of broadleaf herbicide where required (10 years) ■ Corrective action on rehabilitated portions of backfilled open pits

Aspect / component	Scheduled closure measures
	▪ Earthworks for rectification of subsidence at backfilled areas ▪ Corrective action to improve soil fertility ▪ Corrective action to improve vegetation establishment

15.3.2 Additional allowances

Table 10: Additional allowances

Aspect / component	Scheduled closure measures
Preliminaries and general.	■ P and G's is 15 percent of sub-total 1. This rate is higher than the allowance prescribed by the DMR Guideline and has been increased in consultation with demolition contractors, based on Exxaro's stringent health and safety requirements and the first-order estimate nature of the costing. This figure must be revised as part of the annual updates required by GN R. 1147 and aligned with regional industry averages.
Contingencies.	■ Additional contingency allowance of 25 percent of the total for infrastructure and related aspects (sub-total 1 on summary costing table) This rate is higher than the allowance prescribed by the DMR Guideline and has been increased in consultation with demolition contractors, and the first-order estimate nature of the costing
Engineering and project management.	■ No specific allowance has been made in this regard
Specialist studies	■ Allowance for completion of specialist studies associated with closure: Ground water modelling, subsidence risk assessment, determination of long-term break back line of open pit, trials and scientific work for tree stations, engineering designs, mine fleet optimisation for rehabilitation, thermal heat scan, and/or other as needed

16.0 KNOWLEDGE GAPS AND MATTERS REQUIRING FURTHER ATTENTION

- A number of potential residual/latent risks identified as an outcome of the screening risk assessment (refer to Section 8.0) that are further discussed in Section 21.0 could require ongoing operational monitoring and further attention with future closure costs determinations. These include the following:
  - Excessive/more extensive secondary settlement on the backfilled pits that is envisaged with the design of the upper surface waving which allows for routine corrective action to mitigate. Occurrence of this risk would most likely require importation of soils and associated earthworks, reinstatement of trees and vegetation after the required re-profiling has been done.
  - An assessment/monitoring of the likelihood of subsidence/differential settlement of the overburden material backfilled into the open pit.

  - Further secondary reinstatement of trees on especially on pit, due to possible adverse climate and soil conditions, especially over the long term.
  - Potential requirement for some form of water treatment to address the possible adversely affected groundwater quality on the aquifer, due to potential waste loads from the exposed in-situ carbonaceous material that will remain after closure.
  - Sloughing of the pit benches and/or drying out of flooded pit floor, resulting in air intake and incidences of spontaneous combustion of exposed carbonaceous material, albeit that the potential of this occurring is likely limited given the relatively limited areas of material that would remain exposed after closure.
- Develop a predictive post mining landform model based on the current mine plan and compile a first order volumetric assessment and LoM materials balance. Refine the model once bulking factors have been verified during the initial mining phases and adjust accordingly. Manage backfill operations to design elevations;
- The likely pit side wall break-back line should be determined, to inform a safe setback distance of the proposed enviro-bund and associated surface runoff channel;
- It is furthermore recommended that the outcomes of a number of operational rehabilitation trials that can be conducted for Grootegeluk, be used to confirm the following for Turfvlakte:
  - Optimisation of the envisaged waving final surface profile of the backfilled open pits to ensure optimal surface drainage and infiltration management.
  - Feasibility of establishing tree stations on the backfilled open pits.
  - Determination/refinement of vegetation species mix for rehabilitated open pit areas, and associated implementation and care and maintenance requirements, to ensure desired revegetation trajectory and sustained long-term cover resilience.
  - Planning for and scheduling of integration of rehabilitated areas into the greater Ferroland-Manketti game reserve. Dedicated veld management of rehabilitated areas measures will also have to be devised and implemented.

17.0 MONITORING AUDITING AND REPORTING REQUIREMENTS

The rehabilitation performance of all areas rehabilitated after decommissioning and closure, but prior to site relinquishment (i.e. the pre-site relinquishment monitoring period), will be documented in a dedicated biannual rehabilitation performance report until site relinquishment criteria are met. The report should reflect on the findings of the monitoring undertaken, rehabilitation performance, and whether corrective action is required.

The rehabilitation monitoring programme and proposed preliminary site relinquishment criteria (including required analysis criteria for surface rehabilitation and surface and groundwater) are presented in Table 11.

The monitoring programme and site relinquishment criteria were developed for the following purposes:

- To establish and create a post-closure knowledge base, that is comparable to the operational phase knowledge base;
- To demonstrate compliance with regulatory requirements; and
- To demonstrate success/performance of the implemented closure measures (i.e. to demonstrate that the site relinquishment criteria have been achieved) in support of a final closure certificate.

Table 11: Proposed monitoring programme and preliminary site relinquishment criteria

Monitoring				Site relinquishment criteria		Reporting and corrective action	
Component/ aspect	**Monitoring objective**	**Monitoring network**	**Monitoring method and frequency**	**Metrics/target**	**Initial criteria (performance success)**	**Reporting**	**Recommended corrective action**
Surface water							
In-stream surface water quality and flow	Not expected to be relevant to Turfvlakte as the site has no defined surface drainage lines, however, should be re-evaluated and monitored after closure of Grootegeluk	N/A					
Biomonitoring		N/A					
Groundwater							
Groundwater quality	To monitor ground water quality in both natural aquifers and mine workings, to track water quality changes (improvements) over time as a result of closure rehabilitation activities	Review operational groundwater monitoring and sampling network and revise as advised by a specialist	Review the operational groundwater monitoring plan and program, and revise to meet post-mining monitoring needs by: Ensuring that key borehole sampling sites are retained (or new ones introduced as required) to monitor groundwater quality at key points in the mining rights area Continuing to monitor the comprehensive suite of water quality parameters that allow an ion balance to be calculated (same as those analysed during operations) - provides assurance on accuracy of lab results, and ensure that all potentially harmful cations and anions are analysed Groundwater samples will be collected bi-annually for chemical analysis by an accredited water laboratory Monitoring of boreholes will continue for at least 5 years post-closure (or until a closure certificate is issued)	Water quality analyses show that groundwater at and beyond the mine boundary meets the National Water Quality Standards for potable water at 95th percentile (or as a minimum have a chemistry typical of baseline groundwater quality of the area) The groundwater monitoring plan is able to demonstrate the movement and extent of any contaminated groundwater plumes Offsite borehole water qualities are not impacted by the closed mine, and do not impact neighbours The calculated ion balance for each water sample does not exceed a 5% imbalance (sanity check on lab results)	Groundwater samples show improving water qualities trending towards background levels	Results and findings will be compiled into a quarterly water report, with attached laboratory results An annual compliance report will be compiled and submitted to the authorities for evaluation and comment	Investigate the cause of any non-compliance in borehole water qualities (using the source – pathway – receptor model) and develop appropriate mitigation measures to reduce the generation of contamination at source where possible, or to contain or intercept polluted groundwater movement towards sensitive receptors where this is necessary
Groundwater flows/ levels	To monitor the piezometric (water table) levels in all monitoring borehole	Water table heights measured at the same	Groundwater levels measured quarterly	Movements in groundwater level (mamsl/mbgl) to determine groundwater recharge rate	Rate of recharge of mine water corresponds with	Results and findings will be compiled into a bi-annual	Reassess and revise groundwater management plan for the mine to manage

Monitoring				Site relinquishment criteria		Reporting and corrective action	
Component/ aspect	**Monitoring objective**	**Monitoring network**	**Monitoring method and frequency**	**Metrics/target**	**Initial criteria (performance success)**	**Reporting**	**Recommended corrective action**
	openings to determine the dewatering impacts of mining, and to measure the rate of recharge to underground workings in closed mining areas	borehole sampling sites as above	Monitoring will continue for at least 10 years post-closure (or until a closure certificate is issued)		modelled predictions of the recharge rate Mine water levels stabilise at predicted levels and do not enhance predicted seepage/decant rates	site groundwater water report	and mitigate possible water contamination
Surface rehabilitation							
Land capability	To measure rehabilitation performance against the land capability objectives committed to as part of next land use planning	All areas disturbed by mining activities and land reinstated by rehabilitation activities	Conduct a post-mining land capability assessment that includes: An assessment of soil depth and soil bulk density on a 100 x 100 m grid Digging of a soil test pit every 9 ha, to: Collect soil samples for lab analysis of soil properties (bulk density & soil texture), record rooting depth, root density, and bio-perturbation, collect soil samples for lab analysis of soil (pH, resistance, organic carbon, major cations and anions) Create land capability map for rehabilitated sites according to the Chamber of Mines' Rehabilitation Guidelines (2018) Land capability assessment is typically a once-off exercise on rehabilitated units within 3 years of completion of the rehabilitation work	Land capability commitments are achieved	Site has an accurate post-mining land capability map based on ongoing assessment according to site-wide land capability commitments The areas rehabilitated to different land capability classes in the post-mining landscape do not vary by more than 10% from defined land capability targets		Consult with DMR on any land capability shortfalls that cannot be addressed with available topsoil resources and agree new post-mining land capability targets that will determine the scope of post-mining land uses, that can then be communicated with key stakeholders as part of the mine closure process Use topsoil stockpile reserves, if available, to improve land capability, where possible In-fill areas where differential settling has occurred, and re-shape to be free draining (towards maintaining prescribed land capability depths)
Soil fertility	To achieve basal soil fertility levels that will support a self-sustaining vegetation cover (within 5 – 10 years of completion of rehabilitation)	All areas disturbed by mining activities and land reinstated by rehabilitation activities	Sample rehabilitated soils annually for the first 3 years, and every 3 years thereafter until fertility targets met or a closure certificate is issued Analyse samples at a certificated soils laboratory	Soil fertility meets the minimum requirements for maintenance of the target vegetation communities. Soil analyses indicated: ■ pH in range of 5.0 to 8.5 ■ Resistance is >300 Ω, ■ P is >20 mg/kg, and ■ K is >100 mg/	Soil analyses indicate that soils on rehabilitated areas are not salinized, have the correct pH, and have sufficient levels of fertility to support a sustainable vegetation cover.	Findings will be reported in a soil fertility report, after each assessment	Where soil is deficient, ameliorate sufficiently to address the deficiency and to provide a sustainable vegetation cover in support of the next land use

Monitoring				Site relinquishment criteria		Reporting and corrective action	
Component/ aspect	**Monitoring objective**	**Monitoring network**	**Monitoring method and frequency**	**Metrics/target**	**Initial criteria (performance success)**	**Reporting**	**Recommended corrective action**
				■ N is in adequate supply so as not to induce yellowing of vegetation			
Surface erosion	To monitor rehabilitated areas for soil erosion to ensure that a self-sustaining vegetation cover is established that will minimise soil loss through raindrop impact and rainfall runoff erosion	All areas disturbed by mining activities and land reinstated by rehabilitation activities	Conduct visual inspections for erosion (sheet, rill, and gulley erosion) on an annual basis for the first 3 years (end of wet season), and every 5 years thereafter until landform equilibrium is met	Visual inspections of rehabilitated areas indicate that erosion has been stabilised by rehabilitation activities, and is not significantly higher than surrounding natural areas	No new erosion seen on rehabilitated land after 5 years	Findings will be reported in an internal rehabilitation report after each assessment	Eroded areas will be stabilised by infilling and reshaping, and by establishing vegetation on the repaired areas/ bare patches, as required
Vegetation establishment	To ensure the successful establishment of suitable perennial grass species where appropriate, as well as the envisaged tree stations on rehabilitated areas, and that these perennial species persist in the rehabilitated landscape	All areas disturbed by mining activities and land reinstated by rehabilitation activities	Monitor the establishment and persistence of vegetation on rehabilitated areas (species composition and basal cover), using standard pasture assessment methods. To be undertaken by a suitably qualified specialist Monitor annually for 3 years, then every 3 years until a sustainable vegetation cover has been established	The vegetation established on rehabilitated areas should comprise appropriate perennial grass species, one of which is a creeping grass, and which collectively provide a minimum basal cover of 15% after 3 years; as well as locally representative woody shrub species through natural succession	The vegetation established on rehabilitated areas should comprise appropriate perennial grass species, one of which is a creeping grass, and which collectively provide a minimum basal cover of 15% after 3 years; as well as locally representative woody shrub species through natural succession	Findings will be reported in an annual rehabilitation report	Where the rehabilitation targets for vegetation establishment are not met, re-seed and apply appropriate adaptive management strategies to correct any deterioration in the species composition and cover (e.g. review defoliation/ fertilisation practices and modify accordingly)
Invasive alien species	To eradicate or control declared Category 1, 2 and 3 invader species on both rehabilitated land and on unmined areas within the mining rights area. To minimise the threat posed by invasive species to reinstated natural ecosystems and habitats, and biodiversity	All areas disturbed by mining activities and land reinstated by rehabilitation activities	Conduct a visual inspection for invasive species over the site on an annual basis, focussing on rehabilitated and previously disturbed areas, and on areas where invasive species have been eradicated Inspect annually for the first 3 years after closure, and then every 5 years, at least, until closure	The site is free of declared alien invasive plant species (Cat 1 – 3 invader species as per CARA, 1983 & Cat 1a, 1b and 2 as per NEM:BA, 2004)	The site is free of declared alien invasive species (CARA Cat 1 – 3 & NEMBA 1a, 1b and 2) invader species), and if not compliant the control programmes in place are effective and are eradicating alien invasive plant species	Findings will be reported in a rehabilitation report after each assessment	Where measures do not effectively control/eradicate alien invasive plant species, review control measures and modify to improve effectiveness.

18.0 ORGANISATIONAL CAPACITY

An initial organisational structure to execute the proposed closure plan and action plan has been formulated, as illustrated in Figure 7. The key functional roles within the organisational structure are outlined to ensure the knowledge gaps identified are addressed and the actions and measures are implemented prior to closure.

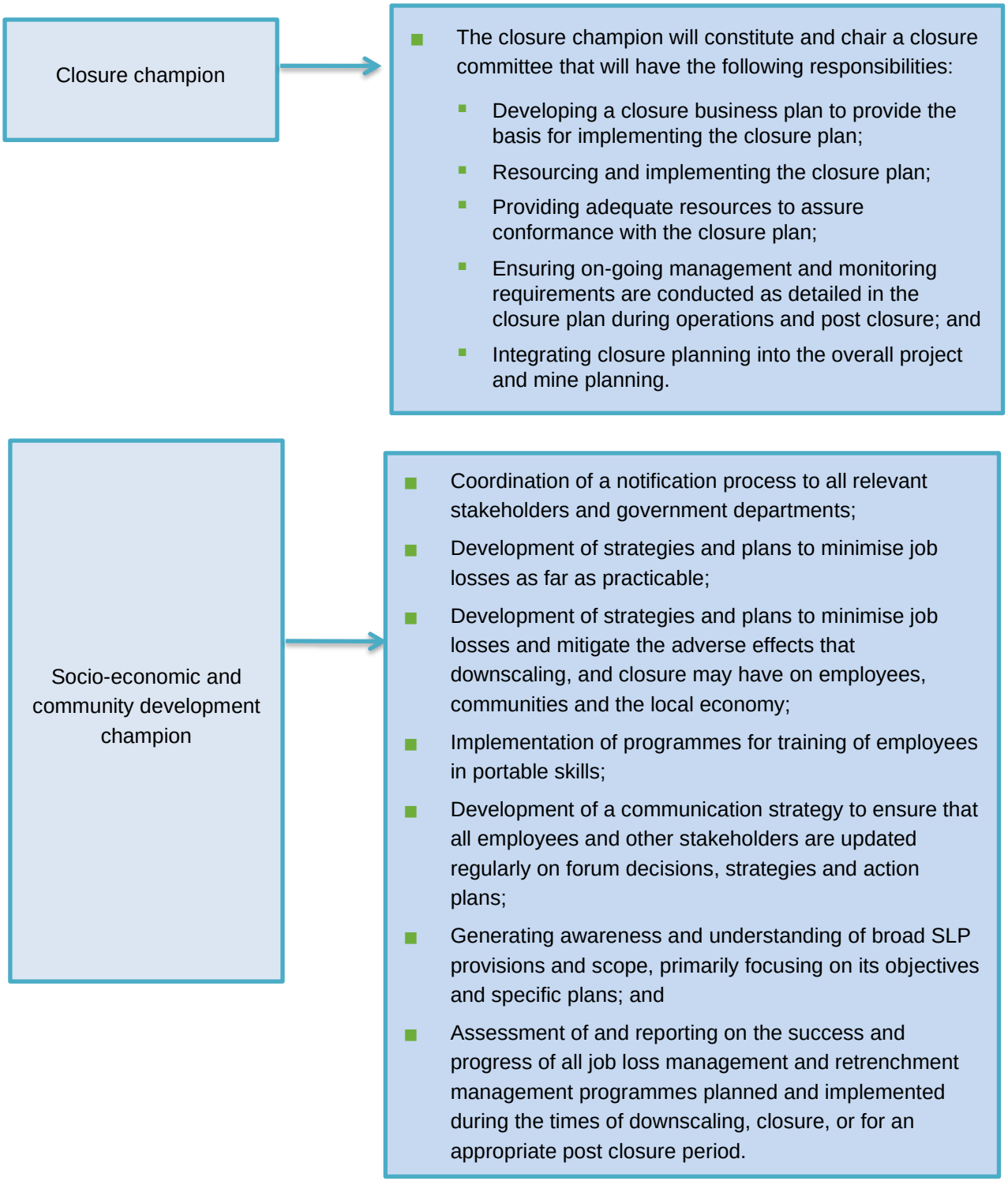

Figure 7: Organisational capacity for closure plan implementation

PART C: CLOSURE COSTS

19.0 CLOSURE COSTS

19.1 Methodology

The approach followed for the initial 2019 closure costs estimate determination for Turfvlakte was as follows:

- Review the available background information as well as most recent Grootegeluk closure costs to contextualise the current Turfvlakte closure cost work;
- Measure the individual infrastructure and operational areas that inform the closure costs determination, using Google Earth and the available conceptual mine layout and planning drawings;
- Develop and populate a site-specific closure costing workbook based on the above;
- Revise and update the Golder master unit rates table according to the latest third-party rates; unit rates for earthworks were obtained from a suitably experienced contractor to allow for site-specific rates;
- Identify site-specific aspects requiring unique mitigation approaches not catered for by the “standard” unit rate sheet, and devise appropriate measures and associated unit rate costs for these in consultation with specialist contractors/suppliers, based on similar work recently completed for Grootegeluk;
- Determine the costs associated with monitoring, maintenance and aftercare that would be required to verify that key rehabilitation success criteria have been achieved;
- Provide narratives for each closure cost item, describing key assumptions/qualifications and other considerations which have been considered in the cost item; and
- Compile summary sheets providing aggregated costs at facility and operational complex-wide levels.

19.2 Unit rates

The unit rates for general rehabilitation and closure measures/ activities were obtained from Golder’s existing closure costing database, which is regularly updated in consultation with demolition and earthworks contractors, as well as with rehabilitation practitioners. Golder undertakes a thorough review of its unit rate database, as follows:

- Minor unit rates are adjusted with standard inflation at least twice a year;
- Key rates for the dismantling of infrastructure are benchmarked at least annually by a specialised demolition contractor, to ensure that they remain market-related and take account of the latest dismantling and demolition techniques. It is noted that as these technologies improve, these rates in real terms are trending downwards;
- Earthworks rates are benchmarked against recent tenders available to Golder as well as benchmarking in discussion with contractors; and
- Aggregated rates dependent on base infrastructure or earthworks-related rates are recalculated given the latest base rates.

19.3 Costing-specific assumptions and qualifications

19.3.1 General

The following overarching and contextual assumptions have been applied to inform the process of determining the Turfvlakte closure costs:

- The computed closure costs are in terms of scheduled closure, as the project is still in the permitting/approval stage and hence no disturbance on site has taken place yet;
- The full closure of the Turfvlakte would likely comprise a number of cost components, some of which are not directly related to the physical closure and site rehabilitation process. This report therefore only addresses the decommissioning and rehabilitation costs, equating to an outside (third-party) contractor establishing on-site and conducting the rehabilitation-related work. Other components such as workforce matters, separation packages, re- training/re-skilling, etc. are outside the scope of this report;
- Dedicated contractors would be commissioned to conduct the demolition and rehabilitation work on the Turfvlakte site. This would inter alia require establishment costs for the contractors and hence, the allowance for preliminary and general (P&Gs) matters and contingencies in the cost calculation. Current experience indicates that generally higher allowances for these aspects are needed than has previously been the norm, due to increasingly stringent health and safety requirements and costs associated with labour sourcing and supply chain requirements, amongst others. Furthermore, the level of variability of the computed closure is still expected to be high given the conceptual nature of the project at this point. Accordingly, the allowance made for Ps&Gs was determined as 25% of the total “routine” demolition and rehabilitation costs (sub-total 1 of the closure costs). In addition, the contingencies allowance for addressing unexpected matters during closure implementation has been determined as 15% of sub-total 1;
- Allowance has also been made for third-party contractors and consultants to conduct post closure care and maintenance work, as well as monitoring of the rehabilitated areas to ensure that the required revegetation trajectories and site relinquishment criteria are achieved;
- In accordance with the DMR guideline and international good practice, no cost off-sets due to possible salvage values were considered and gross rehabilitation costs are reported;
- Costs are reflected exclusive of VAT; and
- The costs are presented in present day costs (with no discounting) with longer running costs items, for example the ongoing abstraction of contaminated groundwater, performance monitoring and care and maintenance, etc. reflected as cumulative amounts.

19.3.2 Decommissioning and site rehabilitation

Furthermore, the following specific assumptions were made regarding the decommissioning and demolition of the surface infrastructure and subsequent rehabilitation of the mining-related disturbances:

- At scheduled closure, the Turfvlakte site would be rehabilitated to a wilderness state, with the only notable exception being the open pit final voids that will remain after closure;
- All existing access roads will be maintained after closure for rehabilitation monitoring and maintenance purposes, and to support the next land use;
- All new gravel and dirt roads, haul roads and any potential tar/asphalt and paved surfaces created as part of the project and that will not be needed to support the next land use will be rehabilitated at closure;
- Crushed concrete will be transported to the Grootegeluk Dump 6 existing general waste site or alternatively to the nearest Turfvlakte open pit for disposal. All other inert demolition waste and other non-hazardous waste (if any) will also be disposed at the Dump 6 waste site;

- The respective pit access ramps will remain at scheduled closure, but will be made safe for the purposes of potentially utilising available pit water to support game watering;
- Profiling and shaping of the backfilled open pit areas will be done in a similar manner to that which is proposed for Grootegeluk, to achieve a “waving” surface profile pattern, with associated drainage;
- Embankments will be constructed on the final void pit floor to ensure adequate inundation of pit floor, to limit the potential of spontaneous combustion of exposed carbonaceous material. Additionally, available laterite will be used to line the exposed carbonaceous bench faces and sections of the pit floor where feasible, to limit the generation of acid mine drainage from the pit;
- Surface water quality monitoring will not be required as there are no potentially affected watercourses in the vicinity of Turfvlakte; and
- Groundwater quality monitoring, rehabilitation monitoring and aftercare of rehabilitated areas will be conducted for a 10-year period after initial implementation of the closure plan, as per the current requirements of GN R. 1147.

19.4 Closure costing summary

The total estimated scheduled closure costs, as at August 2019, amount to approximately **R 245 million** (including P&Gs and contingencies, but excluding VAT), for the preferred scenario, as summarised in Table 12.

Table 12: Turfvlakte Coal Mine Closure Costs, as at August 2019

Closure components		Pit 1 to Pit 2 (Preferred)
1 to 4	**Demolition and rehabilitation costs**	
1	Infrastructural aspects	R 21,163,746
2	Mining aspects	R 145,079,243
3	General surface rehabilitation	R 1,128,326
4	Runoff management	R 72,504
	Sub-Total 1	**R 167,443,819**
5	**P&Gs, Contingencies and Additional Allowances**	
5.1	Preliminaries and general	R 25,116,573
5.2	Contingencies	R 41,860,955
5.3	Additional studies	R 2,735,000
	Sub-Total 2	**R 69,712,528**
6	**Pre-site Relinquishment Monitoring and Aftercare**	
6.1	Groundwater monitoring	R 5,673,708
6.2	Rehabilitation monitoring of rehabilitated areas	R 142,458
6.3	Care and maintenance of rehabilitated areas	R 1,730,760
		R 7,546,926
	Grand Total Excl. VAT. (Sub-total 1 +2 +3)	**R 244,703,273**

PART D: ENVIRONMENTAL RISK ASSESSMENT FOR POST-CLOSURE RESIDUAL RISKS

20.0 NEMA GN R. 1147 CHECKLIST

The required content of the Environmental Risk Assessment (ERA) is detailed in **Table 13**, which also provides cross references to the relevant sections where these requirements are addressed.

Table 13: Content of Environmental Risk Assessment (as per GN R. 1147, Appendix 5)

Content of an environmental risk assessment	Reference to section
The environmental risk assessment report must contain information that is necessary to determine the potential financial liability associated with the management of latent environmental liabilities post closure, keeping in mind the planned post-mining end use, once the initial relinquishment criteria has been achieved and must include-	
a) Details of- (ii) The person or persons that prepared the plan; (iii) The professional registrations and experience of the preparers;	Included in Project information in Section at the beginning of this document (i.e. Page 1)
b) Details of the assessment process used to identify and quantify the residual risks, including - (i) Description of the risk assessment methodology inclusive of risk identification and quantification;	Refer to Section 21.2 (Part B) for residual environmental risk assessment methodology
(ii) Substantiation why each risk is residual, including why the risk was not or could not be mitigated during concurrent rehabilitation and remediation or during the implementation of the final rehabilitation, decommission and closure plan;	Refer to Section 21.3 (Part B) for residual environmental impacts
(iii) A detailed description of the drivers that could result in the manifestation of the risks, to be presented within the context of closure actions already having been implemented during the execution of concurrent rehabilitation or during the implementation of the final rehabilitation, decommissioning and closure plan;	Refer to Section 21.4 (Part B)
(iv) A description of the expected timeframe in which the risk is likely to manifest, typically as expected years after closure, and the duration of the impact, including motivation to support these timeframes;	Refer to Section 21.8 (Part B)
(v) A detailed description of the triggers which can be used to identify that the risk is imminent or has manifested, how this will be measured and any cost implications thereof;	This section will be included once more information is available on the residual risks identified
(vi) Results and findings of the risk assessment;	Refer to Section 21.3 (Part B) for residual environmental impacts
(vii) An explanation of changes to the risk assessment results as applicable in annual updates to the plan;	Not applicable at this stage as this is the first risk assessment undertaken for Turfvlakte in terms of GN R. 1147

Content of an environmental risk assessment	Reference to section
Management activities, including- (i) Monitoring of results and findings, which informs adaptive or corrective management and/or risk reduction activities; (ii) An assessment of alternatives to mitigate or manage the impacts once the risk has become manifested, which must be focussed on practicality as well as cost of the implementation; (iii) Motivation why the selected alternative is the appropriate approach to mitigate the impact; (iv) A detailed description of how the alternative will be implemented;	This section will be included once more information is available on the residual risks identified, noting that the proposed preliminary monitoring measures identified in Section 17.0 are expected to apply for the majority of potential residual risks identified
c) Costing, calculated using the current value of money and no discounting or net present value calculations included in the determination of the quantum of the liability, including– (i) A cost estimation, which must include— (aa) An explanation of the closure cost methodology; (bb) An auditable calculation of costs per activity or infrastructure; (cc) cost assumptions; (dd) Monitoring costs post closure to determine whether the risk is imminent or has manifest are to be included in the assessment as are monitoring costs likely to be incurred during the implementation of the strategy to manage or mitigate the impacts once the risk has become manifest; (ii) Where appropriate, a differentiation between capital, operating, replacement and maintenance costs; (iii) Cost estimates for operations, or components of operations that are more than 30 years from closure prepared as conceptual estimates within an accuracy of ± 50 per cent. Cost estimates will have an accuracy of ± 70 per cent for operations, or components of operations, 30 or less years (but more than ten years) from closure and ± 80 per cent for operations, or components of operations ten or less years (but more than five years) from closure. Operations with 5 or less years will have an accuracy of ± 90 per cent Motivation must be provided to indicate the accuracy in the reported number and as accuracy improves, what actions resulted in an improvement in accuracy; and	Refer to Section 21.9 for costs associated with residual risks
d) Monitoring, auditing and reporting requirements, which must include requirements prior to the manifestation of the risk and impacts as well as those once the impacts resulting from the manifestation of the risk are realised, inclusive of the approach that will be taken to analyse monitoring results and how these results will be used to inform adaptive or corrective management and/or risk reduction activities.	Refer to Section 21.7 but also Section 17.0

21.0 RESIDUAL ENVIRONMENTAL RISKS

21.1 Introduction

Residual risks are defined as post-site relinquishment risks that remain after implementing scientifically sound mitigation measures at closure, and which need to be managed in the long term. This report documents preliminary residual risks identified for Turfvlakte and recommends suitable mitigation measures to lower these risks and/or further quantify them as Limpopo approaches closure.

Once these risks are better understood, the closure measures required to adequately mitigate the risks will be costed and these costs will be reported. However, since this is the first time that residual risks have been identified for Turfvlakte, additional information and specialist studies are required to further inform the required closure measures and determine the associated costs. Additional studies required for this purpose have been recommended below and will be taken into consideration in future updates of this closure-planning document.

21.2 Risk assessment methodology

The methodology/approach used in the screening level risk assessment, undertaken as part of the Environmental Risk Assessment (ERA), can be summarised as follows:

- Conducting a screening level risk assessment to quantify all possible risks that could be applicable and associated with closure of the site (refer to Section 8.0 – Part A);
- Screening-out of the above suite of risks those that are not significant as these could be omitted and/or readily mitigated;
- Developing corrective and/or mitigation measures for those risk that could not be screened-out;
- Identifying initial residual risks;
- Assessing the initial residual risks related to the long-term performance and sustainability of the developed measures to correct and /or mitigate the identified remaining residual risks;
- Arriving at a suite of probable residual risks that require dedicated attention with closure planning going forward; and
- Developing and scoping the work required for a full understanding of the residual risks and addressing these by scheduling the required work for execution.

The probability and consequence tables as well as the detailed risk spreadsheet can be found in APPENDIX C. It is envisioned that the understanding of the impacts associated with the residual risks will be progressively improved upon during iterative annual updates of this plan, as illustrated in Figure 8.

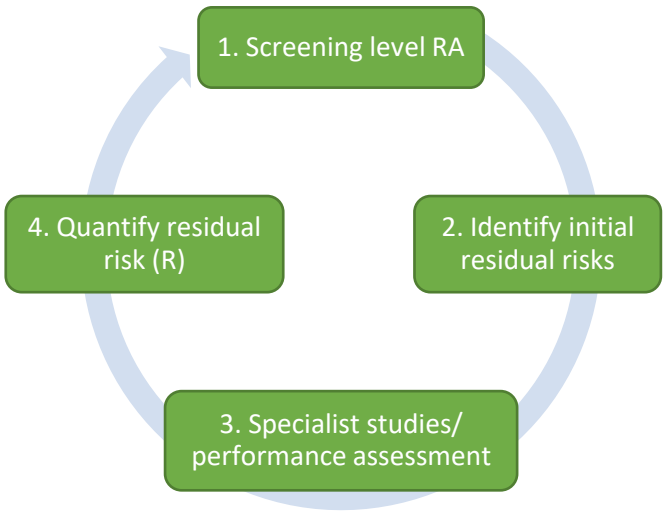

Figure 8: Schematic indicating the key components and process of risk determination

21.3 Preliminary residual risks

Likely residual and/or latent risks that could require attention with future closure costs determinations include the following:

- Excessive/more extensive secondary settlement on the backfilled pits that is envisaged with the design of the upper surface waving which allows for routine corrective action to mitigate. Occurrence of this risk would most likely importation of soils and associated earthworks, reinstatement of trees and vegetation after the required re-profiling has been done;
- Possible open pit rehabilitation cover material shortage at time of closure due to varying soil potential, poor stripping and stockpiling practices, alternative use of soils during operations for non-rehabilitation purposes etc. This aspect could translate into post site relinquishment costs to be considered with future closure costing updates;
- Further secondary reinstatement of trees on on the backfilled pit, due to possible adverse climate and soil conditions, especially over the long term;
- Potential requirement for some form of water treatment to address the possible adversely affected groundwater quality on the aquifer due to potential waste loads from the open pit over the remaining operational period;
- Sloughing of the pit benches and/or drying out of flooded pit floor resulting in air intake and incidences of spontaneous combustion of exposed carbonaceous material; and
- Long term water provision for game watering as well as operation of the game farm until it can be proven that a land capability with no impediments to the establishing of a game reserve can be achieved.

21.4 Risk drivers

A detailed description of the risk drivers resulting in the manifestation of the residual risks identified is integrated in the environmental risk assessment table (Table 3). The risk drivers associated with the significant residual risks identified in this table will be further updated in future closure plan updates, once these are better understood based on ongoing operational monitoring information.

21.5 Alternative mitigation measures

Alternative mitigation measures for each residual risk identified will be sought once the residual risks are better understood. At this stage, preliminary residual risks have been identified with corresponding initial mitigation measures. Once more information is available to inform the risks, these risks will be re-evaluated, and alternative mitigation measures will be explored.

21.6 Work required to address knowledge gaps

The following operational rehabilitation trials and further specialist work are recommended to further inform the quantification of the residual risks identified:

- Determination of the likely pit side wall break-back line, in order to determine safe setback distance of the proposed enviro-bund and associated surface runoff channel
- An assessment/monitoring of the likelihood of subsidence/differential settlement of the overburden material backfilled into the open pit
- Optimisation of the envisaged waving final surface profile of the backfilled open pits to ensure optimal surface drainage and infiltration management.

- Investigation of the feasibility of establishing tree stations on the backfilled open pits.
- Determination/refinement of vegetation species mix for rehabilitated open pit areas, and associated implementation and care and maintenance requirements, to ensure desired revegetation trajectory and sustained long-term cover resilience.

21.7 Monitoring and auditing requirements

The monitoring and auditing requirements for the identified residual risks will be detailed once more information is available to further inform the risks, as is identified and listed in Section 21.6 (Part B).

As additional information becomes available in future annual updates of this report, this information will be used to compile a monitoring plan for each residual risk identified and auditing requirements will be defined based on the monitoring required.

21.8 Timeframe estimate of risk manifestation

Since this is the first residual risk assessment undertaken for Turfvlakte, the information needed to establish the time frames of residual risk manifestation is unavailable. These time frames will be defined in future annual updates of this report, as recommended specialist studies and additional work is undertaken, as suggested in Section 21.6.

21.9 Post site relinquishment costs

Post site relinquishment costs will not be determined in this preliminary residual risk identification stage. Before post site relinquishment costs can be determined, further work is required to better understand and quantify the residual risks. It is foreseen that these costs will be quantified in the level 4 residual risk determination stage, as is shown in the envisioned process of residual risk assessment determination (Figure 8), as more information becomes available.

21.10 Conclusions

This is the first Environmental Risk Assessment report compiled for Turfvlakte, and as such there is still work required to improve the assessment and management of the residual risks identified. As the additional studies recommended in this report are carried out, the understanding of the risks will progressively improve until such a time that the mitigation measures required for the residual risks are able to be costed with an acceptable level of confidence.

PART E: ANNUAL REHABILITATION PLAN

22.0 ANNUAL REHABILITATION PLAN

The primary focus and content of an annual rehabilitation plan (ARP) is to identify and address those operational aspects that would contribute to achieving the closure objectives as stipulated in the latest mine closure plan. Generally, the rehabilitation plan does not address routine environmental matters and considerations arising from operations, as these are covered in the environmental management plan (EMP) and are implemented through the mine's environmental management system (EMS) and supporting standards and procedures.

As the Turfvlakte mining operation has not been commissioned yet, no rehabilitation backlog exists at present and is not expected to occur for the first two years or so of the project lifecycle, as all activity on site during this time will revolve around establishing the minimum infrastructure (access and haul roads, fences, temporary infrastructure areas, limited support service infrastructure, etc.), and opening the initial open pit/s (depending on which mining scenario is pursued) box cuts.

However, thereafter operational rehabilitation will essentially revolve around backfilling the open pit voids with available overburden, and conducting preliminary compaction, shaping and levelling to receive the cover material for the final waving profile, followed by re-vegetation where areas become available for this purpose. Annual rehabilitation activities will therefore be scheduled and costed in subsequent updates of this closure plan, once adequate operational mine planning information becomes available to do so.

23.0 STATEMENTS OF INDEPENDENCE AND COMPENTENCE

23.1 Statement of independence

Golder is an independent international environmental consultancy. Neither Golder nor its staff, have or have had, any interest in this project capable of affecting their ability to give an objective and unbiased opinion, and have and/or will not receive any pecuniary or other benefits in connection with the project, other than normal consulting fees.

23.2 Statement of competence

Golder prides itself as being at the forefront of mine closure and rehabilitation not only within Africa, but the world. Golder in Africa is currently taking the lead with respect to the technical innovation in this field, being the first with a numerical closure costing model, landform modelling as well as unsaturated flow through soil covers.

We are actively engaged in the evolution of international best practice, as represented by the standards of the World Bank and the IFC, as well as in the application of that best practice in our environmental and social consulting. We are also experienced in ensuring that our products, while meeting World Bank and IFC standards, are compliant with pertinent national legislation and clients' corporate standards.

Golder has in-depth experience in environmental and mining-related civil engineering, closure planning and cost determination. All closure-related work is guided and reviewed by Francois Marais, Brent Baxter, Brent Johnson or Mark Aken, in their respective capacities as senior strategic advisors in terms of rehabilitation and closure related projects.

The Golder Land Use and Closure team has conducted closure planning, including facilitation/consultation with the respective regulatory authorities/agencies, throughout Africa. The team specializes in the closure of mining and industrial complexes, addressing the matter from both a strategic and detailed closure/costing perspective.

The South African closure cost and liability effort is strongly connected to the global Golder family and knowledge sharing, and advancement within the discipline is facilitated in this way. In addition, Golder is known throughout the mining industry for its extensive experience in mining-related environmental assessment and permitting and has over the years conducted a broad range of services for all major mining houses and commodities throughout South Africa and the rest of the continent, as well as abroad.

Golder Associates Africa (Pty) Ltd.

J Bothma
Land Use and Closure

M Schlechter
Senior Environmental Consultant

JB/MS/nbh

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APPENDIX A

Closure Costing Spreadsheets

UNIT RATES FOR DEMOLITION, EARTHWORKS, REHABILITATION AND RELATED WORK										Reason for change	
Ref no		**Currency**	**Unit Rate (Dec 2018)**	**Unit**	**Comment**	**Unit Rate (Nov 2016)**	**Nov 2016 - Dec 2018, 9.4% esc**	**Unit Rate (Dec 2018 from Golder Master Sheet); and aligned to Matla**			**Matla Dec 2018 unit rates**
A	**Concrete**										
A1	**Demolition of concrete structures**										
A1.1	Very heavy concrete with thickness greater than 750 mm	: Rands	R 1 571.27	/m^3	Demolition cost of reinforced concrete, excluding screening & sorting and disposal of waste	R 1 460.17	R 1 617.57	R 1 571.27		As agreed with Jet Demolition on 17 Sept 2016	R 1 571.27
A1.2	Heavy concrete with thickness 500 - 750 mm	: Rands	R 1 176.76	/m^3	Demolition cost, excluding screening & sorting and disposal of waste	R 1 093.55	R 1 211.43	R 1 176.76		Previous rate was for 250 mm to 750 mm concrete. New rate for 500 mm to 750mm (average concrete thickness changed from 500 mm to 625 mm). This rate is more appropriate for use at Grootegeluk, than the old one	R 1 176.76
A1.3	Medium concrete with thickness between 250 and 500 mm	: Rands	R 782.24	/m^3	Demolition cost, excluding screening & sorting and disposal of waste	R 726.92	R 805.29	R 782.24			R 782.24
A1.4	Light concrete thickness less than 250 mm	: Rands	R 496.54	/m^3	Demolition cost, excluding screening & sorting and disposal of waste	R 461.43	R 511.18	R 496.54			R 496.54
A2	**Demolition of concrete floors, bases and foundations**				Based on unit rates A1						
A2.1	Strip foundation	: Rands	R 164.27	/m	Reinforced (0.35 m x 0.6m x 1 m x Medium concrete unit rate)	R 153.00	R 169.49	R 164.27			R 164.27
A2.2	Column footing	: Rands	R 1 320.02	/m^3	(1.5 m x 1.5 m x 0.75 m) x (Medium concrete unit rate)	R 1 227.00	R 1 359.27	R 1 320.02		Previous rate was nominal allowance for a single column footing. New rate is in m3	R 1 320.02
A2.3	Bases and floors after removal of super structures	: Rands	R 273.78	/m^2	Reinforced (0.35 m x 1 m^2 x Medium concrete unit rate)	R 254.00	R 281.38	R 273.78			R 273.78
A2.4	Heavy duty floors and bases after removal of super structure	: Rands	R 391.12	/m^2	0.5 m x 1 m^2 x Heavy concrete unit rate	R 547.00	R 605.97	R 391.12		Rate recalculated as live formula. Product of rate A1.2	R 391.12
A2.5	Concrete slabs < 200 mm thick , no reinforcement	: Rands	R 99.31	/m^2	Excludes disposal (Light concrete unit rate x 0.20 m)	R 92.00	R 101.92	R 99.31		Rate recalculated as live formula. Product of rate A1.4	R 99.31
A2.6	Concrete slabs < 250 mm, no reinforcement	: Rands	R 124.14	/m^2	Excludes disposal (Light concrete unit rate x 0.25 m)	R 115.00	R 127.40	R 124.14			R 124.14
A2.7	Dam concrete liner 150 mm thickness	: Rands	R 74.48	/m^2	Removal of 150 mm thick concrete liner, excluding disposal. [0.150 m x Light concrete unit rate]	R 69.00	R 76.44	R 74.48			R 74.48
A3	**Concrete crushing**										
A3.1	Aggregate from crushed concrete	: Rands	R 209.56	/m^3	Crushing concrete to 75 mm aggregate.	R 194.75	R 215.74	R 209.56			R 209.56
B	**Steel structures and equipment**										
B1	**Dismantling/demolition of steel buildings and related infrastructure (Including Sheeting)**				Based on unit rated of B2						
B1.1	Light plant or structures	: Rands	R 324.44	/m²	Up to 300 kg of steel per square metre. Includes sheeting	R 292.20	R 323.70	R 324.44			R 324.44
B1.2	Light/medium plant or structures	: Rands	R 677.94	/m²	Up to 500 kg of steel per square metre. Includes sheeting	R 608.75	R 674.37	R 677.94			R 677.94
B1.3	Medium plant or structures	: Rands	R 1 308.53	/m²	Up to 800 kg of steel per square metre. Includes sheeting	R 1 168.80	R 1 294.80	R 1 308.53		Categories of light to very heavy plant adjusted (kg/m2). All descriptions and rates changed. No material impact on closure costs, as the majority of steel components were measured in ton, not m2	R 1 308.53
B1.4	Medium/heavy plant or structures	: Rands	R 2 324.35	/m³	Up to 1200 kg of steel per square metre. Includes sheeting	R 2 076.60	R 2 300.46	R 2 324.35			R 2 324.35
B1.5	Heavy plant structures	: Rands	R 3 357.40	/m²	Up to 1500 kg of steel per square metre. Includes sheeting	R 3 000.00	R 3 323.40	R 3 357.40			R 3 357.40
B1.6	Very heavy plant structures	: Rands	R 4 067.62	/m^2	Up to 1750 kg of steel per square metre. Includes sheeting	R 3 600.00	R 3 988.08	R 4 067.62			R 4 067.62
B2	**Dismantling/demolition of steel structures**										
B2.1	Steel structures: light	: Rands	R 1 081.47	/t	As per Jet demolition	R 973.75	R 1 078.72	R 1 081.47		Rate was previously for very light infrastructure (10-20kg/m2), which has now been replaced by other rates (for example car ports measured in m2). New rate for demolition of steel in tonnes for plant infrastructure	R 1 081.47
B2.2	Steel structures: medium	: Rands	R 1 635.66	/t	As per Jet demolition	R 1 460.62	R 1 618.08	R 1 635.66		As agreed with Jet Demolition on 17 Sept 2016	R 1 635.66
B2.3	Steel structures: medium/heavy	: Rands	R 1 936.96	/t	As per Jet demolition	R 1 730.31	R 1 916.84	R 1 936.96			R 1 936.96
B2.4	Steel structures: heavy	: Rands	R 2 238.27	/t	As per Jet demolition	R 2 000.00	R 2 215.60	R 2 238.27		As agreed with Jet Demolition on 17 Sept 2016	R 2 238.27
B3	**Dismantling of permanent shed type structures**										
B3.1	0m – 5m high	: Rands	R 76.18	/m^2	Includes sheeting. Cost based on unit rate B1.1, light steel 80 kg/m2	R 68.28	R 75.64	R 76.18			R 76.18
B3.2	5m – 10m high	: Rands	R 134.02	/m^2	Includes sheeting. Cost based on unit rate B1.1, light steel 80 kg/m2	R 122.84	R 136.08	R 134.02		Cost based on unit rate B1.1, light steel 80 kg/m2	R 134.02
B3.3	10m – 15m high	: Rands	R 228.05	/m^2	Includes sheeting. Cost based on unit rate B1.1, light steel 80 kg/m2	R 199.18	R 220.65	R 228.05			R 228.05
B3.4	15m – 20m high	: Rands	R 326.42	/m^2	Includes sheeting. Cost based on unit rate B1.1, light steel 80 kg/m2	R 292.46	R 323.98	R 326.42			R 326.42
B4	**Crane hire and use**										
B4.1	120 ton Crane hire	: Rands	R 40 230.59	/d	Rate per 10 h/day. Include site establishment and personnel accommodation, assuming a minimum of 10 days on site. As per Johnson Crane hire	R 40 960.00	R 45 375.49	R 40 230.59			R 40 230.59
B4.2	180 ton Crane hire	: Rands	R 76 161.00	/d	Rate per 10 h/day, Include site establishment and personnel accommodation, assuming a minimum of 10 days on site. As per Johnson Crane hire	R 63 690.00	R 70 555.78	R 76 161.00			R 76 161.00
B5	**Dismantling/demolition of steel tanks and dams with rubber lining**										
B5.1	≤5m diameter	: Rands	R 6 901.04	/tank	Cost includes an allowance for removal of liner, and excludes demolition of support structure and concrete base	R 6 215.25	R 6 885.25	R 6 901.04			R 6 901.04
B5.2	5m - 10m diameter	: Rands	R 22 758.10	/tank	Cost includes an allowance for removal of liner, and excludes demolition of support structure and concrete base	R 20 481.37	R 22 689.26	R 22 758.10			R 22 758.10
B5.3	10 - 15m diameter	: Rands	R 49 687.50	/tank	Cost includes an allowance for removal of liner, and excludes demolition of support structure and concrete base	R 44 728.61	R 49 550.35	R 49 687.50		Rate recalculated based on a recent project for which tank demolition costs for various steel wall thicknesses was determined. The 2015 rates were based on a standard wall thickness of 12mm. The new rates are based on thicker steel walls for larger tanks	R 49 687.50
B5.4	15 - 20m diameter	: Rands	R 90 541.66	/tank	Cost includes an allowance for removal of liner, and excludes demolition of support structure and concrete base	R 81 515.49	R 90 302.86	R 90 541.66			R 90 541.66
B5.5	20 - 30m diameter	: Rands	R 224 697.91	/tank	Cost includes an allowance for removal of liner, and excludes demolition of support structure and concrete base	R 202 320.52	R 224 130.67	R 224 697.91			R 224 697.91
B5.6	30 - 45m diameter	: Rands	R 604 807.28		Cost includes an allowance for removal of liner, and excludes demolition of support structure and concrete base	R 544 609.52	R 603 318.43	R 604 807.28			R 604 807.28
B5.7	Unlined steel tanks - 5m dia	: Rands	R 6 000.91	/tank		R 5 395.92	R 5 977.60	R 6 000.91			R 6 000.91
B6	**Dismantling of cable racks**										
B6.1	Cable rack - general	: Rands	R 32.44	/m	Light steel structure of 30 kg/m	R 29.39	R 32.56	R 32.44			R 32.44
B7	**General steel aspects**										
B7.1	Cladding and sheeting	: Rands	R 19.36	/m^2	Steel sheeting	R 18.00	R 19.94	R 19.36			R 19.36
B7.2	Car ports (IBR roof)	: Rands	R 49.95	/m^2	Excluding paving	R 46.44	R 51.45	R 49.95			R 49.95
B7.3	Car ports (shade net)	: Rands	R 30.59	/m^2	Excluding paving	R 28.44	R 31.51	R 30.59			R 30.59
B7.4	Substations	: Rands	R 611.95	/m^2	Soft strip substation infrastructure before demolition, excludes brick building and disposal of waste	R 568.90	R 630.23	R 611.95			R 611.95
C	**Demolition of buildings and structures**										
C1	Normal one storey brick buildings	: Rands	R 397.23	/m^2	Soft strip before demolition, excludes disposal of waste. As per Jet Demolition (0.8m3m2 of light concrete)	R 369.15	R 408.94	R 397.23		As agreed with Jet Demolition on 17 Sept 2016	R 397.23
C2	Normal double storey brick buildings	: Rands	R 715.02	/m^2	Soft strip before demolition, excludes disposal of waste As per Jet Demolition	R 660.77	R 732.00	R 715.02		As agreed with Jet Demolition on 17 Sept 2016	R 715.02
C3	Single brick wall (110mm)	: Rands	R 15.85	/m	Free standing single brick wall 110 mm thick x 2000 mm high x per running meter	R 14.73	R 16.32	R 15.85		Unit changed from m2 to running m	R 15.85
C4	Double brick wall (220mm)	: Rands	R 23.05	/m	Free standing double brick wall 220 mm thick x 2000 mm high x per running meter	R 21.42	R 23.73	R 23.05		Unit changed from m2 to running m	R 23.05
C5	Prefabricated Buildings	: Rands	R 99.31	/m^2	As per Jet Demolition (factor of 0.25 of brick buildings)	R 92.29	R 102.24	R 99.31		Linked to unit rate C1	R 99.31
C6	Fibre reinforced walls	: Rands	R 7.93	/m	As per Jet Demolition (half the cost of single brick wall)	R 7.37	R 8.16	R 7.93			R 7.93
C8	Removal of timber structures	: Rands	R 198.62	/m^2	As per Jet Demolition (half the cost of brick building)	R 184.57	R 204.47	R 198.62			R 198.62
C9	**Disposal of Asbestos**										
C9.1	Upfront preparation for asbestos removal	: Rands	R 274 098.46	sum	Preparing area for removal of asbestos material	R 270 485.62	R 299 643.97	R 274 098.46			R 274 098.46
C9.2	Asbestos	: Rands	R 186.28	/m^2	Removal of asbestos material, excluding disposal	R 173.11	R 191.77	R 186.28			R 186.28
D	**Linear infrastructure**										
D1	**Conveyors**										
D1.1	**Demolition of overland conveyors**										
D1.1.1	Overland conveyors - light, without cladding	: Rands	R 404.24	/m	Single conveyor including dismantling of steel and demolition of concrete footings, excludes disposal of waste. Assumes 180kg / m	R 368.88	R 408.65	R 404.24		Rate recalculated based on 180 kg/m. Also affected by higher steel rates / m2	R 404.24
D1.1.2	Overland conveyors - light, with cladding	: Rands	R 464.88	/m	Single conveyor including dismantling of steel and demolition of concrete footings, excludes disposal of waste. Assumes 180kg / m and 15% for cladding	R 424.22	R 469.95	R 464.88			R 464.88
D1.1.3	Overland conveyors - medium, without cladding	: Rands	R 458.30	/m	Single conveyor including dismantling of steel and demolition of concrete footings, excludes disposal of waste. Assumes 230kg / m	R 417.58	R 462.60	R 458.30			R 458.30
D1.1.4	Overland conveyors - medium, with cladding	: Rands	R 527.04	/m	Single conveyor including dismantling of steel and demolition of concrete footings, excludes disposal of waste. Assumes 230kg / m and 15% for cladding	R 480.22	R 531.99	R 527.04			R 527.04

UNIT RATES FOR DEMOLITION, EARTHWORKS, REHABILITATION AND RELATED WORK											Reason for change	
Ref no		**Currency**		**Unit Rate (Dec 2018)**	**Unit**	**Comment**	**Unit Rate (Nov 2016)**	**Nov 2016 - Dec 2018, 9.4% esc**	**Unit Rate (Dec 2018 from Golder Master Sheet); and aligned to Matla**			**Matla Dec 2018 unit rates**
D1.1.5	Overland conveyors - heavy, without cladding	:	Rands	R 533.97	/m	Single conveyor including dismantling of steel and demolition of concrete footings, excludes disposal of waste. Assumes 300kg / m	R 485.76	R 538.13	R 533.97		Rate recalculated based on 300kg/m. Also affected by higher steel rates / m2	R 533.97
D1.1.6	Overland conveyors - heavy, with cladding	:	Rands	R 614.07	/m	Single conveyor including dismantling of steel and demolition of concrete footings, excludes disposal of waste. Assumes 300kg / m and 15% for cladding	R 558.63	R 618.85	R 614.07			R 614.07
D1.2	**Demolition of suspended conveyors**											
D1.2.1	Suspended conveyors - light, without cladding	:	Rands	R 505.30	/m	Single conveyor including dismantling of steel, support structures and demolition of concrete footings, excludes disposal of waste. Included a 25% premium on overland conveyors	R 461.11	R 510.81	R 505.30			R 505.30
D1.2.2	Suspended conveyors - light, with cladding	:	Rands	R 581.10	/m	Single conveyor including dismantling of steel, support structures and demolition of concrete footings, excludes disposal of waste. Included a 25% premium on overland conveyors	R 530.27	R 587.43	R 581.10			R 581.10
D1.2.3	Suspended conveyors - medium	:	Rands	R 658.80	/m	Single conveyor including dismantling of steel, support structures and demolition of concrete footings, excludes disposal of waste. Included a 25% premium on overland conveyors	R 521.98	R 578.25	R 658.80			R 658.80
D1.2.4	Suspended conveyors - heavy, without cladding	:	Rands	R 667.46	/m	Single conveyor including dismantling of steel, support structures and demolition of concrete footings, excludes disposal of waste. Included a 25% premium on overland conveyors	R 607.21	R 672.66	R 667.46			R 667.46
D1.2.5	Suspended conveyors - heavy, with cladding	:	Rands	R 767.58	/m	Single conveyor including dismantling of steel, support structures and demolition of concrete footings, excludes disposal of waste. Included a 25% premium on overland conveyors	R 698.29	R 773.56	R 767.58			R 767.58
D2	**Demolition of overland power lines**											
D2.1	Minor power lines	:	Rands	R 26.90	/m	< 11 kV (local lines, usually wooden poles). Assume 1 km / day, therefore approximately 20 poles demolished per day	R 25.00	R 27.70	R 26.90		Costs decreased due to increased efficiency of demolition equipment available for this purpose	R 26.90
D2.2	Major power lines	:	Rands	R 67.26	/m	> 11 kV (not usually used because transferred to service provider). Assume 500 m per day, 25% added premium for additional steel handling at a cost of R25 000 / day	R 62.50	R 69.24	R 67.26			R 67.26
D3	**Dismantling of pipelines**											
D3.1	Overland steel pipeline on plinths (< 200 mm)	:	Rands	R 49.06	/m	5m plinths spacing, includes disposal of waste @ 10 km	R 36.71	R 40.67	R 49.06		Plinth height changed from 150 mm to 200 mm. Also affected by increased steel/m2 rates	R 49.06
D3.2	Overland steel pipeline on plinths (200-350mm)	:	Rands	R 86.62	/m	5m plinths spacing, includes disposal of waste @ 10 km	R 79.00	R 87.51	R 86.62			R 86.62
D3.4	Overland steel pipeline on plinths (350-500mm)	:	Rands	R 141.21	/m	5m plinths spacing, includes disposal of waste @ 10 km	R 128.25	R 142.07	R 141.21		Error in 2013 unit rate sheet. Rate was supposed to be R100.70, vs. R10.70. Increase would have been 21%	R 141.21
D3.5	Overland steel pipeline on plinths (500-1000mm)	:	Rands	R 222.13	/m	5m plinths spacing, includes disposal of waste @ 10 km	R 201.30	R 223.00	R 222.13			R 222.13
D3.6	Suspended steel pipeline	:	Rands	R 178.34	/m	Includes removal of support structures	R 161.02	R 178.38	R 178.34			R 178.34
D3.7	HDPE pipelines (< 350mm)	:	Rands	R 17.93	/m	Assume 1.5 km a day at R15 000 labour plus R10000 cutting cost	R 16.67	R 18.46	R 17.93			R 17.93
D3.6	HDPE pipelines (350mm - 500mm)	:	Rands	R 26.89	/m	Assume 1 km a day at R15 000 labour plus R10000 cutting cost	R 25.00	R 27.70	R 26.89			R 26.89
D4	**Dismantling of cabling**											
D4.2	Copper cables	:	Rands	R 1 047.84	/t	Removal and dismantling of copper cables	R 973.75	R 1 078.72	R 1 047.84		Unit changed from ton to meter	R 1 047.84
D5	**Railway lines**											
D5.1	**Dismantling of electrified**											
D5.1.1	Demolition of electrified medium gauge railway line	:	Rands	R 247.37	/m	Demolish rail tracks, sleepers and collect ballast for local stockpiling for re-use. Assumed removal of overhead powerlines at 0.75 of overhead powerlines	R 229.97	R 254.76	R 247.37		Rate recalculated from first principles. Previously allowance was made to deep bury ballast in trench next to railway line. New rate allows for stockpiling of ballast for re-use.	R 247.37
D5.1.2	Demolition of electrified medium gauge railway line	:	Rands	R 196.55	/m	Demolish rail tracks, sleepers and collect ballast for local stockpiling for re-use. Assumed removal of overhead powerlines at 0.75 of overhead powerlines	R 229.97	R 254.76	R 196.55			R 196.55
D5.2	**Dismantling of non-electrified**											
D5.2.1	Demolition of non-electrified medium gauge railway line	:	Rands	R 196.55	/m	Demolish rail tracks, sleepers and collect ballast for local stockpiling for re-use.	R 182.72	R 202.41	R 196.55		Rate recalculated from first principles. Previously allowance was made to deep bury ballast in trench next to railway line. New rate allows for stockpiling of ballast for re-use.	R 196.55
D5.2.2	Demolition of non-electrified medium gauge railway line	:	Rands	R 196.55	/m	Demolish rail tracks, sleepers and collect ballast for local stockpiling for re-use.	R 182.72	R 202.41	R 196.55			R 196.55
E	**Removal of roads, paving and walkways**											
E1	Tar roads with 500 - 600mm layer works	:	Rands	R 63.76	/m²	Layer works buried in trench next to road , but excludes the disposal of tar as this will be stockpiled for beneficial re-use by local Municipalities. Assume asphalt thickness of 75 mm	R 59.27	R 65.66	R 63.76			R 63.76
E2	Haul roads	:	Rands	R 25.95	/m²	Include ripping, dozing (D9), shaping/level and vegetation of road, excludes veneer clean-up at a road width of 45 m	R 24.13	R 26.73	R 25.95		Rate recalculated based on typical road width of 45 m	R 25.95
E3	Gravel road with engineered surface	:	Rands	R 50.98	/m²	Roads where layer works are stabilised with cement. ripping, profiled and vegetated	R 47.39	R 52.50	R 50.98			R 50.98
E4	Normal gravel roads	:	Rands	R 10.64	/m²	Gravel roads without layer works or stabilisation of layer works - ripping, profiled and vegetated	R 9.89	R 10.96	R 10.64		Rates updated based on latest dozing and earthworks rates	R 10.64
E5	Two track gravel road	:	Rands	R 6.49	/m		R 6.04	R 6.69	R 6.49			R 6.49
E6	Hard stand	:	Rands	R 60.66	/m²	Excluding disposal	R 56.39	R 62.47	R 60.66			R 60.66
E7	Brick paving	:	Rands	R 21.96	/m²	Excluding disposal (note: included in demolition waste calculator, disposal costs to be assigned)		R 0.00	R 21.96			R 21.96
F	**Shafts, inclines and dam impoundments**											
F1	**Plugging/sealing of shafts**											
F1.1	Sealing of vertical shaft of 2 m diameter			R 1 280 064.16	sum		R 1 190 000.00	R 1 318 282.00	R 1 280 064.16			R 1 280 064.16
F1.2	Sealing of vertical shaft of 2.5 m diameter			R 1 462 930.47	sum		R 1 360 000.00	R 1 506 608.00	R 1 462 930.47			R 1 462 930.47
F1.3	Sealing of vertical shaft of 3.5 m diameter			R 1 871 690.45	sum		R 1 740 000.00	R 1 927 572.00	R 1 871 690.45			R 1 871 690.45
F1.4	Sealing of vertical shaft of 5 m diameter			R 2 603 155.68	sum		R 2 420 000.00	R 2 680 876.00	R 2 603 155.68		All rates recalculated using shaft sealing calculator. No relevance to Grootegeluk	R 2 603 155.68
F1.5	Sealing of vertical shaft of 5.5 m diameter			R 2 839 806.20	sum	Refer to shaft calculator	R 2 640 000.00	R 2 924 592.00	R 2 839 806.20			R 2 839 806.20
F1.6	Sealing of vertical shaft of 7 m diameter			R 3 711 110.37	sum		R 3 450 000.00	R 3 821 910.00	R 3 711 110.37			R 3 711 110.37
F1.7	Sealing of vertical shaft of 8 m diameter			R 4 324 250.35	sum		R 4 020 000.00	R 4 453 356.00	R 4 324 250.35			R 4 324 250.35
F1.8	Sealing of vertical shaft of 10 m diameter			R 5 690 369.24	sum		R 5 290 000.00	R 5 860 262.00	R 5 690 369.24			R 5 690 369.24
F1.9	Sealing of vertical shaft of 12.5 m diameter			R 7 583 573.37	sum		R 7 050 000.00	R 7 809 990.00	R 7 583 573.37			R 7 583 573.37
F1.10	Incline shaft reinforced plug (3.5mx5m)	:	Rands	R 277 574.33	sum	For 3.5x5m dimension, includes venting, excludes portal filling	R 258 044.45	R 285 861.64	R 277 574.33			R 277 574.33
F1.11	Incline shaft reinforced plug (3.5mx8m)	:	Rands	R 444 118.93	sum	For 3.5x8m dimension, includes venting, excludes portal filling	R 412 871.12	R 457 378.63	R 444 118.93		Not relevant to Grootegeluk	R 444 118.93
F1.12	Adits (1.5x1.5)		Rands	R 35 688.13	sum	Routine adits of 1.5mx1.5m derived from incline shaft plug rate	R 33 177.14	R 36 753.64	R 35 688.13		Not relevant to Grootegeluk	R 35 688.13
F2	**Removal of dam liners and plugging and sealing of penstock**											
F2.1	Single HDPE liner	:	Rands	R 4.84	/m²	Removal and disposal of single HDPE liner	R 7.63	R 8.45	R 4.84			R 4.84
F2.2	Three HDPE liners	:	Rands	R 7.26	/m²	Removal and disposal of three HDPE liners	R 16.79	R 18.60	R 7.26			R 7.26
F2.3	Plug outlet and seal penstock of tailings dam	:	Rands	R 80 676.31	sum		R 65 306.80	R 72 346.88	R 80 676.31			R 80 676.31
G	**Rehabilitation of disturbed areas**											
G1	**Profiling**											
G1.1	Shaping/levelling of infrastructural footprint areas (500 mm)	:	Rands	R 78 323.25	/ha	Includes stockpiling of material, backfilling of excavations in cut to fill operation and final profiling, at an average depth of 500 mm over footprint area	R 91 600.00	R 101 474.48	R 78 323.25			R 78 323.25
G1.2	Shaping/levelling of infrastructural footprint areas (750 mm)	:	Rands	R 117 484.88	/ha	Includes stockpiling of material, backfilling of excavations in cut to fill operation and final profiling, at an average depth of 750 mm over footprint area	R 137 400.00	R 152 211.72	R 117 484.88			R 117 484.88
G1.3	Reshaping / profiling of dumps (general)	:	Rands	R 188 922.04	/ha		R 151 187.86	R 167 485.91	R 188 922.04			R 188 922.04
G1.4	Import cover material and spread (300 mm)	:	Rands	R 132 072.07	/ha	3000 m3 over 2 km average @ R /m3	R 129 371.03	R 143 317.22	R 132 072.07			R 132 072.07
G1.5	Import cover material and spread (500 mm)	:	Rands	R 220 120.11	/ha	5000 m3 over 2 km average @ R /m3	R 215 618.38	R 238 862.04	R 220 120.11			R 220 120.11
G1.6	Shaping and levelling of cover material	:	Rands	R 11.53	/m²	Including quality control in terms of levelling (60% of routine dozing rate)	R 4.04	R 4.48	R 11.53			R 11.53
G1.7	Profiling of general disturbed areas (excluding infrastructural footprint areas)	:	Rands	R 1 945.16	/ha	Minimal dozing to enhance site drainage - no backfilling of excavations etc.	R 15 118.79	R 16 748.59	R 1 945.16			R 1 945.16
G1.8	Breach dam wall and reshape to 1:5	:	Rands	R 760.78	/m	Dam wall of approx. 5 m high with existing side slopes 1:3	R 632.66	R 700.86	R 760.78		Rate recalculated with latest earthworks rates	R 760.78
G2	**Vegetation**											
G2.1	Establishment of vegetation (general)	:	Rands	R 34 333.45	/ha	General - on flat areas	R 50 352.17	R 55 780.13	R 34 333.45		Rate readjusted to include more intensive soil amelioration and seed bed preparation	R 34 333.45
G2.2	Establishment of vegetation on dumps	:	Rands	R 44 334.29	/ha	Averaged rate for top and sloped surfaces	R 61 801.22	R 68 463.39	R 44 334.29		Rate adjusted to include more intensive soil amelioration and seed bed preparation	R 44 334.29
G2.3	Establishment of vegetation (Natural grassland)	:	Rands	R 8 729.15	/ha	Vegetation established from the seedbed harvested from the surrounding undisturbed grasslands areas. Include auger harvesting, seeding and labour.	R 7 778.76	R 8 617.31	R 8 729.15			R 8 729.15
G2.4	Establishment of woody / thorny species	:	Rands	R 17 430.11	/ha		R 16 125.27	R 17 863.57	R 17 430.11		Excludes soil amelioration	R 17 430.11
G2.5	Establishment of wetland vegetation (vegetation plugs)	:	Rands	R 193 623.15	/ha	Establish vegetation plugs with hydroscopic gel along scarified strips 500 mm apart in organic silt trap cells. @ R 36 /m2	R 180 000.00	R 199 404.00	R 193 623.15			R 193 623.15
G2.6	Removal of exotic/alien vegetation/small trees	:	Rands	R 6 497.04	/ha	For small areas <10ha	R 5 963.67	R 6 606.55	R 6 497.04			R 6 497.04
G2.7	Removal of exotic/alien vegetation/small trees (>100ha)	:	Rands	R 3 562.26	/ha	For substantial areas >100ha		R 0.00	R 3 562.26			R 3 562.26
G2.8	Removal of individual trees	:	Rands	R 46.50	/ha	For substantial areas >100ha	R 3 065.05	R 3 395.46	R 46.50			R 46.50
G2.10	Hydro seeding	:	Rands	R 23 151.57	/ha	Seeding slurry (artificial seed and compost mix) is transported in a tank, either truck mounted and sprayed over prepared surface. @ R 3.70 /m2	R 20 193.64	R 22 370.51	R 23 151.57		Not relevant to Grootegeluk	R 23 151.57
G2.11	Stabilize PH levels of soil with lime	:	Rands	R 498.51	t	As obtained from Willem de Fry	R 450	R 498.51	R 10 541.70		Based on new quote obtained from W de Frey	R 10 541.70
G2.12	Establish tree stations	:	Rands	R 95 999.00	/ha	Excavation 1.5m X 1.5m X 1.5m = 3.375m3. Including excavation rate R32.60 X 2. Assume 5 trees per station @ R150 per tree. Additional 15% of labour + fertilisers. 80 tree stations per ha		R 0.00	R 95 999.00			R 95 999.00
G3	**Water management (pans, riparian areas, re-instatement of drainage lines)**											
G3.1	Reinstatement of general surface drainage lines	:	Rands	R 5 874.24	/ha	Using a drainage density of 0.2 on average (Pittman et al.), average drainage corridor depth of 250 mm, general shaping and levelling rate but excludes 25% extra over	R 1 374.00	R 1 522.12	R 5 874.24		Using a drainage density of 0.2 on average (Pittman et al.)	R 5 874.24
G3.2	Routing of storm water along pit toe	:	Rands	R 290.43	/m		R 270.00	R 299.11	R 290.43			R 290.43
G3.3	Routing of storm water along outer slopes/upper surface	:	Rands	R 3 240.61	/ha		R 2 925	R 3 240.61	R 812 082.33			R 812 082.33
G3.4								R 0.00				
G3.4	**Boreholes**											
G3.4.1	Drilling of general boreholes (< 35m)	:	Rands	R 58 934.05	/unit	The rate includes site establishment and related costs, labour and PVC casing	R 54 787.50	R 60 693.59	R 58 934.05			R 58 934.05
G3.4.2	Equipping of scavenger borehole (Pump, electrical and piping)	:	Rands	R 53 784.21	/unit	Nominal allowance	R 50 000.00	R 55 390.00	R 53 784.21			R 53 784.21
G3.4.3	Pumping of water	:	Rands	R 2.03	/m³		R 2.00	R 2.22	R 2.03			R 2.03
G3.6	**Plug and seal of boreholes**											
G3.6.1	Surface plug (5m)	:	Rands	R 7 221.56	sum	The rate includes site establishment and related costs, all plug material and labour.	R 6 753.81	R 7 481.87	R 7 221.56			R 7 221.56
G3.6.2	Full depth plug (35m)	:	Rands	R 17 268.89	sum	The rate includes site establishment and related costs, all plug material and labour.	R 16 150.37	R 17 891.38	R 17 268.89			R 17 268.89
G4	**Surface subsidence**											
G4.1	Placement of composite rock grid with geotextile	:	Rands	R 59.05	/m²	10% added for stitching of overlaps	R 54.10	R 59.93	R 59.05			R 59.05

UNIT RATES FOR DEMOLITION, EARTHWORKS, REHABILITATION AND RELATED WORK										Reason for change	
Ref no		**Currency**	**Unit Rate (Dec 2018)**	**Unit**	**Comment**	**Unit Rate (Nov 2016)**	**Nov 2016 - Dec 2018, 9.4% esc**	**Unit Rate (Dec 2018 from Golder Master Sheet); and aligned to Matla**			**Matla Dec 2018 unit rates**
G4.2	Rehabilitation of sinkholes and subsided areas	Rands	R 477 225.61	/ha	Infilling and stabilisation of cracks. Assumed double rate of rip, general shaping & levelling, and vegetation. Assume 1 m3 of infill material would be required for every 100 m2 (3km haul distance)	R 443 648.45	R 491 473.75	R 477 225.61			R 477 225.61
G4.3	Placement of geotextile over surface	Rands	R 46.44	/m^2	A8 bidim material	R 43.17	R 47.82	R 46.44			R 46.44
G5	**Demolition waste handling and disposal**										
G5.1	Disposal of inert demolition waste at an appropriate disposal facility	Rands	R 117.55	/m^3	Excluding transport	R 109.28	R 121.06	R 117.55			R 117.55
G5.2	Disposal of hazardous waste	Rands	R 1 338.40	/m^3	Excluding transport	R 1 244.23	R 1 378.36	R 1 338.40			R 1 338.40
H	**Earthworks**										
H1	**Excavation**										
H1.1	Minor excavation	Rands	R 35.91	/m^3	(< 10 000 m3). As per Fraser Alexander	R 32.60	R 36.11	R 35.91		2013 rate was most likely a bulk instead of minor excavation rate, showing a significant increase	R 35.91
H1.2	Bulk excavation	Rands	R 22.98	/m^3	(> 100 000 m3)	R 21.47	R 23.78	R 22.98		For very large quantities. Rate obtained from Fraser Alexander	R 22.98
H1.4	Trench excavation	Rands	R 45.35	/m^3	Continuous trench excavation. As per Fraser Alexander	R 42.33	R 46.89	R 45.35		Rate now excludes backfilling of trench	R 45.35
H1.5	Removal of gunited embankments	Rands	R 105.25	/m^2	Excludes disposal. As per Fraser Alexander	R 92.29	R 102.24	R 105.25			R 105.25
H1.6	Clean-up of contaminated materials/soils	Rands	R 47.86	/m^3	Excavation only, load and haul and disposal to be determined separately. As per Fraser Alexander	R 44.00	R 48.74	R 47.86			R 47.86
H1.7	Dragline	Rands	R 5.28	/m^3		R 4.91	R 5.44	R 5.28			R 5.28
H2	**Materials transport**										
H2.1	**General load and haul**										
H2.1.1	Load and haul (1km haul)	Rands	R 34.47	/m^3	Small volumes on site (< 10 000 m3). As per Fraser Alexander	R 32.60	R 36.11	R 34.47			R 34.47
H2.1.2	Load and haul (2 km haul)	Rands	R 44.12	/m^3	Small volumes on site (< 10 000 m3). As per Fraser Alexander	R 39.08	R 43.29	R 44.12			R 44.12
H2.1.3	Load, haul (1- 2 km free haul) and spread cover	Rands	R 40.26	/m^3	Including flattening/dozing of material. As per Fraser Alexander	R 35.00	R 38.77	R 40.26			R 40.26
H2.1.4	Extra over rates for overhaul outside free haul distance	Rands	R 6.73	/m^3/km	Small volumes on site (< 10 000 m3). As per Fraser Alexander	R 6.48	R 7.18	R 6.73		Previous extra over was for large volumes. Methodology changed. Weighted extra over applied as median between small and large volumes. It is noted that the weighted average applied is lower than Golder's standard extra over, as the earthworks at Grootegeluk will almost always be conducted in bulk	R 6.73
H2.2	**Bulk load and haul (restricted to 5km)**										
H2.2.1	0 - 1km (CAT 777)	Rands	R 28.84	/m^3	Bulk volumes (> 50 000 m3)	R 26.40	R 29.24	R 28.84			R 28.84
H2.2.2	1 - 2km (CAT 777)	Rands	R 30.70	/m^3	Bulk volumes (> 50 000 m3)	R 28.13	R 31.17	R 30.70			R 30.70
H2.2.3	2 - 3km (CAT 777)	Rands	R 32.68	/m^3	Bulk volumes (> 50 000 m3)	R 30.49	R 33.78	R 32.68			R 32.68
H2.2.4	3 - 4km (CAT 777)	Rands	R 35.88	/m^3	Bulk volumes (> 50 000 m3)	R 32.76	R 36.29	R 35.88			R 35.88
H2.2.5	4 - 5km (CAT 777)	Rands	R 37.37	/m^3	Bulk volumes (> 50 000 m3)	R 35.49	R 39.31	R 37.37			R 37.37
H3	**Ripping**										
H3.1	General ripping	Rands	R 5 155.85	/ha	D 7 dozer - 3 ripper tines to depth of 500 mm. As per Fraser Alexander	R 4 855.00	R 5 378.37	R 5 155.85		Rate obtained from Fraser Alexander, showing a larger than anticipated difference between 500 mm as opposed	R 5 155.85
H3.2	Deep ripping (heavy)	Rands	R 20 049.34	/ha	D 9 dozer - 1 ripper tine to depth of 1 m. As per Fraser Alexander	R 14 663.00	R 16 243.67	R 20 049.34			R 20 049.34
H3.3	Ripping for alleviation of compaction	Rands	R 3 517.00	/ha	D 6 dozer - 3 ripper tines to depth of 500 mm. As per Fraser Alexander	R 3 155.00	R 3 495.11	R 3 517.00			R 3 517.00
H3.4	Scarify upper surface of dumps	Rands	R 3 014.49	/ha	4X4 Tractor for vegetation preparation . As per Fraser Alexander	R 2 684.50	R 2 973.89	R 3 014.49			R 3 014.49
H4	**Dozing rates**										
H4.1	Flat dozing for profiling	Rands	R 19.21	/m^3	Small volumes, cut to fill including final profiling- Dozing of loose material D6/7. As per Fraser Alexander	R 18.32	R 20.29	R 19.21		Latest rates obtained from Fraser Alexander. Note that site-specific dozing rates are applicable for the rehabilitation of Dump 4& 5	R 19.21
H4.2	Down dozing of material	Rands	R 15.13	/m^3	Small volumes - no profiling – Dozing of loose material D6/7. As per Fraser Alexander	R 13.65	R 15.12	R 15.13			R 15.13
H5	**General earthworks**										
H5.1	Crushing of inert building rubble/waste rock	Rands	R 215.74	/m^3		R 195	R 215.74	R -			
H5.3	Compaction	Rands	R 27.80	/m^3	Compaction in layers of 250 mm thickness. As per Fraser Alexander	R 24.60	R 27.25	R 27.80			R 27.80
H5.4	Blasting	Rands	R 19.36	/m^3		R 18.00	R 19.94	R 19.36		Latest third party rate	R 19.36
I	**Fencing**										
I1	**Erect fence**										
I1.1	Security fencing	Rands	R 170.05	/m		R 158.03	R 175.06	R 170.05			R 170.05
I1.2	Stock fencing	Rands	R 34.01	/m		R 31.61	R 35.01	R 34.01			R 34.01
I1.3	Concrete palisade	Rands	R 1 015.18	/m		R 1 000.00	R 1 107.80	R 1 015.18			R 1 015.18
I2	**Dismantle fence**										
I2.1	Security fencing	Rands	R 43.04	/m	Include in inert demolition	R 40.00	R 44.31	R 43.04			R 43.04
I2.2	Stock fencing	Rands	R 13.60	/m	Include in inert demolition	R 12.64	R 14.01	R 13.60			R 13.60
I2.3	Concrete palisade	Rands	R 149.64	/m	Include in inert demolition	R 139.06	R 154.05	R 149.64			R 149.64
J	**Post-closure aspects**										
J1	Rehabilitation monitoring	Rands	R 3 821.91	ha		R 3 450	R 3 821.91				R 7 304.42
J2	Care and maintenance (low intensity)	Rands	R 46 433.44	ha	For wilderness areas	R 41 915	R 46 433.44			New amelioration and erosion control specifications for	R 94 166.70
J3	Care and maintenance	Rands	R 46 433.44	/ha		R 41 915	R 46 433.44				R 47 055.42
K	**Post-closure monitoring (Site Specific)**				**Refer to project information tab for calculation**						
K1	Surface water	Rands	R 310 786.64	/yr.	Duration and intervals are indicated as per calculation and line item description	R 280 544	R 310 786.64				
K2	Groundwater	Rands	R 567 370.85	/yr.	Duration and intervals are indicated as per calculation and line item description	R 512 160	R 567 370.85				
L	**Other**										
L1	Not applicable	Rands	R 0.00	N/A		R 0.00	R 0.00				
L2	Sum allowance	Rands	R 0.00	/sum	Only to be used for post-closure aspects and additional allowances	R 0.00	R 0.00	R -			
L3	Rate	Rands	R 0.00	/unit		R 0.00	R 0.00	R -			
M	**Site Specific**				**Refer to project information tab for calculation**						
M1	Load and haul (5km)	Rands	R 68.01	/m^3	Refer to project information tab for calculation	R 61.39	R 68.01			Changed due to higher extra over rate (for smaller volumes) applied. Previously the low extra over for large volumes was applied	
M2	Load and haul (3km)	Rands	R 53.10	/m^3	Refer to project information tab for calculation	R 47.93	R 53.10				
M3	Load and haul (22km)	Rands	R 186.86	/m^3	Refer to project information tab for calculation	R 168.68	R 186.86				
M4	Load and haul to Holfontein	Rands	R 5 345.12	/m^3	Refer to project information tab for calculation	R 4 824.98	R 5 345.12				
M5	Load and Haul 120km	Rands	R 890.36	/m^3	Refer to project information tab for calculation	R 803.72	R 890.36				
M6	Load and haul 2 km (Dump 4&5 soil handling)	Rands	R 42.16	/m^3	Site specific extra over rate	R 38.1	R 42.16				
M7	Load and haul 5 km (Dump 4&5 soil handling)	Rands	R 60.31	/m^3	Site specific extra over rate	R 54.4	R 60.31				
M8	Load and haul 7 km (Dump 4&5 soil handling)	Rands	R 72.41	/m^3	Site specific extra over rate	R 65.4	R 72.41				
M9							R 0.00				
M10							R 0.00				
M11	Transport of sediment from oxidation ponds to dump 4 and 5	Rands	R 99.47	/m3	10km haul distance (small volumes)	R 91	R 99.47				
M12	Load and haul (10km)	Rands	R 89.42	/m3	Large volumes	R 82	R 89.42				
M13	Drainage in open pit	Rands	R 65.98	/m	Nominal allowance	R 60.31	R 65.98				
M14	Shaping and rough and loose configuration	Rands	R 74 665.50	ha	Adopted dozing rate for bulk dozing, assume 1m3 of earthworks of 50 percent of 1ha.	R 68 250	R 74 665.50				
M15	Air quality monitoring	Rands	R 131 411.28	yr.	Rate per annum	R 120 120	R 131 411.28				
M16	Rehabilitation monitoring of rehabilitated mine residues (year 1 to 3)	Rands	R 1 805.10	ha	For three years	R 1 650.00	R 1 805.10				
M17	Rehabilitation monitoring of rehabilitated mine residues (year 4 to 10)	Rands	R 1 969.20	ha	Year 4 to 10	R 1 800.00	R 1 969.20				
M18	Construction of a decontamination bay	Rands	R 130 317.43	/sum	Nominal allowance	R 119 120.14	R 130 317.43				
M19	Nominal allowance (over and above normal removal of buildings) to lift out transformers	Rands	R 19 547.61	/sum	85 transformers as per mechanical list	R 17 868.02	R 19 547.61				
M20	Capping Dump 6 general waste site	Rands	R 457 411.95	/sum	Refer to 'Demolition waste total' work sheet	R 418 109.64	R 457 411.95				
M21	Allowance for trials and establishment of biological processes as part of vegetation cover establishment on Dump 4 and 5	Rands	R 5 470.00	ha	Nominal allowance. To be refined further on in project with Piet van Deventer	R 5 000.00	R 5 470.00				
M22	Specialist studies to inform closure process	Rands	R 2 735 000.00	/sum	Nominal allowance for contaminated land assessment, closure-related permitting and authorisations	R 2 500 000.00	R 2 735 000.00				
M23											
M24	Remove penstock infrastructure and dispose of as per infrastructural aspects above	Rands	R 65 158.71	sum		R 59 560.07	R 65 158.71				
M25	Dismantling of Armco barrier guard rails	Rands	R 52.13	no		R 47.65	R 52.13				
M26	Hydraulic power pack - approximate mass 1,225.50kg	Rands	R 32 579.36	sum		R 29 780.03	R 32 579.36				
M27	355kW Drive pack, assembly (base mounted type) c/w motor, couplings, gearbox and base plate	Rands	R 32 579.36	sum		R 29 780.03	R 32 579.36				
M28	1 Ton hand operated winch	Rands	R 32 579.36	sum		R 29 780.03	R 32 579.36				
M29	Drive pulley; belt 600mm (700mm face); diameter 400mm; 12mm lagging rubber c/w plumber block & bearings	Rands	R 19 547.61	sum		R 17 868.02	R 19 547.61				
M30	Take up pulley; belt width 600mm (700mm face); diameter 400mm; 12mm lagging rubber c/w plumber block & bearings	Rands	R 19 547.61	sum		R 17 868.02	R 19 547.61				
M31	Snub pulley; belt width 600mm (700mm face); diameter 219mm; 12mm lagging rubber c/w plumber block & bearings	Rands	R 19 547.61	sum		R 17 868.02	R 19 547.61				
M32	Tail pulley; belt width 600mm (700mm face); diameter 400mm; 12mm lagging rubber c/w plumber blocks & bearings	Rands	R 19 547.61	sum		R 17 868.02	R 19 547.61				
M33	Bend pulley; belt width 600mm (700mm face); diameter 100mm; 12mm lagging rubber c/w plumber blocks & bearings	Rands	R 19 547.61	sum		R 17 868.02	R 19 547.61				
M34	Remove all service infrastructure (electricity supply, in-pit dewatering pumps and piping, etc.) and equipment in the pit	Rands	R 65 158.71	sum		R 59 560.07	R 65 158.71				

UNIT RATES FOR DEMOLITION, EARTHWORKS, REHABILITATION AND RELATED WORK											
Ref no		Currency	Unit Rate (Dec 2018)	Unit	Comment	Unit Rate (Nov 2016)	Nov 2016 - Dec 2018, 9.4% esc	Unit Rate (Dec 2018 from Golder Master Sheet); and aligned to Matla	Reason for change	Matla Dec 2018 unit rates
M35	Determine/calculate the pit's long term safe break back line (anticipated to be 50 m from pit lip);	Rands	R 97 738.07	sum		R 89 340.10	R 97 738.07			
M36	Combined cost for railway extension and new road (adopted from Digby Wells)	Rands	R 1 088 763.03	sum	Once the infrastructure has been constructed, the costs have to be updated using third party contractor rates. Digby Wells' costs escalated from September 2014 to December 2016	R 995 213	R 1 088 763.03			
M37	Extension of GG4&5 railway stock yard, including upgrade of three existing stackers	Rands	R 4 813 600.00	sum	Assume similar as for Matimba blending beds, excluding stackers (already existing). Allowance to be recalculated once the stockyard extension is complete	R 4 400 000	R 4 813 600.00			
M38	New railway and road loud-out stations (adopted from Digby Wells)	Rands	R 2 486 782.61	sum	Once the infrastructure has been constructed, the costs have to be updated using third party contractor rates. Digby Wells' costs escalated from September 2014 to December 2016	R 2 273 110	R 2 486 782.61			
M39	GG6/2 stock yard extension (incl new stacker, extension of new multi-product conveyor and substation upgrade)	Rands	R 753 319.85	sum	Once the infrastructure has been constructed, the costs have to be updated using third party contractor rates. Digby Wells' costs escalated from September 2014 to December 2016	R 688 592	R 753 319.85			
M40	GG10 stockyard (including new product conveyor, crushing and screening plant, product conveyors, lined stockpiles, multi-product stock yard (incl. stackers and reclaimers), electrical control systems, stormwater management). Costs adopted from Digby Wells	Rands	R 1 086 896.68	sum	Once the infrastructure has been constructed, the costs have to be updated using third party contractor rates. Digby Wells' costs escalated from September 2014 to December 2016	R 993 507	R 1 086 896.68			
M41	Multi-product overflow stockyard (Medupi Phase II expansion stockpile south of blending beds)	Rands	R 753 319.85	sum	Assume similar as for GG6 stockyard computed by Digby Wells. To be re-calculated once stockpile pad is constructed	R 688 592	R 753 319.85			
M42	Fuel depot storage tanks and associated infrastructure i.r.o. additional storage capacity for fleet expansion. Costs adopted from Digby Wells	Rands	R 8 612.64	sum	Once the infrastructure has been constructed, the costs have to be updated using third party contractor rates. Digby Wells' costs escalated from September 2014 to December 2016	R 7 873	R 8 612.64			
M43	New tar road next to the new railway loop (fines recovery project)	Rands	R 170 237.71	sum	Once the infrastructure has been constructed, the costs have to be updated using third party contractor rates. Digby Wells' costs escalated from September 2014 to December 2016	R 155 610	R 170 237.71			
M44	New conveyor from fines tailings dam to the power station conveyor	Rands	R 1 019 649.03	sum	Once the infrastructure has been constructed, the costs have to be updated using third party contractor rates. Digby Wells' costs escalated from September 2014 to December 2016	R 932 038	R 1 019 649.03			
M45	Warehouse gate expansion at Reductants Plant	Rands	R 2 262 497.78	sum	Once the infrastructure has been constructed, the costs have to be updated using third party contractor rates. Digby Wells' costs escalated from September 2014 to December 2016	R 2 068 097	R 2 262 497.78			
M46	New canteen	Rands	R 1 730 904.67	sum	Once the infrastructure has been constructed, the costs have to be updated using third party contractor rates. Digby Wells' costs escalated from September 2014 to December 2016	R 1 582 180	R 1 730 904.67			
M47	New HDV Workshop	Rands	R 4 646 737.06	sum	Once the infrastructure has been constructed, the costs have to be updated using third party contractor rates. Digby Wells' costs escalated from September 2014 to December 2016	R 4 247 474	R 4 646 737.06			
M48	New in pit crushing and conveying system (IPCC)	Rands	R 22 230 964.44	sum	Average distance of very heavy conveyor up to pit high wall at LOM. Crusher nominal allowance of R12.5 million.	R 20 320 808	R 22 230 964.44			
M49	New Kidney stacker	Rands	R 46 321.37	sum	Once the infrastructure has been constructed, the costs have to be updated using third party contractor rates. Digby Wells' costs escalated from September 2014 to December 2016	R 42 341	R 46 321.37			
M50	GG6 plant expansion	Rands	R 1 750 333.63	sum	Once the infrastructure has been constructed, the costs have to be updated using third party contractor rates. Digby Wells' costs escalated from September 2014 to December 2016	R 1 599 939	R 1 750 333.63			
M51	Remove infrastructure from upper surfaces of dump 4&5 (stackers and conveyors)	Rands	R 109 400.00	sum	Nominal allowance	R 100 000	R 109 400.00			
M52										
M53	Extra over on excavation rate for specialised equipment needed to excavate potentially burning discard where spontaneous combustion could occur at identified hot spots at Dump 4&5	Rands	R 49.93	m3	Extra over on excavation rate for specialised equipment needed to doze potentially burning discard where spontaneous combustion could occur at identified hot spots at Dump 4&5. 40% extra over on rate for minor excavation. Assume this also covers health and safety considerations.	R 46	R 49.93			
M54	Conduct soil fertility testing and ameliorate the placed soils to sustain the desired cover vegetation on Dump 4&5	Rands	R 39 049.24	ha	Includes allowance for soil fertility testing, application of lime and superphosphate with a tractor drawn spreader (5t/ha), scarification and spreading of N:P:K (2:3:2 -28% +Zn) with a tractor drawn spreader	R 35 694	R 39 049.24			
M55	Care and maintenance for soil covers on waste dumps (specifically Dump 4 & 5)	Rands	R 68 781.97	ha	Care and maintenance for 10 years. Refer to 'Rehab monitoring and care and maintenance - V2' calculator	R 62 872	R 68 781.97			
M56	Nominal allowance for specialist studies and technical work needed to support closure (scheduled closure)	Rands	R 8 205 000.00	sum	Closure plan, subsidence risk assessment, determination of long-term break back line, trials and scientific work for tree stations, mine fleet optimisation for rehabilitation, thermal heat scan, water use licence and waste management licence	R 7 500 000	R 8 205 000.00			
M57	Nominal allowance for specialist studies and technical work needed to support closure (unscheduled closure)	Rands	R 13 128 000.00	sum	Closure plan, subsidence risk assessment, determination of long-term break back line of open pit, trials and scientific work for tree stations, engineering designs and tender letting for dump rehabilitation, mine fleet optimisation for rehabilitation, thermal heat scan, water use licence and waste management licence	R 12 000 000	R 13 128 000.00			
M58	On-going hand pulling of trees and saplings and localised application of broadleaf herbicide	Rands	R 88 067.00	yr.	For 10 years. Assume one full time worker would spend one day for every two ha to hand pull saplings and apply herbicide, per year. 322 man days per year @ R200 per day. Plus allowance of R50 / day for herbicide. R250 p/d * 322 man days	R 80 500	R 88 067.00			
M59	Correcting poor soil fertility (per typical ha)	Rands	R 39 049.24	ha	Once-off event	R 35 694	R 39 049.24			
M60	Correcting poor vegetation establishment (for one full ha)	Rands	R 18 311.92	ha	Once-off seeding event, and cut/bale in year 3	R 16 739	R 18 311.92			
M61	Alleviate soil compaction and control erosion	Rands	R 24 660.95	ha	Once-off compaction alleviation and three years' care and maintenance	R 22 542	R 24 660.95			
M62	Establishment of saplings in tree stations (including amelioration)	Rands	R 1 094.00	no	Allowance for purchasing an established 60 litre tree plus amelioration. Assume R600 for four trees per station plus soil amelioration (50% of R600) and labour (R100 per station).	R 1 000	R 1 094.00			
M63	Down dozing of material on Dump 4 & 5		R 37.80	/m3	2.5 x Normal down dozing rate to distance of 50m-60m	R 34	R 37.80			
M64	Load and haul 4 km (Dump 4&5 soil handling)	: Rands	R 54.26	/m^3	Site specific extra over rate	R 49.0	R 54.26			
M65	Load and haul 6 km (Dump 4&5 soil handling)	: Rands	R 65.53	/m^3	Site specific extra over rate	R 59.9	R 65.53			
M66	Load and haul 8 km (Dump 4&5 soil handling)	: Rands	R 78.45	/m^3	Site specific extra over rate	R 70.8	R 78.45			
M67	Site specific shaping and levelling of cover materials	Rands	R 18.28	/m^3	Dozing to tolerance of 50mm	R 17	R 18.28			
M68	Cover material stripping and placement dedicated supervision	Rands	R 1 994 040.00	Year	Assume total Cost to company per individual of R900k per year. Two supervisors required	R 1 800 000	R 1 994 040.00			
M69	Backfilling of tree station excavations	Rands	R 65.27	/m^3	Assume median haul distance from Glenrosa stockpiles	R 59	R 65.27			
M70	Drilling of boreholes for fresh water supply for stock watering, and establishment of stock watering points	Rands	R 3 150 720.00	sum	Assume two boreholes per 1000 ha @ R80 000 each (including pumping equipment)	R 2 880 000	R 3 150 720.00			
M71	Stock undisturbed areas with a suitable selection of game browser species	Rands	R 7 876 800.00	sum	Assume carrying capacity for light browsers like Rooibok ± 0.2 to 2.25 ha per stock unit. Assume 6000 stock units bought in batches of R120 000 per 100 stock units.	R 7 200 000	R 7 876 800.00			
M72	Full time game park manager and game rangers	Rands	R 15 261 300.00	yr.	18 000 ha. One section ranger per 2000 ha, plus four field rangers. Assume section ranger R350 000 p/ a and field rangers R300 000 p/a. Allowance for 10 years until site handover	R 13 950 000	R 15 261 300.00			
M73	Game park boma	Rands	R 65 640.00	sum		R 60 000	R 65 640.00			
M74	Game fences (2.2 to 2.4 m high)	Rands	R 103.74	m	Assume three times standard stock fencing rates	R 95	R 103.74			
M75	Game fences (electrical fencing to protect high value game)	Rands	R 207.46	m	20% extra over on electrical fencing	R 190	R 207.46			
M76	Care and maintenance of rehabilitated wilderness areas	Rands	R 64 928.90	ha	For 10 years.	R 59 350	R 64 928.90			
M77	Dozing of spoiled material to embankment profile	Rands	R 8.02	m3	Assume 40% of normal dozing rate as it will mostly involve cutting of top of spoil heaps and profiling of side slopes	R 7	R 8.02			
M78	Treestation excavation	Rands	R 39.23	m3	10% Extra over for routine excavation rate to spoil excavated material	R 36	R 39.23			
M79	Levelling of spoiled material	Rands	R 6.01	m3	Assume 30% of normal dozing rate as it will mostly involve cutting of top of spoil heaps	R 5	R 6.01			
			.			.				
N	**Stream Diversion**									
N1	Quarry development	: Rands	R 5 746 452.31	sum		R 5 252 699	R 5 746 452.31			
N2	Screening of excavated rock	: Rands	R 51.72	/m^3		R 47	R 51.72			
N3	Placement and profiling of rock	: Rands	R 19.39	/m^3	Stabilise flood protection levee using suitable rock cladding	R 18	R 19.39			
N4	Corrective rehabilitation of flood plain area	: Rands	R 129 298.86	/ha	Includes 750 mm shaping, placement of 500 mm topsoil and establishment of vegetation	R 118 189	R 129 298.86			
N5	Stabilise the stream diversion inlet and outlet	: Rands	R 3 447 871.38	sum	Stabilise the inlet and outlet of the stream diversion	R 3 151 619	R 3 447 871.38			
N6	Construct gabion weirs	: Rands	R 959.39	/m^3	Includes 150mm rip and recompact base to 95% Proctor at a moisture content of +-2% OMC, geotextile 340g/m2 underneath structure, gabion stone as well as gabion baskets.	R 877	R 959.39			
N8	Corrective rehabilitation to meet cropping requirements	: Rands	R 60 770.46	/ha		R 55 549	R 60 770.46			

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Open pit

Ref.		Closure Component (Select)	Pit 1 to Pit 2(Preferred)						
			Applicable	Quantity	Unit	Unit rate code	Unit rate	Total cost	Notes
	1	**Infrastructural Areas**							
	1.1	**Dismantling of processing plant and related structures**							
	1.1.1	Processing plant structures	No	0	N/A	L1	R 0.00	R	No processing plant will be constructed as part of current project
		Removal of bases and floors	No	0	N/A	L1	R 0.00	R	
		Sub-total for Dismantling of processing plant and related structures						**R**	
	1.2	**Demolition of steel buildings**							
	1.2.1	Not applicable	No	0	N/A	L1	R 0.00	R	No processing plant will be constructed as part of current project
		Sub-total for Demolition of steel buildings						**R**	
	1.3	**Demolition of other buildings and structures**							
		Carports	Yes	187.5	/m2	B7.2	R 49.95	R 9 365.63	Assumed area for internal parking and associated paving - 15 parking spaces, assume IBR
		Sub-total for Demolition of other buildings and structures						**R 9 365.63**	
	1.4	**Rehabilitation of roads and paved surfaces**							
	1.4.1	Paving areas asociated with plant/elsewhere on site	Yes	375	/m2	E6	R 60.66	R 22 747.50	Assumed hardstand area for internal parking and paving - 15 parking spaces and associated areas
	1.4.2	New haul roads	Yes	91000	/m2	E2	R 25.95	R 2 361 450.00	Assume existing haul roads and ramps excluded, haul road footprint as measured
	1.4.3	New haul road bridge over existing western boundary road							
		Demolish bridge concrete structure	Yes	1000	/m3	A1.3	R 782.24	R 782 240.00	Assumed concrete volume for overpass structure
		Excavate earthen embankments	Yes	337500	/m3	H1.2	R 22.98	R 7 755 750.00	Large volumes, bridge length of 500m x assumed 27m max height at approx. 1:10 slope and 50m average width
		Load and haul embankment material to open pit area	Yes	337500	/m3	H2.2.1	R 28.84	R 9 733 500.00	Assume material will be utilised for pit rehabilitation purposes, assume CAT 777, or 0.5 km superlink unit rate
	1.4.4	Existing access roads	No	0	N/A	L1	R 0.00	R	Assume major gravel road with engineered surface, road will be maintained post closure for site access and monitoring/maintenance purposes
		Sub-total for Rehabilitation of roads and paved surfaces						**R 20 655 687.50**	
	1.5	**Demolition and rehabilitation of railway lines**							
	1.5.1	Not applicable							
		Sub-total for Demolition and rehabilitation of railway lines						**R**	
	1.6	**Other linear infrastructure**							
		Not applicable							
		Sub-total for Other linear infrastructure						**R**	
	1.7	**Fencing**							
	1.7.1	Perimeter fence							
		Light concrete thickness less than 250 mm	Yes	118.75	/m3	A1.4	R 496.54	R 58 964.13	Assume concrete footings@5m intervals, of 0.5m x 0.5m x 0.25m
		Dismantling of stock fencing	Yes	9500	/m	I2.2	R 13.60	R 129 200.00	Assume fencing will be similar to existing Grootegeluk perimeter fence, approximate measured perimeter of project area
		Sub-total for Fencing						**R 188 164.13**	
	1.8	**Disposal of demolition waste**							
	1.8.1	Steel equipment and scrap steel							
		Construction of a decontamination bay	No	0	N/A	L1	R 0.00	R	No processing plant will be constructed as part of current project
		Decontamination of steel equipment	No	0	N/A	L1	R 0.00	R	
		Transport of steel demolition waste for salvaging	No	0	N/A	L1	R 0.00	R	
	1.8.2	Concrete demolition waste							
		Decontamination of concrete	No	0	N/A	L1	R 21 030.10	R	No processing plant will be constructed as part of current project
		Crushing of concrete to 75mm aggregate	Yes	1 119	/m3	A3.1	R 209.56	R 234 445.25	Crushing of bridge overpass structure and fence concrete footings
		Transport of crushed concrete to Grootegeluk Dump 6 general waste disposal site	Yes	1119	/m3	M1	R 68.01	R 76 083.77	5 km haul distance
	1.8.3	Asphalt surfaces							
		Transport of asphalt surfaces for stockpiling for re-use	No	0	N/A	L1	R 0.00	R	No new asphalt roads will be constructed as part of the project
	1.8.4	General demolition waste							
		Sorting and screening of demolition waste	No	0	N/A	L1	R 0.00	R	Minimal/no building related waste will be generated during decommissioning phase of project
		Transport of waste to Grootegeluk Dump 6 general waste disposal site	No	0	N/A	L1	R 0.00	R	
	1.8.5	Hazardous waste							
		Transport hazardous waste to Holfontein	No	0	N/A	L1	R 0.00	R	No processing plant will be constructed as part of current project
		Disposal costs	No	0	N/A	L1	R 0.00	R	
		Sub-total for Disposal of demolition waste						**R 310 529.02**	
	1.9	**Making good of infrastructure**							
	1.9.1	Not applicable	No		N/A	L1	R 0.00	R	
		Sub-total for Making good of infrastructure						**R**	
		Sub-total for Infrastructural Areas						**R 21 163 746.27**	
	2	**Mining Areas**							
	2.1	**Open pit rehabilitation including final voids and ramps - PIT 1**							Note: Open pit operational backfilling landform design required to optimise useable land and pit configuration. As per memorandum TURFVLAKTE MINERAL RESIDUES MASS BALANCE 1784950_Mem_007 (Golder, 2019) -
	2.1.1	Conduct final backfilling, profiling and shaping of the backfilled areas to achieve the devised waving pattern with associated drainage (Pit 1).							Assume 51% of total pit area (157.5 ha) will be void at closure, thus 77.18 ha backfilled at closure
		Backfill overburden material into pit	No		N/A	L1	R 0.00	R	As per latest mass balance, overburden backfilling will occur during operations with no backlog remaining at closure
		Flat dozing (for profiling)	No		N/A	L1	R 0.00	R	
		Extra over dozing for integration with surround surface drainage pattern	No		N/A	L1	R 0.00	R	
	2.1.2	Protect the pit access roads/ramps against unwanted access and severe erosion by providing cross walls and drainage							Assume ramps to be maintained for potential future access and water use. Cross walls 2m high, 13m wide cross wall with 5m wide crest width, i.e. 26m2/m @ 30m widths = 780m³ per cross wall. 50m spacing over assumed final length of 950 m. Thus 19 cross walls at total of 14 820 m3
		Cross walls	Yes	14820	/m3	H2.2.5	R 37.37	R 553 823.40	
		Drainage	Yes	1520	/m	M13	R 65.98	R 100 289.12	Assume drainage channels associated with each cross wall as well as entire length of ramp
	2.1.3	Excavate / establish “tree stations” of 1.5 m x 1.5 m at locations and species to be determined by a rehabilitation ecologist. Infill the excavated cavities with stockpiled Glenrosa soils stripped and stockpiled ahead of the mining face(s):							Assume tree stations over all rehabilitated open pit areas will only be implemented at scheduled closure. LOM material balance must be updated to ensure sufficinet soils are available

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Open pit

Ref.		Closure Component (Select)	Pit 1 to Pit 2(Preferred)						
			Applicable	Quantity	Unit	Unit rate code	Unit rate	Total cost	Notes
		Transport of stockpiled Glenrosa soils to tree station locations on backfill (5km Load and haul)	Yes	20838.6	/m3	M69	R 65.27	R 1 360 168.26	Assume 77.18 ha to receive tree stations at end of operations @ 80 tree stations/ha
		Excavation of tree stations (minor excavation)	Yes	20838.6	m3	M78	R 39.23	R 817 515.78	10% Extra over for routine excavation rate to spoil excavated material, and 50% extra over for labour
		Establishment of saplings in tree stations (including amelioration)	Yes	6174.4	no	M62	R 1 094.00	R 6 754 793.60	
	2.1.6	Dress/cover exposed coal seams within pit side walls to prevent spontaneous combustion and reduce water ingress							
		Blasting of high wall and side walls as required for profiling	Yes	2107700	/m3	H5.4	R 19.36	R 40 805 072.00	Assume that 75% of final void perimeter (i.e. excluding low wall face) will require blasting i.e. 3245 m * 0.75 = 2434 m. Of this assume that 1655 m (southern pit edge excluding ramp) will be high wall and will be approximately vertical, to be initially blasted to 1:1 for shaping purposes, requiring 1250m3/m material to be blasted. Also assume that remainder of pit side wall (excluding low wall face) i.e. 779 m will be benched at approx. 1:2 in 4 rises, with 12.5 m lifts and 25 m benches requiring 50m3/m material to be blasted
		Dozing of surrounding material to above coal seam roof at a slope of 1:2.5	Yes	94016	/m3	H4.1	R 19.21	R 1 806 040.16	Assume will be required for final pit perimeter (estimated 51% of 5899 m thus 3008.5 m) to an average height of 25 m above pit floor. @1:2.5 assume maximum of 31.25m3/m material will be required to doze down pit side slopes. Recommend investigating alternate methods for steep slope stabilisation during the operations
		Compaction of dozed material not compacted by dozer		23504	/m3	H5.3	R 27.80	R 653 408.59	Assume 25% of total
	2.1.4	Dress/cover exposed pit floor (carbonaceous material) with a 500 mm layer overburden or material to prevent spontaneous combustion							
		Load and haul 2 km	Yes	401650	/m3	H2.2.3	R 32.68	R 13 125 922.00	Assume to be approx. 51% of total pit footprint area, thus 80.33 ha
		Levelling of spoiled material	Yes	401650	m3	M79	R 6.01	R 2 414 970.43	Assume 30% of normal dozing rate as it will mostly involve cutting of top of spoil heaps. Levelling of overburden heaps placed at the correct spacing to facilitate the required 500 mm depth.
	2.1.5	Create "paddocked" profiling of pit floor to ensure adequate inundation of pit floor to limit potential of spontaneous combustion of exposed carbonaceous material							
		Pit floor profiling	Yes	803300	m3	M77	R 8.02	R 6 439 921.15	Assume material imported to dress pit floor will be profiled to form shallow paddocks
		Compaction of paddocking	Yes	200825	/m3	H5.3	R 27.80	R 5 582 935.00	Assume rudimentary compaction to 250mm depth to achieve a reasonably watertight paddock system
	2.1.7	Determine and take into consideration with enviro bund placement the 100 year break-back line around the open pit (anticipated to be 50 m from pit lip) to allow spalling and sloughing to proceed naturally to form stable long-term pit shell slopes	Yes	1	sum	M35	R 97 738.07	R 97 738.07	
	2.1.8	Excavate a dished corridor approximately 10 m from the safe break back line (thus approximately 60 m from the pit lip) around the full perimeter of the pit.	Yes	3731.75	/m3	H1.2	R 22.98	R 85 755.62	Assume 2m deep, 3m wide base width and 9m wide at the top, 1:1.5 side slopes. Thus 12m²/m along 60m offset of pit perimeter. Note that this may not be required on the low wall side if the backfill can be done to achieve a flatter slope. This approach could make a larger proportion of the rehabilitated pit useable.
	2.1.9	Utilise the above excavated material to construct an enviro-bund between the dished corridor and the safe break back line around the full perimeter of the pit with a height of 3 m and slopes no flatter than 1:2 but no greater than the angle of repose	Yes	3731.75	/m3	H4.1	R 19.21	R 71 686.92	Assume 2m wide crest width, 1:2 side slopes, thus 12m²/m. Dozing.
	2.1.10	Establish indigenous thorny/spiny vegetation between enviro-bund and the pit lip	Yes	19	/ha	G2.4	R 17 430.11	R 339 364.24	Pit perimeter offset by about 60m.
	2.1.11	Erect a game fence on the outer side of the envirobund. The fence will be maintained as part of the overall game park management.	Yes	3731.75	/m	I1.2	R 34.01	R 126 916.82	
		Sub-total for Open pit rehabilitation including final voids and ramps - PIT 1						**R 81 136 321.16**	
	2.2	**Open pit rehabilitation including final voids and ramps - PIT 2**							Note: Open pit operational backfilling landform design required to optimise useable land and pit configuration. As per memorandum TURFVLAKTE MINERAL RESIDUES MASS BALANCE 1784950_Mem_007 (Golder, 2019) -
	2.2.1	Conduct final backfilling, profiling and shaping of the backfilled areas to achieve the devised waving pattern with associated drainage (Pit 2).							Assume 70% of total pit area (64.3 ha) will be void at closure, thus 19.29 ha backfilled at closure
		Backfill soft and hard overburden material into pit	No	0	N/A	L1	R 0.00	R	As per latest mass balance, overburden backfilling will occur during operations with no backlog remaining at closure
		Transport interburden and discard material to Grootegeluk	No	18227	/m3	H2.2.5	R 37.37	R	Interburden and discard eminating from Grootegeluk plant to be backfilled in Grootegeluk open pit via stacker-reclaimer and will constitute operational cost, as the movement of this material is in totality a function of the planned mining sequence of events, and does not form part of rehabilitation-related activities.
		Flat dozing (for bulk profiling)	Yes	5.787	/ha	G1.2	R 117 484.88	R 679 885.00	Assume 30% of backfilled pit area will require profiling at closure, thus 5.79 ha
		Extra over dozing for integration with surround surface drainage pattern	Yes	28935	/m3	H4.1	R 19.21	R 555 841.35	Assume average depth of 500mm over initial profiled area, to establish "waving pattern" over backfilled section of pit as per Grootegeluk
	2.2.2	Protect the pit access roads/ramps against unwanted access and severe erosion by providing cross walls and drainage							Assume ramps to be maintained for potential future access and water use. Cross walls 2m high, 13m wide cross wall with 5m wide crest width, i.e. 26m2/m @ 30m widths = 780m³ per cross wall. 50m spacing over assumed final length of 950 m. Thus 19 cross walls at total of 14 820 m3
		Cross walls	Yes	14820	/m3	H2.2.5	R 37.37	R 553 823.40	
		Drainage	Yes	1520	/m	M13	R 65.98	R 100 289.12	Assume drainage channels associated with each cross wall as well as entire length of ramp
	2.2.3	Excavate / establish “tree stations” of 1.5 m x 1.5 m at locations and species to be determined by a rehabilitation ecologist. Infill the excavated cavities with stockpiled Glenrosa soils stripped and stockpiled ahead of the mining face(s):							Assume tree stations over all rehabilitated open pit areas will only be implemented at scheduled closure
		Transport of stockpiled Glenrosa soils to tree station locations on backfill (5km Load and haul)	Yes	5208.3	/m3	M69	R 65.27	R 339 953.95	Assume 19.29 ha to receive tree stations at end of operations @ 80 tree stations/ha. LOM material balance must be updated to ensure sufficinet soils are available
		Excavation of tree stations (minor excavation)	Yes	5208.3	m3	M78	R 39.23	R 204 325.98	10% Extra over for routine excavation rate to spoil excavated material, and 50% extra over for labour
		Establishment of saplings in tree stations (including amelioration)	Yes	1543.2	no	M62	R 1 094.00	R 1 688 260.80	
	2.2.6	Dress/cover exposed coal seams within pit side walls to prevent spontaneous combustion and reduce water ingress							
		Blasting of high wall and side walls as required for profiling	Yes	2125350	/m3	H5.4	R 19.36	R 41 146 776.00	Assume that 75% of final void perimeter (i.e. excluding low wall face) will require blasting i.e. 3716 m * 0.75 = 2787 m. Of this assume that 1655 m (southern pit edge excluding ramp) will be high wall and will be approximately vertical, to be initially blasted to 1:1 for shaping purposes, requiring 1250m3/m material to be blasted. Also assume that remainder of pit side wall (excluding low wall face) i.e. 1132 m will be benched at approx. 1:2 in 4 rises, with 12.5 m lifts and 25 m benches requiring 50m3/m material to be blasted

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Open pit

Ref.		Closure Component (Select)	Pit 1 to Pit 2(Preferred) Applicable	Quantity	Unit	Unit rate code	Unit rate	Total cost	Notes
		Dozing of surrounding material to above coal seam roof at a slope of 1:2.5	Yes	81288	/m3	H4.1	R 19.21	R 1 561 532.88	Assume will be required for final pit perimeter (estimated 70% of 3716 m thus 2601.2m) to an average height of 25 m above pit floor. @1:2.5 assume maximum of 31.25m3/m material will be required to doze down pit side slopes
		Compaction of dozed material not compacted by dozer		20322	/m3	H5.3	R 27.80	R 564 948.13	Assume 25% of total
	2.2.4	Dress/cover exposed pit floor (carbonaceous material) with a 500 mm layer overburden or material to prevent spontaneous combustion							Assume to be approx. 70% of total pit footprint area, thus 45.01 ha
		Load and haul 2 km	Yes	225050	/m3	H2.2.3	R 32.68	R 7 354 634.00	Assume to be approx. 70% of total pit footprint area, thus 45.01 ha
		Levelling of spoiled material	Yes	225050	m3	M79	R 6.01	R 1 353 141.03	Assume 30% of normal dozing rate as it will mostly involve cutting of top of spoil heaps. Levelling of overburden heaps placed at the correct spacing to facilitate the required 500 mm depth.
	2.2.5	Create "paddocked" profiling of pit floor to ensure adequate inundation of pit floor to limit potential of spontaneous combustion of exposed carbonaceous material							
		Pit floor profiling	Yes	450100	m3	M77	R 8.02	R 3 608 376.08	Assume material imported to dress pit floor will be profiled to form shallow paddocks
		Compaction of paddocking	Yes	112525	/m3	H5.3	R 27.80	R 3 128 195.00	Assume rudimentary compaction to 250mm depth to achieve a reasonably watertight paddock system
	2.2.7	Determine and take into consideration with enviro bund placement the 100 year break-back line around the open pit (anticipated to be 50 m from pit lip) to allow spalling and sloughing to proceed naturally to form stable long-term pit shell slopes	Yes	1	sum	M35	R 97 738.07	R 97 738.07	
	2.2.8	Excavate a dished corridor approximately 10 m from the safe break back line (thus approximately 60 m from the pit lip) around the full perimeter of the pit.	Yes	3290.15	/m3	H1.2	R 22.98	R 75 607.65	Assume 2m deep, 3m wide base width and 9m wide at the top, 1:1.5 side slopes. Thus 12m²/m along 60m offset of pit perimeter. Note that this may not be required on the low wall side if the backfill can be done to achieve a flatter slope. This approach could make a larger proportion of the rehabilitated pit useable.
	2.2.9	Utilise the above excavated material to construct an enviro-bund between the dished corridor and the safe break back line around the full perimeter of the pit with a height of 3 m and slopes no flatter than 1:2 but no greater than the angle of repose	Yes	3290.15	/m3	H4.1	R 19.21	R 63 203.78	Assume 2m wide crest width, 1:2 side slopes, thus 12m²/m. Dozing.
	2.2.10	Establish indigenous thorny/spiny vegetation between enviro-bund and the pit lip	Yes	17	/ha	G2.4	R 17 430.11	R 299 205.27	Pit perimeter offset by about 60m.
	2.2.11	Erect a game fence on the outer side of the envirobund. The fence will be maintained as part of the overall game park management.	Yes	3290.15	/m	I1.2	R 34.01	R 111 898.00	
		Sub-total for Open pit rehabilitation including final voids and ramps - PIT 2						**R 63 487 635.49**	
	2.3	**Sealing of shafts, adits and inclines**							
	2.3.1	Not applicable	No		N/A	L1	R 0.00	R	
		Sub-total for Sealing of shafts, adits and inclines						**R**	
	2.4	**Rehabilitation of stockpiles and processing residues**							
	2.4.1	**Topsoil stockpiles**							Assume all material from stockpile will be removed prior to and as part of closure; and that infrastructure servitude will not be developed as part of current project
		Rip the remaining footprint area to alleviate compaction	Yes	20.7	/ha	H3.2	R 20 049.34	R 415 021.34	
		Shape to facilitate drainage	Yes	20.7	/ha	G1.7	R 1 945.16	R 40 264.81	
		Sub-total for Rehabilitation of stockpiles and processing residues						**R 455 286.15**	
	2.5	**Rehabilitation of clean water impoundments**							
		Not applicable							
		Sub-total for Rehabilitation of clean water impoundments						**R**	
	2.6	**Rehabilitation of dirty water impoundments**							
	2.6.1	Not applicable							
		Sub-total for Rehabilitation of dirty water impoundments						**R**	
	2.7	**Rehabilitation of subsided areas**							
	2.7.1	Not applicable	No		N/A	L1	R 0.00	R	
		Sub-total for Rehabilitation of subsided areas						**R**	
		Sub-total for Mining Areas						**R 145 079 242.79**	
	3	**General Surface Rehabilitation**							
	3.1	**Infrastructural Areas**							
	3.1.1	Plant infrastructure footprint							
		Not applicable	No	0	N/A	L1	R 0.00	R	No processing plant will be constructed as part of current project
	3.1.2	Temporary infrastructure and infrastructure servitudes							
		Not applicable	No	0	N/A	L1	R 0.00	R	Assume that infrastructure servitude will not be developed as part of current project
	3.1.3	Haul road shoulders and other areas							
		Excavate coal veneer from haul road shoulders and other footprint areas	Yes	12500	/m3	H1.1	R 35.91	R 448 875.00	Assume excavation to 250mm over 5 ha area
		Transport coal veneer and deposit safely within the open pit	Yes	12500	/m3	H2.2.1	R 28.84	R 360 500.00	Load and haul average 1km to final void, CAT 777
		Rip to 500mm depth	Yes	5	/ha	H3.2	R 20 049.34	R 100 246.70	
		Establish vegetation (woody/thorny species and locally appropriate pioneer grass species)	Yes	5	/ha	G2.4	R 17 430.11	R 87 150.55	
		Sub-total for Infrastructural Areas						**R 996 772.25**	
	3.2	**Other surface disturbances**							
	3.2.1	Open pits							Assume that initial revegetation of pit 2 will have been done as concurrent rehabilitation during operations. Establishment of tree stations included under Open pit rehabilitation including final voids and ramps above
		Shape disturbed area to be free draining	No	0	N/A	L1	R 0.00	R	Included under Open pit rehabilitation including final voids and ramps above
		Establish vegetation (woody/thorny species and locally appropriate pioneer grass species)	Yes	5.787	/ha	G2.4	R 17 430.11	R 100 868.05	Assume 30% of backfilled pit area will require revegetation at closure, thus 5.79 ha. Establishment of tree stations included under Open pit rehabilitation including final voids and ramps above
	3.2.2	Ramps							
		Not applicable	No	0	N/A	L1	R 0.00	R	Assume ramps to be maintained for potential future access and water use
	3.2.3	Topsoil/softs stockpile footprints							
		Establish vegetation (woody/thorny species and locally appropriate pioneer grass species)	No	20.7	/ha	G2.4	R 17 430.11	R	Topsoil stockpile areas not applicable as per latest mine layout plan
	3.2.4	Eradicate exotic vegetation							
		Eradicate alien vegetation	Yes	4.72305	/ha	G2.6	R 6 497.04	R 30 685.84	Assume alien vegetation will establish over 15% of rehabilitated areas and will need to be eradicated during aftercare
		Sub-total for Other surface disturbances						**R 131 553.89**	
		Sub-total for General Surface Rehabilitation						**R 1 128 326.14**	
	4	**Water Management**							
	4.1	**River diversions and watercourse reinstatement**							
	4.1.1	Not applicable	No		N/A	L1	R 0.00	R	
		Sub-total for River diversions and watercourse reinstatement						**R**	

1784950 Exxaro Resources: Turfvlakte Coal Mine Closure Costs, as at August 2019										
Open pit										
Ref.		Closure Component (Select)	Pit 1 to Pit 2(Preferred)							
			Applicable	Quantity	Unit	Unit rate code	Unit rate	Total cost		Notes
	4.2	**Reinstatement of drainage lines**								
	4.2.1	Drainage lines	Yes	37.27	/ha	G1.7	R 1 945.16	R	72 503.89	
		Sub-total for Reinstatement of drainage lines						**R**	**72 503.89**	
		Sub-total for Water Management						**R**	**72 503.89**	
		Sub-Total 1 (for INFRASTRUCTURE, MINING AREAS, GENERAL SURFACE REHABILITATION AND WATER MANAGEMENT)						**R**	**167 443 819.10**	
	5	**P&Gs, Contingencies and Additional Allowances**								
	5.1	Preliminaries and general	Yes	15	/sum	L2	R 25 116 572.87	R	25 116 572.87	Assumed 15 % of Sub-total 1
	5.2	Contingencies	Yes	25	/sum	L2	R 41 860 954.78	R	41 860 954.78	Assumed 25 % of Sub-total 1
	5.3	Additional studies	Yes	1	/sum	M22	R 2 735 000.00	R	2 735 000.00	Nominal allowance for contaminated land assessment, closure-related permitting and authorisations
		Sub-Total 2 (for ADDITIONAL ALLOWANCES)						**R**	**69 712 527.64**	
	6	**Pre-site Relinquishment Monitoring and Aftercare**								
	6.1	Surface water quality monitoring	No	10	/yr.	K1	R 310 786.64	R		No notable drainage lines present in vicinity of Turfvlakte
	6.2	Groundwater quality monitoring	Yes	10	/yr.	K2	R 567 370.85	R	5 673 708.48	
	6.3	Rehabilitation monitoring of rehabilitated areas	Yes	37.27	ha	J1	R 3 821.91	R	142 457.87	
	6.4	Care and maintenance of rehabilitated areas	Yes	37.274	/ha	J3	R 46 433.44	R	1 730 759.93	
		Sub-Total 3 (for PRE-SITE RELINQUISHMENT aspects)						**R**	**7 546 926.28**	
		Grand Total Excl. VAT. (for Sub-total 1 +2 +3)						**R**	**244 703 273.03**	

APPENDIX B

Legal Requirements

LEGISLATION PERTAINING TO MINE CLOSURE

Apart from the GN R. 1147 (as amended) regulations summarised at the beginning of each Part of the main body of this document, mine closure planning is also required to be compliant with the following legislation:

- Minerals Petroleum and Resources Development Act No. 28 of 2002 (MPRDA). Section 43 states that a holder of a prospecting right, mining right, retention permit or mining permit remains responsible for any environmental liability, pollution or ecological degradation and the management thereof, until the Minister has issued a closure certificate to the holder concerned
- National Environmental Management Act, No. 107 of 1998 (NEMA):
  - If it is determined that a mine, having regard to its known ore reserves, is likely to cease mining operations within a period of five years, the owner of that mine must promptly notify the Minister in writing -
    - of the likely cessation of those mining operations; and
    - of any plans that are in place or in contemplation for the rehabilitation of the area where the mining operations were conducted after mining operations have stopped; and
    - the prevention of pollution of the atmosphere by dust after those operations have stopped.
  - Duty of care to take reasonable measures to prevent significant pollution or degradation of the environment from occurring, continuing or re-occurring or where such pollution or degradation cannot be reasonably stopped or avoided, such person must take reasonable measures to minimize and rectify such pollution or degradation.
- **Environmental Impact Assessment Regulations, 2014.** An application for an environmental authorisation (Basic Assessment) must be submitted for the decommissioning of any activity requiring:
  - A closure certificate in terms of section 43 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002); or
  - A prospecting right, mining right, mining permit, production right or exploration right, where the throughput of the activity has reduced by 90% or more over a period of 5 years excluding where the competent authority has in writing agreed that such reduction in throughput does not constitute closure.

NEMA Principles

- In terms of section 38 of the MPRDA, holders of reconnaissance permissions, prospecting rights, mining rights, mining permits or retention permits must promote compliance with the principles set out in section 2 of the NEMA, which provide that -
  - The disturbance of ecosystems and loss of biological diversity is avoided, or, wherever it cannot altogether be avoided, is minimised and remedied;
  - Pollution and degradation of the environment is avoided, or where it cannot be altogether avoided, is minimised and remedied;
  - The disturbance of landscapes and sites that constitute a nations cultural heritage is avoided, or where it cannot be altogether avoided, is minimised and remedied;
  - A risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions; and
  - Negative impacts on the environment and on people's environmental rights be anticipated and prevented, and when they cannot be altogether prevented, are minimised and remedied.

- **The National Water Act (NWA), Act No. 36 of 1998** requires the following:
  - A duty is imposed on the owner of land, a person in control of land or a person who occupies or uses the land to take all reasonable measures to prevent the pollution of a water resource from occurring, continuing or recurring.
  - Regulations on the Use of Water for Mining and Related Activities Aimed at the Protection of Water Resources, GN R. 704
  - Any person in control of an existing mine must notify the DWA 14 days before the temporary or permanent cessation of the operation of the mine;
  - Any person in control of a mine must at temporary or permanent cessation of mining operations, ensure that -
    - Any person in control of a mine or activity must at temporary or permanent cessation of operations ensure that all pollution control measures have been designed, modified, constructed and maintained in accordance with GN R. 704; and
    - Any person in control of a mine or activity must ensure that the in-stream and riparian habitat of any water resource, which may be effected or altered by the mine or activity, is remedied so as to comply with GN R. 704.
  - Provision is made for, *inter alia* -
    - Regulation 4: Restrictions on locality regarding infrastructure;
    - Regulation 5: Restrictions on use of material;
    - Regulation 6: Capacity requirements of clean and dirty water systems; and
    - Regulation 7: Protection of water resources.
- **Regulation 7 of GN R. 704:**
  - 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 and must retain or collect such substance or water for use, re-use, evaporation or for purification and disposal in terms of the Act;
    - Cause effective measures to minimise the flow of any surface water or floodwater into mine workings, open cast workings, other workings or subterranean caverns, through cracked or fissured formations, subsided ground, sinkholes, outcrop excavations, audits, entrances or any other openings; and
    - Prevent the erosion or leaching of materials from any residue deposit or stockpile from any area and contain such material or substances so eroded and leached in such area by providing effective suitable barrier dams, evaporative dams or any other effective measures to prevent this material or substance from entering and polluting any water resources.
- **Conservation of Agricultural Resources Act No. 43 of 1983,**
  - Regulation 15 of the Conservation of Agricultural Resources (CARA), Act No. 43 of 1983 provides a list of Category 1 plants (Weeds) and Category 2 and Category 3 plants (invaders) that must be controlled. Category 1, 2 and 3 plants may not occur on any land or inland water surface other than in biological control reserves and must be controlled by means of the methods prescribed in the regulations (unless exemption granted).

- **Constitution of the Republic of South Africa, Act No. 108 of 1996, Section 33:**
  - Everyone has the right to administrative action that is lawful, reasonable and procedurally fair.
  - Everyone whose rights have been adversely affected by administrative action has the right to be given written reasons.
  - Any application for, for example, a closure certificate or an application for transfer of liabilities and responsibilities in terms of the MPRDA must be considered by the relevant authority according to the criteria contained in Section 33 of the Constitution.
  - Where the relevant authority has been given a discretion, that discretion must be exercised in a reasonable manner and without bias, prejudice or any personal agenda.

Where the state fails to exercise just administration, the decision in question may be set aside by way of an application to court or any internal procedures prescribed by the empowering legislation.

APPENDIX C

Screening Risk Assessment Tables

WATER QUALITY														
RISK IDENTIFICATION						RISK TREATMENT PLAN (TP)	RISK AT PLANNED CLOSURE (PRE IMPLEMENTATION OF TREATMENT PLAN)		TARGET RISK (POST IMPLEMENTATION OF TREATMENT PLAN)		RISK CALCULATION			
RISK ID*	Category	RISK NAME*	RISK DESCRIPTION	CAUSES	IMPACTS/EFFECTS	TREATMENT PLAN	LIKELIHOOD (current)*	OTHER IMPACT (current)*	LIKELIHOOD (target)*	OTHER IMPACT (target)*	RR (current)	PRIORITY (current)	RR (target)	PRIORITY (target)
WQ-01	Geochemical	AMD	Generation of AMD in pyrite bearing exposed coal face	Chemical and biological oxidation of pyritic materials under conditions where soil covering does not adequately reduce the ingress of water and air into the reactive materials resulting in the production of AMD (where materials are PAG)	AMD seepage affects groundwater and water quality of the in-pit lakes should these form	Implement measures to reduce oxidation potential of PAG materials remaining in pit at closure, including covering exposed seam faces with suitable material Compile post closure integrated water management plan including comprehensive geochemical characterisation and integrate with same for Grootegeluk as relevant Climate change over the LOM is likely to have an impact on the water balance and research should be done on this topic to indicate how this will impact the water balance model	(2) Unlikely (>10 - 35%)	(3) Moderate	(2) Unlikely (>10 - 35%)	(2) Minor	**24**	**Priority III**	**16**	**Priority IV**
WQ-02	Groundwater	Groundwater contamination	Presence of contaminants of concern above agreed criteria within groundwater table	Groundwater contamination due to hydrocarbon spillages and salt leach, exacerbated due to poor management practices during the operational period Presence at closure of contaminant plume/s (hydrocarbons, leached salts etc.) generated during operations a key risk at closure being inadequate containment of the contaminant plume(s)	Prevention of beneficial groundwater use Downstream impacts to receptors (human and environmental health)	Surface water and groundwater monitoring will be conducted Rehabilitating all haul roads and parking/laydown areas, including associated coal veneers, fugitive coal and potential hydrocarbon spillages, thus removing potential contamination to surface and groundwaterCompile post closure integrated water management plan including comprehensive geochemical characterisation At present it is deemed unlikely that groundwater abstraction, treatment and/or management will be required, however conduct operational water quality monitoring for a predetermined period (pre site relinquishment, and extended post closure in the case of unscheduled closure) to verify whether this will be required	(3) Possible (>35% - 60%)	(3) Moderate	(3) Possible (>35% - 60%)	(2) Minor	**36**	**Priority II**	**24**	**Priority III**
WQ-03	Groundwater	Reduced groundwater availability	Reduced groundwater availability	Pit creates a drawdown cone that might affect availability of groundwater within the dewatering cone of depression	Long term prolonged groundwater drawdown effecting water resource yield to the west of the pit	Continue with ground water quality and levels monitoring during and after closure, and determine whether in-pit water quality after closure will be suitable to support target next land uses	(3) Possible (>35% - 60%)	(3) Moderate	(3) Possible (>35% - 60%)	(3) Moderate	**36**	**Priority II**	**36**	**Priority II**
WQ-04	Groundwater	Pit lake water quality	Poor pit lake water quality	Contamination of pit lake water as the rebounding water table floods remaining exposed coal seams in the pit	Contaminated pit water renders this unfit for use (wild life and stock watering), as well as potentially contaminating the surrounding aquifers if pit lake is not a sink	Limit final void water make to regional groundwater recharge and direct rainfall Consider the need for on-going dewatering Compile post closure integrated water management plan including comprehensive geochemical characterisation to confirm technical studies to date - see note	(3) Possible (>35% - 60%)	(3) Moderate	(3) Possible (>35% - 60%)	(2) Minor	**36**	**Priority II**	**24**	**Priority III**
WQ-05	Surface water	Waterlogging of final landforms	Insufficient draining of final landforms, particularly planned backfilled pit	Rehabilitated areas have not been reshaped to be free-draining resulting in waterlogging of flat areas or depressions	Waterlogging results in: Death of vegetation Capillary rise of salts into the surface soils affecting soil texture and plant growth Trapping of livestock	Compile detailed postmining landform and cover design based on a volumetric assessment Manage the backfilling operations to achieve the design elevations and continually calibrate the life of mine materials balance Reinstate surface drainage lines aligned to existing surface macro-topography and to ensure free drainage Routing clean runoff to local / natural drainage lines as far as possible Ensuring that the drainage lines created on the rehabilitated surfaces will not scour and be sources of erosion	(3) Possible (>35% - 60%)	(3) Moderate	(2) Unlikely (>10 - 35%)	(3) Moderate	**36**	**Priority II**	**24**	**Priority III**
WQ-06	Surface water	Erosion	Erosion of rehabilitated areas	Inappropriate side slopes of the backfilled pit low wall and side walls Significant downpours Vegetation failure	Soil, surface water and groundwater contamination Further vegetation failure, loss of biodiversity Impacted landscape visual appeal	Drainage channels around pit are cleaned and the silt disposed of appropriately to prevent overtopping and associated erosion Physically stable and sustainable landforms are ensured at closure Rehabilitation trials to determine most appropriate / sustainable profile and cover design Determine appropriate cover designs (based on findings of rehabilitation trials) of remnant residue with "clean" material of an appropriate thickness to capacitate vegetation establishment; thus preventing mobilisation of mine residue	(2) Unlikely (>10 - 35%)	(3) Moderate	(2) Unlikely (>10 - 35%)	(1) Insignificant	**24**	**Priority III**	**8**	**Priority IV**

LAND USE - PHYSICAL STABILITY														
RISK IDENTIFICATION						RISK TREATMENT PLAN (TP)	RISK AT PLANNED CLOSURE (PRE IMPLEMENTATION OF TREATMENT PLAN)		TARGET RISK (POST IMPLEMENTATION OF TREATMENT PLAN)		RISK CALCULATION			
RISK ID*	Category	RISK NAME*	RISK DESCRIPTION	CAUSES	IMPACTS/EFFECTS	TREATMENT PLAN (Additional Mitigation Measures to Achieve Target Risk)	LIKELIHOOD (current)*	OTHER IMPACT (current)*	LIKELIHOOD (target)*	OTHER IMPACT (target)*	RR (current)	PRIORITY (current)	RR (target)	PRIORITY (target)
LU-PS-01	Geotechnical	Erosion of landforms	Instability of constructed landforms as a result of erosion of cover materials	Landform features (rehabilitated open pit areas) designed with slopes that are too steep and on which the energy of runoff water is not properly controlled. Landforms do not have the desired vegetation cover that persists in the long term (i.e. in adequate soil fertility and improper selection of suitable grasses and other vegetation)	Unsustainable vegetation covers on rehabilitated landforms with steep slopes of especially the pit low wall results in soil loss and exposure of underlying reactive materials (with attendant environmental impacts) Unnecessary cost to repair Deposition of material into downstream environment (e.g. drainage lines) and subsequent alteration of established hydrological processes	Slopes on backfilled pit areas will be shaped to be free draining with an outer slopes no steeper than 1:3 The upper surfaces and outer slopes will be stabilised by means of shaping and the provision of suitable covers to limit water ingress, the occurrence of spontaneous combustion and resultant erosion Design and construct free draining landforms based on landform modelling informed by suitable erosion modelling and LoM volumetric assessment Rehabilitation monitoring and care and maintenance to ensure achievement of performance objectives and site relinquishment criteria to be well established prior to scheduled closure, and to be extended post closure to confirm success	(3) Possible (>35% - 60%)	(3) Moderate	(2) Unlikely (>10 - 35%)	(3) Moderate	**36**	**Priority II**	**24**	**Priority III**
LU-PS-02	Geotechnical	Pit wall failure	Pit wall failure due to loss of geotechnical integrity	Inappropriate highwall design for closure, weathering of exposed strata in highwall, and wetting of highwall with pit lake formation	Injury to humans and / or fauna Exposure of materials prone to spontaneous combustion	The benches of the pit will be blasted to a gradient of 1:3, combining the benches into one uniform slope “Push-up” berm(s) will be created at the base of the uniform slope A dished corridor will be created outside the safe 100 year break back line with a environ bund created with the material 20 m back from the break back line with a height of 3 m and slope angle of 1:2 Allowing spalling and sloughing to proceed naturally to “create” stable long-term pit shell slopes Rock engineering study: primary objective included in the study is to determine the slope stability of the pit wall in the areas that may be affected by the proposed water management and dump rehabilitation strategy Rehabilitation monitoring and care and maintenance to ensure achievement of performance objectives and site relinquishment criteria to be well established prior to scheduled closure, and to be extended post closure to confirm success	(2) Unlikely (>10 - 35%)	(4) Major	(1) Rare (< 10%)	(4) Major	**32**	**Priority II**	**16**	**Priority II**
						Include potential climate change (e.g. severe storm / rainfall events) to the study assumptions Expand rock engineering studies during the operational period to determine the slope stability of the pit wall in the areas that may be affected by water management and dump rehabilitation strategy - thus establishing baseline data from which to extend / augment future studies								

LAND USE - CONTAMINATION & WASTE													
RISK IDENTIFICATION						RISK TREATMENT PLAN (TP)	RISK AT PLANNED CLOSURE (PRE IMPLEMENTATION OF TREATMENT PLAN)		TARGET RISK (POST IMPLEMENTATION OF TREATMENT PLAN)		RISK CALCULATION			
RISK ID*	Category	RISK NAME*	RISK DESCRIPTION	CAUSES	IMPACTS/EFFECTS	TREATMENT PLAN (Additional Mitigation Measures to Achieve Target Risk)	LIKELIHOOD (current)*	OTHER IMPACT (current)*	LIKELIHOOD (target)*	OTHER IMPACT (target)*	RR (current)	PRIORITY (current)	RR (target)	PRIORITY (target)
LU-CW-01	Contamination	HAZMAT contamination	Uncontrolled release of HAZMAT to the environment	Incomplete or incorrect source information (volumes, parameters, locations) and lack of sufficient associated disposal protocols Exposure to HAZMAT materials during decommissioning	Contamination of groundwater, surface water or environment	Ongoing site-wide waste management and mitigation of spills and areas of contamination to minimise build-up of hazardous materials on site at closure, along with soil contamination to be remediated at closure At closure, removing, for safe disposal, all potential operations / process-related contaminants and other hazardous material to ensure that no hazardous waste is present on the respective sites once these have been rehabilitated Undertake site wide contaminated land assessment as part of final closure planning to ensure that no areas of contamination are remnant post closure; implementing additional measures, as required	(3) Possible (>35% - 60%)	(3) Moderate	(2) Unlikely (>10 - 35%)	(3) Moderate	**36**	**Priority II**	**24**	**Priority III**
LU-CW-02	Waste Management	Demolition waste	Unauthorised method of disposing of demolition waste	Failure to identify an appropriate location for demolition waste, including potentially contaminated material Not timeously engaging with regulators on demolition waste disposal	Failure to meet site relinquishment criteria Environmental degradation	Potentially contaminated soils will be cleaned up during operations to limit requirement at closure; any remaining hydrocarbon contamination will be cleaned up and dealt withas per existing Grootegeluk management measures Concrete from bridge and fence post footings will be crushed and disposed of in the pit/s and/or Dump 6 Limited steel and related material from demolition, once decontaminated, having salvage value will remain on-site for sale	(2) Unlikely (>10 - 35%)	(3) Moderate	(2) Unlikely (>10 - 35%)	(1) Insignificant	**24**	**Priority III**	**8**	**Priority IV**

LAND USE - REHABILITATION														
RISK IDENTIFICATION						RISK TREATMENT PLAN (TP)	RISK AT PLANNED CLOSURE (PRE IMPLEMENTATION OF TREATMENT PLAN)		TARGET RISK (POST IMPLEMENTATION OF TREATMENT PLAN)		RISK CALCULATION			
RISK ID*	Category	RISK NAME*	RISK DESCRIPTION	CAUSES	IMPACTS/EFFECTS	TREATMENT PLAN (Additional Mitigation Measures to Achieve Target Risk)	LIKELIHOOD (current)*	OTHER IMPACT (current)*	LIKELIHOOD (target)*	OTHER IMPACT (target)*	RR (current)	PRIORITY (current)	RR (target)	PRIORITY (target)
LU-R-01	Geochemical	Spontaneous combustion	Spontaneous combustion of exposed coal on remaining mining benches	Chemical and biological oxidation of exposed pyrite in coal resulting in spontaneous combustion, in the absence of a suitable (soil or water) cover	Sponcom of exposed coal affects air quality for closure contractors, resulting in inefficient rehabilitation works (needing to be careful around burning areas) Hot spots close to the final rehabilitated surface can affect revegetation success, thus resulting in failure of cover, surface erosion	Concurrent rehabilitation of open pit: - Maintaining a sufficient advance rate of materials placement thereby limiting the time of exposure to the atmosphere - Sealing the backfill in compartments at various intervals as backfilling takes place with available overburden material - The interburden material will be backfilled according to the Grootegeluk Standards in compartments to prevent spontaneous combustion - The discard material will be backfilled on top of the interburden material using conveyor systems (face never sealed to form a compartment) - The discards layouts consist of a pre-built berm, followed by a side seal and top cover which must be placed in advance or within 8 weeks after discards have been placed Learn from and adjust rehabilitation measures as per findings of dump rehabilitation trials Undertake rehabilitation monitoring and care and maintenance to ensure achievement of performance objectives and site relinquishment criteria to be well established prior to scheduled closure, and to be extended post closure to confirm success	(3) Possible (>35% - 60%)	(3) Moderate	(2) Unlikely (>10 - 35%)	(3) Moderate	**36**	**Priority II**	**24**	**Priority III**
LU-R-02	Surface water / biodiversity	Endorheic pans	Inability to recreate endorheic pans (pan fields) as unique habitat for biodiversity conservation on rehabilitated areas	Construction of pans requires a trail so as to prove the viability of the concept. This will require careful planning and execution, requiring different approaches than current rehabilitation practice at Grootegeluk Design challenges and solutions current not fully understood Lack of integration / alignment between mine environmental team and operational team on requirement and practicalities of recreating pans	Loss of pan habitat and associated biodiversity / eco-services	Use outcome of proof of concept to inform best construction practice and successful outcomes, so as not to influence the required site relinquishment criteria / performance objectives associated to final rehabilitation of the open pit (i.e. free draining, limiting water ingress, etc.) Should proof of concept be viable undertake appropriate planning and placement of pans according to final land use plan and site wide rehabilitation plan	(3) Possible (>35% - 60%)	(3) Moderate	(2) Unlikely (>10 - 35%)	(3) Moderate	**36**	**Priority II**	**24**	**Priority III**
LU-R-03	Rehabilitation	Inability to establish and sustain native vegetation	Inability to establish and sustain native vegetation and therefore meet closure objectives	Unsustainable vegetation cover caused by: - Soil cover material with suboptimal depth, texture and / or fertility - Inappropriate selection of species for the rehabilitated landforms - Lack of appropriate and timely weed control - Prolonged droughts/climate change impacts - Overstocking and overgrazing - Lack of available seed	Loss of vegetation cover resulting in: - Loss of veld carrying capacity - Increased soil loss by water erosion - Landform instability - Increased wind borne dust - Loss of faunal habitat - Weed infestation and loss of recovering biodiversity - Imbalance in local and regional ecosystems - Increased rework costs - Delayed closure	Selection of low intensity post-closure land use Dedicated vegetation assessment to determine key species growing within the naturally occurring area towards defining a species mix that uses pioneer species to achieve priority rehabilitation objectives (erosion) towards establishing ecologically functional climax conditions (endemic, hardy and drought resistance species) Establishing or allowing for the natural establishment, as applicable, of viable self-sustaining vegetation communities (keystone pioneer vegetation species), and thus the preparation of ecosystem processes, productivity and services via natural succession Ensuring that the rehabilitated mine site is free draining and that disturbed areas are suitably prepared for the natural establishment of vegetation (where planned for); however ensuring that the drainage lines created on the rehabilitated surfaces will not scour and be sources of head cuts Ensuring that the growth medium has the required organic content and the potential to sustain microbial activity to ensure infiltration, limit runoff and improved soil stability Using shrub and forb species create micro-climates to cool the upper surfaces to encourage grass germinations	(4) Likely (>60% - 80%)	(4) Major	(2) Unlikely (>10 - 35%)	(4) Major	**64**	**Priority I**	**32**	**Priority II**
						Implement rehabilitation measures, according to rehabilitation plan, progressively and adjust measures based on monitoring and learnings to improve, as necessary Undertake rehabilitation monitoring and care and maintenance to ensure achievement of performance objectives and site relinquishment criteria to be well established prior to scheduled closure, and to be extended post closure to confirm success Monitor and suitably eradicate invasive alien vegetation that hinders the success of indigenous vegetation establishment deters from the environmental quality of the rehabilitated site					**#N/A**		**#N/A**	**#N/A**

RISK ID*	Category	RISK NAME*	RISK DESCRIPTION	CAUSES	IMPACTS/EFFECTS	TREATMENT PLAN (Additional Mitigation Measures to Achieve Target Risk)	LIKELIHOOD (current)*	OTHER IMPACT (current)*	LIKELIHOOD (target)*	OTHER IMPACT (target)*	RR (current)	PRIORITY (current)	RR (target)	PRIORITY (target)
LU-R-04	Rehabilitation	Failure to establish native fauna habitat	Failure to establish native fauna habitat overall biodiversity targets	Inadequate habitat within final landform for fauna recolonisation Loss of unique habitats due to the location of a number of seasonal pans within the approved mine plan and mining right area	Inability to meet proposed biodiversity objectives	Assess whether the rehabilitated areas, with limited intervention and change, could be adapted to provide suitable habitats for small mammals, improving the overall biodiversity, while also identifying those aspects / obstacles once site rehabilitation has been completed which could inhibit and/or deter animal life from returning to the rehabilitated project sites Utilise woody debris as a valuable rehabilitation material that provides several benefits, including habitat creation Create an environment where as wide as possible diversity of species would be tolerant and form a stable and sustainable environment, rather than creating different habitats for specific species Rework post-closure Monitor habitats post-closure, with targeted rework as required	(4) Likely (>60% - 80%)	(3) Moderate	(2) Unlikely (>10 - 35%)	(3) Moderate	**48**	**Priority II**	**24**	**Priority III**
LU-R-05	Rehabilitation	Post-closure land use limitations	Post-closure land use limitations due to rehabilitation process	Backlogs in concurrent rehabilitation roll-out may hinder envisaged end land use(s) from being realised	Limits the extent to which the site is re-integrated into the surrounding landscape and also the range of potential and planned end or next land uses	Progressive rehabilitation plan which considers short term and medium term rehabilitation goals Short term: annual, 12-month period Medium term: 5-year period Undertake dedicated / committed operational implementation, with adjustment of measures based on learnings Undertake rehabilitation monitoring and care and maintenance to ensure achievement of performance objectives and site relinquishment criteria to be well established prior to scheduled closure, and to be extended post closure to confirm success	(3) Possible (>35% - 60%)	(3) Moderate	(2) Unlikely (>10 - 35%)	(3) Moderate	**36**	**Priority II**	**24**	**Priority III**
LU-R-06	Rehabilitation	Open pit cover resources / material availability	Insufficient cover resources / materials insufficient to meet closure requirements	Incorrect cover configuration with available soil resources Inadequate stripping and stockpiling of usable soils ahead of mining and soils lost by not being placed according to soil placement plan	Achieved land capabilities on rehabilitated land suboptimal and not supporting sustainable planned next land uses	Evaluate cover soil depths criteria of cover material by means of auger observations on a 50 x 50 m grid basis (by a soil specialist). Spatial maps to provide by soil specialist to indicate cover soil depth and non-compliant sections Compile succinct and focused topsoil management plan which is aligned to mine and other operational planning, based on technical / specialist studies Ensure sign off and dedicated progressive implementation of this plan Undertake rehabilitation monitoring and care and maintenance to ensure achievement of performance objectives and site relinquishment criteria to be well established prior to scheduled closure, and to be extended post closure to confirm success	(4) Likely (>60% - 80%)	(3) Moderate	(3) Possible (>35% - 60%)	(3) Moderate	**48**	**Priority II**	**36**	**Priority II**
LU-R-07	Climate	Climate change impacts	Closure design does not sufficiently account for potential climate change impacts Climate change impacts on vegetation on rehabilitated land and also on structures designed for current climate norms	Closure design utilised historical climate data only, without consideration of potential future variability Failure to evaluate the effects of climate change for the area on vegetation sustainability and the adequacy of stormwater management structures	Failure of agreed post-closure criteria to be met	Use outcome of future Grootegeluk climate change impact study, to ensure long term post closure view, with review of existing planned rehabilitation and closure measures in light of the findings of the climate change study, and adjustment of measures as necessary	(3) Possible (>35% - 60%)	(4) Major	(2) Unlikely (>10 - 35%)	(4) Major	**48**	**Priority I**	**32**	**Priority II**

SOCIO-ECONOMIC RESILIENCE														
RISK IDENTIFICATION						RISK TREATMENT PLAN (TP)	RISK AT PLANNED CLOSURE (PRE IMPLEMENTATION OF TREATMENT PLAN)		TARGET RISK (POST IMPLEMENTATION OF TREATMENT PLAN)		RISK CALCULATION			
RISK ID*	Category	RISK NAME*	RISK DESCRIPTION	CAUSES	IMPACTS/EFFECTS	TREATMENT PLAN (Additional Mitigation Measures to Achieve Target Risk)	LIKELIHOOD (current)*	OTHER IMPACT (current)*	LIKELIHOOD (target)*	OTHER IMPACT (target)*	RR (current)	PRIORITY (current)	RR (target)	PRIORITY (target)
SE-01	Safety	Unauthorised site access	Safety concerns due to access and exposure to vertical faces and drops	Unauthourised / uncontrolled access to vertical faces	Personal injury or death	Pit will be blasted to a gradient of 1:3, combining the benches into one uniform slope “Push-up” berm(s) will be created at the base of the uniform slope A dished corridor will be created outside the safe 100 year break back line with a environ bund created with the material 20 m back from the break back line with a height of 3 m and slope angle of 1:2 Allowing spalling and sloughing to proceed naturally to “create” stable long-term pit shell slopes	(1) Rare (< 10%)	(3) Moderate	(1) Rare (< 10%)	(3) Moderate	**12**	**Priority III**	**12**	**Priority III**
SE-02	Air quality	Dust generation	Dust generation from post-closure landforms	Disturbance of materials during land forming, strong wind events, drying of materials Spontaneous combustion products could be a long term air quality issue if all discard in pit is not covered / flooded	Visual amenity, respiratory problems, contamination to surrounding areas if dust contains elevated metals	Ongoing / concurrent rehabilitation of available disturbed areas as per GN R. 1147 requirements - including establishment of vegetation to curb dust generation Undertake air quality monitoring, rehabilitation monitoring and care and maintenance to ensure achievement of performance objectives and site relinquishment criteria to be well established prior to scheduled closure, and to be extended post closure to confirm success	(3) Possible (>35% - 60%)	(3) Moderate	(3) Possible (>35% - 60%)	(3) Moderate	**36**	**Priority II**	**36**	**Priority II**
SE-04	Geomorphologi-cal	Compromised visual amenity	Compromised visual amenity as perceived by relevant stakeholders	Deviation from expected / desired / anticipated outcome Inadequacy of consultation with stakeholders	Inability to meet desired relinquishment criteria and timeframes Negative reputation	Re-establishing vegetation on rehabilitated areas, as required, to be aesthetically pleasing, aligned to surrounding natural vegetation cover Shaping and levelling rehabilitated areas to create landforms that emulate the surroundings and to facilitate drainage Establish realistic and achievable site relinquishment criteria with respect to visual amenity Undertake stakeholder engagement during authorisation processes for the rehabilitation of remnant mine residue facilities (configuration and cover) to obtain and address concerns as far as possible, as well as to demonstrate design feasibility and responsiveness to environmental considerations Undertake continued engagement during the closure planning process, particularly with respect to inputs into post closure land use and visual amenity	(4) Likely (>60% - 80%)	(3) Moderate	(2) Unlikely (>10 - 35%)	(3) Moderate	**48**	**Priority II**	**24**	**Priority III**
SE-05	Socio-economic	Local and regional economic impacts	Unfavourable socio-economic impacts upon local community and industry upon mine closure	Large number of local community employed by the mine Local businesses supply the mine and are largely dependent upon it Closure of the mine will remove this demand Mine workers, many of their family members and suppliers to the mine are financially largely dependent upon the mine (and indirectly the employees of the existing Matimba and future Medupi power station, as both will likely close once both Prothetelic and Thabametsi mines close), which would impact upon their livelihoods at closure	Local increase in un-employment, movement of communities to other areas in search of work Closure of local businesses	Align social and labour plan projects and strategies to post closure land use and alternative livelihood planning Undertake comprehensive, ongoing, focused and industry-wide stakeholder engagement, particularly with provincial and regional players on enabling of replacement industries / livelihood opportunities Ensure, as applicable, that effective hand-over of pre-determined mining-related surface infrastructure / equipment for future use by other parties takes place, and undertaking, until hand-over of the mining-related surface infrastructure, training and awareness creation to empower the community to effectively manage the financial and / or commercial resources transferred from the mine is provided	(5) Almost Certain (>80% - 100%)	(4) Major	(4) Likely (>60% - 80%)	(3) Moderate	**80**	**Priority I**	**48**	**Priority II**

RISK ID*	Category	RISK NAME*	RISK DESCRIPTION	CAUSES	IMPACTS/EFFECTS	TREATMENT PLAN (Additional Mitigation Measures to Achieve Target Risk)	LIKELIHOOD (current)*	OTHER IMPACT (current)*	LIKELIHOOD (target)*	OTHER IMPACT (target)*	RR (current)	PRIORITY (current)	RR (target)	PRIORITY (target)
SE-06	Socio-economic	Lack of viable post closure land use	Absence of potentially self-sustaining industry following mine closure limiting the post-closure land use options of the mine	Post-closure land use options for the mine unlikely to be as economically favourable for local businesses	Loss of businesses within the local community Limited opportunities for post-closure land uses which incorporate business,) as these would require some sort of third-party management	Align social and labour plan projects and strategies to post closure land use and alternative livelihood planning Undertake comprehensive, ongoing, focused and industry-wide stakeholder engagement, particularly with provincial and regional players on enabling of replacement industries / livelihood opportunities Ensure third party agreements are concluded that effective hand-over of pre-determined mining-related surface infrastructure / equipment for future use by other parties takes place Undertake training and awareness creation to empower the community to effectively manage the financial and / or commercial resources transferred from the mine prior to hand over	(5) Almost Certain (>80% - 100%)	(4) Major	(3) Possible (>35% - 60%)	(3) Moderate	**80**	**Priority I**	**36**	**Priority II**
SE-07	Socio-economic	Lack of stakeholder engagement	Insufficient stakeholder engagement resulting in stakeholder and community dissatisfaction	Lack of engagement with relevant stakeholders Perceived inability to address concerns or adopt thinking Misaligned planning and not addressing stakeholder requirements throughout the operational period, leading up to mine decommissioning and closure	Community outrage Lack of support from the community for closure Staff losses, with staff seeking new permanent employment Failure to agree on relinquishment criteria	Develop rehabilitation and closure focused stakeholder engagement plan with intensity ramping up as the LoM nears Ensure that stakeholder engagement has clear outcomes to be addressed in closure planning process, particularly with respect to performance objectives and site relinquishment criteria	(4) Likely (>60% - 80%)	(3) Moderate	(2) Unlikely (>10 - 35%)	(3) Moderate	**48**	**Priority II**	**24**	**Priority III**
SE-08	Socio-economic	Unfulfilled operational commitments	EMP, SLP and closure-related commitments remaining unfulfilled at closure during operations	SLP not implemented or updated during operations to reflect true status of engagement SLP projects not budgeted during operations	The need for financial resources to address commitments post-operation which have not been considered in the cost estimate	Track / monitor socio-economic mitigation measures to confirm success post implementation of SLP projects, to inform development of appropriate and sustainable measures to mitigate anticipated impacts at closure Integrate SLP and closure planning, based on findings / outcomes of stakeholder engagement (particularly with respect to performance objectives and relinquishment criteria), and commence with the implementation of social readiness planning for closure (similar to annual progressive / concurrent rehabilitation planning and associated implementation), ramping up as the LoM nears	(3) Possible (>35% - 60%)	(3) Moderate	(2) Unlikely (>10 - 35%)	(3) Moderate	**36**	**Priority II**	**24**	**Priority III**

LEGAL & COMPLIANCE														
RISK IDENTIFICATION						RISK TREATMENT PLAN (TP)	RISK AT PLANNED CLOSURE (PRE IMPLEMENTATION OF TREATMENT PLAN)		TARGET RISK (POST IMPLEMENTATION OF TREATMENT PLAN)		RISK CALCULATION			
RISK ID*	Category	RISK NAME*	RISK DESCRIPTION	CAUSES	IMPACTS/EFFECTS	TREATMENT PLAN (Additional Mitigation Measures to Achieve Target Risk)	LIKELIHOOD (current)*	OTHER IMPACT (current)*	LIKELIHOOD (target)*	OTHER IMPACT (target)*	RR (current)	PRIORITY (current)	RR (target)	PRIORITY (target)
LC-01	Legal	Failure to obtain regulator acceptance	Not obtaining regulatory approval closure plan and associated site relinquishment criteria	Failure to engage relevant stakeholders regarding closure of the site Misalignment between closure study and regulatory expectations Regulatory changes	Delay in commencement of closure execution and eventual site relinquishment, with continued / prolonged liability	Stakeholder engagement with key regulatory stakeholders Obtain written approval from regulatory decision makers on rehabilitation performance objectives and site relinquishment criteria	(4) Likely (>60% - 80%)	(3) Moderate	(3) Possible (>35% - 60%)	(3) Moderate	**48**	**Priority II**	**36**	**Priority II**
LC-02	Legal	Insufficient financial provisioning	Failure to adequately account for the true cost of closure in financial provisions a	Insufficient technical investigations and engineering design at required estimate accuracy level, insufficient quantification of residual risks Failure to define the scope of closure and associated assumptions Failure to understand the full risk profile of the project	Inability to set realistic performance objectives and measures to achieve these Increased cost to close, or ongoing financial liabilities to implement additional closure interventions	Closure cost estimate prepared and regularly updated - aligned to requirements of GN R. 1147 (regulations entail external audit of annual closure cost determinations) Concurrent / progressive rehabilitation, also aligned to GN R. 1147 will be undertaken, thus minimising eventual closure liability Estimate includes contingencies Nearing LoM, according to detailed closure planning schedule, undertake more detailed technical investigations / post closure predictions to confirm assumptions made in closure cost determinations, particularly those related to residual risk, and adjust closure measures and associated financial provisioning, as necessary Obtain specialist demolition and rehabilitation practitioner quotations to confirm closure allowances	(3) Possible (>35% - 60%)	(3) Moderate	(2) Unlikely (>10 - 35%)	(3) Moderate	**36**	**Priority II**	**24**	**Priority III**

APPENDIX D

Document Limitations

DOCUMENT LIMITATIONS

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