Appendix 1

Final Rehabilitation, decommissioning and mine closure plan & Environmental Risk Assesment

Golden Tropic Mining (Pty) Ltd

NC 30/5/1/3/2/10858 MP

Contends

1 INTRODUCTION

This document serves to comply with regulation 6 of the NEMA Financial Regulations (2015) that states that an applicant must determine the financial provision through a detailed itemisation of all activities and costs, calculated based on the actual costs of implementation of the measures required for—

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

(b) final rehabilitation, decommissioning and closure of the prospecting, exploration, mining or production operations at the end of the life of operations, as reflected in a final rehabilitation, decommissioning and mine closure plan; and

(c) remediation of latent or residual environmental impacts which may become known in the future, as reflected in an environmental risk assessment report.

1.1 The annual rehabilitation plan

The annual rehabilitation plan provide for concurrent or progressive rehabilitation and contain information that defines activities on an annual basis and how these relate to the Final closure vision, as detailed in this final rehabilitation, decommissioning and mine closure plan.

The objective of the annual rehabilitation plan is to─

- review concurrent rehabilitation and remediation activities already implemented;
- establish rehabilitation and remediation goals and outcomes for the forthcoming 12 months, which contribute to the gradual achievement of the post-mining land use, closure vision and objectives identified in the holder's final rehabilitation, decommissioning and mine closure plan;
- establish a plan, schedule and budget for rehabilitation for the forthcoming 12 months;
- identify and address shortcomings experienced in the preceding 12 months of rehabilitation; and
- evaluate and update the cost of rehabilitation for the 12 month period and for closure, for purposes of supplementing the financial provision guarantee or other financial provision instrument.

Taking into acount the objective of the annual rehabilitation plan it is clear that it cannot form part of the environmental management programme to be submitted in terms of section 24N of the Act and the Environmental Impact Assessment Regulations, 2014 but will be submitted on an annual basis as part of the environmental audit report in terms of Regulation 34 (1)(b) of the NEMA EIA Regulations (2014).

1.2 Final rehabilitation, decommissioning and mine closure plan

According to the NEMA Financial Regulations the final rehabilitation, decommissioning and mine closure plan will form a component of the environmental management programme to be submitted in terms of section 24N of the Act and the Environmental Impact Assessment Regulations, 2014 and will be subjected to the same requirements of the environmental management programme with regards opportunities for stakeholder review and comment as well as auditing.

The objectives of this final rehabilitation, decommissioning and mine closure plan is to to identify a post-mining land use that is feasible through-

- providing the vision (goals), objectives, targets and criteria for final rehabilitation, decommissioning and closure of the project;
- outlining the design principles for closure;
- explaining the risk assessment approach and outcomes and link closure activities to risk rehabilitation;

- detailing the closure actions that clearly indicate the measures that will be taken to mitigate and/or manage identified risks and describes the nature of residual risks that will need to be monitored and managed post closure;
- committing to a schedule, budget, roles and responsibilities for final rehabilitation, decommissioning and closure of each relevant activity or item of infrastructure;
- identifying knowledge gaps and how these will be addressed and filled;
- detailing the full closure costs for the life of project at increasing levels of accuracy as the project develops and approaches closure in line with the final land use proposed; and
- outlining monitoring, auditing and reporting requirements.

This document fulfill the requirements of the Final rehabilitation, decommissioning and mine closure plan and is submitted as a seoerate document as it needs to be reviewed in an annual basis.

1.3 Environmental risk assessment report

According to the NEMA Financial Regulations the environmental risk assessment report will also form a component of the environmental management programme to be submitted in terms of section 24N of the Act and the Environmental Impact Assessment Regulations, 2014 and will be subjected to the same requirements of the environmental management programme with regards opportunities for stakeholder review and comment as well as auditing.
The objective of the environmental risk assessment report is to—

- ensure timeous risk reduction through appropriate interventions;
- identify and quantify the potential latent environmental risks related to post closure;
- detail the approach to managing the risks;
- quantify the potential liabilities associated with the management of the risks; and
- outline monitoring, auditing and reporting requirements.

The Environmental risk assessment form part of the BAR.

2 CONTEXT OF THE CLOSURE PLAN

Three approaches were employed to identify the key aims for the closure process that form part of the plan:

- Technical assessments which involved the recording of the project activities over the full life cycle of the mining operation (including closure) and the consequent potential impacts on the environment (including cumulative impacts). This resulted in the compilation of a draft closure plan that facilitated discussions with the authorities as well as Interested and Affected Parties (I&APs).
- Identification and consultation with the relevant authorities to record their requirements as well as public meetings with I&APs to solicit/record their suggestions/issues/concerns.
- The collection of available/published environmental data, the review thereof for adequacy and hence the identification of the need for more comprehensive environmental studies/investigations and/or further information gathering.

Subsequent to the above activities/processes, advertisements of the operation were placed in local newspapers to notify I&AP's about the intended projects and invitations to register and participate in the consultation process.

As a result of the consultation and recommendations from the environmental studies/investigations completed the company identified three key closure goals for the final decommissioning and closure of the mining operation that are listed below.

- To create a safe and healthy post-mining environment with no residual environmental impact.
- To create a stable, free draining post mining landform, which is compatible with the surrounding landscape
- To provide optimal post-mining social opportunities

Each goal is supported by a suite of key objectives and activities which are elaborated on in section 3 of this report. This report also describes how these objectives are planned to be met and elaborate on the implementation of certain risk mitigation actions (section 5). Aftercare and maintenance of rehabilitated sites is often the difference between the ultimate successes or failure of rehabilitation and monitoring of rehabilitation will determine whether rehabilitation objectives and requirements are being achieved (section 4).

Several pieces of legislation are applicable to mine closure. Importantly, public participation is an integral part of mine closure and the process followed needs to fulfil the requirements of all relevant legislation. The following government departments have been identified amongst others as playing a key role in the closure process:

- Department of Minerals Resources (DMR). Lead agent, facilitator of closure inspections and issues the closure certificate,
- Department of Water and Sanitation (DWAS). Lead agent for potential water related issues and signs off on the mine closure certificate. Cancellation of Water Use license.
- Provincial Department of Environment and Nature Conservation. Gives input into the closure plan and guides and monitors protection of the natural environment.
- The local municipality and district municipality. Gives input into the mine closure plan and interfacing thereof with their integrated development plan (IDP) of the local area.

2.1 Overall operation

The proposed Granite mining area is situated on a 5ha portion of Plot 2100 Concordia Township, which is zoned as Agriculture 1. The granite mining operation is to be carried out by the Applicant, Golden Tropic Mining (Pty) Ltd.

<u>Logistics:</u>

Most of the logistics to be used during mining is available at any of the nearby business hubs and at the quarry satellite logistics are supplied.

Development of infrastructure and waste management facilities still needs to be implemented as part of the construction phase, only for facilities not available at any of the nearby business hubs.

<u>Granite Waste Dumps</u>

Waste dumps must be designed to meet minimum slope stability and safety standards and vegetated with reduce erosion and runoff.

In view of the fact that the flat terrain of the project site and existing waste dumps with limited topsoil available, the best option for waste dumps is excavations to bedrock and filling and levelling the top of these dumps "heaped fill".

2.2 Project Description

This mining operation can be classified as quarrying the open, or surface excavation of granite. Quarrying start from the earth's surface and maintain exposure to the surface throughout the extraction period. For both access and safety, the excavation usually has stepped or benched side slopes. Quarrying methods depend mainly on the desired size and shape of the stone and its physical characteristics and the main equipment used is diamond saws (Rotary saws). Diamond saws are large diamond-impregnated circular blades up to 2 m in diameter that are used to form vertical cuts in the rock by moving the machine along a guideline or rail. Extremely accurate cuts can be made in this way. Wire saws are also used, these consist of several pulleys over which passes an endless carborundum or diamond-impregnated steel wire. The project can be divided in three phases as follow:

- Construction, including the planning and implementation phases, creation of infrastructure, mine or pit footprint, access ramps and haul roads, waste, residue and product stockpiles, handling areas, water reticulation and electrical power.
- Operation, including daily activities, mine development and expansion.
- Decommissioning and Closure, including scaling down of activities ahead of temporary or permanent closure, cessation of mining or production, implementation of rehabilitation program, monitoring and maintenance for prescribed period after cessation of operations; and closure, including completion of rehabilitation goals, application for closure, transfer of liability to the State and agreed post-closure monitoring or maintenance

2.2.1 Construction phase

Most of the logistics to be used during mining is available at any of the nearby business hubs and at the quarry satellite logistics are supplied. Development of infrastructure and waste management facilities still needs to be implemented as part of the construction phase, only for facilities not available at any of the nearby business hubs, and when fully developed the logistics area with waste management facilities will consist of the following:

- Access and Haul Roads
- With regard to access to the mine the existing roads will be used and must be upgraded and maintained as haul roads for trucks as needed by the mine.
- Refer to Diagram 3 for the location of the existing farm tracks that provide access to the proposed project site.
- Existing farm tracks will be used as haul roads and no new roads will be developed.
- Services and associated infrastructure
- Water will be sourced from the local authority and trucked onto site to be stored in 5 000-liter plastic tanks.
- Electrical supply for the rock saws and logistics are generated by mobile gensets.
- Accommodation and Logistics Surface disturbance
- Accommodation will be arranged at any of the nearby business hubs
- Mobile shipping containers to be used for site office and secure storage area.
- The sorting and dispatch yard together with stockpile area for low grade blocks to be demarcated and the footprint contained.
- A demarcated laydown area to be demarcated and the footprint contained.
- A demarcated salvage yard for temporary storage of scrap to be demarcated and the footprint contained.
- Petrochemical and hazardous waste including contaminated/used spares, filters and used to be collected and stored in special containers with spill containment measures and transported weekly to be disposed at a registered disposal site.
- Waste management facilities
- Bio cell for bioremediation of any potential petrochemical pollution
- The generators need to be supplied with generator bays with a sump for collection of spills and contaminated run off
- Domestic waste will be collected in plastic containers and transported on a regular basis to

the municipal waste disposal site.

- Oil/grease/diesel management systems
- Provision of drip trays for stationary equipment in the parking area and service bay
- Contaminated soil and sludge from the collection sumps will be treated in a bio cell (soil farm) to be provided on site.

2.2.2 Operational phase

The mining method consist of:

- The establishment of a flat floor through the use of diamond wire saws.
- The flat floor is then fitted with parallel rails which serve the rotary saws which cut blocks from the ore body with less waste than other systems. The saws have a diameter of 3-4m.
- Cutting will be done according to benches not higher than 2meters so as to ensure at final closure no high wall will be left that needed to be profiled and the remaining steps will blend in with the natural topography of the area.
- A total of four benches will be developed.
- The base of the blocks is separated by small diameter plug and feather technique.
- The raw cut block is lifted out of the hole and placed for transport by block carrying front end loader to the dressing area.
- At the dressing area, the block is neatened up through removal of any protuberances and the 1st grade blocks are then transported to the dispatch yard and the 2nd grade blocks to a separate stockpile area.
- Waste blocks and offcuts are transported by block carrying front end loader to the waste rock dump. Excavators are used to keep the top of the waste dump level to promote traffic movement.
- At final closure of the operation all remaining product (blocks) from the demarcated dispatch yard and low-grade stockpile area will be removed to the waste rock dump or stacked within the quarry against the remaining high wall or used to fill any remaining deep excavations if any.
- In the case of "heaped fill" waste dumps, excavations with the final designed perimeter of the dump will be created to obtain cover material for the top of the dumps and profiling the slope of historic dumps to be extended.
- The excavations will serve as a base for extending the waste dump. Thereafter, dumping will proceed above surface on the top of this buried dump at successive tiers with an appropriate height of around 6 to 10m, leaving terraces of 6m wide and working from the perimeter toward the center.
- This will allow for reclamation of the outside profiles at a much earlier stage, resulting in very little outstanding reclamation toward the end of the life of the dump.

2.2.3 Decommissioning and closure phase

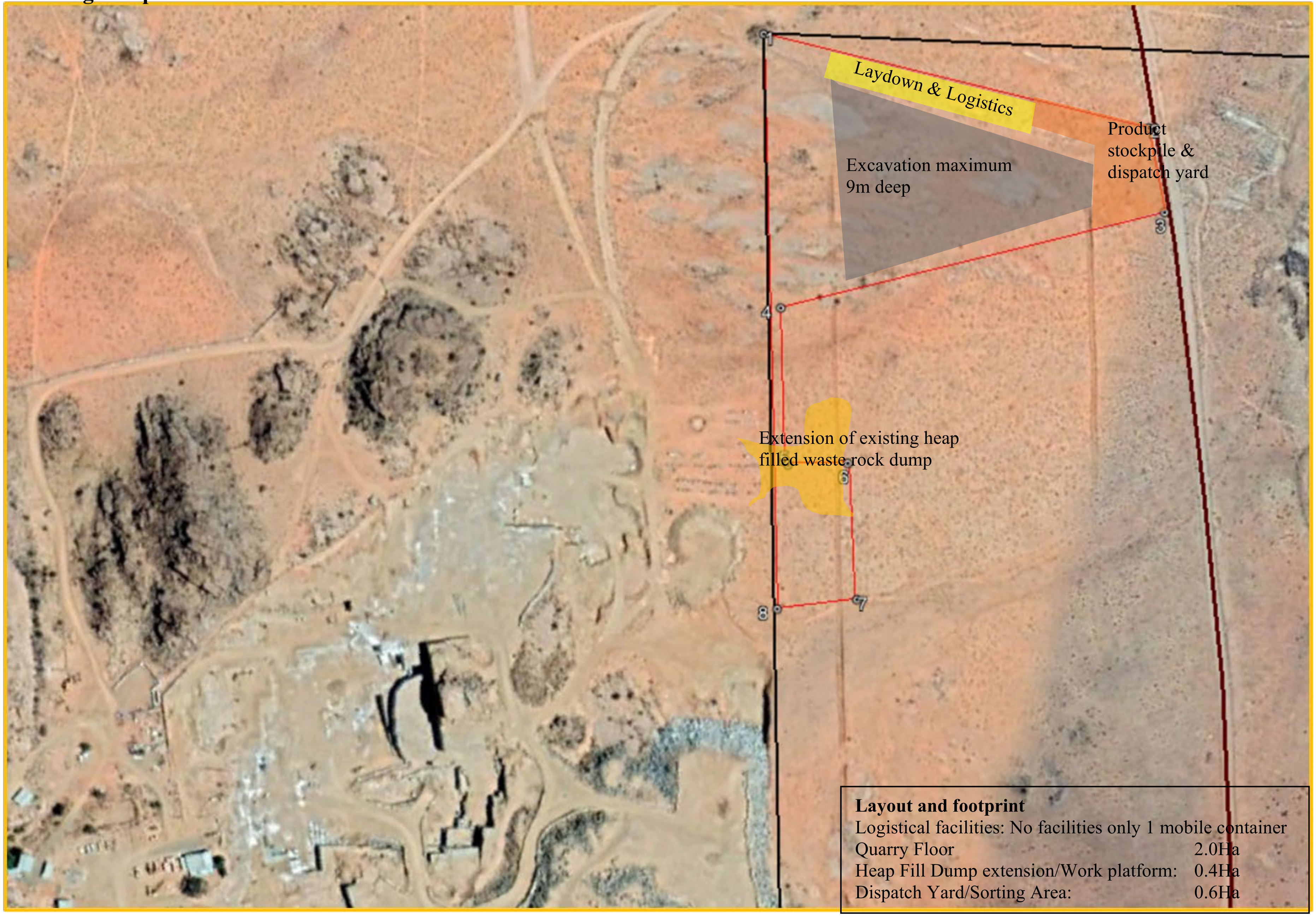
Planning for closure and restoration from the beginning of an operation makes the process more efficient:

- Waste can be removed as it is created,
- Excavation can be planned so that topography restoration is less complicated, and
- Topsoil can be re-used at shorter interval.
- Site rehabilitation can make the land more valuable and attractive for resale. Additionally, establishing a closure strategy (and communicating that activity to the public) can help enhance the company’s reputation as a socially-responsible operation.
- Rehabilitation is carried out on a continuous basis as work progresses. Such rehabilitation is undertaken by scarifying the disturbed and or compacted areas to promote natural

revegetation. This will be monitored continuously to ensure effective restoration and revegetation of disturbed areas. The rehabilitation work will be conducted in-house under the supervision of an ECO.

The decommissioning and closure phase at the end of the life of the mine will consist of implementing this final rehabilitation, decommissioning and closure plan.

2.3 Mine design map



3 CLOSURE PLAN AND SCHEDULE

3.1 Environmental Authorisation (EMP) requirements

The key closure objective described in the plans submitted as part of the Environmental Authorisation (EA) is to ensure that the affected environment is maintained in a stable condition that will not be detrimental to the safety and health of humans and animals and that will not pollute the environment or lead to the degradation thereof. The aesthetic value of the area will also be reinstated.

The main closure objective is to leave the site in as safe and self-sustaining a condition as possible and in a situation where no post-closure intervention is required. This key closure objective is divided in three closure objectives as stated below with their supported suite of key mitigating activities.

The objectives to meet the set goals as applied to the final decommissioning and mine closure can be summarised as follow:

- Objective 1 - To create a safe and healthy post-mining environment
  - ➢ Safe excavations
    - Slope stability of remaining excavation
    - No potentially dangerous areas secured if required
  - ➢ Limited residual environmental impact
    - Develop a landscape that reduces the requirement for long term monitoring and management
    - No surface and/or groundwater contamination
    - Waste management practices not creating or leaving legacies
- Objective 2 - To create a stable, free draining post mining landform, which is compatible with the surrounding landscape
  - ➢ Economically viable and sustainable land, as close as possible to its natural state.
    - Prepare area to promote natural re-establishment of vegetation that is self-sustaining, perpetual and provides a sustainable habitat for local fauna and successive flora species
    - Prevent long term changes in land use by implementing prompt rehabilitation and maintenance of disturbances when possible as part of annual rehabilitation plan.
  - ➢ Stable, free draining post mining landform
    - Prevent alteration or diverting natural drainage lines and reduced natural runoff.
    - Prevent concentration of runoff, mixing of clean runoff with contaminated runoff and creation of large open water bodies.
- Objective 3 – To provide optimal post-mining social opportunities
  - ➢ Optimised benefits for the social environment
    - Positive and transparent relationships with stakeholders and maintaining communication channels, providing stakeholders including government authorities with relevant information as per legislative requirements.
    - Undertaking environmental management according to approved EMP and Closure plans and regular auditing of the environmental management system.
  - ➢ Minimal negative aesthetic impact
    - Mitigate the nuisance effects of air emissions (dust), visual intrusion and the cumulative effect of a raise in the ambient noise levels
    - Prevent disturbance of archaeological sites and implement mitigating measures according to the archeological assessment.

3.2 Final Decommissioning and Closure of Mining Operation

From the point of view of the environmental impact created, dimension stone mining is a relatively benign industry. There are no emissions besides those of the diesel-powered earthmoving equipment utilised in its extraction and a small amount of blasting gases. Contamination of water resources is only likely in the event of petrochemical spillages from storage facilities and equipment, and these can largely be either prevented or cleaned up effectively.

Similarly, mining methods themselves generally have a low impact on the surrounding environment due to the need to carefully extract large blocks or slabs without damage to the stone. Recent advances in dimension stone mining technology have also had the effect of reducing environmental impacts. Particularly in granites, improvement in diamond wire sawing and rotary saw efficiency has significantly reduced the use of explosives in the extraction of blocks. This has resulted in higher recovery of saleable blocks and therefore less waste to be disposed of, as well as reducing the emissions of blasting gases (S02 and NOX), noise and ground vibration.

According to Ashmole and Motloung (2008) the major environmental impacts are of a visual nature, while in sensitive areas, habitat destruction and the destruction of archaeological heritage may become significant impacts but as the environmental impacts is often highly visible in comparison with the environmental impacts of other industries the attitude of the general public is based on the erroneous assumption that adverse visual impact is the same as severe environmental impact.

However, the environmental impacts of dimension stone are generally not significant, are mainly of temporary duration, and can be effectively managed. While there is an economic cost to limiting environmental impacts, these costs are not significant in dimension stone mining if proper planning and consideration is applied from the exploration stage through to mine closure.

Concurrent or progressive rehabilitation of disturbed areas is good practice and should be undertaken as this offers a number of such as limiting the mine's environmental liability and limiting costs at closure as rehabilitation is included in the operational activities of the mine.

Rehabilitation measures to be implemented include improving the visual appearance of the disturbed areas, establishing a cover to provide erosion control, improving runoff water quality by minimising silt loads and controlling dust.

Concurrent rehabilitation and remediation are provided for in the annual rehabilitation plan and contain information that defines activities on an annual basis and how these relate to the Final closure vision, as detailed in this final rehabilitation, decommissioning and mine closure plan.

Annual reviews in terms of regulations 6(a) and 11(1)(a) of the NEMA Financial Regulations, that form part of the Annual Environmental Audit, assesses what closure objectives and criteria are being achieved through the implementation of the plan.

While some disturbed areas can be rehabilitated on a progressive basis during operation, others cannot be rehabilitated until mining is complete. For this reason, some rehabilitation is generally still required during and after closure.

Remedial initiatives to minimize environmental impact during and after mining can be divided into three main categories:

Firstly, the removal of surface infrastructure that cannot be used for other purposes.

Secondly, the remediation and rehabilitation of old pits to remove the hazard they present to people and animals. Earthworks and contouring the mine area to as close as possible to the pre-mining landscape. This includes filling pits, trenches and small excavations; making pit side's safe and covering the surface area with subsoil and topsoil as necessary; and mitigation or restoration of all surface disturbances and revegetation of the pit slopes and waste rock dumps.

Lastly, the removal and isolation of potential pollutants from the environment. Containment and treatment of contaminated water and correct storage and removal of hazardous materials. Waste rock present specific problems, as they are unsuitable for other uses. For this reason, all waste rock and even low-grade product produced are destined to remain in the environment. Where possible, natural systems will be used to control water pollution and vegetation cover should limit windblown dust pollution. Gradients will be reduced to levels where erosion is minimal, and potentially polluting wastes will be capped to prevent infiltration.

Areas that are not covered during concurrent rehabilitation as described in the Annual rehabilitation plan that require specific intervention as part of this final rehabilitation, decommissioning and mine closure plan are discussed below. In order to make a value judgement regarding activities that must be controlled during mining, the operation was assessed relative to best practice principles.

3.2.1 Infrastructure and Logistics area

i. Basic rehabilitation methodology

The main post closure objective for the infrastructure area is to leave the site in as safe and self-sustaining a condition as possible and in a situation where no post-closure intervention is required. The aim is to ensure that the affected environment is maintained in a stable condition that will not be detrimental to the safety and health of humans and animals and that will not pollute the environment or lead to the degradation thereof. The aesthetic value of the area will also be reinstated.

The general approach adopted is the complete removal of all infrastructure and equipment and to reuse all infrastructures and equipment at another location by the company. Redundant structures, buildings and civil foundations (down to one meter below surface for subsurface infrastructure) will be removed for use elsewhere or demolished and discarded. All steel structures and reinforcing will be discarded or sold as scrap. Building rubble will be buried together with any remaining waste blocks. The compacted salvage yard, lay down and movement areas will be screened for petrochemical spills and cleaned before it is ripped and leveled. All redundant water pipes, pumps, power lines and cable associated with raw water and electrical supply will be removed. Service roads needs to be maintained and handed over to the landowner in a good state of repair and all redundant fences needs to be removed. All temporary waste storage areas need to be cleaned out and waste removed. Waste material of any description, including receptacles, scrap, rubble and tyres, will be removed entirely from the complete mining area and disposed of at a recognised landfill facility. It will not be buried or burned on the site. The risk sources in the context of the receiving environment within the infrastructure and logistical area are provided below and shown in diagram 1 with quantification that form part of the section 6 'Quantified Closure elements.

ii. Risk sources

- Access and Haul Roads
- Services and associated infrastructure
- Accommodation and Logistics Surface disturbance
- Waste management facilities
- Oil/grease/diesel management

3.2.2 Quarry and waste dumps

i. Basic rehabilitation methodology

Granite mining operations commonly have a permanent impact on rock masses that influences the topography on the site and can impact post-mining slope stability. As the ore body is traced deeper and deeper into the ground a series of benches for both access and safety needs to be

used. Sometimes rock surrounding the ore has to be removed so that the sides of the pit do not become dangerously steep.
The influence on topography can only be partially mitigated during rehabilitation and the opportunities for land use following open-pit mining are limited, because it is very expensive to fill the pit. The main objective is usually to make the pit walls safe and to landscape the waste rock dumps. Due to semi-arid conditions, the opencast pits in this case will not intercept shallow groundwater table zones with resulting water-make in the pit that will require pumping and storage in order to reduce inundation of active areas.
During operations, all waste will be dumped in a heap fill waste dump to be developed.

The post closure objective is to restore the land to its pre-mining carrying capacity for stock farming considering the altered landform on the mining area due to mining activities and the absence of natural vegetation on the granite domes. Re-vegetation of disturbed areas will follow a process of natural plant succession starting with pioneer plants Post mining topography for most of the area will follows the original landform shape except where changes due to quarrying or waste dumps has occurred.

The main closure objective therefore is to leave the site in as safe and self-sustaining a condition as possible and in a situation where no post-closure intervention is required. The aim is to ensure that the affected environment is maintained in a stable condition that will not be detrimental to the safety and health of humans and animals and that will not pollute the environment or lead to the degradation thereof. The aesthetic value of the area will also be reinstated.

The basic rehabilitation methodology will therefore strive to replicate the pre-mining topography, wherever possible, or at least not to increase overall slope gradients without emplacement of adequately designed erosion control or runoff diversion structures.
The risk sources in the context of the receiving environment within the mining area are provided below and shown in diagram 1 with quantification that form part of the section 6 'Quantified Closure elements.

ii. Risk sources

- Opencast workings and excavations (including final voids and ramps)
- Residue deposits overburden and spoils

4 AFTERCARE AND MAINTENANCE

Maintenance of rehabilitated sites is often the difference between the ultimate successes or failure of rehabilitation and monitoring of rehabilitation will determine whether rehabilitation objectives and requirements are being achieved.
As the final phase in the project cycle, decommissioning may present positive environmental opportunities associated with the return of the land for alternative use and the cessation of impacts associated with operational activities.
Depending on the nature of the operational activity, the need to manage risks and potential residual impacts may remain well after operations have ceased. Examples of potential residual impacts and risks include erosion, slow recovery of vegetation, stock that has been abandoned (e.g. oil drums, scrap equipment) and old (unserviceable) structures.
The main closure objective is to hand back the rehabilitated properties in a stable condition that will not be detrimental to the safety and health of humans and animals and that will not pollute the environment or lead to the degradation thereof. The aim therefore is to leave the site in as safe and self-sustaining a condition as possible and in a situation where no post-closure

intervention is required. Aftercare and maintenance required can only be identified post decommissioning and depending on success of rehabilitation and mitigating measures.

5 Risk Assessment

5.1 Risk impact rating

Refer BAR

5.2 Risk Identification

The potential risks arising from the operation are generic for any granite mine and listed below.

5.2.1 Potential Risks with regard to Safe excavations

- Collapsing slope(s) of high walls can be detrimental to the safety and health of humans and animals.
- Potentially dangerous areas like high walls or equipment left behind and uncontrolled access to a potentially unsafe post-mining area
- Post mining topography not compatible with original landform.
- Unsafe erosion gulley's

5.2.2 Potential Risk of residual environmental impact

- Post mining landscape that increases the requirement for long term monitoring and management.
- Unwanted ruins, buildings, foundations, footings and waste management practices creating or leaving legacies.
- Sub-surface infrastructure remaining behind, limiting the intended post closure land use including footings and foundations and power supply and water installations including pumps and pipelines.
- Equipment and other items used during the mining operation left behind.
- Incomplete removal of re-usable infrastructure.
- Rubble from demolished infrastructure left behind.
- Waste classes not kept in separate streams and incomplete removal of waste
- Large volumes of large blocks and boulder rubble that requires large dumping areas.
- Creation of waste rock residue deposits or stockpiles with infiltration of leachate due to inadequate basal sealing or leakage from sealed pollution control facilities.
- Stockpiles and leftover product left behind
- Increased erosion, dust generation and potential chemical contaminants reduce surface water quality or result in discharge that exceeds the maximum concentrations permitted.
- Vehicle wash bays and workshop facilities produce petrochemical and solvent contaminated runoff.
- Sanitary conveniences, fuel depots or storage facilities of potentially polluting substances can contaminate surface water.
- Oil fuel leaks onto virgin soil through the earthmoving and transport equipment and machinery or spillage of fuel during transfer from fuel bowser to equipment in the field.
- Drainage of benches and concentration of rainfall leads to creation of large volume open water bodies in worked out pit and can lead to increased groundwater recharge and potential regional impact of low-quality water.
- Pumping of process water from the pit sump can discharge poor quality water exceeding minimum standards.

5.2.3 Potential Risks with regard to economically viable and sustainable land, as close as possible to its natural state.

With granite mines, complete disruption of the surface always occurs, which affects the soil, fauna, flora and surface water, thereby influencing all types of land use. Opencast mining and related infrastructure are a permanent destruction and rehabilitation cannot restore all pre-mining habitats. Granite quarries cannot be completely refilled and form permanent depressions that must be accommodated through imaginative utilisation during the post-closure period and the residual impact of open-pit mining is usually a completely different land use. Risks associated with economically viable and sustainable land include:

- Uncontrolled expansion of mining footprint by not restricting the area disturbed by mining and the associated activities/infrastructure - loss of land with agricultural potential.
- Uncontrolled development of roads - existing farm roads not used for mining operations and redundant internal roads left behind. Duel used roads still needed by the landowner and fences not maintained or repaired.
- Post mining landform not compatible with the surrounding landscape and not capable of a productive land use that achieves a land capability equal to that of pre-mining conditions
- Long term changes in land use caused by not implementing prompt rehabilitation and maintenance of disturbances when possible as part of annual rehabilitation plan.
- Unsuccessful rehabilitation can reduce the post-mining land use options. Rehabilitated areas could be too unstable to support post-mining land use objectives compatible with surrounding areas.
- Disturbance of agricultural potential and subdivision of high potential arable land into uneconomic farming units. Inadequate planning or loose development can subdivide high potential land or habitats into un-viable small areas.
- Disturbance of ecology due to loss of habitat and cumulative impact of illegal collecting or land use during long-term or life of mine can degrade areas and reduce the viability of adjacent areas. Inadequate control of alien species can result in establishment of populations or seed sources that threaten adjacent areas.

5.2.4 Potential Risks with regard to stable, free draining post mining landform

Opencast pit creates area of lowered topography that can act as a sump for storm water runoff and intersects groundwater and if the operation extends to depths below the water table, it will affect the near-surface groundwater. Apart from reducing natural recharge to the shallow and deep groundwater zones, the increased runoff and altered storm hydrograph will also impact areas downstream or downslope where the flow is concentrated.

- Impact on surface water through modification of infiltration rates by increasing the extent of hardened surfaces.
- Inadequate topsoil restoration or creation of un-natural surface topography or slope form which could impact lower or adjacent slopes due to increased runoff velocity.
- Altered storm water runoff response due to large impervious areas and concentrated runoff in drainage systems. Concentrated storm runoff from the pit surrounds and infrastructure areas is erosive, causing sheet, rill and donga erosion features.

5.2.5 Potential Risks with regard to benefits for the social environment

- No positive and transparent relationships with stakeholders and not maintaining communication channels – not providing stakeholders including government authorities with relevant information as per legislative requirements.
- Not undertaking environmental management according to approved EMP and plans and no auditing of the environmental management system.

- Disturbance to sensitive environments such as land with historical or conservation value, urban areas, wetlands or rivers, high potential agricultural land, transport infrastructure, power transmission lines. Slow continuous damage to habitat e.g. wood collection are typical impacts on adjacent areas.
- Staff losing their jobs - mine closure can have devastating effects on communities that are reliant on mine-based income Job losses of secondary industries, businesses and contractor's Contractual agreements with service providers surpassing mine closure date
- Closure standards not accepted and/or are changing. Mine closure being jeopardised by other land uses
- Poorly defined transition from mining to farming activities within different legislation
- Mine closure stalled due to non-compliance with South African legislation (national, provincial and local)
- Insufficient funds for complete rehabilitation

5.2.6 Potential Risks with regard to aesthetic impact

Terrain morphology plays a critical role in defining the visual envelope of mining developments and can either reduce or enhance visual impact. Apart from visual intrusion there is also the risk of reduced sense of place. Visual intrusion impact of mining activity on nearby roads, homesteads, settlements, tourist sites.

- Visual disturbance from the public road views – excavations or overburden dumps blocking the view. Large buildings, colour contrast of disturbed areas against adjacent veld or dust emission plumes
- Nuisance effects of air emissions (dust) no implementation and maintenance of dust monitoring programs accompanied by dust suppression activities if required.
- Accumulation of spoils from rock saws (fines) can expose highly erodible fine sediment to wind transport and lead to dust generation and dispersal. Dust can retard vegetation growth and reduce the palatability of vegetation.
- Dust generated on haul roads reduces visibility in opencast pit, representing a safety hazard.
- The cumulative effect of a raise in the ambient noise levels or high noise levels in specific areas that exceed specified levels. Noise disturbance and light pollution as a result of night activities.
- Disturbance of archaeological sites not implement mitigating measures according to the archeological assessment. Progressive development can encroach upon or disturb archaeological sites, cultural heritage sites or graves.

5.3 Risk Mitigation and Closure objectives

Internationally, there seem to be three schools of thought with regard to closure objectives:

- "What the affected community wants, the affected community gets" – that is, the key focus is on providing the end product requested by the affected communities, rather than focusing on the previous status quo of the receiving environment
- "Restoration of previous land use capability" – the original thought process in the South African context, because mining often occurs on land with high agricultural potential
- "No net loss of biodiversity" – the focal point in the ICMM/IUCN dialogue sponsored guidelines for mining and biodiversity, and of many mining corporate policies.

The thought process for the closure of this operation is based on the last two. In addition to the goals and objectives for final decommissioning and mine closure the vision for the post closure land form is to leave the site in as safe and self-sustaining a condition as possible and in a situation where no post-closure intervention is required. The vision is to ensure that the affected environment is maintained in a stable condition that will not be detrimental to the

safety and health of humans and animals and that will not pollute the environment or lead to the degradation thereof and that the aesthetic value of the area will be reinstated.
For the vision to be realised the objectives and associated risk management strategies and mitigating measures described below needs to implemented, monitored and evaluated.
Risk management strategies were identified for the potentially significant risks, while data collection and analysis programmes were pursued to evaluate the uncertain risks.
The aim with risk mitigation actions is to over time manage significant (red) and medium (yellow) risks to become insignificant (green), or at least medium and under control with management actions. Once achieved, a risk will continue to be monitored to confirm its insignificance rating of green (1) medium and controlled rating of yellow (2) as part of aftercare and maintenance.

The closure process involves a series of actions, executed over a number of years as indicated in the annual closure plans, with continual monitoring, review and remedial actions (if required). Identified and assessed risks feed into mitigation actions (or primary tasks) of which successful implementation result in achievement of the mine closure goals and objectives.

The three key mine closure objectives are elaborated on in more detail and in context of the relevant risks below (each of the objectives are supported by several key aims):

- Objective 1 - To create a safe and healthy post-mining environment
    - ➢ Safe excavations
    - Slope stability of remaining excavation
    - No potentially dangerous areas secured if required
    - ➢ Limited residual environmental impact
    - Develop a landscape that reduces the requirement for long term monitoring and management
    - No surface and/or groundwater contamination
    - Waste management practices not creating or leaving legacies
- Objective 2 - To create a stable, free draining post mining landform, which is compatible with the surrounding landscape
    - ➢ Economically viable and sustainable land, as close as possible to its natural state.
    - Prepare area to promote natural re-establishment of vegetation that is self-sustaining, perpetual and provides a sustainable habitat for local fauna and successive flora species
    - Prevent long term changes in land use by implementing prompt rehabilitation and maintenance of disturbances when possible as part of annual rehabilitation plan.
    - ➢ Stable, free draining post mining landform
    - Prevent alteration or diverting natural drainage lines and reduced natural runoff.
    - Prevent concentration of runoff, mixing of clean runoff with contaminated runoff and creation of large open water bodies.
- Objective 3 – To provide optimal post-mining social opportunities
    - ➢ Optimised benefits for the social environment
    - Positive and transparent relationships with stakeholders and maintaining communication channels, providing stakeholders including government authorities with relevant information as per legislative requirements.
    - Undertaking environmental management according to approved EMP and Closure plans and regular auditing of the environmental management system.
    - ➢ Minimal negative aesthetic impact

- Mitigate the nuisance effects of air emissions (dust), visual intrusion and the cumulative effect of a raise in the ambient noise levels
- Prevent disturbance of archaeological sites and implement mitigating measures according to the archeological assessment.

The legal framework within which all the above lies entails:

- Defining and meeting closure standards.
- Complying with legislation.
- Sufficient financial provision for mine closure activities.
- Monitoring and plan for latent environmental impact.

The closure process involves a series of actions, with continual monitoring, review and remedial actions (if required). Identified and assessed risks feed into mitigation actions (or primary tasks) of which successful implementation result in achievement of the mine closure objectives and aims. Risks associated with each closure objectives are discussed with their mitigation actions and believed impact rating at closure. In addition, the closure standard for each key aim is listed and quantified. Financial provision is made in section 6 to deal with these mitigating measures in case of temporary closure or sudden closure during the normal operation of the project or at final planned closure.

5.3.1 Create a safe and healthy post-mining environment

a) Safe post mining landscape without long term monitoring and management

Steep high walls are potentially unstable and failure can impact areas away from the opencast pit rim. The stability of the rock mass is determined by the three-dimensional orientation and spacing of joint planes, shear zones or faults and fracture planes and their intersection with the natural structural grain of the rock or landforms. The structural properties required of a successful dimension stone is for a massive and competent ore body without faults and fractures and any remaining high wall or slope will therefore be stable. The risks associated with a safe post mining landscape is as follow:

- Collapsing slope(s) of mine pit can be detrimental to the safety and health of humans and animals.
- Potentially dangerous areas like deep mine pit or equipment left behind and uncontrolled access to a potentially unsafe post-mining area
- Post mining topography not compatible with original landform.
- Unsafe erosion gulley's

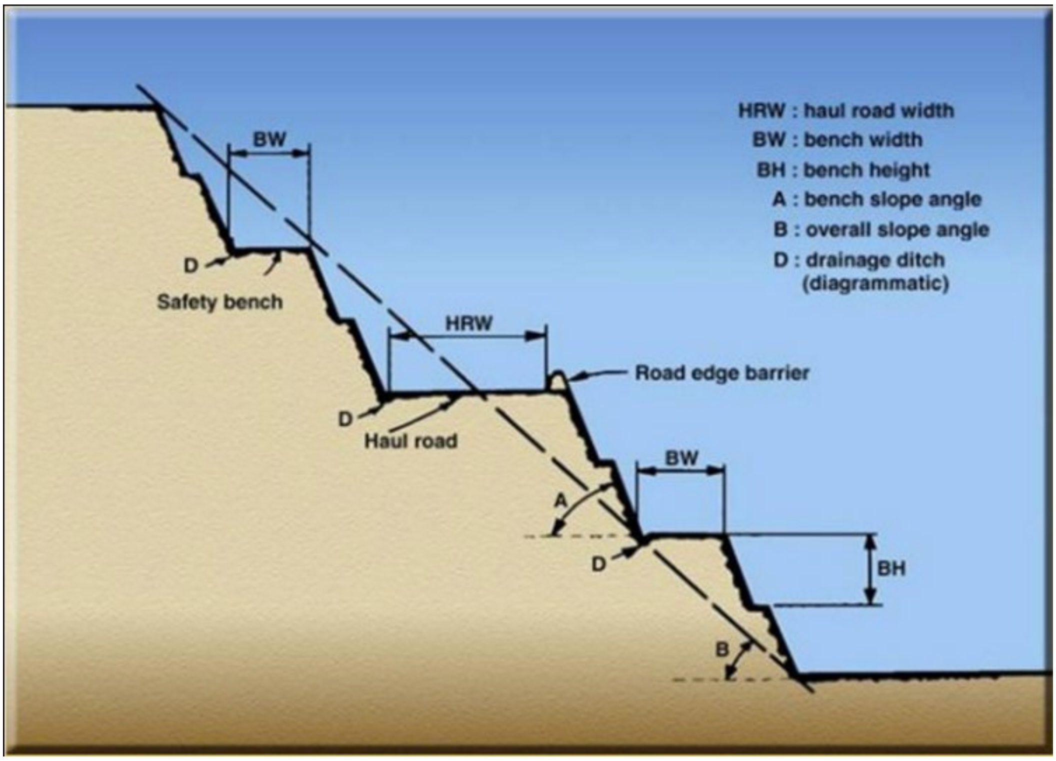
The focus of topographic rehabilitation may not be obvious at the time of mine planning and must be addressed as the mine develops and the CP must be reviewed periodically for continued relevance in the light of changed mine path or long-term plans.

Implementation of the following tasks to manage the risks associated with high wall stability of the quarry and slope stability of the waste dump will ensure a safe post mining landscape without the requirement for long term monitoring and management. Regular inspections and audits will be used as management system to ensure compliance.

- Due to cutting with circular saws smaller and vertical benches of average 1m are created that can be planned so as to prevent an excessive high wall remaining.
- During construction terrain form will be used to shield opencast pit from developed or sensitive areas as protection in the unlikely event of high wall or slope collapse.
- During production, the height of high walls will be reduced by separating benches to increase stability.
- Overall slope angle between 60° and 70° will fit in with the natural topography of the mountainous terrain and due to the massive and competent nature of the ore body will still be stable (Figure 1).

- At final closure, geotechnical investigations will identify unstable rock conditions, slopes that require support in the short-, medium- and long-term. Geotechnical slope stabilisation methods including concreting (gunnite), rock bolting, wire mesh restraint, bench wrecking to lower high walls, rehabilitative blasting etc. will be investigated and implemented during decommissioning.
- A row of blocks will be packed in a straight line at the base of the high wall to reduce the overall height as an additional preventative measure, minimizing safety risks. After the rehabilitation phase no maintenance will be required as the blocks will be permanent fixtures that can only be moved via front end loaders.
- The final slope of the pit floor would be towards the drainage channel to prevent collection of storm water. During operations pump rainwater that collects in the pit and store for use as process water or dust suppression.

Figure 1: A simple diagram showing different design parameters

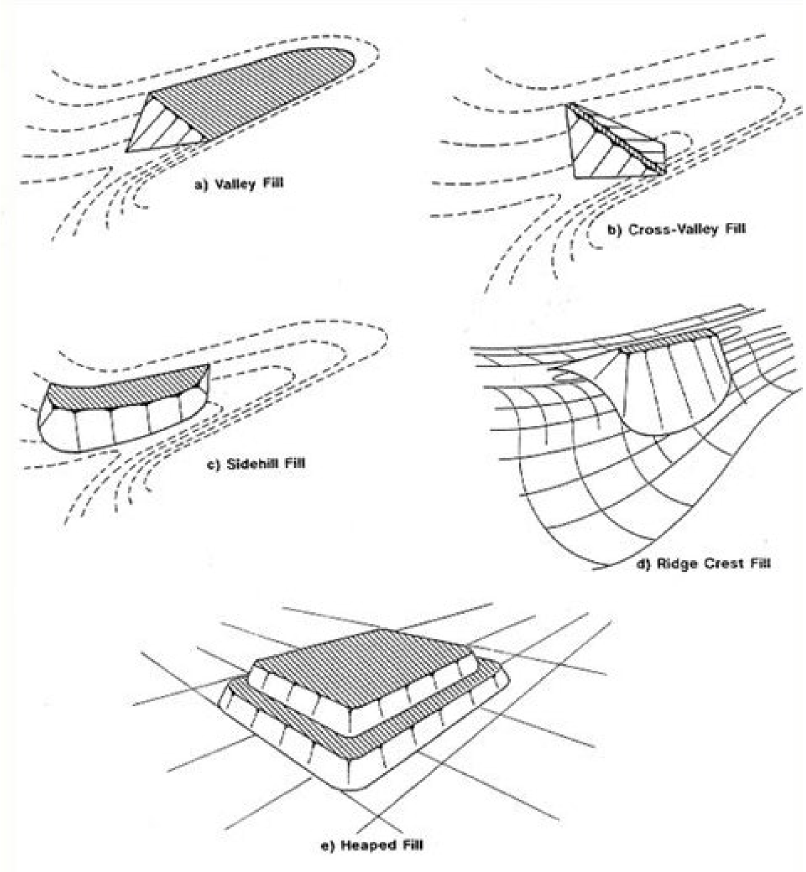


- Any remaining high wall will be fenced off at final closure in order to deter people or animals from falling over.
- At final closure of the operation all remaining product (blocks) from the demarcated stockpile will be restored to pit wherever possible to reduce highwall height and provide surface for rehabilitation or used to fill any remaining deep excavations if any.
- Waste dumps must be designed to meet minimum slope stability and safety standards and vegetated with reduce erosion and runoff.
- In view of the fact that the mountainous terrain consists of natural depressions along the slope, and the limited topsoil available the best option for waste dumps is filling and levelling the top of these natural depressions "valley fill" (Figure 2). The natural angle of repose 37° for granite waste dumps is compatible with the natural rocky terrain with steep slopes and no terracing will be required.
- Waste dumps on the sides of kopjes "sidehill fill" (Figure 2), which have large slopes will be terraced once the dump has reached its final profile at the top level, by dumping additional material along the sides at progressively lower levels, and developing these

terraces at differing angles. Final reclamation will thus only occur toward the end of the life of the quarry.

- In the case of waste dumps in the valleys "heaped fill" (Figure 2), excavations with the final designed perimeter of the dump will be created to obtain cover material for the top of the dumps and profiling the slope of historic dumps to be re-used. The excavations will serve as a base for extending the waste dump. Thereafter, dumping will proceed above surface on the top of this buried dump at successive tiers with appropriate height around 6-10m, leaving terraces of 6m wide, and working from the perimeter toward the centre. This will allow for reclamation of the outside profiles at a much earlier stage, resulting in very little outstanding reclamation toward the end of the life of the dump.

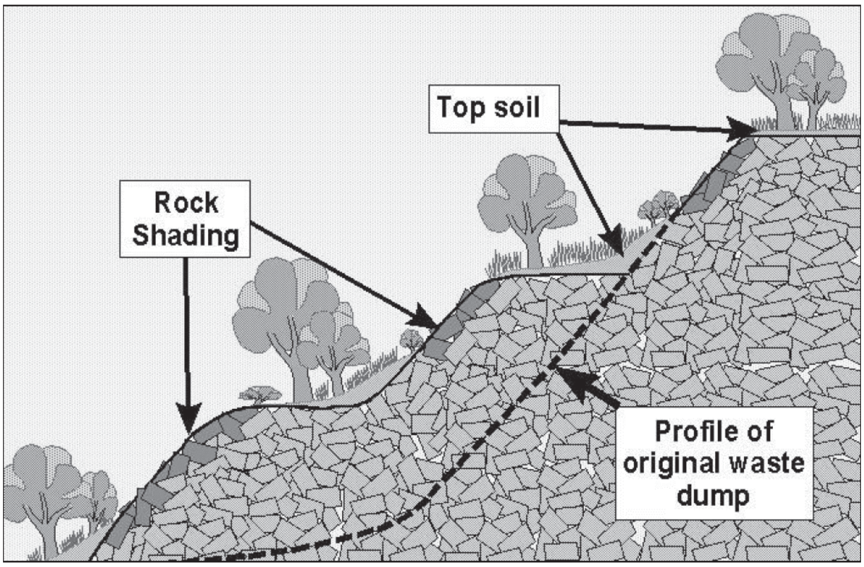
Figure 2: Mine dump Classification



- The natural colour of rock is a result of weathering of the outer l-2mm of the rock surface, and the natural process can be mimic by coating the rock surface with ferric chloride (FeC13) available commercially in large quantities at a reasonable price, as it is extensively used in sewage treatment. Concentrations of around 40% gave the best results and is ideal, as one of the products supplied commercially for sewage treatment is a 43% concentration of contained FeC13. Freshly sprayed areas need several days to dry as rain within the first 24-48 hours after spraying caused much of the ferric chloride to be washed off, requiring that the work be repeated. Due to these factors, it is preferential that spraying of rock surfaces with ferric chloride be conducted during the dry season. However, care must be taken, as experience has shown that where there is excessive dust collection on the rock surfaces, such as is the case with dumps close to haul roads, haematite tends to from around the dust particles rather than on the rock surface, resulting in substantial loss of coverage when the rains wash off the dust. This can be overcome by washing down these surfaces with water several days prior to spraying, or by treating these areas during dry window periods within the rainy season.

- Mitigation of the visual impact of "heaped fill dumps" will include rock shading and limited topsoil application to the slope and revegetation on the top of the dump as illustrated in figure 3 below.

Figure 3: Mitigation of visual impact of dimension stone waste dump



b) Create a healthy post-mining environment with no residual environmental impact

Granite mining methods themselves generally have a low impact on the surrounding environment due to the need to carefully extract large blocks or slabs without damage to the stone. Recent advances in dimension stone mining technology have also had the effect of reducing environmental impacts. Particularly in granites, improvement in diamond wire sawing efficiency and rotary saws has significantly reduced the use of explosives in the extraction of blocks. This has resulted in higher recovery of saleable blocks and therefore less waste to be disposed of, as well as reducing the emissions of blasting gases (S02 and NOX), noise and ground vibration. The risks to be dealt with at final closure include:

- Post mining landscape that increases the requirement for long term monitoring and management.
- Unwanted ruins, buildings, foundations, footings and waste management practices creating or leaving legacies.
- Sub-surface infrastructure remaining behind, limiting the intended post closure land use including footings and foundations and power supply and water installations including pumps and pipelines.
- Equipment and other items used during the mining operation left behind.
- Incomplete removal of re-usable infrastructure.
- Rubble from demolished infrastructure left behind.
- Waste classes not kept in separate streams and incomplete removal of waste
- Vehicle wash bays and workshop facilities produce petrochemical and solvent contaminated runoff.
- Sanitary conveniences, fuel depots or storage facilities of potentially polluting substances can contaminate surface water.
- Oil fuel leaks onto virgin soil through the earthmoving and transport equipment and machinery or spillage of fuel during transfer from fuel bowser to equipment in the field.

- Drainage of benches and concentration of rainfall leads to creation of large volume open water bodies in worked out pit and can lead to increased groundwater recharge and potential regional impact of low-quality water.
- Pumping of process water from the pit sump can discharge poor quality water exceeding minimum standards.

Maintaining organization and general tidiness at the quarry allows for efficiency in daily task performance, creates a less hazardous work environment, and portrays a sense of corporate responsibility to site visitors, potential customers, and neighbors.

Waste management will be implemented throughout the life of the mine and will be audited as part of the annual performance audit and will also form part of final closure.

The waste and residues from various mines fall into a number of categories, and these can include:

- Waste that is collected within the settling dams;
- Waste rock from the mining process;
- Overburden, cover, and/or "soft" material;
- Other non-specification waste such as sub-economic lower grade ore:
- Industrial waste (i.e., including hazardous wastes and oils and greases);
- Recycling and reusing materials may reduce garbage haul fees or generate income through the sale of scrap metal and old equipment. Domestic waste (i.e., waste that is generated from the accommodation and offices);
- Waste water (i.e., including process water and water from sanitation processes, as well as sewage sludge); and

The following activities to manage the risks associated with Final Closure and demolition activities will ensure that waste management practices do not create and/or leave legacies and will limit the residual impact of mine closure. Regular inspections and audits will be used as management system to ensure compliance.

- Waste that is collected within the settling dams;
  - The physical properties required of a successful dimension stone and due to the requirement for inert materials which are not affected by weathering, dimension stone residues are typically benign from a pollution point of view.
  - Water used for cooling of saw blades together with the fine residue (cutting spoils) will be collected in a series of settling dams from where the water will be re-used.
  - Sludge collected within the settling ponds will be disposed of within the waste rock dump.
- Waste rock from the mining process;
  - Like natural aggregates, dimension stone is used in its natural state, and does not require concentration and extraction from an ore. It is these latter two processes that result in significant environmental impacts such as acid mines drainage and other toxic effects associated with many of the metal extraction industries.
  - The focus with regard to all waste should be to reduce, recover, recycle and reuse. Every effort must be made to minimise waste. This is achieved by understanding and changing processes to reduce and prevent waste. This is also known as process or resource efficiency.
  - Waste or un-salable blocks will be dump in the demarcated waste dump on a regular basis (refer previous section).
  - Bury all surplus loose, isolated waste rock and un-saleable blocks in designated sub surface pits and cover with growth medium or move waste to the designated mine residue deposit site.

- Waste or low-grade blocks can be subjected to secondary processing by cutting into smaller blocks, used as refill or landscaping, crushed for other applications (such as concrete production), or otherwise dealt with responsibly.

- Overburden, cover, and/or “soft" material including topsoil;
  - Stored overburden in the form of boulders, rubble and other stone waste should not be left in piles, and should be used to cover waste dumps.
  - Soil removal creates permanent impacts that can be mitigated through restoration of soil cover, although the significance of the impact remains high. This is most apparent in steep rocky slopes where there is thin soil cover of limited areal extent which is seldom removed and stockpiled ahead of mining. However, rocky post-mining slopes can usually be rehabilitated with fine waste rock or tailings to provide the ecological niche provided by the thin patchy lithosol (rocky soil).
  - Remove and stockpile 300mm topsoil in berms or heaps less than 1,5m high and turn soil or re-use every six months. Do not use as permanent storm water control feature.
  - Remove and stockpile topsoil from roads, building platforms and stockpile areas prior to construction for use to restore disturbed areas. To ensure long-term stability, the restored soil cover should attempt to mimic the pre-mining distribution of soil texture and thickness.
  - Contaminated soil must be treated by first removing the source of contamination - removing the source of contamination should allow the system to recover without further cleanup required.
  - Petrochemical spillages to be collected in a drip tray and drum to store excavated spill affected soil for disposal at a registered facility or onsite treatment.
  - The most promising techniques for in on-site treatment involve bioremediation. Bioremediation involves the use of microorganisms to destroy hazardous contaminants.
- Other non-specification waste such as sub-economic lower grade ore:
  - Any product stockpiles left or oversize builders must be removed and used to backfill excavations or to slope remaining high walls.
  - Waste or low-grade blocks can be subjected to secondary processing by cutting into smaller blocks, used as refill or landscaping, crushed for other applications (such as concrete production), or otherwise dealt with responsibly.
- Industrial waste (i.e., including hazardous wastes and oils and greases);
  - Separation of wastes into classes will ensure that waste is disposed of safely and according to the correct procedure. In order to ensure that waste classes are kept in separate streams, communication will be passed on and people will be trained on the different waste classes.
  - Unwanted steel, sheet metal and equipment need to be stored in a demarcated salvage yard.
  - Unwanted steel, sheet metal and equipment in the salvage yard will be sold or disposed of as scrap metal. Recycling and reusing materials may reduce garbage haul fees or generate income through the sale of scrap metal and old equipment.
  - All steel structures and reinforcing will be discarded or sold as scrap.
  - All equipment and other items used during the mining operation needs to be removed from the site.
  - Used oils / hydrocarbons fuels / liquids are to be collected in sealed containers (stored on concrete slabs) and removed from site for recycling by a reputable company.
  - All waste in the temporary storage area for used lubrication products and other hazardous chemicals will be disposed of at a collection point from where it will be collected by a waste recycling company.
  - Generator bays will be constructed with the necessary pollution control measures.
  - Clean out content of oil traps and dispose of waste at registered and purpose designed landfill sites.

- Hydrocarbon contaminated sludge (collected in oil traps) - Removed from the oil traps and removed from site for recycling (if possible) or disposal at a suitably permitted facility.
- All temporary waste storage areas need to be cleaned out and waste removed.
- Tyres to be return to supplier or a company that uses old tyres for making door mats, shoes, swings, etc.
- Batteries to be return to supplier or dispose at a permitted hazardous waste facility.
- Fluorescent tubes to be collected in sealed containers (stored on concrete slabs) and removed from site for disposal at a permitted hazardous waste facility.
- Chemical containers to be returned to supplier or disposed of at a legal, permitted facility that is capable of disposing of the waste. (DO NOT sell chemical containers to workers or communities).
- Laboratory waste (chemicals) - Returned to supplier or disposed of at a permitted facility that is capable of disposing of the waste.
- Industrial chemicals (laboratory waste) - Returned to supplier or disposed of at a permitted facility that is capable of disposing of the waste. These liquid wastes cannot be disposed of on the waste dumps.

• Domestic waste (i.e., waste that is generated from the accommodation and offices);

- Domestic waste - Separated at source into recyclable products. These must then be removed and recycled by recognised contractors. (Note that the mine is responsible for the waste from cradle to grave).
- Disposal at a registered and officially permitted commercial or municipal landfill site is the most cost-effective option for materials that cannot be recycled.
- Domestic waste generated by workers needs to be sorted and all biodegradable waste must be stored in separate drums provided for.
- This biodegradable will be dumped in a landfill provided for onsite.

• Waste water (i.e., including process water and water from sanitation processes, as well as sewage sludge)

- Equipment used in the mining process will be adequately maintained in the workshops offsite so that during operations it does not spill oil, diesel, fuel, or hydraulic fluid.
- By keeping contaminated and clean water separate and establishing controlled runoff washing bays, the flow and end destination of decontamination washing water will be controlled.
- A Standard French drain system will be developed for sewage and grey water disposal.
- Although erosion and runoff are natural processes it should be managed by maintaining topsoil in any areas not in use and maintaining maximum existing vegetation coverage.
- Slow storm water runoff with contoured, low-gradient drains and channels, as well as retention ponds. A series of ponds may also be used to remove sediment and other contaminants from water before reuse or reintroduction into natural waterways.
- Storm water diversion and erosion control contour berms separate clean and contaminated water systems around the pit and infrastructure areas.
- Provision must also be made for efficient storm water control to prevent erosion of roadways.
- Sewage - No sewage outfall may be located within 100m of a water feature. No sewage may be discharge into a water body.

• Other mitigating with regard to residual environmental impact

- Implementing screening as part of the cleaning activities before materials are moved from the mine.
- The infrastructure area will be screened for petrochemical spills and cleaned and waste from the temporary storage facility will be removed and the area cleaned.

- The compacted salvage yard, lay down and movement areas will be screened for petrochemical spills and cleaned before it is ripped and levelled.
- Redundant structures, buildings and civil foundations (down to one meter below surface for subsurface infrastructure) will be removed for use elsewhere or demolished and discarded.
- All redundant infrastructure and services need to be demolished including ruins, buildings, foundations, footings.
- Building rubble will be used as backfill in excavations or removed from site in the absence of excavations.
- Remove all power and water supply installations not to be retained by landowner in terms of section 44 of the MPRDA.
- Removing underground infrastructure to one meter below surface.
- Excavations created by removing subsurface infrastructure needs to be filled, levelled and compacted.
- Final walk through of complete mining lease area to ensure no mining related waste and of re-usable infrastructure remain on site.
- As part of this phase training of personnel in the implementation of the Closure Plan will done and the implementation of the environmental awareness plan will be an ongoing process.

The above risks and their levels are listed together with their associated mitigating actions in Table 1. At the time of final closure, no significant risks will remain. only one medium level risk will possibly remain, the possibility of post mining topography not compatible with original landform.

Table 1: Risks, risk levels and mitigating actions in terms of a safe and healthy post-mining environment

Risk	Risk Rating	Mitigation Actions
Collapsing slope	DC PM	Limit height of high walls Design stable slopes by creating benches. Re-shaping waste dump slopes to stable conditions following identification of instable areas through observations and regular inspections
Uncontrolled access to a potentially unsafe area	DC PM	Use terrain form to shield quarry from developed. Fence dangerous areas. Remaining product (blocks) restored to reduce high wall. Limiting and controlling access while rehabilitation activities are in progress
Post mining topography not compatible with original landform	DC PM	Natural angle of repose 37° for granite waste dumps is compatible with the natural rocky terrain with steep slopes. Waste dumps in the valleys will be partially buried and surface deposition will create artificial kopjes compatible with the natural rocky terrain with steep slopes
Erosion gulley's	Refer to objective 2 productive land uses	
Post mining landscape that increases the requirement for long term monitoring and management	DC PM-NA	Implementing waste management as per current approved procedure.
Incomplete removal of waste	DC PM	Final walk through of complete lease area to ensure no mining related waste remaining on site.
Waste classes not kept in separate streams	DC PM-NA	Communication and training on the importance of separating waste streams

Documentation and monitoring results will be provided as objective evidence of achieving the objective of minimum legacies as listed in Table 2. The criteria with the contents of these documents must comply with are also given in this table.

Table 2: Objective evidence and closure criteria for safe post-mining environment

Closure objective	Document scope	Author	Success criteria (standard)
Slope and High wall stability	Inspection of the post-mining areas with the objective to identify unstable areas and formation of erosion gulley's	Independent EAP	Post-mining area declared stable by DMR mine health and safety
Secured potentially Dangerous post-mining sites	Inspection of the post-mining surface area with the objective to identify unsafe areas	Independent EAP	Post-mining area declared safe by DMR
Waste management practices do not leave/create legacies	Inspection of the post-mining surface area with the objective to identify pollution	Independent EAP	Post-mining area declared safe by DMR
	Assessment of the completeness of removal of mine waste	Independent EAP	Final performance assessment report declares 100% removal of waste and equipment

5.3.2 Create a stable, free draining post mining landform

a) Economically viable and sustainable land, as close as possible to its natural state.

With granite mines, complete disruption of the surface always occurs, which affects the soil, fauna, flora and surface water, thereby influencing all types of land use. Opencast mining and related infrastructure are a permanent destruction and rehabilitation cannot restore all pre-mining habitats. Granite quarries cannot be completely refilled and form permanent depressions that must be accommodated through imaginative utilisation during the post-closure period and the residual impact of open-pit mining is usually a completely different land use. Risks associated with economically viable and sustainable land include:

- Uncontrolled expansion of mining footprint by not restricting the area disturbed by mining and the associated activities/infrastructure - loss of land with agricultural potential. Uncontrolled development of roads - existing farm roads not used for mining operations and redundant internal roads left behind. Duel used roads still needed by the landowner and fences not maintained or repaired.
- Post mining landform not compatible with the surrounding landscape and not capable of a productive land use that achieves a land capability equal to that of pre-mining conditions
- Long term changes in land caused by not implementing prompt rehabilitation and maintenance of disturbances when possible as part of annual rehabilitation plan.
- Unsuccessful rehabilitation can reduce the post-mining land use options. Rehabilitated areas could be too unstable to support post-mining land use objectives compatible with surrounding areas.
- Disturbance of agricultural potential and subdivision of high potential arable land into uneconomic farming units. Inadequate planning or loose development can subdivide high potential land or habitats into un-viable small areas.
- Disturbance of ecology due to loss of habitat and cumulative impact of illegal collecting or land use during long-term or life of mine can degrade areas and reduce the viability of adjacent areas. Inadequate control of alien species can result in establishment of populations or seed sources that threaten adjacent areas.

The activities and actions associated with achieving a post mining landform, which is compatible with the surrounding landscape and which is capable of a productive land use that achieves a land capability equal to that of pre-mining conditions are listed below. It is important to note that for the mine to meet this objective it is imperative that its other key objectives, viz. a safe post-mining area with limited residual impacts and optimal post-mining social opportunities are met. Should the attenuation measures for prevention of pollution as described in section 6.2.1 be implemented, the effect on sustainability will be insignificant. For safety, monetary, and environmental reasons, extreme care must be taken to minimize the operational footprint at the quarry site. Proper management can curtail occupational hazards and environmental degradation, ultimately creating financial savings.

The following maintenance practices will make site closure less labor intensive (and thus less fiscally demanding) and will allow a faster recovery rate for the local ecosystem.

- Focus developments and avoid un-necessary subdivision of land and activities that could be sited on already disturbed land. Consider developments in surrounding areas and design post-mining land use options to support and enhance long-term development options
- Rehabilitation must ensure long-term stability and not compromise post-mining land use objectives.
- Plan to focus developments through multi-use options and avoid splitting land and habitats. Consolidate development areas and develop multi-use options or infrastructure corridors for roads, pipelines, power and communication links.
- Minimising footprint of disturbed areas including stockpile platforms and loading and hauling areas.
- Minimise the loss of land with agricultural potential: minimize footprint of disturbances to facilitate recovery of degrading patches into active patches through colonization of the patch by dispersing species (patch dynamics)
- Minimise loss of vegetation within the disturbance footprint: scarifying of all compacted areas as soon as possible for natural plant succession. Unnecessary destruction of vegetation should be avoided by ensuring that traffic and personnel movement be restricted to demarcated areas. No traffic should be allowed on the rehabilitated areas.
- Movement of vehicles will be restricted to demarcated areas so as to keep the footprint of the mining operation to the absolute minimum. Movement of equipment must be restricted to existing roads and no ad hoc driving or turning outside demarcated loading and hauling areas will be allowed.
- Recreate habitats where possible or structure altered landscapes to be compatible with regional habitat mosaics to resist water and wind erosion of soils.
- Minimise disturbance of ecology due to loss of habitat and noise/visual/dust
- Excavations created to obtain subsoil for working platforms will be backfilled with waste rock. The excavations will then be covered with top soil and allowed to re-vegetate naturally resulting in an even depression with no residual impact.
- Surplus soil from the excavation will be stored to cover the waste dumps.
- All compacted areas due to stockpiling, loading and hauling will be ripped with erosion control measures and all roads not required by landowner must be ripped (30cm deep) and repairs to all fences and gates.
- Monitoring and management during the life of a mine is critical to ensure that undisturbed areas are not impacted by the mining activities that disturb adjacent land and that plants from these areas are not illegally removed and utilised.

b) Stable, free draining post mining landform.

Opencast pit creates area of lowered topography that can act as a sump for storm water runoff and intersects groundwater and if the operation extends to depths below the water table, it will affect the near-surface groundwater. Apart from reducing natural recharge to the shallow and deep groundwater zones, the increased runoff and altered storm hydrograph will also impact areas downstream or downslope where the flow is concentrated. Risks relating to a free draining post mining landform is as follow:

- Impact on surface water through modification of infiltration rates by increasing the extent of hardened surfaces.
- Inadequate topsoil restoration or creation of un-natural surface topography or slope form which could impact lower or adjacent slopes due to increased runoff velocity.
- Altered storm water runoff response due to large impervious areas and concentrated runoff in drainage systems. Concentrated storm runoff from the pit surrounds and infrastructure areas is erosive, causing sheet, rill and donga erosion features.

The activities and actions associated with achieving a free draining post mining landform are listed below. It is important to note that for the mine to meet this key objective it is imperative that its other key objectives, viz. a safe post-mining area with limited residual impacts and optimal post-mining social opportunities are met. Should the attenuation measures for prevention of pollution as described in section 5.1 be implemented, the effect on soil and water will be insignificant. The most important of these is that:

- To prevent significant negative effects arising from changes in post-mining surface water quantities, the post-mining topography at the excavations will be adjusted where possible to minimise the effect on water flow and increase potential for re-vegetation.
- Actions to mitigate the risk of erosion will be through implementation of practices such as leaving the profiling contours.
- Mining must be conducted in such a manner as to ensure that natural drainage lines are not destabilized and that surface and ground water quality is not impaired.
- Prevent attenuating or diverting any of the natural flow.
- Minimise risk of erosion from either increased base flow or mining operations followed by prompt rehabilitation and maintenance of erosion events. Provision of efficient storm water control to prevent erosion of steep slopes and roadways and elsewhere are required.
- Initiate catchment management to control and reduce erosive runoff containing suspended sediment. Create and maintain clean water drainage systems to isolate contaminated areas and separate clean and dirty water systems so that neither can interact more than one in 50 years.
- Implement DWAS best practice guidelines with regard to water Reuse and Reclamation to encourage the reuse and reclamation of water in order to ensure that scarce water resources are used in an effective way that is beneficial to the environment by preventing pollution and deterioration in water quality; conserve water resources by reducing consumption and minimising losses; maximise water reuse opportunities; and ensure the sustainability of water usage across the mine’s life cycle.
- Implement DWAS best practice guidelines with regard to Storm Water Management to address all impacts of the mine’s operation on the hydrological cycle and vice versa, during the entire life cycle of the mine by keeping water clean; collect and contain dirty water; sustainability over mine life cycle; and consideration of regulations and stakeholders.

A summary of the above risks and their mitigation actions is given in Table 3. Also, shown in this table is the level of each risk. At the time of final closure, no significant risks and only one medium level risk, the risk of post mining landform not compatible with the surrounding landscape and not capable of a productive land use that achieves a land capability equal to that of pre-mining conditions will remain. When more information becomes available, appropriate actions will be taken if proved necessary.

Table 3: Risks, risk levels and mitigating actions in terms of a stable, free draining post mining landform, which is compatible with the surrounding landscape

Risk	Risk Rating	Mitigation Actions
Uncontrolled expansion of mining footprint by not restricting the area disturbed by mining and the associated activities/infrastructure - loss of land with agricultural potential	DC	Plan to focus developments through multi-use options and avoid splitting land and habitats. Consolidate development areas and develop multi-use options or infrastructure corridors for roads, pipelines, power and communication links.
	PM	
Post mining landform not compatible with the surrounding landscape and not capable of a productive land use that achieves a land capability equal to that of pre-mining conditions	DC	Minimise the loss of land with agricultural potential: minimize footprint of disturbances to facilitate recovery of degrading patches into active patches through colonization of the patch by dispersing species (patch dynamics)
	PM	Minimise loss of vegetation within the disturbance footprint: scarifying of all compacted areas as soon as possible for natural plant succession. Unnecessary destruction of vegetation should be avoided by ensuring that traffic and personnel movement be restricted to demarcated areas.
Long term changes in land caused by not implementing prompt rehabilitation and maintenance of disturbances when possible as part of annual rehabilitation plan.	DC	Monitoring and management during the life of a mine is critical to ensure that undisturbed areas are not impacted by the mining activities that disturb adjacent land and that plants from these areas are not illegally removed and utilized. Implementing of annual rehabilitation plan
	PM	
Disturbance of agricultural potential and subdivision of high potential arable land into uneconomic farming units. Inadequate planning or loose development can subdivide high potential land or habitats into un-viable small areas.	DC	Focus developments and avoid un-necessary subdivision of land and activities that could be sited on already disturbed land. Consider developments in surrounding areas and design post-mining land use options to support and enhance long-term development options
	PM	
Impact on surface water through modification of infiltration rates by increasing the extent of hardened surfaces	DC	Create contours on excavation slopes. Monitoring through observations and regular inspections. Implementing final topography changes if required
	PM	
Inadequate topsoil restoration or creation of un-natural surface topography or slope form which could impact lower or adjacent slopes due to increased runoff velocity.	DC	This will only be a risk until re-vegetation is successful.
	PM	
Altered storm water runoff response due to large impervious areas and concentrated runoff in drainage systems.	DC	Installation of conservative run-off and land-use plan. Create a rough surface to act as contours and prevent overgrazing and trampling due to agricultural activities. Create contours on excavation slopes. Monitoring through observations and regular inspections. Implementing final topography changes if required
	PM	
	PM	

The documentation which will be submitted as objective evidence of the state of the above risks at the time of closure is listed in Table 4. With the contents of these documents showing compliance with the closure criteria - also listed in Table 4 - it will be accepted that the mine has achieved the objective of stable, free draining post mining landform, which is compatible with the surrounding landscape.

Table 4 Objective evidence and closure criteria for stable, free draining post mining landform, which is compatible with the surrounding landscape

Closure objective	Document scope	Author	Success criteria (standard)
Post mining landform compatible with the surrounding landscape and achieves a land capability equal to that of pre-mining conditions	Report on the monitoring results with regard to succession tempo of total cover in comparison with virgin vegetation adjacent to mining area	Independent EAP	Total cover and species composition are comparable to that of the adjacent virgin area
No negative effect on surface water flow and waste management practices do not leave/create legacies	Inspection of the post-mining surface area with the objective to identify erosion due to storm water and sheet flow	Independent EAP	Post-mining area declared stable by DMR
	Assessment of the completeness of removal of mine waste	Independent EAP	Final performance assessment report declares 100% removal of waste and equipment
Adequate topsoil restoration or creation of natural surface topography	Monitoring results of erosion on steep slopes (20% gradient) and disturbed areas	Independent EAP	At the time of closure, soil loss has stabilised over the whole previously disturbed area

5.3.3 Provide optimal post-mining social opportunities

a) Optimised benefits for the social environment

- No positive and transparent relationships with stakeholders and not maintaining communication channels – not providing stakeholders including government authorities with relevant information as per legislative requirements.
- Not undertaking environmental management according to approved EMP and plans and no auditing of the environmental management system.
- Disturbance to sensitive environments such as land with historical or conservation value, urban areas, wetlands or rivers, high potential agricultural land, transport infrastructure, power transmission lines. Slow continuous damage to habitat e.g., wood collection are typical impacts on adjacent areas.
- Staff losing their jobs - mine closure can have devastating effects on communities that are reliant on mine-based income Job losses of secondary industries, businesses and contractor's Contractual agreements with service providers surpassing mine closure date
- Closure standards not accepted and/or are changing. Mine closure being jeopardised by other land uses
- Poorly defined transition from mining to farming activities within different legislation
- Mine closure stalled due to non-compliance with South African legislation (national, provincial and local)
- Insufficient funds for complete rehabilitation

The impact of mine closure is limited and is not expected to alter the socio-economic circumstances of the study area significantly however those losing employment will experience significant impacts.

- Developments must be sustainable and recognise people as an element of the environment.
- Mine closure must be planned from inception though adequate social planning and infrastructure development that can be maintained by the communities after closure. Opportunities to redirect skills must be sought and alternatives to demolition of mine infrastructure that can be redeveloped must be investigated.

- Maintain positive and transparent relationships with stakeholders and maintaining communication channels. Provide stakeholders including government authorities with relevant information as per legislative requirements. Contract durations with service providers will be limited to address the risk of contractual agreements with service providers surpassing the mine closure date.
- Undertaking environmental management in accordance with the approved EMP and Closure Plan.

b) Minimal negative aesthetic impact

Terrain morphology plays a critical role in defining the visual envelope of mining developments and can either reduce or enhance visual impact. Apart from visual intrusion there is also the risk of reduced sense of place. Visual intrusion impact of mining activity on nearby roads, homesteads, settlements, tourist sites.

- Visual disturbance from the public road views – excavations or overburden dumps blocking the view. Large buildings, colour contrast of disturbed areas against adjacent veld or dust emission plumes
- Nuisance effects of air emissions (dust) no implementation and maintenance of dust monitoring programs accompanied by dust suppression activities if required.
- Accumulation of spoils from rock saws (fines) can expose highly erodible fine sediment to wind transport and lead to dust generation and dispersal. Dust can retard vegetation growth and reduce the palatability of vegetation.
- Dust generated on haul roads reduces visibility in opencast pit, representing a safety hazard.
- The cumulative effect of a raise in the ambient noise levels or high noise levels in specific areas that exceed specified levels. Noise disturbance and light pollution as a result of night activities.
- Disturbance of archaeological sites not implement mitigating measures according to the archeological assessment. Progressive development can encroach upon or disturb archaeological sites, cultural heritage sites or graves.

Although the location of quarries is primarily determined by the location of geologic deposits, being situated nearby a major highway is preferable to minimize transportation costs. This often results in quarry sites that are established close to human habitation. Blasting, cutting, and truck traffic contribute to noise, vibration, and dust problems for local residents. Further, the public may protest the unfavorable aesthetics and the safety hazards posed by stone piles and quarry holes. By following best practices, these effects on quarry neighbors and the negative perceptions held by the general public can be mitigated.

Minimal negative aesthetic impact will be achieved by the implementation of the tasks required to limit residual environmental impact listed above including the following:

- Effective use of topography, architectural design and vegetation screens can limit long distance visibility. Residue dumps can be designed to lower the profile and silhouette and reduce colour contrast and dust plumes through rehabilitation. Well-vegetated residue stockpiles and end-use rehabilitation scenario adjacent to an urban area can reduce the perceived impact of visual intrusion.
- One of the most prominent environmental impacts of granite mining is the loss of visual integrity but these operations are not developed close to urban areas and/or main roads.
- Identify infrastructure and services to remain after closure.
- All infrastructures, temporary housing and services used during the mining period will be removed from the site.
- Waste material of any description, including receptacles, scrap, rubble and tyres, must be removed entirely from the mining area and disposed of at a recognised landfill facility. It will not be buried or burned on the site.

- All equipment and other items used during the mining operation needs to be removed from the site at final closure.
- Dust suppression must be undertaken in conjunction with a dust monitoring programme that places dust deposition gauges or receiving buckets, directional dust collection receptacles, high volume active air samplers or continuous particle monitors or even personal exposure samplers at generation sites, around the mine and in adjacent areas.
- Nuisance dust reduces environmental amenity without necessarily being harmful and comprises particles in the 50 μm to 1 mm size range and equates to the total suspended particles (TSP
- The best form of control is not to allow emissions to occur. From a particulate perspective, this will entail preventing dust from being picked up on exposed surfaces. The only long-term sustainable solution is to have a vegetation cover preventing dust pickup. This could also include a mixture with rock to roughen up the surface.
- Exposed areas such as roads can be sprayed with water. This works effectively for a while but dries out and thus needs to be continually applied to be effective. Dust binders can be sprayed on these exposed areas to give longer term protection.
- The wind velocity on the surfaces of large areas needs to be reduced to prevent dust pickup. This can be done by ploughing the area perpendicular to the prevailing wind direction using a deep plough. This is known as “ridge ploughing”. Other techniques include the installation of netting or other barriers in rows perpendicular to the prevailing wind.
- Retain or replace as much native vegetation as possible throughout the quarry’s operation. Root structures help maintain soil stability, while tall vegetation— particularly trees—can act as a filter for dust plumes flowing through.
- Vehicles should be washed regularly to reduce the volume of fines dispersed onto roads.
- All remaining service roads needs to be graded with provision of efficient storm water control to prevent erosion of steep slopes and roadways and elsewhere are required.
- During decommissioning and rehabilitation levels of dust generation need to be monitored and if dust levels rise above acceptable limits dust should be controlled in the interest of improved worker health and safety. In this instance, periodic wetting of the maneuvering areas can be considered (No used oil or diesel is to be used for dust suppression).
- Involve all employees/contractors in the speed reduction campaign as road surface condition is more related to speed than to frequency of use.
- Prepare a noise reduction plan to cover all significant impacts at source and implement noise reduction and screening to limit exposure. Drilling and blasting is generally intermittent and should be limited to daylight hours when ambient noise levels are highest.
- The highest magnitude noise impacts are commonly the high intensity, short duration noise levels created by blasting in surface or opencast mines. Blasting should not be carried out under very overcast conditions or low-level cloud cover as this increases the noise and vibration transmission. This impact can be reduced through selection of explosives, sequencing of the blasts, deflection by structures and timing of the blast to coincide with periods of high activity or increased ambient noise levels.
- Turn off saws and machines when not in use, and consider one-way on-site traffic to lessen the use of backup sirens.
- Conduct cultural heritage resource assessment through existing databases and a site-specific search in areas to be disturbed or sites of known occurrences.
- Implement mitigating measures as identified in the archaeological assessment completed for the area. Demarcate sensitive areas and control access.

Risks and risk levels associated with the objective of optimum post-mining social activities are listed in Table 5. At the time of final closure there will be no significant risks.

Table 5 Risks, risk levels and mitigating actions in terms of optimum post-mining social opportunities

Risk	Risk Rating	Mitigation Actions
Dust generation during demolition activities Noise generation during demolition activities Traffic during demolition activities	DC PM - N/A	Maintenance of the existing complaints register Communication of dust, noise and increased traffic related activities to the affected community and the expected durations of these activities Continuation of current dust suppression activities
Dust from farm roads and disturbed land	DC PM	Continuation of current dust suppression activities

The documentation which will be submitted as objective evidence and the closure criteria against which the contents of these documents will be measured are summarised in Table 6. Achieving these criteria will be evidence of achieving the objective of optimum post-mining social opportunities.

Table 6 Objective evidence and closure criteria for optimum post-mining social opportunities

Closure objective	Document scope	Author	Success criteria (standard)
Limited environmental impacts during demolition activities	Summary of all complaints received during demolition activities and follow up actions	Mine SHE Head, audited by independent EAP	Nuisance levels consistently on par with legislative standards after completion of demolition activities All incidents older than 90 days investigated and feedback given to complainant

6 ESTIMATED COST FOR REQUIREMENTS TO FULLY DECOMMISSION THE SITE

According to regulation 6 an applicant must determine the financial provision through a detailed itemisation of all activities and costs, calculated based on the actual costs of implementation of the measures required for— (a) annual rehabilitation, as reflected in an annual rehabilitation plan; (b) final rehabilitation, decommissioning and closure of the prospecting, exploration, mining or production operations at the end of the life of operations, as reflected in a final rehabilitation, decommissioning and mine closure plan; and (c) remediation of latent or residual environmental impacts which may become known in the future, including the pumping and treatment of polluted or extraneous water, as reflected in an environmental risk assessment report.

In terms of regulation 11(2) the holder of a right or permit must, on completion of the actions contemplated in sub regulation (1), ensure that the adequacy of the financial provision is assessed and any adjustments that need to be made to the financial provision are identified within one year of the commencement of the operations authorised in the right or permit; or where the operations has commenced immediately after its financial year end that follows such commencement.

6.1 Assesment of financial provision

The assessment of the financial provision requirements for annual rehabilitation in terms reg. 6(a) is provided for as part of the annual rehabilitation plan that form part of the annual environmental audit of the implementation of the environmental authorization and closure plan in terms of the NEMA EIA regulations (2014).

No remediation of latent or residual environmental impacts which may become known in the future were identified at this stage. Financial provision in terms of reg. 6(c) are covered by the requirements for the actual costs of implementation of the measures required for final rehabilitation, decommissioning and closure of the mining operations at the end of the life of operations as reflected in this final rehabilitation, decommissioning and mine closure plan in terms of reg. 6(b).

6.2 Calculation of Closure cost

This calculation is not based on the standard rates provided for calculation of closure cost as the guideline are calculated using assumptions that are far removed from the mining methods or topographical characteristics of the waste (in particular that dimension stone waste is inert and offer no pollution potential, and that waste dumps located on a sound footing are stable at the natural angle of repose 37°).

Additionally the costs of a "sidehill fill" or "heaped fill" waste dumps that requires terracing and landscaping will be vastly different from a "valley fill" which only requires topsoil replacement on the top to allow for natural revegetation. Planting of vegetation and irragation and adding fertilisers is also not an option in semi-arid areas and the specific vegetation units where trees are mostly absent.

A detailed itemized costing were done that involved the identification of the specific closure elements. For each closure element, various possible combinations of required rehabilitation work were identified and costs were calculated for each of these, based on rates used are from the Contractors Plant Hire Association (Table 7).

Table 7: Rates ad tariffs used for Calculation of Closure cost

Cost Factor	Closure Element	Cost calculation				
1	**Demolish and remove Buildings/Infrastructure including subsurface structures and bunded fuel storage - Salvage useable material, break structure and dispose in waste dump**	**Cost/h**	**Service hours**	**Labour**	**Total**	
	Tipper Truck 10m^3 transport building rubble to waste rock dump	R519.00	8.00	0	R4 152.00	
	Excavator - 20 Ton Demolish concrete and loading	R592.00	16.00	0	R9 472.00	
	Cleanup	R45.00	8.00	4	R1 440.00	
	Total				**R15 064.00**	
2	**Remove waste from temporary storage and scrap from salvage yard**	**Cost/h**	**Service hours**	**Labour**	**Total**	
	Tipper Truck 10m^3 transport to waste disposal site	R519.00	16.00	0	R8 304.00	
	Treat petrochemical in oil seperator - washbay	R2 000.00	4.00	R0.00	R8 000.00	
	Treat petrochemical in oil seperator - fuel storage & apron	R2 000.00	4.00	R0.00	R8 000.00	
	Cleanup	R45.00	8.00	2	R720.00	
	Total				**R25 024.00**	
3	**Final cleanup - remove all mining related waste walk through with landowner**	**Cost/h**	**Service hours**	**Labour**	**Total**	
	Tipper Truck 10m^3 transport to waste disposal site	R519.00	8.00	0	R4 152.00	
	Cleanup	R45.00	8.00	2	R720.00	
	Total				**R4 872.00**	
4	**Loading and transport of soil**	**Load Vol m^3**	**Loads/h**	**m^3/h**	**R/h**	**R/m^3**
	Excavator cycle	1.2	120	144	R722.00	R5.01
	ADT cycle	17	7	119	R602.00	R5.06
	Total cost					**R10.07**
5	**Shape waste dumps (Terracing)**	**h/ 1.6m^3**	**m^3/h**	**Cost/h**	**Cost/m^3**	**Cost/m^2**
	FEL 30 ton	0.67	144.00	R1 182.00	R8.21	
	2 Tier Total cost/m^2@ 1.6m^3		1.6			**R13.13**
	3 Tier Total cost/m^2@ 2.8m^3		2.8			**R22.98**
6	**Spreading topsoil level area**	**m^3/h**	**m^3 Soil /m^2**	**R/m^3**	**R/m^2**	**R/Ha**
	Loading and transport of topsoil		5	R10.07	R2.01	R2 014.54
	Shaping Grader 140 K	1020		R0.71	R0.14	R1 417.65
	Total cost				**R2.16**	**R3 432.19**
7	**Spreading topsoil dump slopes**	**m^3/h**	**m^3 Soil /m^2**	**R/m^3**	**R/m^2**	**R/Ha**
	Loading and transport of topsoil		10	R10.07	R1.01	R1 007.27
	Excavator 20Ton	108		R6.69	R0.67	R6 685.19
	Total cost				**R1.68**	**R7 692.46**
8	**Sloping Sides gravel pit 18°**	**m^2/h**		**Cost/h**	**R/m^2**	**R/Ha**
	Excavator - 20 Ton	120		1182.00	R9.85	R11 642.70
9	**Ripping and levelling**	**Speed**	**Ripper/Blade**	**h/Ha**	**R/h**	**R/Ha**
	Grader 140 K	8	3.5	0.36	R687.00	R245.36
	Total cost/Ha					**R245.36**
10	**Loading and transport of 0.5m soil cover**	**Load Vol m^3**	**Loads/h**	**m^3/h**	**R/h**	**R/m^3**
	Excavator cycle	1.2	120	144	R722.00	R5.01
	ADT cycle	17	7	119	R602.00	R5.06
	Total cost/m^3					**R10.07**
	Total cost/m^2@0.5mcover					**R5.04**
11	**Rockshading wastedump**	**m^2/h**	**m^2/kg**	**R/kg**	**R/m^2**	
	Ferric Cloride		20	R3.50	R0.18	
	Labour	30		R45.00	R1.50	
	Consubables Sprayer @R400/month				R1.00	
	Total cost/m^2				**R2.68**	
12	**Rockshading rockface**	**m^2/h**	**m^2/kg**	**R/kg**	**R/m^2**	
	Ferric Cloride		10	R3.50	R0.35	
	Labour	50		R45.00	R0.90	
	Consubables Sprayer @R400/month				R1.00	
	Total cost/m^2				**R2.25**	
13	**Blasting of highwalls**	**Spacing m**	**depth m**	**R/m**	**R/hole**	
	Drilling Cost	0.6	4	R15.00	R60.00	
	Blasting cost per hole				R129.00	
	Total cost/m advance			**R113.40**	**R189.00**	
14	**Moving of blocks to designated areas**	**b/h<300m**	**Cost/h**	**Cost/block**	**Cost/m**	
	FEL 30 ton	12.00	R1 182.00	R98.50		
	Placing of blocks safety barrier				R49.25	

6.3 Quantified Closure elements

The closure elements were identified captured and quantified by making use of a GIS software programme and aerial photography. The diagrams under section 4 show the locality and footprint of the closure element and the quantification of the closure elements are provided below.

Cost Factor 1 - Demolish and remove Buildings/Infrastructure including subsurface structures and bunded fuel storage - Salvage useable material, break structure and dispose in waste dump

Waste Management Structures Part of Logistical facilities and Laydown area 0.25 Ha

Cost Factor 2 - Remove waste from temporary storage and scrap from salvage yard

Part of Logistical facilities and Laydown area 0.25 Ha

Cost Factor 3 - Final clean-up - remove all mining related waste walk through with landowner

Total Mining Area 5Ha

Cost Factor 4 - Loading and transport of soil

Included as part of Cost Factor 6

Cost Factor 5 - Shape waste dumps (Terracing)

0.4 Ha Heap Fill Waste Dump to be developed as part of production

Cost Factor 6 - Spreading topsoil level area (dump top)

0.4 Ha Heap Fill Waste Dump ongoing as part or dumping to facilitate traficability

Cost Factor 7 - Spreading topsoil dump slopes

0.4 Ha Heap Fill Waste Dump to be done as part of production and annual rehabilitation Plan

Cost Factor 9 - Ripping and levelling Roads and all compacted areas

0.72 Ha

Cost Factor 11 - Rock Shading waste dumps

0.4 Ha Heap Fill Waste Dump no rock shading required as covered with topsoil

Cost Factor 12 - Rock shading rock face

2 Ha Quarry floor with 100m X 3m highwall present for rock shading will be determined as mine develop

Cost Factor13 - Blasting of high walls

2 Ha Quarry floor with highwall present for blasting will be determined as mine develop

Cost Factor 14 - Moving of blocks to designated areas

±500 blocks used for demarcation to be moved at final closure

0.5Ha sorting area covered with ±1000 waste and low grade blocks to be moved to designated ares will be adressed as part of the anual rehabilitation plan as mine develop.

The following risk-based criteria and assumptions were used to calculate the final rehabilitation, decommissioning and closure cost:

- Removal of all structures and infrastructure not to be retain by the landowner in terms of section 44 of the MPRDA.
- All fixed assets that can be profitably removed will be removed for salvage or resale.
- Any item that has no salvage value to the mine, but could be of value to individuals, will be sold (zero salvage assumed in cost estimation) and the remaining treated as waste and removed from site.
- All structures will be demolished and terracing and foundations removed to the lesser of 500 mm below the original ground level.
- Inert waste, which is more than 500 mm underground, such as pipes, will be left in place
- A hazardous disposal site will not be constructed and all hazardous waste will be removed from site and transported to the nearest licensed facility.

- All services related to the mining operation, water supply lines and storage on site will have to be demolished; the closure cost is therefore included in this estimate.
- Existing tracks will be used and no new roads will be developed.
- The stockpile and logistics area will not exceed the planned footprint.
- It is assumed that the post-mining pit stability and waste dump profile will be addressed as part of the operation and necessary remedial actions implemented prior to closure.
- The historic waste dump will not be reused and no rehabilitation will be done as the area is nearly fully revegetated through natural plant succession.

6.4 Total estimated cost to fully decommissioned the mining site at final closure

Cost Factor 1

Demolish and remove Buildings/Infrastructure including subsurface structures and bunded fuel storage - Salvage useable material, break structure and dispose in waste dump

Risk based criteria and assumptions with regard to rehabilitation of bulk sample sites

All structures will be demolished and terracing and foundations removed to the lesser of 500 mm below the original ground level.
Inert waste, which is more than 500 mm underground, such as pipes, will be left in place
All services related to the mining operation, water supply lines and storage on site will have to be demolished; the closure cost is therefore included in this estimate.

Mining/Sampling Area	Unit	No Units	Unit Cost	Cost per Element
Logistical facilities 0.25 Ha	Areas	1.00	R7 212.00	**R7 212.00**
			Sub-Total	**R7 212.00**

Cost Factor 2

Remove waste from temporary storage and scrap from salvage yard

Risk based criteria and assumptions with regard to rehabilitation of bulk sample sites

A hazardous disposal site will not be constructed and all hazardous waste will be removed from site and transported to the nearest licensed facility.

Mining/Sampling Area	Unit	No Units	Unit Cost	Cost per Element
Part of Logistical facilities	Areas	1.00	R7 328.00	**R7 328.00**
			Sub-Total	**R7 328.00**

Cost Factor 3

Final cleanup - remove all mining related waste walk through with landowner

Risk based criteria and assumptions with regard to rehabilitation of bulk sample sites

Removal of all structures and infrastructure not to be retain by the landowner in terms of section 44 of the MPRDA.
All fixed assets that can be profitably removed will be removed for salvage or resale.
Any item that has no salvage value to the mine, but could be of value to individuals, will be sold (zero salvage assumed in cost estimation) and the remaining treated as waste and removed from site.

Mining/Sampling Area	Unit	No Units	Unit Cost	Cost per Element
Total mining footprint	Area 5-15 Ha	1.00	R4 328.00	**R4 328.00**
			Sub-Total	**R4 328.00**

Cost Factor 5

Shape waste dumps (Terracing)

Risk based criteria and assumptions with regard to rehabilitation of bulk sample sites

It is assumed that the post-mining stability and waste dump profile will be addressed as part of the operation and necessary remedial actions implemented prior to closure.
The historic heaped fill dumps will not be re-commisioned and will therefore not form part of this closure plan.
The planned sidehill fill wastedump will be covered with soil to serve as working platform and will also serve as growth medium for re-vegetation.

Mining/Sampling Area	Unit	No Units	Unit Cost	Cost per Element
Heap fill waste dump (working platform)	m²	4 000.00	R7.53	**R30 120.00**
			Sub-Total	**R30 120.00**

Cost Factor 6

Spreading topsoil level area (Top of wastedump)

Risk based criteria and assumptions with regard to rehabilitation of bulk sample sites

It is assumed that the post-mining stability and waste dump profile will be addressed as part of the operation and necessary remedial actions implemented prior to closure.
Spreading of sub-soil is done as part of operations to improve traficability on the top of the wastedump.

Mining/Sampling Area	Unit	No Units	Unit Cost	Cost per Element
Heap fill waste dump (working platform)	Ha	0.40	R3 253.06	**R1 301.22**
			Sub-Total	**R1 301.22**

Cost Factor 7				
Spreading topsoil dump slopes				
Risk based criteria and assumptions with regard to rehabilitation of bulk sample sites				
It is assumed that the post-mining stability and waste dump profile will be addressed as part of the operation and necessary remedial actions implemented prior to closure. The sides of sidehill filled dumps will be evaluated in terms of natural topography and vegetation requirements at final footprint.				
Heap fill waste dump (working platform)	Ha	1.20	R6 101.15	**R7 321.38**
			Sub-Total	**R7 321.38**
Cost Factor 9				
Ripping and levelling Roads and all compacted areas				
Risk based criteria and assumptions with regard to rehabilitation of bulk sample sites				
Existing tracks will be used and no new roads will be developed. The stockpile and logistics area will not exceed the planned footprint.				
Service roads	Ha	0.72	R245.36	**R176.66**
			Sub-Total	**R176.66**
Cost Factor 11				
Rockshading wastedump				
Risk based criteria and assumptions with regard to rehabilitation of bulk sample sites				
No rock shading required on heapfill dumps Shading on toe of sidehill fill to be evaluated at final footprint taking into account surrounding topography and visual impact				
Mining/Sampling Area	**Unit**	**No Units**	**Unit Cost**	**Cost per Element**
Heap fill waste dump (working platform)	No rock shading			
			Sub-Total	**R0.00**
Cost Factor 12				
Rockshading rockface				
Risk based criteria and assumptions with regard to rehabilitation of bulk sample sites				
Shading on high wall to be evaluated at final footprint taking into account surrounding topography and visual impact				
Mining/Sampling Area	**Unit**	**No Units**	**Unit Cost**	**Cost per Element**
Benches to be developed	No highwall present for rock shading will be determined as mine develop			
			Sub-Total	**R0.00**
Cost Factor 13				
Blasting of highwalls				
Risk based criteria and assumptions with regard to rehabilitation of bulk sample sites				
Blasting of high wall to be evaluated at final footprint taking into account surrounding topography and pit stability				
Mining/Sampling Area	**Unit**	**No Units**	**Unit Cost**	**Cost per Element**
Benches to be developed	No highwall present for blasting will be determined as mine develop			
			Sub-Total	**R0.00**
Cost Factor 14				
Moving of blocks to designated areas				
Risk based criteria and assumptions with regard to rehabilitation of bulk sample sites				
Placing of blocks in designated areas to be done as part of housekeeping in the anual rehabilitation plan. Removal of blocks used for demarcation and low grade product to the demarcated waste dump at final closure. Removal of safety barrier to be evaluated at final footprint and depth of mine pit				
Mining/Sampling Area	**Unit**	**No Units**	**Unit Cost**	**Cost per Element**
Safety barrier and leftover product	Blocks	1 000.00	R37.67	**R37 670.00**
			Sub-Total	**R37 670.00**
Total estimated cost to fully decommissioned the mining site at final closure				**R95 457.26**

7 THE PUBLIC PARTICIPATION PROCESS

7.1 Principles and Objectives

The Public Participation Process (PPP) was designed to fulfil the requirements of several pieces of legislation applicable to mine closure. It forms an integral component of the mine closure process by affording Interested and Affected Parties (I&AP) the opportunity to identify environmental issues and concerns relating to the proposed closure, which they feel should be addressed. This is consistent with the provisions of the National Environmental Management

Act (Act No. 107 of 1998), Section 2(4)(f), which states that "the participation of all interested and affected parties in environmental governance must be promoted, and all people must have the opportunity to develop the understanding, skills and capacity necessary for achieving equitable and effective participation, and participation by vulnerable and disadvantaged persons must be ensured".

The objective of the prospecting operation is to develop a working PPP that informs key stakeholders', I&APs and the general public about mine closure objectives and activities during the life of the mine. The PPP was designed to provide sufficient and accessible information to I&APs in an objective manner to assist them to:

- Identify issues of concern, and provide suggestions for enhanced benefits and alternatives associated with mine closure,
- Identify risks not yet identified during the risk assessment exercise,
- Identify risks associated with mine closure and rehabilitation,
- Contribute local knowledge and experience,
- Verify that their issues have been considered.
- Comment on the Risk Assessment and Mine Closure Plan at the time of final decommissioning of the project, including the significance of potential risks that have been identified and associated impacts,
- Play an oversight role in the monitoring and evaluation of mine closure.

7.2 Stakeholder Identification and Project Data Base

Existing data bases were used to inform the list of stakeholders. Special consideration was given to ensure that organizations and individuals that had expressed interest in the activities of the operation, and those who are potentially affected by mine closure, were included on the data base. The following are principles which governed the PPP:

- Key stakeholder groups and the general public comprised the target audience in the development of the PPP.
- Providing information to lay people to allow them to contribute to and participate meaningfully in the process.
- Stakeholder participation is most effective when the proponent and the practitioner recognise, acknowledge and validate stakeholder values when designing a PPP (i.e. there should be no underestimation of the technical and professional competence of citizens).
- The recognition that in the current political climate of South Africa, consultation, empowerment and capacity building is particularly important.

The process of involving stakeholders had three main objectives:

- Steps should be taken to ensure that stakeholder input into the project is relevant and representative.
- Stakeholders should be made aware of their objectives and role in the process,
- An efficient communication and feedback mechanism should be developed during the process to ensure that all stakeholders are kept informed of progress.

Stakeholders were drawn from the sectors outlined below:

- National (DWAS, DMR), Provincial (DENC, DALR) and Local Government (Local and District Municipalities)
- Industry (commercial farmers)
- Corporations and businesses (service providers to operation)
- Operations staff

The operation set up a database of I&APs using existing project databases as a starting point. Names of persons and organisations will be added to or deleted from the database where appropriate.

8 WAY FORWARD

This final Rehabilitation, Decommissioning and Mine Closure Plan will be reviewed on an annual basis to align such approved financial provision set out in regulations 9 and 11, of the NEMA Financial Regulations. Concurrent rehabilitation and remediation will be provided for in the annual rehabilitation plan and will contain information that defines activities on an annual basis and how these relate to the closure vision, as detailed in this final rehabilitation, decommissioning and mine closure plan.

When final planned closure is applied for the operation will submit a final environmental performance audit report to DMR as lead agent for final perusal with the objective to issue a closure certificate. At that point, the closure process, and associated public participation program, will close.