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Tshipi Borwa Mine

Preliminary Mine Closure Plan

SLR Project No.: 710.20008.00036

Report No.: 1

Rev 0

July 2017

Tshipi é Ntle Manganese Mining (Pty) Ltd

Tshipi é Ntle
Manganese Mining

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Project Manager	S van Niekerk
Project Manager e-mail	svanniekerk@slrconsulting.com
Author	S van Niekerk
Reviewer	A Pheiffer
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EXECUTIVE SUMMARY

This preliminary closure plan has been prepared in accordance with GNR 1147 of the National Environmental Management Act (107/1998): Regulations pertaining to the financial provision for prospecting, exploration, mining or production operations, published 20 November 2015 (Financial Provisioning Regulations, 2015).

The preliminary closure plan objectives and principles have been developed against the background of the mine location in the Kuruman region of the Northern Cape Province, and include the following:

- Environmental damage is minimised to the extent that it is acceptable to all parties involved.
- At closure, the land will be rehabilitated to achieve an end use of wilderness and/or grazing.
- All surface infrastructure will be removed from site after closure. The open pit will be completely backfilled and the remaining waste rock dumps shaped to 1V:3H (18°) to create a stable landform.
- Contamination beyond the mine site by wind, surface run-off or groundwater movement will be prevented.
- Mine closure is achieved efficiently, cost effectively and in compliance with the law.
- The social and economic impacts resulting from mine closure are managed in such a way that negative socio-economic impacts are minimised.

Additional and more specific closure objectives may be tied to the final land use for the mine area, and these will be determined in collaboration with local communities and other stakeholders during ongoing operations of the Tshipi Borwa Mine.

The table below details the requirements of GNR 1147 and also the relevant sections in the report where these requirements are addressed.

GNR 1147 – Appendix 3, 4 and 5		**Relevant section in the report**
Annual Rehabilitation Report (Appendix 3)		
3(a)-(g)	Content of report	Section 12
Mine Closure Plan (Appendix 4)		
3(a)	Details of the specialists	Section 1
3(b)(i)	Material information	Section 2.1
3(b)(ii)	Environmental and social context	Section 2.2
3(b)(iii)	Stakeholder issues and comments	Section 2.3
3(b)(iv)	Mine plan and schedule	Section 2.4
3(c)(i)	Risk assessment methodology	Section 3.1
3(c)(ii)	Identification of indicators	Section 3.3
3(c)(iii)	Strategies to manage/mitigate risks	Section 3.2
3(c)(iv)	Reassessment of risks	Section 3.4
3(c)(v)	Changes to risk assessment results	n/a – will be identified during the ongoing operation of the mine

3(d)(i)	Legal and governance framework	Section 4.1
3(d)(ii)	Closure vision and objectives	Section 4.2
3(d)(iii)	Evaluation of alternatives	Section 4.3
3(d)(iv)	Motivation for closure option	Section 4.4
3(d)(v)	Motivation for closure period	Section 4.5
3(d)(vi)	Details of ongoing research	Section 4.6
3(d)(vii)	Assumptions made for closure	Section 4.7
3(e)(i)	Post-mining land use	Section 5
3(e)(ii)	Map of post mining land use	n/a – will be developed during the ongoing operation of the mine
3(f)(i)	Specific technical solutions	Section 6.1
3(f)(ii)	Threats and uncertainties	Section 6.2
3(g)(i)&(iii)	Schedule of actions	Section 7
3(g)(ii)	Assumptions and drivers	Section 7
3(h)(i)-(iii)	Organisational capacity and structure	Section 8
3(i)	Indication of gaps	Section 9
3(j)	Relinquishment criteria	Section 10
3(k)(i)	Closure cost estimate & accuracy	Section 11.1, 11.3 and Appendix C
3(k)(ii)	Closure cost estimate methodology	Section 11.2
3(k)(iii)	Annual updates	n/a – will be updated during the ongoing operation of the mine
3(l)(i)-(iii)	Monitoring, auditing and reporting	Section 13, Appendix B
3(m)	Amendments to the closure plan	n/a – uncertainties and gaps will be investigated during the ongoing operation of the mine, and detailed in future amendments to the closure plan
Environmental Risk Assessment (Appendix 5)		
(a)	Details of the specialists	Section 1
(b)(i)	Risk assessment methodology	Section 3.1
(b)(ii)	Latent risk substantiation	Section 3.2, Table 3-2
(b)(iii)	Risk drivers	Section 3.2, Table 3-2
(b)(iv)	Expected timeframe	n/a – no latent risks identified
(b)(v)	Risk triggers	n/a – no latent risks identified
(b)(vi)	Risk assessment results	Section 3.2, Table 3-2
(b)(vii)	Changes to risk assessment results	n/a – can only be identified during the ongoing operation of the mine
(c)(i)	Monitoring to inform management	Section 3.4 (see Section 27 of EIA and EMP report)
(c)(ii)-(iv)	Alternative mitigation measures following impacts	n/a – can only be identified during the ongoing operation of the mine, and where current proposed mitigation measures prove inadequate
(d)(i)-(iii)	Cost estimation and accuracy	Overall cost estimate included in Section 11 and Appendix C. No latent risks costed.
(e)	Monitoring, auditing and reporting	Section 13, Appendix B

The calculated closure costs for the components considered (i.e. excluding backfill of the pit void) is estimated to have an accuracy of at least 70%, as required by the Financial Provisioning Regulations, 2015 (GNR 1147) for mines with a remaining life of between 10 and 30 years, and are summarised below. All the closure costs are at Current Value (CV) as at July 2017.

Time-frame	Date	Closure Cost Liability incurred during the period (incl. VAT)	Progressive Closure Cost Liability (incl. VAT)	Progressive Closure Cost Liability as a % of LOM liability
Current	July 2017	n/a	R 118,842,762	63.3 %
+5 years	July 2022	R 29,547,462	R 148,390,224	79.0 %
+ 10 years	July 2027	R 24,016,339	R 172,406,563	91.8 %
+ 25 years (LOM)	**July 2042**	**R 15.384,891**	**R 187,791,454**	**100%**

The Financial Provisioning Regulations require that Tshipi provide for the anticipated liability 10 years from now i.e. R 172,406,563 (incl. VAT).

This preliminary closure plan for the Tshipi Borwa Mine, and hence the overall level of confidence in the closure cost liability can be improved by:

- Ongoing research related to the proposed closure options, such as:
    - Partial backfilling of the open pit void to a level where the formation of a pit lake does not occur - estimated to be about 50 m below ngl. This will significantly reduce the closure cost liability associated with the open pit void, and is not expected to detrimentally affect the rehabilitated area post closure.
    - Monitoring of trial revegetation programmes to evaluate the effectiveness and sustainability of revegetation efforts; methods to further improve and/or optimise; as well as inform the post closure maintenance and aftercare period.
- Investigating the opportunities, threats and uncertainties associated with the proposed closure option, such as:
    - Ongoing review and updating of the overall risk assessment through a committee made up of environmental, health and safety, production, and engineering managers, union representatives and external consultants.
    - Ongoing engagement with all employees and contractors to not unnecessarily pollute and/or negatively impact the environment.
    - Follow good operational, decommissioning and rehabilitation practices and procedures.
    - Support the operations executive, environmental department and stakeholder engagement forums to adhere to the commitments made in the EIA and EMP report.

  - Field quality of rehabilitated areas must be maintained post-closure (i.e. not over-grazed) for the closure objectives (prevent contaminated stormwater runoff, dust, land degradation etc.) to be met.
  - Effects of climate change on the maintenance and aftercare period, as well as, the long-term sustainable preferred post closure land use of wilderness and/or grazing.
  - Social threat from nearby communities that derive the bulk of its income from the mining operation and is reliant on the mine for the provision of services.
  - Confirm the demolition and removal of all infrastructure (including buildings, powerlines, water supply and treatment, access roads etc.).
- Addressing the currently identified gaps, such as:
  - Maintain a database of hazardous materials on site at closure, and the associated method of safe disposal.
  - Obtain site (and/or area specific) rates for the scheduled closure activities.
  - Check topsoil and growth medium material availability.
  - Compile a detailed schedule of activities, contract specifications and bill of quantities.
  - Identify what species of grasses, shrubs and trees will best support the post closure land use of wilderness and/or grazing, and identify field quality targets.

In order to fully comply with GNR 1147 (which is currently anticipated to be effective from February 2019), the following will also need to be undertaken:

- Development of an annual rehabilitation plan,
- Generation of a post mining land use map (as per Appendix 4, 3(e)(ii) of GNR 1147), and
- Obtain site specific rates for the scheduled closure activities (i.e. DMR guideline rates will no longer be accepted).

PRELIMINARY MINE CLOSURE PLAN

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ACRONYMS AND ABBREVIATIONS

Below a list of acronyms and abbreviations used in this report.

Acronyms / Abbreviations	Definition
amsl	Above mean sea level
BIF	Banded iron formation
DMR	Department of Mineral Resources
DWAF	Department of Water Affairs and Forestry (now DWS)
DWS	Department of Water and Sanitation
EIA	Environmental Impact Assessment
EMP	Environmental Programme Management
GNR	Government Notice Regulation
IAPs	Interested and Affected Parties
LOM	Life of Mine
NEM:WA	National Environmental Management: Waste Act (No. 59 of 2008).
ngl	Natural ground level
SANS	South African National Standards
SLR	SLR Consulting (Pty) Ltd
SMME	Small, medium and micro enterprise
Tshipi	Tshipi é Ntle Manganese Mining (Pty) Ltd
WRD	Waste Rock Dump

PRELIMINARY MINE CLOSURE PLAN

1 SPECIALIST INPUT

1.1 SPECIALISTS THAT PREPARED THE CLOSURE PLAN

The details of the specialists who prepared this preliminary closure plan report are provided in Table 1-1 below:

TABLE 1-1: DETAILS OF THE SPECIALISTS

Details	Project Manager	Environmental Assessment Practitioner
Name:	Stephen van Niekerk	Natasha Smyth
Tel No.:	011 467 0945	011 467 0945
Fax No.:	011 467 0978	011 467 0978
E-mail address	svanniekerk@slrconsulting.com	nsmyth@slrconsulting.com

Neither SLR nor any of the specialists involved in the preliminary mine closure plan process have any interest in the Tshipi Borwa Mine other than fair payment for consulting services rendered as part of the preliminary mine closure plan process.

1.2 EXPERTISE OF THE SPECIALISTS

Stephen van Niekerk is a technical director at SLR, holds a MSc Civil Engineering degree, has over 20 years of relevant experience and is registered as a Professional Engineer (#20010256) with the Engineering Council of South Africa (ECSA). Natasha Smyth holds a BSc Honours degree in Geography and Environmental Management and has approximately 7 years of relevant experience.

2 CONTEXT OF THE PROJECT

2.1 MATERIAL INFORMATION

This preliminary closure plan has been prepared for Tshipi é Ntle Manganese Mining (Pty) Ltd (Tshipi) in accordance with GNR 1147 of the National Environmental Management Act (107/1998): *Regulations pertaining to the financial provision for prospecting, exploration, mining or production operations*, published 20 November 2015 (Financial Provisioning Regulations, 2015).

The Tshipi Borwa Mine is located in the John Taolo Gaetsewe District Municipality in the Northern Cape Province. The mine is situated 18km south of Hotazel, 46km north of Kathu and 48km north west of Kuruman. The mine is an open pit operation that commenced in 2011.

The mine has a design capacity of between 2.5 and 4.5 million tonnes of manganese ore per annum that is transported off-site by rail. There is no processing of ore (other than crushing and screening) and no operational tailings storage facilities. The remaining life of mine for open pit mining is at least 25 years (excluding any potential longer term open pit expansion and/or underground mining extensions).

The mine layout and details are presented in Appendix A. Current mining operations in the area include various other manganese open pit mines (Mamatwan and UMK). The land capability of the mine area and surrounding area is considered only suitable for wilderness and/or grazing (as per the pre-mining land use).

2.2 ENVIRONMENTAL AND SOCIO-ECONOMIC OVERVIEW

The baseline environmental and socio-economic information is summarised below. Further details can be found in the amended EIA and EMP report for the Tshipi Borwa Mine.

2.2.1 TOPOGRAPHY

The Tshipi Borwa mine site is relatively flat with a gentle slope towards the north west. The elevation on site varies from 1080 m amsl (at the west boundary) to 1107 m amsl (at the south east boundary). The highest topographical features near the mine are the Mamatwan waste rock dumps approximately 0.2 km south east of the Tshipi Borwa Mine.

2.2.2 CLIMATE

The mean annual rainfall ranges from 386 mm to 455mm per annum, falling in the summer months between October and April. The average annual maximum temperature is approximately 26°C and the average annual minimum temperature is approximately 10°C. The mean annual (Lake) evaporation is approximately 1971 mm. The predominant wind directions are from the south east and north east.

2.2.3 GEOLOGY

The manganese ore body is contained within the Hotazel banded iron formation deposit of the Kalahari Manganese Field. Three beds of manganese ore are interbedded with the Hotazel banded iron formation. The lowermost of the three beds, Mn1 is the thickest and most viable to mine. The ore body is overlain by between 70m and 330m of gravels, clays, calcrete and Aeolian sand of the Kalahari Formation. From the outcrop, the ore body dips gently in a north westerly direction at approximately five degrees.

2.2.4 SOILS

Soils found at the Tshipi Borwa Mine include the Hutton and Clovelly soil types which are homogeneous in terms of texture, structure, and soil depth. These soil types are sandy and deep (> 1.5m) soils with a low clay content and will therefore drain rapidly. The Hutton and Clovelly soil types are generally slightly acidic to mildly alkaline with low phosphorus levels. Soil types located at the mine have low dryland arable agricultural potential due to high infiltration rates and lack of fertility and a moderate irrigation potential due to the low clay content.

2.2.5 WETLANDS

No wetlands occur on the mine property.

2.2.6 BIODIVERSITY

The mine area falls within the Kathu Bushveld which is described as an open savannah. The area is characterised by flat sandy plains and consists of a mixture of vegetation types that have undergone various changes due to grazing and past mining activities. Low rainfall in the area has also influenced the structure of this vegetation. This vegetation has a fairly well-developed tree stratum and a moderately developed shrub layer. The grass cover depends on the amount of rainfall during the growing season. No red data plant species are expected to occur within the mine area, however, some protected tree species are present. Some intruder/alien/weed species are also present due to overgrazing and/or previous mining activities.

Grassland and bushveld bird species, as well as, burrowing mammals do occur in the area. There is a possibility of three red data bird species occurring in the area (namely: Martial Eagle, Ludwig's Bustard and Secretary Bird) that have been recorded in the general surrounding area (quarter degree square 2227BD). Similarly, there exists the possibility that two red data mammal species may occur in the area (namely: South African Hedgehog and Honey Badger).

2.2.7 SURFACE WATER

There are no surface water resources within the Tshipi Borwa Mine mining right and surface use area. The closest watercourses to the mine are the Vlermuisleegte (±2km southwest), the Witleegte (± 10km northeast), and the Ga-Mogara (± 6 km west). Both the Vlermuisleegte and the Witleegte are tributaries of the Ga-Mogara River, which is a tributary of the Kuruman River. All three watercourses are non-perennial, ephemeral and highly seasonal.

The three watercourses are characterised by gentle gradients and sandy soils, with the end result that only fairly heavy rain will induce any significant surface runoff. No reliable water use is possible from any of the watercourses (Gamogara, Witleegte, Vlermuisleegte) due to the highly seasonal river flow.

2.2.8 GROUNDWATER

The hydrocensus undertaken as part of the approved EIA and EMP process indicated that the average ground water level within the mine property ranged from 20 m to 45 metres below ground level (mbgl) (Metago, May 2009). This is indicative of low rainfall in the area and highly permeable soils. In the mine area, the groundwater flows from south-west to north-east.

There are two aquifers present on the mine site, namely:

- A shallow aquifer made of the Kalahari Beds, sand and calcrete; and
- A deep fractured aquifer made of the Dywka clay and the Mooidraai dolomite Formation.

The average yield for the shallow aquifer system is <1 L/s and for the deep aquifer is approximately 0.9 L/s. The deeper aquifer is of local importance for water supply to the farmers in the area to supply drinking water for cattle and in some instances supply water for domestic use. Monitoring results indicate that the ground water quality could be regarded as medium to poor mainly due to elevated nitrate levels. Monitoring parameters such as: electrical conductivity, total dissolved solids, Chloride, manganese, molybdenum and iron exceed the SANS 241 (2011) drinking water standards. Monitoring parameters such as total dissolved solids and nitrate exceed the DWAF livestock water guideline limits and molybdenum exceeds the DWAF water quality guidelines.

2.2.9 GEOCHEMISTRY

The geology of the area and the activity of hydrothermal leaching results in the possibility of the following constituents being detected in abnormally high concentrations in the groundwater: carbon dioxide (CO2), manganese oxide (Mn3O4), iron oxide (Fe2O3), calcium oxide (CaO), magnesium oxide (MgO), lead (Pb) and boron (B) (Du Plooy, 2002).

2.2.10 HERITAGE

No significant heritage resources or cultural materials were identified during the phase 1 Heritage Impact Assessment for the original EIA and EMP for Tshipi Mine (PGS, 2009).

2.2.11 SOCIAL

The Tshipi Borwa Mine is located in the John Taolo Gaetsewe District Municipality in the Northern Cape Province.

The Northern Cape Province is one of the least populated provinces in South Africa because of its dry and arid environment. The mining industry is the most dominant industry of the Northern Cape economy. Human settlement in the province is concentrated close to centres of economic activity, due to the potential of earning a livelihood there.

There is a low conversion factor of school education into tertiary education in the region, which limits the availability of highly skilled labour in the area (e.g. for the mining sector). The bulk of the potentially active sector of the population without tertiary education therefore rely heavily on the limited low-skilled or unskilled labour employment opportunities available in the mining and agriculture sectors. The current unemployment rate for the Northern Cape Province is approximately 45% (for youth, 15 to 34 years old) and approximately 22% (for adults, 35 to 64 years old) (StatsSA, 2015).

2.3 STAKEHOLDER ISSUES AND COMMENTS

A summary of the issues and concerns raised by interested and affected parties (IAPs) and regulatory authorities (taken from the original EIA and EMP report, May 2009 and public consultation undertaken to date) that have specifically informed the preliminary closure plan is provided in Table 2-1 below.

TABLE 2-1: SUMMARY OF ISSUES RAISED BY IAPS AND REGULATORY AUTHORITIES

IAP DETAILS		DATE OF COMMENT	ISSUE RAISED
Andrew Pyper	Surrounding land owner	Public scoping meeting, 20 October 2008	Are there ongoing rehabilitation measures in place while prospecting and mining operations are in progress?
Machiel Andries Kruger	Surrounding land owner	Faxed letter, 18 October 2008	How will the quality and quantity of underground water be affected by mining? Water is already a problem for some farms; the understanding is that the mines are responsible for this.
			Water quality is already deteriorating on some farms and we suspect the surrounding mines are responsible for it.
Carel Reyneke	Surrounding land owner	Public scoping meeting, 20 October 2008	It was recently discovered that several boreholes have yielded poisonous water, is there a possibility that it could be linked to blasting chemicals?
Machiel Andries Kruger	Surrounding land owner	Social scan, 5 July 2013	There is so much dust. The plants are covered in dust and in some instances, these plants almost appear white from all the dust sitting on the leaves and branches.

IAP DETAILS		DATE OF COMMENT	ISSUE RAISED
Andrew Pyper	Surrounding land owner	Scoping meeting with authorities, 30 July 2013	Vegetation is susceptible to both diesel fumes as well as diesel spills. Some sort of investigation should be undertaken in which the issue is studied from a grazing perspective and the impact that this will have on livestock. Tshipi should take remedial measures to avoid or lessen the impact that such spills and emissions have on surrounding flora.
			In the Kalahari, when the surface is disturbed, this takes years and years to recover. To establish even a small amount of vegetation takes up to 20 years and during this time only the pioneer species will recover. The better grasses and shrub species may take much longer. Existing farming activities have already resulted in the disturbance of naturally occurring grass species and, due to overgrazing and mismanagement, many species have become threatened. Each time there is some sort of disturbance relating to mining, this existing effect is compounded.

2.4 MINE PLAN AND SCHEDULE

Manganese ore is mined from a single open pit (currently 68 ha) using conventional truck and shovel methods. The mining operations started from the south east and are progressing to the north and west. The depth of the manganese seam at the mining start point was approximately 70m below surface with the deepest point approximately 330m below surface. The open pit will extend to depths of approximately 200 or more metres. In the longer term underground mining extensions may be required to access the deeper ore.

2.4.1 LIFE OF MINE

The remaining life of mine (for open pit mining) is at least 25 years. The life of mine could be further extended with the expansion of the open pit and/or development of an underground manganese mine.

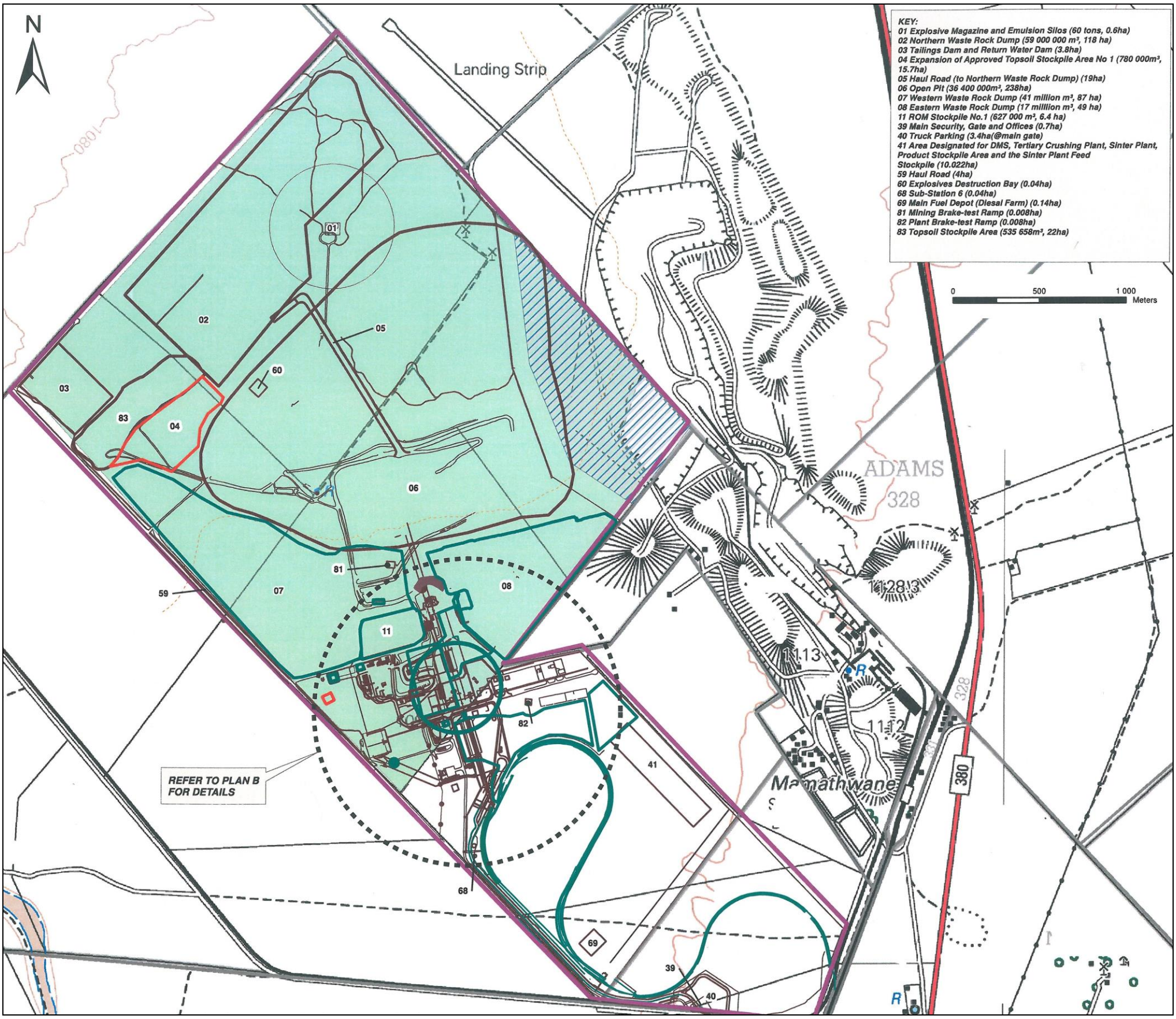
2.4.2 AREAS OF DISTURBANCE

The current areas of disturbance associated with the Tshipi Borwa Mine are shown in Figure 2-1 (and Appendix A), and include:

- Open pit and waste rock dumps.
- Topsoil stockpiles.
- Tailings storage facility (facility constructed but not yet operational).
- Explosives magazine.

- Electrified railway line, siding and load out station.
- Fuel storage and handling yards.
- Ore/product stockpile areas.
- Offices, change rooms, laboratory and substations.
- Mining contractors yard and laydown areas.
- Contractors yards and laydown areas.
- Crushing and screening operations.
- Water including process water and stormwater storage facilities.
- Access and haul roads including parking areas.
- Non-mineralised waste handling and storage facilities.
- Soil bioremediation facility.
- Various support services and infrastructure.

FIGURE 2-1: INFRASTRUCTURE LAYOUT AT TSHIPI BORWA MINE



3 ENVIRONMENTAL RISK ASSESSMENT

3.1 RISK ASSESSMENT METHODOLOGY

An Environmental Impact Assessment has been carried out as part of the EIA and EMP amendment for the Tshipi Borwa Mine. Potential environmental impacts were identified by SLR and other stakeholders, and considered in a cumulative manner such that current baseline conditions on site and in the surrounding area were discussed and assessed together.

The assessment methodology used (see Section 6.6 of the amended EIA and EMP report) enabled the assessment of environmental issues including: cumulative impacts, the severity of impacts (including the nature of impacts and the degree to which impacts may cause irreplaceable loss of resources), the extent of the impacts, the duration and reversibility of impacts, the probability of the impact occurring, and the degree to which the impacts can be mitigated.

The findings of the EIA indicated that all potential impacts can be prevented or reduced to acceptable levels (i.e. potential impacts with a medium or low significance).

3.2 IDENTIFICATION OF STRATEGIES TO MANAGE AND MITIGATE THE IMPACTS AND RISKS

The environmental impacts (at the Decommissioning and Closure phases) as identified by the EIA were:

- Loss and sterilisation of mineral resources
- Hazardous excavations and infrastructure
- Loss of soil resources and land capability through contamination
- Loss of soil resources and land capability through physical disturbance
- Physical destruction of biodiversity
- General disturbance of biodiversity
- Alteration of surface water drainage lines
- Contamination of surface water resources
- Contamination of groundwater resources
- Air pollution
- Noise
- Negative visual views
- Loss of heritage/cultural and palaeontological resources
- Change in land use

These impacts are discussed in more detail in Table 3-1.

The assessment of these impacts and associated risk, in the unmitigated and mitigated scenario, are presented in Table 3-2. If all the mitigation measures as per the EIA and EMP report are successfully implemented, then it is anticipated that there will be no latent or residual environmental impacts.

Adherence to the mitigation measures identified in Table 3-2 are the drivers that will result in the elimination and/or reduction of these impacts and the associated risks.

3.3 IDENTIFICATION OF INDICATORS

Two key indicators have been defined which will facilitate evaluation of the ongoing environmental impacts and associated risk to closure (risk triggers). These two key indicators can be evaluated through analysis of ongoing monitoring results. The two key indicators are namely:

- Groundwater quality, and
- Vegetative cover.

Surface water quality has not been selected as a key indicator given the lack of surface water anticipated post closure. The closest three watercourses outside of the Tshipi Mine surface use and mining right area are non-perennial, ephemeral and highly seasonal.

The first indicator, groundwater quality, is an important measure of the effectiveness of mitigation activities (particularly for the latent environmental impact of groundwater associated with the open pit and remaining waste rock facilities) and for protecting the health and safety of neighbouring and/or down gradient land users, livestock, and wildlife.

The second indicator, vegetative cover, is highly correlated with all the other major environmental parameters of the area, including erosion, dust, physical stability, chemical stability, soil quality and hydrology. Good vegetative cover results in a reduction in the volume of surface runoff, increases soil and slope stability, and leads to the formation of an organic layer. In addition, vegetative growth is visually correlated with successful rehabilitation (and/or protection of the surrounding environment). This is an extremely important indicator because it provides a simple, very effective and relevant measure of the lands' current (and/or future) capability.

Other indicators of rehabilitation success (such as dust fallout, slope stability etc.) have also been included in the overall general rehabilitation monitoring programme as described in Appendix C.

TABLE 3-1: POTENTIAL IMPACT SUMMARY DURING OPERATIONS AND AT CLOSURE

Potential impact	Aspect	Impact discussion
Loss and sterilisation of mineral resources	Geology	Mineral resources can be sterilised and/or lost through the placement of infrastructure and activities in close proximity to mineral resources, by preventing access to potential mining areas, and through the disposal of mineral resources onto mineralised waste facilities (waste rock dumps and tailings dam). Related mitigation measures include best mining practises to ensure that mineral sterilisation is minimised as far as possible.
Hazardous excavations and infrastructure resulting in safety risks	Topography	Hazardous excavations and infrastructure include all structures into or off which third parties and animals can fall and be harmed. Included in this category are facilities that can fail such as the approved tailings dam. Related mitigation measures focus on infrastructure safety and design and limiting access to third parties and animals.
Loss of soil resources and land capability through contamination	Soil and land capability	Soil is a valuable resource that supports a variety of ecological functions and is the key to re-establishing post closure land capability. Soil and related land capability can be compromised through pollution and through physical disturbance through compaction, removal and erosion. Related mitigation measures focus on pollution prevention, implementing soil conservation procedures and limiting site clearance to what is absolutely necessary.
Loss of soil resources and land capability through physical disturbance		
Physical destruction of biodiversity	Biodiversity	Areas of high ecological sensitivity are functioning biodiversity areas with species diversity and associated intrinsic value. In addition, some of these areas host protected species. The linking areas have value because of the role they play in allowing the migration or movement of flora and fauna between the areas which is a key function for the broader ecosystem. The project has the potential to impact on biodiversity both through physical destruction (mainly during infrastructure establishment) and on-going physical disturbance during all project phases. Related mitigation measures focus on limiting the project footprint area, biodiversity action plans and operation controls to limit on-going disturbance.
General disturbance of biodiversity		
Alteration of surface water drainage patterns	Surface water	Rainfall and surface water run-off are collected in all areas that have been designed with water containment infrastructure. The collected run-off will therefore be lost to the catchment and can result in the alteration of drainage patterns. Related mitigation measures focus on minimising the footprint areas associated with containing rainfall and runoff and diverting clean run-off away from the mine site.

Potential impact	Aspect	Impact discussion
Contamination of surface water resources	Surface water	The project has the potential to contaminate surface water resources. Related mitigation measures focus on pollution prevention and monitoring.
Contamination of groundwater resources	Groundwater	There are a number of sources in all mine phases that have the potential to pollute groundwater. Some sources are permanent (approved tailings dam) and some sources are transient (starting later and at different time-steps) and becoming permanent (pit backfilling). Even though some sources are temporary in nature, related potential pollution can be long term. Related mitigation measures focus on monitoring, compensation for third party loss of water supply and basic infrastructure design.
Air pollution	Air quality	The main contaminants associated with the proposed project includes: inhalable particulate matter less than 10 microns in size (PM10), larger total suspended particulates (TSP) that relate to dust fallout, Mn concentrations, SO_2, NO_2 and gaseous emissions mainly from vehicles and generators. At certain concentrations, contaminants can have health and/or nuisance impacts. Related mitigation measures focus on pollution prevention and monitoring.
Noise pollution	Noise	Two types of noise are distinguished: noise disturbance and noise nuisance. The former is noise that can be registered as a discernible reading on a sound level meter and the latter, although it may not register as a discernible reading on a sound level meter, may cause nuisance because of its tonal character (eg. distant humming noises). Related mitigation measures focus on noise pollution prevention and monitoring when required.
Negative visual views	Visual	Visual impacts are assessed by considering changes to the visual landscape. Mine infrastructure and activities will change this landscape and the changes will have different impacts that will vary between the different viewpoints and the associated visual receptors. Related mitigation measures focus on landscaping interventions particularly during the decommissioning and rehabilitation stages.
Loss of heritage/ cultural and paleontological resources	Heritage /cultural and paleontological resources	In the event of a chance find where undisturbed areas will be cleared as part of the establishment of additional facilities and activities (barrier pillar) there is a potential to damage heritage/cultural and palaeontological resources (if present), either directly or indirectly, and result in the loss of the resource for future generations. Related mitigation measures focus on notifying heritage/cultural and palaeontological specialists in the event of a chance find.

Potential impact	Aspect	Impact discussion
Change in land use	Land use	Land uses within the Tshipi Borwa Mine area include mining activities and infrastructure associated with the mine. Land use surrounding the Tshipi Borwa Mine area includes existing mining operations, agriculture, infrastructure (road, rail network, powerlines, water pipeline, sewage works), solar plant and isolated farmsteads. Related mitigation measures include communication with neighbouring communities, land users, and land owners to facilitate information sharing.

TABLE 3-2: ASSESSMENT OF SIGNIFICANT IMPACTS AND RISKS AT CLOSURE

Potential impact	Significance (unmitigated)	Management actions and mitigation measures	Significance (mitigated)	Extent to which the impact can be avoided or addressed through the implementation of management measures	Is the risk (and associated impact) considered latent or residual?
Loss and sterilisation of mineral resources	High	• Management through best practises	Low	Can be managed/mitigated to acceptable levels during operations and closure	No
Hazardous excavations and infrastructure resulting in safety risks	High	• Manage through access control • Control through management and monitoring • Control through rehabilitation • Remedy through emergency response procedure	Low	Can be managed/ mitigated to acceptable levels during operations and closure	No
Loss of soil resources and land capability through contamination	High	• Manage through waste management practices • Control through rehabilitation • Control through appropriate design • Remedy through emergency response procedure	Low	Can be managed/ mitigated to acceptable levels during operations and closure	No

Potential impact	Significance (unmitigated)	Management actions and mitigation measures	Significance (mitigated)	Extent to which the impact can be avoided or addressed through the implementation of management measures	Is the risk (and associated impact) considered latent or residual?
Loss and soil resources and land capability through physical disturbance	High	• Manage through limiting project footprint • Manage through soil conservation procedures • Control through closure planning and rehabilitation	Low (Medium for approved tailings dam)	Can be managed/ mitigated to acceptable levels during operations and closure	No
Physical destruction of biodiversity	High	• Management through biodiversity action plan and offset (when relevant) • Managing through limiting the project footprint • Management through rehabilitation • Control through permits for removal	Medium	Can be managed/ mitigated to acceptable levels during operations and closure	No
General disturbance of biodiversity	High	• Management through alien invasive species programme • Management through training • Management through monitoring • Management through appropriate design • Remedy through emergency response procedures	Medium	Can be managed/ mitigated to acceptable levels during operations and closure	No
Alteration of natural drainage lines	Medium	• Management through stormwater control • Manage through monitoring water requirements	Low	Can be managed/ mitigated to acceptable levels during operations and closure	No

Potential impact	Significance (unmitigated)	Management actions and mitigation measures	Significance (mitigated)	Extent to which the impact can be avoided or addressed through the implementation of management measures	Is the risk (and associated impact) considered latent or residual?
Contamination of surface water resources	Medium	• Management through waste management practises • Management through monitoring • Management through compensation • Remedy through emergency response procedures	Low	Can be managed/ mitigated to acceptable levels during operations and closure	No
Contamination of groundwater resources	Low	• Management through monitoring • Management through compensation • Management through appropriate design • Remedy through emergency response procedures	Low	Can be managed/ mitigated to acceptable levels during operations and closure	No
Air pollution	High	• Control through air controls and monitoring	Medium (High for Mn)	Can be managed/ mitigated to acceptable levels during operations and closure	No
Noise pollution	Medium	• Control through noise control measures and monitoring (if required)	Low	Can be managed/ mitigated to acceptable levels during operations and closure	No
Negative visual views	Medium	• Manage through limiting project footprint, rehabilitation and visual controls	Low	Can be managed/ mitigated to acceptable levels during operations and closure	No

Potential impact	Significance (unmitigated)	Management actions and mitigation measures	Significance (mitigated)	Extent to which the impact can be avoided or addressed through the implementation of management measures	Is the risk (and associated impact) considered latent or residual?
Loss of heritage /cultural and palaeontological resources	N/A	• Control through avoidance • Remedy through emergency response procedure	N/A	Can be avoided during operations and closure	No
Change in land use	Medium	• Remedy through compensation • Control through closure planning	Low	Can be managed/ mitigated to acceptable levels during operations and closure	No

3.4 REASSESSMENT OF RISKS

An environmental monitoring programme has been established at the Tshipi Borwa Mine to provide early warning systems necessary to avoid environmental emergencies, and for informing continual improvement of the mine closure plan. The monitoring programme includes:

- Soil resources;
- Surface water resource quality;
- Groundwater resource quality;
- Air quality; and
- Disturbance of biodiversity.

Impacts requiring monitoring (including responsibility and frequencies) are detailed in Section 27 (see Table 50) of the EIA and EMP Amendment report.

The environmental manager will conduct internal management audits against the commitments in the EMP report in accordance with an annual audit plan. In the operational phase, these audits will be conducted on a quarterly basis. The audit findings will be documented for both record keeping purposes and for informing continual improvement of the mine closure plan. In addition, an independent qualified professional conducts an EMP performance assessment in accordance with the relevant NEMA Regulations (GNR 982, 2014),. The mine's compliance with the provisions of the EMP and the adequacy of the EMP report relative to the on-site activities are assessed in the performance assessment.

3.5 FINANCIAL PROVISION FOR LATENT ENVIRONMENTAL IMPACTS

The costs associated with the post closure management and monitoring of environmental impacts has been estimated and included in the overall closure cost calculation (see Section 11 and Appendix C for specific details). No specific residual or latent environmental impacts have been identified and/or costed at this stage.

Additional remediation activities (i.e. remediation activities not currently anticipated, and if required) will be identified during the ongoing operation of the mine through the various monitoring programmes, environmental audits and/or updated risk assessment and pollution potential studies.

4 CLOSURE DESIGN PRINCIPLES

4.1 LEGAL AND GOVERNANCE FRAMEWORK

This preliminary mine closure plan has been drafted in accordance with the Financial Provisioning Regulations, 2015 (GNR 1147 of 20 November 2015), for inclusion with the Environmental Impact Assessment (EIA) and Environmental Management Programme (EMP) Amendment report for Tshipi Borwa Mine.

It is a requirement of the Environmental Impact Assessment Regulations, 2014 (GNR 982 of 4 December 2014) that a closure plan must contain the information set out in Appendix 4 of these Regulations (GNR 982), and, where the application for an environmental authorisation is for prospecting, exploration, extraction and primary processing of a mineral or petroleum resource or activities directly related thereto, the closure plan must address the requirements as set in the Financial Provisioning Regulations, 2015 (GNR 1147).

It is a requirement of the Mineral and Petroleum Resources Development Amendment Bill, 2013 (Bill 15 of 2013) that the holder of a mining right must make the prescribed financial provision for the rehabilitation and management of any negative environmental impacts due to mining activities.

4.2 VISION, OBJECTIVES AND TARGETS FOR CLOSURE

The vision, objectives and targets for closure have been developed against the local environmental and socio-economic context of the current mining operations, as well as, regulatory requirements and perceived stakeholder expectations.

Stakeholders will continuously be involved in the closure planning process throughout the mine life. The mine will strive to maintain a good working relationship with stakeholders and the local communities in which they operate. Agreements and final approval will be sought from authorities as closure approaches.

4.2.1 VISION FOR CLOSURE

The vision for closure is to minimise the impacts (biophysical and social) associated with the closure and decommissioning of the mine and to restore the land to a functioning post-mining land use. At this stage, the proposed post closure land use will be a combination of wilderness and/or grazing, provided the field quality is maintained by not exceeding the grazing capacity.

4.2.2 OBJECTIVES FOR CLOSURE

The preliminary closure plan objectives and principles have been developed against the background of the mine location in the Kuruman region of the Northern Cape, and include the following:

- Environmental impact and closure cost liability is minimised to the extent that it is acceptable to all parties involved.
- At closure, the land will be rehabilitated to achieve an end use of wilderness and/or grazing.
- All surface infrastructure will be removed from site after rehabilitation.
- The open pit will be completely backfilled with material from the overburden/waste rock dumps. Inert building rubble from the decommissioning activities will also be buried in the pit void.
- Contamination beyond the mine site by surface run-off, groundwater movement and wind will be prevented.
- Mine closure is achieved efficiently, cost effectively and in compliance with the law.
- The social and economic impacts resulting from mine closure are managed in such a way that negative socio-economic impacts are minimised.

Additional and more specific closure objectives may be tied to the final land use for the Tshipi Borwa mining area, and these will be determined in collaboration with local communities and other stakeholders during the ongoing operations of the mine.

4.2.3 TARGETS FOR CLOSURE

The closure target outcomes for the Tshipi Borwa Mine site are therefore assumed to be as follows:

- Achieve chemical, physical and biological stability for an indefinite, extended time period over all disturbed landscapes and residual mining infrastructure;
- Protect surrounding surface water, groundwater, soils and other natural resources from loss of utility value or environmental functioning;
- Limit the rate of emissions to the atmosphere of particulate matter and salts to the extent that degradation of the surrounding areas' land capability or environmental functioning does not occur;
- Maximise visual 'harmony' with the surrounding landscape; and
- Create a final land use that has economic, environmental and social benefits for future generations that outweigh the long term aftercare costs associated with the mine.

4.3 ALTERNATIVE CLOSURE OPTIONS

The closure options that have been considered at this stage are presented in Table 4-1 below.

TABLE 4-1: ALTERNATIVE CLOSURE OPTIONS CONSIDERED

Aspect	Options Considered	
Post closure land-use	A	Agriculture
	B	Wilderness and/or grazing
Final pit void	A	Leave open to support alternative use (e.g. underground mining operation or post closure water resource)
	B	Complete backfill of the pit void to ngl and rehabilitate area
	C	Partial backfill of the pit void to 50m below ngl (to prevent the formation of a pit lake) and rehabilitate the area
Workshop, stores, other mine buildings	A	Leave for small business development (e.g. light engineering, baking, laundry services, paper recycling, taxi operations, timber products etc.)
	B	Demolish and rehabilitate area
Administrative block	A	Leave for small business development (e.g. call centre, centralized office services, teaching and training college etc.)
	B	Demolish and rehabilitate area
Water treatment facilities	A	Retain for treatment of decant water from underground workings (if applicable)
	B	Demolish and rehabilitate area
Main and internal access roads	A	Retain some for access and/or to support post closure land use
	B	Demolish and rehabilitate area
Water holding facilities	A	Retain for post closure use (e.g. watering livestock)
	B	Demolish and rehabilitate area

Option currently selected

4.4 MOTIVATION FOR PREFERRED CLOSURE OPTION

4.4.1 POST CLOSURE LAND USE

The bulk of the Tshipi Borwa Mine site (prior to the mining operations) was used for livestock grazing since the area is not suitable for agriculture due to the low clay content of the soils and the low rainfall.

The preferred post closure land use is therefore most likely a combination of wilderness and/or grazing (provided the field quality is maintained by not exceeding the grazing capacity).

4.4.2 ALTERNATIVE POST CLOSURE OPTIONS FOR INFRASTRUCTURE

No alternative closure and post closure options for mine infrastructure have been considered at this stage (e.g. industrial development, SMME development, housing, recreational facilities etc.). Any alternative and practical closure and post closure options for mine infrastructure will be further investigated during the ongoing operations of the mine which may necessitate a revision of the closure plan.

The feasibility of alternative closure options will be need to be considered in terms of: sustainability of land use, engineering and environmental aspects, monitoring requirements, capital costs, post closure support services and available institutional capacity and skills.

4.5 MOTIVATION FOR CLOSURE AND POST CLOSURE PERIOD

The backfilling of the final void (currently estimated at 100,000,000 m^3 or more) following mine closure is considered to be the most time consuming aspect of this closure plan, and it will take 2 to 3 years to be completed (including re-vegetation of the area). Tshipi plan to generate a detailed backfill schedule as part of their mine planning process during 2017 in order to optimise this backfilling process.

Thereafter, a 5-year post closure period for maintenance and aftercare is considered reasonable given the estimated time required for revegetation to establish (provided there is sufficient rainfall). This 5-year post closure period has been further sub-divided into three years of active maintenance and two years of passive maintenance (i.e. where maintenance activities have decreased and monitoring frequency declined).

4.6 ONGOING RESEARCH FOR PROPOSED OR ALTERNATIVE CLOSURE OPTIONS

Further research regarding the proposed closure or alternative options will be ongoing during the remaining life of mine, for example:

- Partial backfilling of the open pit void to a level where the formation of a pit lake does not occur - estimated to be about 50 m below ngl (SLR Consulting, 2012). This will significantly reduce the closure cost liability associated with the closure of the open pit void, and is not expected to detrimentally affect the rehabilitated area post closure.
- Monitoring of trial revegetation programmes to evaluate the effectiveness and sustainability of revegetation efforts; methods to further improve and/or optimise; as well as inform the post closure maintenance and aftercare period.

4.7 CLOSURE PLAN ASSUMPTIONS

The following assumptions are made for the development of the Preliminary Closure Plan at this stage of the mining operations:

- The mine will follow and adhere to the commitments made in the EIA and EMP report;
- The mine will follow the mine plan and design /layout to minimise the potential for additional disturbed areas;
- The volume of stockpiled topsoil that has been stripped from infrastructure and operational areas will be sufficient for closure activities;

- The overburden material excavated from the open pit will be available for backfilling of the open pit void at closure;
- Groundwater in the deeper BIF aquifer will not be negatively impacted by the mine workings;
- Runoff water quality from rehabilitated areas will be acceptable and will not require any further treatment;
- No allowance for salvage and/or recycling scrap material has been considered in the estimation procedure;
- Inert building and demolition rubble can be safely disposed and buried on site (or disposed in the final open pit voids);
- Hazardous material can be safely disposed of offsite at a nearby appropriate facility;
- Reagent, fuel, lubricant and explosive manufacturers/suppliers will accept returned product at the end of the mine life;
- No consideration of the social closure costs has been included in this report;
- No assessment of any socio-economic/shared value/ community based programmes being implemented and whether these would continue post-closure of the operation; and
- All costs associated with pre-closure monitoring, auditing and reporting are presumed to be covered under the operations expenditure of the mine, and have not been included in this preliminary closure plan.

Assumptions will be reviewed during the ongoing operations of the mine and any required technical work conducted in order to reduce information gaps and uncertainty prior to mine closure.

5 POST-CLOSURE LAND USE

The preferred final post-closure land use will be wilderness and/or grazing.

All of the disturbed areas can be rehabilitated to support the post-closure grazing land-use and/or wilderness land-use including the backfilled pit area and overburden/waste rock dumps (that will be made safe by shaping and pushing down of steep slopes).

If grazing capacity is exceeded on any of the disturbed areas (i.e. over-grazing) then the closure objectives to prevent dust and contaminated stormwater runoff from the mine site may not be met.

6 CLOSURE ACTIONS

The preliminary closure actions are as follows:

- Surface infrastructure will be demolished and removed;
- The pit void will be completely backfilled and the area rehabilitated;

- Areas where infrastructure has been removed will be levelled and restored in terms of soil horizons (as far as practical), vegetation and drainage; and
- Remaining overburden/waste rock dumps will be shaped to 1V:3H (i.e. 18°) and rehabilitated.

Generally accepted closure methods have been used as the basis for determining the closure cost liability. Further details are provided below

6.1 SPECIFIC TECHNICAL SOLUTIONS

Specific technical solutions related to the preferred closure option for the areas of disturbance are detailed below.

6.1.1 BUILDINGS, PLANT AND MINE INFRASTRUCTURE

Buildings, processing plant and mine infrastructure (conveyors, water supply pipelines etc.) will all be dismantled, and salvageable elements will be sold and removed from site. Inert non-salvageable elements including concrete, plastic liners, brickwork, conveyor belting etc. will be dismantled or broken up and disposed of into the open pit voids before being covered with waste rock.

Concrete foundations and underground services (e.g. electrical, water and sewer) will all be removed or buried at least 0.5m below natural ground surface. Any contaminated soil from the decommissioned areas (that cannot be remediated) will be excavated and disposed of offsite at a nearby appropriate facility. Contaminated soils will typically include those contaminated by hydrocarbons (i.e. diesel, oil, grease etc.) and non-biodegradable chemicals (i.e. reagents, chemicals, dust suppressants etc.).

All the decommissioned areas will be landscaped and levelled so that natural stormwater flow is restored and that there is no ponding of water. The decommissioned areas will be covered with 300 mm topsoil/growth medium material (i.e. whatever was initially stripped from the area prior to construction) and revegetated.

6.1.2 OPEN PIT VOIDS

The remaining pit void will be backfilled to ngl with material from the overburden / waste rock dumps. Initially the pit void will be overfilled with backfill material to allow for settling and consolidation (the exact amount of overfill required will be need to be determined based on the amounts of material used, as well as, the depth of the pit). Care will also be taken to place waste rock (BIF) in the deeper sections of the pit, then subsoil (calcrete and sand) and finally topsoil at ground level (i.e. reinstate the pre-mining soil horizons - as far as practical).

Inert building rubble arising from the demolition of surface infrastructure will also be buried deep in the backfilled open pit void.

6.1.3 OVERBURDEN / WASTE ROCK DUMPS

At closure, material from the overburden / waste rock dumps will be used to backfill open pit voids to ngl. Despite the pit void being overfilled with material, it is still anticipated that a number of overburden / waste rock dumps will remain post closure (due to bulking of the excavated material).

The remaining waste rock dumps will be made safe by pushing down steep slopes, shaping to ensure the surface is free draining, and then covered with 300 mm topsoil/growth medium material (i.e. whatever was initially stripped from the area prior to construction) and revegetated.

6.1.4 ROAD NETWORK

Gravel roads no longer required for post closure use will be ripped and covered with stockpiled topsoil to promote the re-establishment of indigenous vegetation. Major roads no longer required for post closure use will first have the top layer works removed (and carted to a safe disposal facility), and then rehabilitated as per gravel roads.

All concrete lined drainage channels, sumps and culverts associated with closed roads will be broken up and buried deep in the backfilled open pit void.

6.1.5 FENCING

Fencing no longer required for post closure use will be removed and recycled for scrap. Inert material such as concrete foundations will be buried deep in the backfilled open pit void.

6.1.6 POWERLINES

Powerlines no longer required for post closure use will be removed and recycled for scrap. Inert material such as concrete foundations will be buried deep in the backfilled open pit void.

6.1.7 STORMWATER MANAGEMENT

The existing stormwater management plan will be updated to identify what stormwater management structures are required post closure and which can be decommissioned.

All the decommissioned areas of the mine site will be levelled and shaped so that the areas are free draining and there is no ponding of water. Any remaining slopes will be modified to at least 1V:3H (or flatter) to minimise erosion, and long slopes may require energy/flow breakers to curb the velocity of stormwater runoff.

It is currently anticipated that none of the pollution control dams will be required post closure, and hence these facilities and associated infrastructure can be decommissioned (as for concrete foundations, inert liner material etc. as mentioned previously). Any accumulated silt in the pollution control dams (that is typically classified as hazardous) will need to be safely disposed of at a nearby appropriate facility.

The remaining depressions /voids of the pollution control dams may however still prove useful during the maintenance and aftercare phase to act as settling dams and/or silt traps (and can thereafter be filled in and/or shaped to be free draining, and the area revegetated).

6.1.8 REVEGETATION

Revegetation of disturbed areas will be undertaken by replacing the previously stockpiled topsoil and growth medium materials (typically a 300mm layer) and planting with indigenous grasses (i.e. dry seeding) and deep rooted species such as trees/shrubs (i.e. hand planting of seedlings).

Areas requiring revegetation will be shaped and landscaped to ensure that they are free draining (reinstate original drainage lines if practical), steep slopes in excess of 1V:4H are to be avoided (where practical, excluding the side slopes of the remaining waste rock dumps) and all unnecessary remnants (e.g. building rubble and material stockpiles) are removed.

Grass and tree species to be used for revegetation will need to be carefully selected based upon their soil building capabilities, erosion protection characteristics, natural occurrence in the area, social/commercial value, and wildlife habitat value. It is recommended that field trials be undertaken during the mining operations to best determine the plant species and methodology for re-establishing vegetation. Revegetation activities also need to be carefully undertaken so as not to unnecessarily introduce any alien and/or invasive plant species into the area.

It is recommended that seed and plant harvesting be undertaken using vegetation from the surrounding area. Seed collection should be done preferably from April to May. Grass seeds in particular should be harvested as well as pods (from deeper rooted species). A suitable seed store should be established on site. Also, an on-site nursery to germinate tree and shrub species should also be established to provide sufficient stock for revegetation.

Field trials should be undertaken to determine the most successful methods of revegetation that will include the evaluation of: using plugs (seedlings), local seed harvesting, commercially available seed mixes, planting aids (e.g. hydrogel, fertilizer), wet (hydroseeding) or dry seeding techniques, water requirements, maintenance and aftercare requirements, and the time taken to meet the criteria for revegetation success (see section 10.2 later).

Key revegetation challenges include:

- Reducing sand movement (burial) and erosion to allow seedling establishment to take place;
- Low soil nutrient content (that can be further aggravated by incorrect storage);
- Low (and unpredictable/erratic) rainfall in an arid environment i.e. all planting activities should be undertaken at the end of the dry season, although there may still be insufficient summer rainfall to ensure sufficient growth; and
- Establishing key stone (deep rooted) species that assist to promote biodiversity (i.e. shallow rooted species) through hydraulic lift and soil stabilisation.

6.1.9 MAINTENANCE AND AFTERCARE

All the rehabilitated areas will require some form of aftercare and maintenance to ensure closure success. These activities will typically include erosion control and filling of erosion gulley's on slopes; fertilising of struggling rehabilitated areas; monitoring of groundwater quality; monitoring of vegetation composition and diversity; control and eradication of alien plants; monitoring slope stability of waste rock dumps, monitoring of dust fallout, creating firebreaks etc.

It is currently anticipated that most of the maintenance and aftercare activities will be undertaken in the first 3 years following closure (the active maintenance period), and thereafter the frequency of activities is expected to stop (in areas were vegetation is considered self-sustaining) and/or decline (passive maintenance period). The passive maintenance period is a further 2 years of monitoring with a reduced frequency.

6.1.10 GROUNDWATER MANAGEMENT

No groundwater management is currently anticipated (this will however be investigated and confirmed in subsequent closure plan updates).

6.2 OPPORTUNITIES ASSOCIATED WITH CLOSURE OPTION

Opportunities exist to currently engage with the surrounding community to get buy-in and support for the closure phase of the mining operations and the subsequent post closure environment.

There is an opportunity to investigate alternative post closure options (see Table 4-1) that are less disruptive to the stakeholders that will derive the bulk of their income from the mining operation (i.e. develop alternative income sources and promote skills development).

Opportunities also exist to currently engage with all the employees and contractors associated with the mine:

- To inform and educate them around the need to not unnecessarily pollute and/or negatively impact the environment;
- To follow good operational, decommissioning and rehabilitation practices and procedures; and
- To the support the operations executive, environmental department and stakeholder engagement forums to adhere to the commitments made in the EIA and EMP report.

6.3 THREATS ASSOCIATED WITH CLOSURE OPTION

The post closure land use of wilderness and/or grazing is feasible provided the field quality is maintained by not exceeding the grazing capacity. If grazing capacity is exceeded (i.e. over-grazing) then the closure objectives to prevent contaminated stormwater runoff, dust, land degradation etc. may not be met.

The effects of climate change on the future local environment are unknown and may present a threat for the preferred post closure land use, as well as, the time taken (i.e. maintenance and aftercare period) to achieve the criteria for revegetation success - see section 10.2 later. A 5-year maintenance and aftercare period has currently been costed in this preliminary closure plan.

There also exists a social threat from a community that derives the bulk of its income from the mining operation and is reliant on the mine for the provision of services.

6.4 UNCERTAINTIES ASSOCIATED WITH CLOSURE OPTION

It is currently assumed that all infrastructure will be demolished and removed from site. This assumption should be confirmed with post closure stakeholders since there may be some post closure use for certain infrastructure (e.g. offices, workshops, roads, water treatment facilities etc.).

7 SCHEDULE OF CLOSURE ACTIONS

Decommissioning of infrastructure and rehabilitation of disturbed areas will occur concurrently wherever practical (e.g. sloping and revegetation of WRD side slopes), and if not concurrent, decommissioning and rehabilitation will commence at the end of operations and will be completed within a period of one to two years.

Only the rehabilitation of the open pit voids is anticipated to take two to three years to complete (due to the volume of backfill material, currently estimated at 100,000,000 m^3 or more). The amount of backfill material still needs to be confirmed, and Tshipi plan to generate a detailed backfill schedule as part of their mine planning process during 2017 in order to optimise the backfilling process.

All the areas of the mine should be decommissioned simultaneously to enable backfilling of the open pit voids with inert building rubble from all the decommissioning activities on the mine site, prior to backfilling the open pit voids with material from the WRD's.

A preliminary schedule of the decommissioning and rehabilitation activities is shown in Figure 7-1.

FIGURE 7-1: PRELIMINARY SCHEDULE OF DECOMMISSIONING AND REHABILITATION ACTIVITIES

Closure Action	LOM				Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8				Year 9			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Open Pit Mining																																								
Decommissioning of Infrastructure																																								
Backfilling of Open Pit Voids																																								
Rehabilitation of Decommissioned Areas																																								
Active Maintenance & Aftercare																																								
Passive Maintenance & Aftercare																																								
Monitoring																																								
Relinquishment of Mine Site																																								

8 ORGANISATIONAL STRUCTURE AND ROLES

Typical key personnel to ensure compliance to the Closure Plan and associated commitments are the operations executive and the environmental department manager. As a minimum, these roles as they relate to the implementation of monitoring programmes and management activities include:

- Minimise the areas of possible disturbance by mining activities;
- Inform and commit to follow the annual rehabilitation plan;
- Ensure that the monitoring programmes, audits, and plan updates/reviews are scoped and included in the annual mine budget;
- Identify and appoint appropriately qualified specialists/engineers to undertake the monitoring, auditing and planning work;
- To integrate closure planning into the overall mine operations and mine planning work; and
- Appoint specialists in a timeously manner to ensure work can be carried out to acceptable standards.
- Liaise with the relevant structures in terms of the commitments in the Closure Plan;
- Ensure that commitments in the Closure Plan are undertaken and implemented;
- Establish and maintain good working relations with surrounding communities and landowners; and
- Facilitate stakeholder communication, information sharing and grievance mechanism.

8.1 CAPACITY BUILDING

Tshipi has the in-house capacity to undertake mine closure activities or will ensure that the personnel with the correct capacity and experience will be employed. There is therefore unlikely a need for internal capacity building.

Tshipi however, recognises that there is likely to be the need to build the capacity of the local communities who are influenced by the mining activities of the mine and who would be considered project stakeholders. Tshipi will embark on a capacity building program with stakeholders so that stakeholders are in a position to understand: the risks that may exist at closure; the limitations around risk mitigation strategies and that the stakeholders are able to provide meaningful input to engagements around possible post closure land use.

9 GAP IDENTIFICATION

Current gaps (and/or known unknowns) associated with the closure plan, that will be addressed during the ongoing operations of the mine include:

- Calculate the amount of hazardous material (e.g. fluorescent light bulbs, bitumen products from roads etc.) and determine a safe disposal option and/or nearby facility.
- Obtain site specific (and/or area specific) rates for the scheduled closure activities.
- Check topsoil and growth medium material availability.
- Compiling a detailed schedule of activities, contract specifications and bill of quantities.
- Identify what species of grasses, shrubs and trees will best support the post closure land use of wilderness and/or grazing.

10 RELINQUISHMENT CRITERIA

Relinquishment criteria will be developed in communication with the regulatory authorities and project stakeholders to define specific end-points that demonstrate the closure objectives have been met.

Two key indicators have been defined which will facilitate evaluation of closure objectives having been met at the Tshipi Borwa Mine. These two key indicators can be evaluated through analysis of ongoing monitoring results. The two key indicators are namely:

- Groundwater quality, and
- Vegetative cover.

Surface water quality has not been selected as a key indicator given the lack of surface water anticipated post closure. The closest three watercourses outside of the Tshipi Mine surface use and mining right area are non-perennial, ephemeral and highly seasonal.

The first indicator, groundwater quality, is an important measure of the effectiveness of mitigation activities (particularly for the latent environmental impact of groundwater associated with the open pit and remaining waste rock facilities) and for protecting the health and safety of post closure land users, neighbouring and/or down gradient land users, livestock, and wildlife.

The second indicator, vegetative cover, is highly correlated with all the other major environmental parameters of the area, including erosion, dust, physical stability, chemical stability, soil quality and hydrology. Good vegetative cover results in a reduction in the volume of surface runoff, increases soil and slope stability, and leads to the formation of an organic layer. In addition, vegetative growth is visually correlated with successful rehabilitation (and/or protection of the surrounding environment). This is an extremely important indicator of rehabilitation success because it provides a simple, very effective and relevant measure of the rehabilitated lands' capability.

Other indicators of rehabilitation success (such as dust fallout, slope stability etc.) have also been included in the overall general rehabilitation monitoring programme as described in Appendix C.

A summary of the criteria to be utilized for evaluation of rehabilitation success for each of the selected key indicators is provided in the following sections. Details of the decommissioning and rehabilitation monitoring program designed to provide the data necessary to evaluate rehabilitation success, including monitoring methods and frequency, are provided in Appendix C.

10.1 GROUNDWATER QUALITY EVALUATION SYSTEM

To utilise groundwater quality as an indicator of rehabilitation success the Tshipi Borwa Mine will:

- Identify sampling locations for rehabilitation, and post-rehabilitation periods;
- Determine which water quality analyses are required and the required frequency of sampling;
- Establish a detailed field sampling methodology; and
- Analyze and compare the results of chemical analyses of groundwater samples to the agreed standards to provide proof of compliance, and therefore verification of rehabilitation success, over the agreed monitoring period.

The proposed post closure groundwater quality monitoring program for the Tshipi Borwa Mine is described in detail in Appendix C, including methods of analysis, monitoring schedule, and definition of rehabilitation success in terms of the monitoring program.

10.2 VEGETATIVE COVER EVALUATION SYSTEM

The degree to which the vegetation cover is effective at reducing erosion is a function of the height and continuity of the plant canopy, the density of the ground cover, and the root depth. The vegetation cover also dissipates the energy from surface water runoff (and wind), thereby decreasing erosional forces. An increase in the vegetation cover also results in an increase in both the evapo-transpiration rate and the infiltration rate leading to changes in the water balance.

Wildlife diversity (and/or livestock populations) respond positively to an increase in available habitat and food supply that is brought on by the establishment of vegetative cover. Additionally, the success of vegetative cover reflects the chemical and physical suitability of soils to develop and maintain a productive ecosystem that will support a post-closure land use of wilderness and/or grazing (provided the field quality is maintained by not exceeding the grazing capacity).

Three parameters will be measured to evaluate vegetative cover on rehabilitated land:

- The percentage of vegetative cover,
- The tree/shrub (woody species) density, and
- The percentage of indigenous species.

The percentage of vegetative cover is the parameter which best represents the overall success of re-vegetation efforts given all relevant considerations. It is proposed that the Notched Boot Method be utilized to determine the percentage of vegetative cover in representative transects established on rehabilitated lands. This method is utilized worldwide and is advantageous because it is simple and reliable, produces valid results, which are easily interpreted, and does not require any specialised equipment. Tree/shrub density and species composition will be evaluated by direct field count in representative belt transects within the Tshipi Borwa Mine property. The vegetative cover monitoring program is described in detail in Appendix C, including methods of analysis, monitoring schedule, and definition of rehabilitation success in terms of the monitoring program.

A list of vegetative species that are considered appropriate for use in rehabilitation of the mine property will be confirmed during ongoing field trials at the mine site.

It is proposed that rehabilitation success for vegetative cover is demonstrated when monitoring of vegetative cover in rehabilitated areas at the Tshipi Borwa Mine indicates that:

- The percentage of vegetative cover on rehabilitated areas is greater than or equal to 90% of the vegetative cover percentage found on corresponding reference plots with a similar land use;
- The density of tree/shrub species (woody species) on rehabilitated areas is greater than or equal to 90% of the density of tree/shrub species found on corresponding reference plots with a similar land use; and
- The percentage of indigenous/common commercial species on rehabilitated areas is greater than or equal to 90% of the percentage of indigenous/common commercial species found on corresponding reference plots with a similar land use.

11 CLOSURE COST ESTIMATION PROCEDURE

11.1 CLOSURE COST ASSUMPTIONS

The Financial Provisioning Regulations, 2015 (GNR 1147) require the closure cost estimate to have an accuracy of approximately 70% since the LOM is more than 10 years but less than 30 years.

The assumptions made for the development of the Preliminary Closure Plan (see Section 4.7) are also relevant to the closure cost calculation.

11.2 CLOSURE COST METHODOLOGY

The closure cost liability was calculated as per the methodology of the DMR guideline document of January 2005.

As per the DMR guideline, Tshipi Borwa mine is classified as a Class C (low risk) mine, with a medium environmental sensitivity based on the pre-mining environment of the mining area, the proximity of the mine to local communities and the surrounding area's existing economic activity. The topography of the mine area is flat, and the mine location considered peri-urban. Further details of the DMR closure cost methodology can be found in Tshipi's latest closure cost liability calculation (SLR, January 2017).

Time, fee and contingency costs (as per Section 11.2.3) were included in order to improve the accuracy of the DMR guideline closure cost liability estimate, and to comply with the minimum 70% accuracy for the closure components considered.

The closure cost liability associated with the backfilling of the final pit void has not been considered at this stage, and will be included in future updates once the mine plan backfill schedule becomes available (later in 2017).

11.2.1 QUANTITIES

The quantities were calculated from the current and proposed site layouts available to date for the Tshipi Borwa Mine (See Appendix A).

11.2.2 UNIT RATES

The unit (Master) rates for each closure component is taken from the DMR guideline (and inflated by the Consumer Price Index (CPI) to account for escalation since January 2005) and a Multiplication Factor applied depending on the Risk Ranking (low risk) and the Environmental Sensitivity (medium).

The average annual percentage change in the CPI as provided by Statistics South Africa is shown in the table below.

TABLE 11-1: CPI INFLATION AS PROVIDED BY STATISTICS SOUTH AFRICA

January to December												
2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017** [1]
3.4%	4.6%	7.2%	11.5%	7.1%	4.3%	5.0%	5.6%	5.7%	6.1%	4.6%	6.4%	2.9%

The total escalation of the unit rates since January 2005 is 105.6% (i.e. 1.034 x 1.046 x 1.072 … etc.).

[1] CPI for January to June only.

The updated DMR guideline rates (as at July 2017) are provided in the Table 11-2 below. The specific closure components in Table 11-2 that are applicable to the calculation of the Tshipi Borwa closure cost liability are highlighted in grey.

TABLE 11-2: MASTER RATES USED FOR TSHIPI'S CLOSURE COST LIABILITY CALCULATIONS

No.	Description of closure component / activity	Unit	Master Rate (at Jan 2005)	Master Rate (at July 2017)	MF [2]
1	Dismantling of process plant & related structures (incl. overland conveyors & power lines)	m^3	R 6.82	R 14.03	1.00
2 (A)	Demolition of steel buildings & structures	m^2	R 95.00	R 195.37	1.00
2 (B)	Demolition of reinforced concrete buildings & structures	m^2	R 140.00	R 287.91	1.00
3	Rehabilitation of access roads	m^2	R 17.00	R 34.96	1.00
4 (A)	Demolition & rehabilitation of electrified railway lines	m	R 165.00	R 339.32	1.00
4 (B)	Demolition & rehabilitation of non-electrified railway lines	m	R 90.00	R 185.08	1.00
5	Demolition of housing &/or administration facilities	m^2	R 190.00	R 390.73	1.00
6	Opencast rehabilitation including final voids & ramps	Ha	R 96,700.00	R 198,863.19	0.52
7	Sealing of shafts, adits & inclines	m^3	R 51.00	R 104.88	1.00
8 (A)	Rehabilitation of overburden & spoils	Ha	R 66,400.00	R 136,551.35	1.00
8 (B)	Rehabilitation of processing waste deposits & evaporation ponds (basic, salt producing waste)	Ha	R 82,700.00	R 170,072.24	1.00
8 (C)	Rehabilitation of processing waste deposits & evaporation ponds (acidic, metal-rich waste)	Ha	R 240,200.00	R 493,970.41	0.66
9	Rehabilitation of subsided areas	Ha	R 55,600.00	R 114,341.19	1.00
10	General surface rehabilitation	Ha	R 52,600.00	R 108,171.71	1.00
11	River diversions	Ha	R 52,600.00	R 108,171.71	1.00
12	Fencing	m	R 60.00	R 123.39	1.00
13	Water management	Ha	R 20,000.00	R 41,129.93	0.25
14	2 to 3 years of maintenance & aftercare	Ha	R 7,000.00	R 14,395.47	1.00

[2] MF (Multiplication factor) based on Risk Ranking = Class C and Environmental Sensitivity = Medium.

11.2.3 TIME, FEE AND CONTINGENCY COSTS

The following time, fee and contingency costs have also been included in the closure cost calculations based on SLR's experience with similar projects.

TABLE 11-3: TIME, FEE AND CONTIGENCY COSTS

Description	Unit	Rate
Contingency	%	10
Tender process and procurement of contractors	%	6
Contractor P&G's, site establishment and demobilisation	%	20
Site supervision of closure works	%	7.5
Post closure supervision and monitoring costs (See Appendix C, Table C-3)	Sum	R 6.35 m

11.3 CLOSURE COST CALCULATION

The closure cost calculations are provided in Appendix C. The closure costs calculations have been determined for the following periods, namely:

- A current closure cost liability (as at July 2017);
- A future closure cost liability, 5 years from now (as at July 2022);
- A future closure cost liability, 10 years from now (as at July 2027); and
- A Life of Mine (LOM) closure cost liability, 25 years from now (as at July 2042).

A summary of the closure cost liability calculations is provided in Table 11-4 below. All the closure cost liability calculations are at Current Value (CV) as at July 2017. The closure cost liability associated with the Tshipi Borwa Mine as at LOM is R 187,791,454 (incl. VAT). The current Financial Provisioning Regulations require that Tshipi provide for the anticipated liability 10 years from now i.e. R 172,406,563 (incl. VAT).

TABLE 11-4: CLOSURE COST CALCULATION RESULTS

Time-frame	Date	Closure Cost Liability incurred during the period (incl. VAT)	Progressive Closure Cost Liability (incl. VAT)	Progressive Closure Cost Liability as a % of LOM liability
Current	July 2017	n/a	R 118,842,762	63.3 %
+5 years	July 2022	R 29,547,462	R 148,390,224	79.0 %
+ 10 years	July 2027	R 24,016,339	R 172,406,563	91.8 %
+ 25 years (LOM)	**July 2042**	**R 15.384,891**	**R 187,791,454**	**100%**

The overall level of confidence in the closure cost liability calculations can be further improved by:

- Include (partial or complete) pit void backfill into the closure cost liability calculations once the mine plan backfill schedule becomes available.
- Confirm the demolition and removal of all infrastructure (including buildings, powerlines, water supply and treatment, access roads etc.).
- Maintain a database of hazardous materials on site at closure, and the associated method (and hence cost) of safe disposal.
- Obtain site (and/or area specific) rates for the scheduled closure activities.
- Compile a detailed schedule of activities, contract specifications and bill of quantities.

12 ANNUAL REHABILITATION PLAN

According to the Financial Provisioning Regulations, 2015 (GNR 1147), 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.

Annual rehabilitation plans for the forthcoming 12 months will be prepared in future updates of this report.

Annual rehabilitation and remediation activities associated with the annual rehabilitation plan will focus primarily on:

- Clearing of vegetation in accordance with the relevant vegetation management procedures;
- Destructing and disturbing as little vegetation and biodiversity as possible (i.e. limiting the footprint of the mines operation), and retaining as much natural vegetation as possible;
- Stripping and stockpiling of soil resources in areas designated for development in line with a soil conservation procedure;
- Backfilling of mined out pit areas in accordance with the mine plan;
- Rehabilitation of overburden dumps (no longer required) that are expected to remain post closure;
- General, hazardous and medical waste collection, storage and disposal; and
- Ongoing monitoring of groundwater, surface water and air quality.

13 MONITORING, AUDITING AND REPORTING

13.1 PRE-CLOSURE MONITORING, AUDITING AND REPORTING

The environmental department manager will conduct internal management audits against the commitments in the EMP. These audits will be conducted on an on-going basis until final closure. The audit findings will be documented for both record keeping purposes and for informing continual improvement. EMP performance assessment must be undertaken in accordance to the conditions of the environmental authorisation. The site's compliance with the provisions of the EMP and the adequacy of the EMP report relative to the on-site activities will be assessed in the performance assessment.

A monitoring schedule has already been established at the Tshipi Borwa Mine and includes a groundwater and dust monitoring programme. Additional monitoring programmes (e.g. trials for revegetation of disturbed areas) should also be established during the ongoing operations of the mine. Monitoring is the responsibility of the environmental department, and is carried out by the environmental officers, who report to the environmental department manager.

The closure plan, environmental risk assessment and annual rehabilitation plan will be audited (and updated) on an ongoing basis throughout the life of the mine in order to inform the annual financial provision required for closure at LOM, as well as, unforeseen premature closure. The auditing and update of the closure plan, environmental risk assessment and annual rehabilitation plan will be carried out by external and independent environmental consultants.

In accordance with the Financial Provisioning Regulations, 2015 (GNR 1147), financial provision for closure at LOM, as well as, unforeseen premature closure will be updated on an annual basis. The financial provision will be calculated based on the information contained within the closure plan, environmental risk assessment and annual rehabilitation plan. This update will be carried out by external and independent environmental consultants. The financial provision amount will also be audited by an independent auditor that is registered with the Independent Regulatory Board of Auditors.

All costs associated with pre-closure monitoring, auditing and reporting are presumed to be covered under the operations expenditure of the mine, and have not been included in this preliminary closure plan.

13.2 POST-CLOSURE MONITORING, AUDITING AND REPORTING

A preliminary post-closure monitoring and reporting programme has been developed as part of this preliminary closure plan.

The total estimated cost of the post-closure monitoring and inspection activities has been calculated to be R 6,347,500 (excl. VAT) - a breakdown of the cost is provided in Appendix C: Section 6 and Table C-3. This cost makes provision for quarterly and bi-annual water sampling and site inspections by external and independent environmental consultants over a period of 8.5 years. Provision for a small on-site maintenance team over a period of 8.5 years has also been allowed for.

14 RECOMMENDATIONS

This preliminary closure plan for the Tshipi Borwa Mine, and hence the overall level of confidence in the closure cost liability can be improved by:

- Ongoing research related to the proposed closure options (see Section 4.6), such as:
    - Partial backfilling of the open pit void to a level where the formation of a pit lake does not occur - estimated to be about 50 m below ngl (SLR Consulting, 2012). This will significantly reduce the closure cost liability associated with the open pit void, and is not expected to detrimentally affect the rehabilitated area post closure.
    - Monitoring of trial revegetation programmes to evaluate the effectiveness and sustainability of revegetation efforts; methods to further improve and/or optimise; as well as inform the post closure maintenance and aftercare period.

- Investigating the opportunities, threats and uncertainties associated with the proposed closure option (see Section 6.2 to 6.4), such as;
    - Ongoing review and updating of the overall risk assessment through a committee made up of environmental, health and safety, production, and engineering managers, union representatives and external consultants.
    - Ongoing engagement with all employees and contractors to not unnecessarily pollute and/or negatively impact the environment.
    - Follow good operational, decommissioning and rehabilitation practices and procedures.
    - Support the operations executive, environmental department and stakeholder engagement forums to adhere to the commitments made in the EIA and EMP report.
    - Field quality of rehabilitated areas must be maintained post-closure (i.e. not over-grazed) for the closure objectives (prevent contaminated stormwater runoff, dust, land degradation etc.) to be met.
    - Effects of climate change on the maintenance and aftercare period, as well as, the long-term sustainable preferred post closure land use of wilderness and/or grazing.
    - Social threat from nearby communities that derive the bulk of its income from the mining operation and is reliant on the mine for the provision of services.

  - Confirm the demolition and removal of all infrastructure (including buildings, powerlines, water supply and treatment, access roads etc.)

- Addressing the currently identified gaps (see Section 9).
  - Maintain a database of hazardous materials on site at closure, and the associated method of safe disposal.
  - Obtain site (and/or area specific) rates for the scheduled closure activities.
  - Check topsoil and growth medium material availability.
  - Compile a detailed schedule of activities, contract specifications and bill of quantities.
  - Identify what species of grasses, shrubs and trees will best support the post closure land use of wilderness and/or grazing, and identify field quality targets.

In order to fully comply with GNR 1147 (which is currently anticipated to be effective from February 2019), the following will also need to be undertaken:

- Development of an annual rehabilitation plan (see Section 12),
- Generation of a post mining land use map (as per Appendix 4, 3(e)(ii) of GNR 1147), and
- Obtain site specific rates for the scheduled closure activities (i.e. DMR guideline rates will no longer be accepted).

15 CONCLUSION

This preliminary closure plan has been generated based on existing information currently available for the Tshipi Borwa Mine, and as documented in the amended EIA and EMP report.

The calculated closure costs for the components considered (i.e. excluding any backfill of the pit void) is estimated to have an accuracy of at least 70%, as required by the Financial Provisioning Regulations, 2015 (GNR 1147) for mines with a remaining life of between 10 and 30 years.

Steve Van Niekerk

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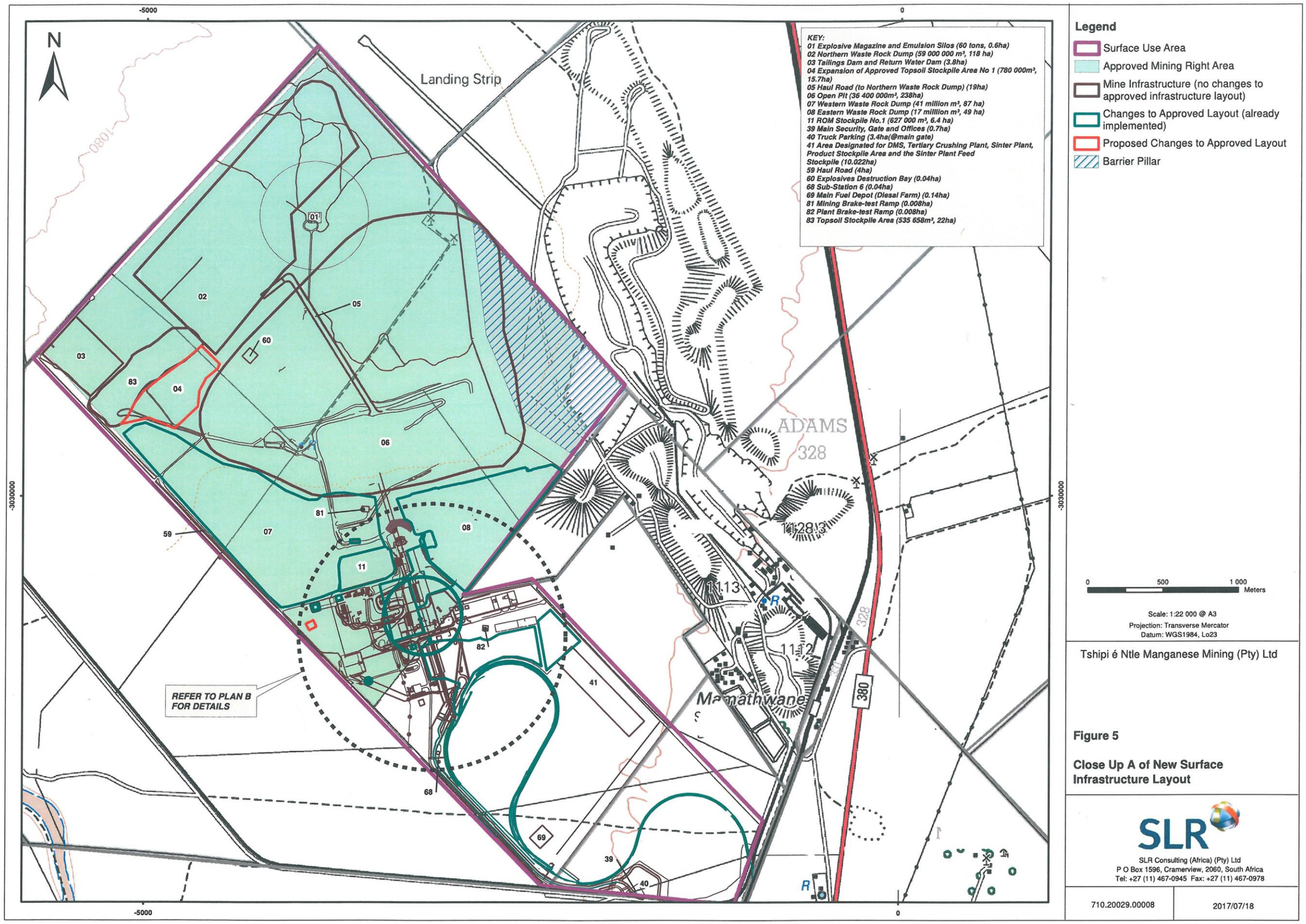
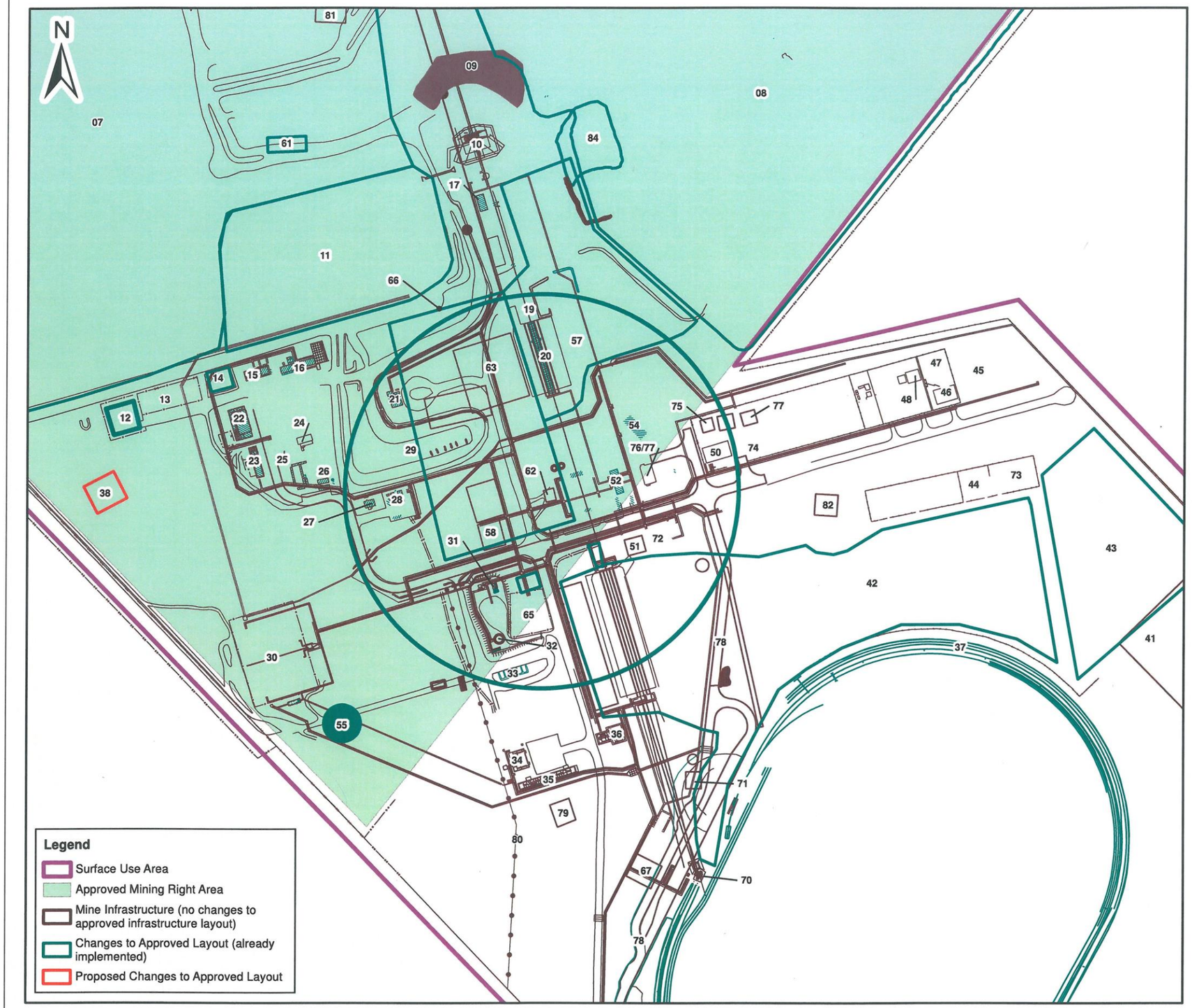
APPENDIX A: SITE LAYOUT AND DETAILS FOR THE TSHIPI BORWA MINE


-5000
0
-3030000
N
Landing Strip
1080
01
02
03
04
05
06
07
08
11
59
60
81
82
83
41
68
69
39
40
REFER TO PLAN B FOR DETAILS
ADAMS
328
1128
1113
1112
Manathwane
380
R
KEY:
01 Explosive Magazine and Emulsion Silos (60 tons, 0.6ha)
02 Northern Waste Rock Dump (59 000 000 m³, 118 ha)
03 Tailings Dam and Return Water Dam (3.8ha)
04 Expansion of Approved Topsoil Stockpile Area No 1 (780 000m³, 15.7ha)
05 Haul Road (to Northern Waste Rock Dump) (19ha)
06 Open Pit (36 400 000m³, 238ha)
07 Western Waste Rock Dump (41 million m³, 87 ha)
08 Eastern Waste Rock Dump (17 million m³, 49 ha)
11 ROM Stockpile No.1 (627 000 m³, 6.4 ha)
39 Main Security, Gate and Offices (0.7ha)
40 Truck Parking (3.4ha(@main gate)
41 Area Designated for DMS, Tertiary Crushing Plant, Sinter Plant, Product Stockpile Area and the Sinter Plant Feed Stockpile (10.022ha)
59 Haul Road (4ha)
60 Explosives Destruction Bay (0.04ha)
68 Sub-Station 6 (0.04ha)
69 Main Fuel Depot (Diesal Farm) (0.14ha)
81 Mining Brake-test Ramp (0.008ha)
82 Plant Brake-test Ramp (0.008ha)
83 Topsoil Stockpile Area (535 658m³, 22ha)
Legend
Surface Use Area
Approved Mining Right Area
Mine Infrastructure (no changes to approved infrastructure layout)
Changes to Approved Layout (already implemented)
Proposed Changes to Approved Layout
Barrier Pillar
0
500
1 000
Meters
Scale: 1:22 000 @ A3
Projection: Transverse Mercator
Datum: WGS1984, Lo23
Tshipi é Ntle Manganese Mining (Pty) Ltd
Figure 5
Close Up A of New Surface Infrastructure Layout
SLR
SLR Consulting (Africa) (Pty) Ltd
P O Box 1596, Cramerview, 2060, South Africa
Tel: +27 (11) 467-0945 Fax: +27 (11) 467-0978
710.20029.00008
2017/07/18



KEY:

07 Western Waste Rock Dump (41 million m³, 87 ha)
08 Eastern Waste Rock Dump (17 million m³, 49 ha)
09 ROM Pad (73 000 m³,16 ha)
10 Primary Crusher (±.0.7ha)
11ROM Stockpile No1 (627 000 m³, 7.6 ha)
12 Workshop Dirty Water Collection Dam (4Ml, 0.2 ha)
13 Spares Yard (0.4ha)
14 Mining Equipment Tyre Bay (0.001ha)
15 Boiler Shop (0.06ha)
16 Mining Equipment Service Bay (0.07ha)
17 Sub-station No. 4 (0.08ha))
19 Crushed ROM Conveyor (2.1ha)
20 Crushed ROM Stockpile (1.7ha)
21 Mining Shift Change Building (0.05ha)
22 Mining Equipment Workshop (0.14ha)
23 LDV Workshop (0.06ha)
24 Wash Bay (0.04ha)
25 Mining Office No.1 (0.1ha)
26 Mining Training Rooms (0.04ha)
27 Sub-station No.3 (0.04ha)
28 Mining Office No.2 (0.3ha)
29 Mining Mobile Equipment Hardpark (1ha)
30 Dirty Water Dams (24Ml, 1.2 ha)
31 Fire Water Tank (Approximately 0.01 ha and 653 m³), Elevated Potable Water Storage Tank (Approximately 0.02 ha and 75 m³), Sedibeng meter and RO plant
32 Potable Water Reservoir (2 000m³, 0.01ha)
33 Ancillary Mobile Equipment Hardpark (0.06ha)
34 Change House and Laundry (0.06ha)
35 Main Admin Offices and Clinic (0.12ha) and Ambulance Bay
36 Laboratory (0.08ha)
37 Railway Line (3ha)
38 Stormwater Dam (78ML,3ha)
40 Road Truck and Vehicle Parking Bay(3.4ha)
41 Sinter Plant, Including Feed and Product Stockpiles (future) (10ha)
42 Product Stockpile Area No. 2 (940 500 m², 17 ha)
43 Topsoil Stockpile Area No.2 (290 000m², 5.8ha)
44 Engineering and Projects Offices (1.7ha)
45 Salvage Yard and Waste Storing/Sorting/Reclaim Area (0.4ha)
46 Ancillary Equipment Workshop (0.05ha)
47 Ancillary Equipment Diesel Storage and Refueling Area (0.003ha)
48 Plant Production Offices (0.05ha)
50 Mine General Store (0.1ha)
51 Generator Powerhouse Diesel Tanks and Engineering Offices (0.2ha)
52 Plant MCC, Control Room and Offices (0.05ha)
54 General Parking Area (0.1ha)
55 Sewage Treatment Plant (Treatment capacity of 96 m³, ± 0.25 ha)
57 Temporary Mobile Crushing Plant (8.9ha)
58 Thickener (future)
61 ROM Weighbridge (210ton) and Control Room
62 Crushed Ore Weighbridge (80ton) and Control Room
63 Secondary Crushing and Screening Plant
65 Temporary Construction Dam (9 000 m³, 0.24ha)
66 Product Stockpile Area No.1 (434 500 m³ 7.9ha)
67 Satellite Workshop
70 Train Load-Out Station
71 Sub-Station No.5 (0.08ha)
72 Sub-station No.1 (0.04ha)
73 Tyre Bay (0.001ha)
74 Core Stores (0.0612ha)
75 Hazardous Store (0.02ha)
76 Engineering Workshop (0.054ha)
77 Rigging Store (0.05ha)
78 Truck Road
79 Heli-pad
80 11 kVA Overhead Power line
81 Mining Brake-test Ramp
82 Plant Brake-test Ramp
84 Temporary ROM Stockpile Area (20 000 m², 1ha)

0 100 200 Meters

Scale: 1:6 000 @ A3
Projection: Transverse Mercator
Datum: WGS1984, Lo23

Tshipi é Ntle Manganese Mining (Pty) Ltd

Figure 6

Close Up B of New Surface Infrastructure Layout

SLR Consulting (Africa) (Pty) Ltd
P O Box 1596, Cramerview, 2060, South Africa
Tel: +27 (11) 467-0945 Fax: +27 (11) 467-0978

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APPENDIX B: COSTED REHABILITATION EVALUATION CRITERIA

APPENDIX B – COSTED REHABILITATION EVALUATION CRITERIA

1 INTRODUCTION

This appendix presents a description of criteria to be utilised in the evaluation of rehabilitation success on rehabilitated areas and a suggested monitoring programme to be implemented for this evaluation. The monitoring programme is designed to measure the success of decommissioning and rehabilitation measures in terms of the rehabilitation success indicators defined in the Preliminary Closure Plan.

The monitoring programme will include evaluation of:

- Vegetative success on rehabilitated areas in terms of vegetative cover, tree/shrub (woody species) density, and indigenous species composition; and
- Groundwater quality surrounding and/or down gradient of the rehabilitated areas.

Other indicators of rehabilitation success (such as dust fallout, slope stability, etc.) have also been included in the overall general rehabilitation monitoring programme as described below.

2 GENERAL REHABILITATION MONITORING

In addition to the specific monitoring activities described in Sections 3 and 4 of this Appendix report, the post-rehabilitation monitoring programme will include regular general inspections of rehabilitated areas to assess their condition and to determine any maintenance requirements. These inspections will include:

- Slope stability of the remaining WRD's;
- Dust fallout monitoring (around the remaining WRD's) – if required, and largely dependent on the progress of the proposed vegetative cover systems;
- Stormwater and erosion control features including drainage channels and diversions;
- Soil erosion, soil conditions (nutrients, trace constituents) and soil structure;
- Faunal habitation of rehabilitated areas;
- Biological productivity;
- Tree growth data (width, height, diameter measurements);
- Protected access, fences and signs erected for public safety;
- Site security; and
- Unusual conditions in any rehabilitated area.

General inspections of all rehabilitated areas will be completed at a minimum of quarterly intervals for the aspects defined. Records of all the monitoring and maintenance activities undertaken will be kept.

If the general site condition monitoring activities reveal the requirement for any maintenance or repair of rehabilitated areas, then the necessary works will proceed in a timely fashion to minimise the potential for damage to rehabilitated areas such as soil loss, plant loss and drainage channel disturbance. Should a condition be identified in any rehabilitated area which has the potential to cause serious environmental damage, or which threatens the health and safety of post closure land users, then the relevant Authorities (DMR, DWS) will be immediately notified of this condition and the remedial measures being undertaken to reduce the potential for harm.

3 VEGETATIVE COVER MONITORING

The vegetative cover monitoring programme is designed to verify that rehabilitated areas are successfully developing a productive, self-sustaining ecosystem, which facilitates the post closure land use.

The success of the vegetative cover is an important aspect in rehabilitation because of its impact on other parameters such as the extent of soil development, soil chemistry and surface erosion (by water and wind). The degree to which the vegetation cover is effective in reducing erosion is a function of the height and continuity of the plant canopy, the density of the ground cover, and the root density. The vegetation cover also dissipates the energy from surface water runoff (and wind), thereby decreasing erosion forces. An increase in the vegetation cover results in an increase in both the evapo-transpiration rate and the infiltration rate leading to changes in the water balance. Finally, wildlife diversity and populations respond positively to an increase in available habitat and food supply that is brought on by the establishment of vegetative cover.

The major potential concerns with vegetative cover on rehabilitated areas are related to the adequacy of ground cover, the overall density of tree/shrub (woody) species and indigenous species composition. The vegetative cover monitoring programme has been designed to evaluate these parameters where appropriate to ensure long-term environmental protection and the suitability of rehabilitated areas for post closure land use.

3.1 VEGETATIVE COVER ANALYSIS

3.1.1 VEGETATIVE COVER PERCENTAGE ANALYSIS

The adequacy of vegetative ground cover in providing effective erosion control, habitat establishment and soil building for post closure land uses is related to the percentage of ground surface covered by vegetation and its products.

Analysis of the percentage of vegetative cover involves determining the percentage of ground surface that falls under the live parts of plants (the crown cover) or the aerial parts plus the mulch (the basal cover). The Notched Boot Method [3] can be utilised for determination of the percentage of vegetative cover on rehabilitated areas, however the latest developed methods must also be considered in order to ensure the best procedure is used.

3.1.2 TREE/SHRUB DENSITY ANALYSIS

The density of tree and shrub (woody) species on rehabilitated areas provides an indication of the success of efforts in re-establishing a diverse forest/bush environment for post closure land use. A direct count of woody species within belt transects is utilised to determine the density of woody species on rehabilitated areas.

Selected transects used in the rehabilitated areas for analysis of vegetative cover percentage as detailed in Section 3.1.1 will be utilised for determining woody species density. A 2 m wide by 100 m long rectangular plot centred on each transect line selected will be demarcated and the number of plants of woody species that are rooted in each plot will be counted, even if not all of an individual plant's aerial canopy is within the plot. Likewise, plants whose aerial canopy overlap the plot but are not rooted within the plot will not be counted. This method is effective in determining woody species density in areas of low to semi-dense stands of vegetation.

3.1.3 SPECIES COMPOSITION ANALYSIS

The composition of indigenous species (and/or common commercial species due to previous farming activity) within rehabilitated areas also provides an indication of the success of revegetation efforts in re-establishing a diverse bush environment which is similar to that found in nearby undisturbed areas, thereby ensuring similar productive capability of the rehabilitated area for post closure land use.

A direct count of vegetative species composition is undertaken on portions of selected belt transects utilised for analysis of woody species density in order to determine the percentage of indigenous species (and/or common commercial species due to previous farming activity) growing on rehabilitated areas.

All vegetation rooted within a representative 5 m long section of each belt transect selected will be identified and classified as either indigenous/common commercial or alien.

[3] This method is utilised by the office of Surface Mining (OSM) in the United States of America (Hunsberger & Michaud, 1994) and is advantageous because it is simple and reliable, produces valid results, and requires no specialised equipment.

3.1.4 HISTORIC RECORD SAMPLING IN REFERENCE AREAS

Representative vegetation reference plots (with similar/identical land uses as per the proposed post closure land use of rehabilitated mine areas) will be demarcated areas near rehabilitated mine areas for determining the degree of achievement of rehabilitation success criteria for vegetative cover. This procedure, known as historic record sampling, provides an indication of the percentage of ground cover, woody species density and percentage of indigenous species found in undisturbed areas.

Vegetative growth on reference plots will be compared with the vegetation on rehabilitated areas. These reference areas will be at least 2500 m^2 in size. Analysis of vegetative cover percentage, tree/shrub density, and percentage of indigenous species will be undertaken on each reference plot. The results of these analyses will be compared with the results of similar analyses on rehabilitated areas as described in Sections 3.1.1, 3.1.2 and 3.1.3 to determine the degree of achievement of rehabilitation success for vegetative cover.

3.2 VEGETATIVE COVER MONITORING SCHEDULE

Vegetative cover monitoring will begin one year after completion of re-vegetation activities and continue annually until rehabilitation success for vegetative cover is achieved. Analyses of vegetative cover percentage, tree/shrub density, and percentage of indigenous species will be completed on rehabilitated areas by trained staff under the supervision of a qualified professional. These monitoring activities will also be completed for reference plots and the values obtained averaged over the aftercare period for the purposes of defining rehabilitation success criteria (see Section 3.3). Vegetative cover monitoring will be completed each year during the seasonal period of peak standing biomass.

Should vegetative cover monitoring after the first year of the aftercare period on any rehabilitated area indicate that the vegetation in that area is not developing in a manner that will lead to achieving vegetative cover success criteria, then necessary remedial measures will be undertaken to enhance vegetative growth in that area to the extent that required standards can be expected to be met.

3.3 REHABILITATION SUCCESS CRITERIA FOR VEGETATIVE COVER INDICATORS

Rehabilitation success for the vegetative cover indicator will be demonstrated when the following criteria are met:

- The percentage of vegetative cover on rehabilitated areas is greater than or equal to 90% of the vegetative cover percentage found on corresponding reference plots with a similar land use;
- The density of tree/shrub species (woody species) on rehabilitated areas is greater than or equal to 90% of the density of tree/shrub species found on corresponding reference plots with a similar land use; and

- The percentage of indigenous/common commercial species on rehabilitated areas is greater than or equal to 90% of the percentage of indigenous/common commercial species found on corresponding reference plots with a similar land use.

Achievement of the rehabilitation success criteria for vegetative cover will ensure that a productive, self-sustaining vegetative community has been established which facilitates a sustainable post closure land use.

4 GROUNDWATER QUALITY MONITORING

The groundwater quality monitoring programme is designed to verify that groundwater quality down gradient of potential sources of pollution such as the WRD's and previously open pit complies with agreed standards.

The major potential concerns with post closure groundwater quality down gradient of potential sources of pollution are related to pH, salts, and metals. The groundwater quality monitoring programme has therefore been designed to evaluate these parameters where appropriate to ensure long-term environmental protection and the suitability of groundwater for post closure land uses.

4.1 GROUNDWATER QUALITY ANALYSIS

Groundwater monitoring should occur at those locations where there are surface activities or infrastructure which has the potential of pollution.

The physical and chemical parameters to be included in laboratory analyses of groundwater samples has been selected based upon site criteria/characteristics and geochemical results to date. A list of recommended parameters is given in Table C-2. This may expand (or reduce) following further geochemical analysis and collection of data.

TABLE C-2: RECOMMENDED GROUNDWATER QUALITY ANALYSIS PARAMETERS

pH	Carbonate as CO_3
Electrical conductivity	Bicarbonate as HCO_3
Fluoride as F	Total dissolved solids
Total alkalinity as $CaCO_3$	Sodium
Chloride as Cl	Potassium
Sulphate as SO_4	Calcium
Nitrate as N	Magnesium
33 metals (ICP-OES scan)	Manganese

4.2 GROUNDWATER QUALITY MONITORING SCHEDULE

The locations (and frequency) of groundwater quality monitoring during decommissioning, rehabilitation and aftercare periods will be based on the groundwater monitoring locations (and frequency) at LOM with additional sampling points added as necessary to ensure all potentially affected groundwater are monitored.

Groundwater quality samples will be collected by suitably qualified staff following standard international protocol for collection of environmental samples. Groundwater monitoring results will be recorded and included in ongoing monitoring reports.

Should statistical analysis of groundwater monitoring results for the three year (active maintenance and aftercare) period following completion of decommissioning and rehabilitation activities indicate that agreed standards for protection of groundwater quality will not be met for a particular area, then a study will be commissioned to determine the causes of such failure, the potential for harm to the environment and/or post closure land users, the need for remedial measures, and to recommend practicable remedial measures if required.

In such a case, if the indicated groundwater quality emanating from rehabilitated areas is representative of baseline/background (or up gradient) groundwater quality on the rehabilitated areas and in the surrounding region, then previously agreed standards may need to be modified (in agreement with the regulatory Authorities, DWS and DMR).

4.3 REHABILITATION SUCCESS CRITERIA FOR GROUNDWATER QUALITY INDICATORS

Rehabilitation success for the groundwater quality indicators will be demonstrated when statistical analysis (and trends) of source term monitoring results for the three year (active maintenance and aftercare) period following the completion of decommissioning and rehabilitation activities indicate that agreed water quality standards for groundwater will not be exceeded at monitored locations. Achievement of the rehabilitation success criteria for groundwater quality will ensure that groundwater on (and immediately down gradient of) the rehabilitated areas are suitable for post closure land users.

5 MONITORING AND INSPECTION COSTS

Unit rates for monitoring, analyses and inspection activities were developed based on the costs of similar activities being undertaken by SLR. The total estimated cost of the monitoring and inspection activities as described is R 6,347,500 (excl. VAT). A breakdown of the cost is presented in Table C-3.

Provision has been made for 14 to 19 water sampling points to be monitored at the following frequency during the 8.5 years of rehabilitation, monitoring and maintenance activities:

- Quarterly during decommissioning and rehabilitation (2.5 years, 19 sampling points),
- Quarterly during active maintenance and aftercare (3 years, 14 sampling points),
- Bi-annually during passive maintenance and aftercare (2 years, 14 sampling points)

The total cost of sampling is thus estimated to be R 857,500 (excl. VAT) over 8.5 years.

Provision has also been made for bi-annual inspections and reporting by a professional engineer and/or environmental scientist. There will thus be 17 inspections over the 8.5 year period. The total provision is R 900,000 (excl. VAT).

The cost of the personnel required for the on-site maintenance and monitoring activities have also been included at R 540,000 per annum. It is assumed that this work will be contracted out and provision has been made for a manager (part-time), a field supervisor (full-time) and 5 labourer's (full time). The total cost over 8.5 years is estimated to be R 4,590,000 (excl. VAT).

TABLE C-3: SUMMARY OF SUPERVISION AND MONITORING COSTS

Item	Monitoring / Maintenance Activity	Sampling Points	Cost / Sample	Duration (years)	Frequency	Unit	Quantity	Total Cost
1	**WATER QUALITY**							
1.1	*Collection and Laboratory Analysis of Surface and Ground Water Samples*							
1.1.1	Decommissioning and Rehabilitation Phase	19	R 1 750	3.5	quarterly	Sum	266	R 465 500
1.1.2	Maintenance and Aftercare (Active)	14	R 1 750	3	quarterly	Sum	168	R 294 000
1.1.3	Maintenance and Aftercare (Passive)	14	R 1 750	2	bi-annual	Sum	56	R 98 000
2	**BI-ANNUAL INSPECTIONS**							
2.1	*Inspection of Decommissioning and reclamation works by a suitably qualified and experienced Professional Engineer / Environmental Scientist*							
2.1.1	Decommissioning and Rehabilitation Phase	1	R 60 000	3.5	bi-annual	Sum	7	R 420 000
2.1.2	Maintenance and Aftercare (Active)	1	R 60 000	3	bi-annual	Sum	6	R 360 000
2.1.3	Maintenance and Aftercare (Passive)	1	R 30 000	2	bi-annual	Sum	4	R 120 000
	No. of Days on Site	*2*						
	Report Compilation	*2*						
	Rate per day	R 15 000.00						
3	**MANAGEMENT OF MONITORING AND MAINTENANCE**							
3.1	*On-Site Maintenance, Monitoring and Aftercare of the Decommissioning and Reclamation Process by an appropriately qualified and experienced team.*					Years	8.5	R 4 590 000
		Days/month	**Rate / day**	**Total/month**	**Total/year**			
	- 1 Manager	*1*	*R 10 000*	*R 10 000*	R 120 000			
	- 1 Field Supervisor	*20*	*R 500*	*R 10 000*	R 120 000			
	- 5 Labourers	*100*	*R 250*	*R 25 000*	R 300 000			
					R 540 000			
							TOTAL	**R 6 347 500**

APPENDIX C: CLOSURE COST CALCULATIONS

CALCULATION OF THE QUANTUM

Mine: **Tshipi Borwa Mine**

Evaluators: **SLR Consulting (Pty) Ltd** Date: **Current Liability as at end December 2016**

Risk Class: **Low (Class C)** Escalation (CPI): **105.6%**

Area Sensitivity: **Medium (for Biophysical, Social and Economic Criteria)** Terrain (Weighting factor 1): **1.00 (Flat)**

Proximity (Weighting factor 2): **1.05 (Peri-Urban)**

No.	Description:	Unit:	Operational Area	A Quantity	B Master rate	C Multiplication factor	D Weighting factor 1	E=A*B*C*D Amount (Rands)
				Step 4.5	Step 4.3	Step 4.3	Step 4.4	
1	Dismantling of processing plant & related structures (incl. overland conveyors & power lines)	m^3	Steel and concrete structures, suspended conveyors	180 020	R 14.03	1	1	R 2 524 835.36
2 (A)	Demolition of steel buildings & structures	m^2	Contractor's Workshops, Warehouse, Powerhouse, Storage Tanks	10 290	R 195.37	1	1	R 2 010 327.95
2 (B)	Demolition of reinforced concrete buildings & structures	m^2	Crushers, Primary and Product Stockpiles, Load-out Station, Conveyor foundations, Diesel Storage and Farm, Washbay, Magazine, LocoPlatform	15 424	R 287.91	1	1	R 4 440 715.84
3	Rehabilitation of access roads	m^2	Roads to be rehabilitated	86 700	R 34.96	1	1	R 3 031 069.89
		m^2	Roads to support post-closure use	69 300	R 0.00	1	1	R 0.00
4 (A)	Demolition & rehabilitation of electrified railway lines	m	Railway Line	5 800	R 339.32	1	1	R 1 968 066.95
4 (B)	Demolition & rehabilitation of non electrified railway lines	m	N/A	0	R 185.08	1	1	R 0.00
5	Demolition of housing &/or administration facilities	m^2	Offices, Change Rooms, Laboratory, Substations	6 265	R 390.73	1	1	R 2 447 950.36
6	Opencast rehabilitation including final voids & ramps	ha	Pit	68.07	R 198 863.19	0.52	1	R 7 039 041.07
7	Sealing of shafts, adits & inclines	m^3	N/A	0	R 104.88	1	1	R 0.00
8 (A)	Rehabilitation of overburden & spoils	ha	Western Dump	63.86	R 136 551.35	1	1	R 8 720 169.46
		ha	Eastern Dump	38.22	R 136 551.35	1	1	R 5 218 992.74
		ha	Northern Dump	17.87	R 136 551.35	1	1	R 2 440 172.69
8 (B)	Rehabilitation of processing waste deposits & evaporation ponds (basic, salt producing waste)	ha	Process and Stormwater Dams	1.63	R 170 072.24	1	1	R 277 217.76
8 (C)	Rehabilitation of processing waste deposits & evaporation ponds (acidic, metal-rich waste)	ha	N/A	0	R 493 970.41	0.66	1	R 0.00
9	Rehabilitation of subsided areas	ha	N/A	0	R 114 341.19	1	1	R 0.00
10	General surface rehabilitation	ha	Truck Stop at Entrance Gate	6.25	R 108 171.71	1	1	R 676 073.16
		ha	Tailings Dam and Magazine Area	9.66	R 108 171.71	1	1	R 1 044 938.67
		ha	Old Crushing Areas	12.43	R 108 171.71	1	1	R 1 344 574.29
		ha	Lightly trafficed access roads to be rehabilitated	28.07	R 108 171.71	1	1	R 3 036 379.76
		ha	Northern WRD area, hardstand area	44.68	R 108 171.71	1	1	R 4 832 570.92
		ha	Railway Line	2.90	R 108 171.71	1	1	R 313 697.94
		ha	Plant, Offices, Workshop Areas	75.70	R 108 171.71	1	1	R 8 188 598.07
11	River diversions (to be decommissioned)	ha	N/A	0	R 108 171.71	1	1	R 0.00
12	Fencing	m	Magazine Area, Process and Stormwater Dams, Tailings Area, Waste Yard, Laydown Areas, Diesel Farm	4 135	R 123.39	1	1	R 510 216.73
13	Water management	ha	In-pit evaporation dam (5% of pit area	3.40	R 41 129.93	0.25	1	R 34 996.43
14	2 to 3 years of maintenance & aftercare	ha	All Areas	325.04	R 14 395.47	1	1	R 4 679 032.91
15 (A)	Specialist study (Screening level risk assessment)	ha	All Areas	1.00	R 195 000.00	1	1	R 195 000.00
							Subtotal 1 (Sum of items 1 to 15 Above)	R 64 974 638.95
16	Multiply Subtotal 1 by Weighting Factor 2 (step 4.4)				5.0% of Subtotal 1			R 3 248 731.95
							Subtotal 2 (Subtotal 1 plus Weighting Factor 2 value)	R 68 223 370.90
18	Contingency				10.0% of Subtotal 2			R 6 822 337.09
17	Procurement, tender process				6.0% of Subtotal 2			R 4 093 402.25
18	P&G's, site establishment and demobilisation				20.0% of Subtotal 2			R 13 644 674.18
18	Site supervision				7.5% of Subtotal 2			R 5 116 752.82
18	Post closure monitoring (See Appendix C, Table C-3)				Sum			R 6 347 500.00
							Subtotal 4 (Subtotal 3 plus Contingency value)	R 104 248 037.24
19	VAT				14.0% of Subtotal 4			R 14 594 725.21
							GRAND TOTAL FOR MINING OPERATIONS (Subtotal 4 plus VAT)	R 118 842 762.45

CALCULATION OF THE QUANTUM

Mine: **Tshipi Borwa Mine**

Evaluators: **SLR Consulting (Pty) Ltd** Date: **Current Liability as at end July 2022**

Risk Class: **Low (Class C)** Escalation (CPI): **105.6%**

Area Sensitivity: **Medium (for Biophysical, Social and Economic Criteria)** Terrain (Weighting factor 1): **1.00 (Flat)**

Proximity (Weighting factor 2): **1.05 (Peri-Urban)**

No.	Description:	Unit:	Operational Area	A Quantity	B Master rate	C Multiplication factor	D Weighting factor 1	E=A*B*C*D Amount (Rands)
				Step 4.5	Step 4.3	Step 4.3	Step 4.4	
1	Dismantling of processing plant & related structures (incl. overland conveyors & power lines)	m^3	Steel and concrete structures, suspended conveyors	180 020	R 14.03	1	1	R 2 524 835.36
2 (A)	Demolition of steel buildings & structures	m^2	Contractor's Workshops, Warehouse, Powerhouse, Storage Tanks	10 290	R 195.37	1	1	R 2 010 327.95
2 (B)	Demolition of reinforced concrete buildings & structures	m^2	Crushers, Primary and Product Stockpiles, Load-out Station, Conveyor foundations, Diesel Storage and Farm, Washbay, Magazine, LocoPlatform	15 424	R 287.91	1	1	R 4 440 715.84
3	Rehabilitation of access roads	m^2	Roads to be rehabilitated	86 700	R 34.96	1	1	R 3 031 069.89
		m^2	Roads to support post-closure use	69 300	R 0.00	1	1	R 0.00
4 (A)	Demolition & rehabilitation of electrified railway lines	m	Railway Line	5 800	R 339.32	1	1	R 1 968 066.95
4 (B)	Demolition & rehabilitation of non electrified railway lines	m	N/A	0	R 185.08	1	1	R 0.00
5	Demolition of housing &/or administration facilities	m^2	Offices, Change Rooms, Laboratory, Substations	6 265	R 390.73	1	1	R 2 447 950.36
6	Opencast rehabilitation including final voids & ramps	ha	Pit	119.50	R 198 863.19	0.52	1	R 12 357 358.72
7	Sealing of shafts, adits & inclines	m^3	N/A	0	R 104.88	1	1	R 0.00
8 (A)	Rehabilitation of overburden & spoils	ha	Western Dump	87.00	R 136 551.35	1	1	R 11 879 967.79
		ha	Eastern Dump	49.00	R 136 551.35	1	1	R 6 691 016.34
		ha	Northern Dump	59.00	R 136 551.35	1	1	R 8 056 529.88
8 (B)	Rehabilitation of processing waste deposits & evaporation ponds (basic, salt producing waste)	ha	Process and Stormwater Dams	4.63	R 170 072.24	1	1	R 787 434.49
8 (C)	Rehabilitation of processing waste deposits & evaporation ponds (acidic, metal-rich waste)	ha	N/A	0	R 493 970.41	0.66	1	R 0.00
9	Rehabilitation of subsided areas	ha	N/A	0	R 114 341.19	1	1	R 0.00
10	General surface rehabilitation	ha	Truck Stop at Entrance Gate	6.25	R 108 171.71	1	1	R 676 073.16
		ha	Tailings Dam and Magazine Area	4.40	R 108 171.71	1	1	R 475 955.50
		ha	Old Crushing Areas	0.00	R 108 171.71	1	1	R 0.00
		ha	Lightly trafficed access roads to be rehabilitated	28.07	R 108 171.71	1	1	R 3 036 379.76
		ha	Topsoil and product stockpile areas	52.00	R 108 171.71	1	1	R 5 624 928.66
		ha	Railway Line	2.90	R 108 171.71	1	1	R 313 697.94
		ha	Plant, Offices, Workshop Areas	73.60	R 108 171.71	1	1	R 7 961 437.49
11	River diversions (to be decommissioned)	ha	N/A	0	R 108 171.71	1	1	R 0.00
12	Fencing	m	Magazine Area, Process and Stormwater Dams, Tailings Area, Waste Yard, Laydown Areas, Diesel Farm	4 135	R 123.39	1	1	R 510 216.73
13	Water management	ha	In-pit evaporation dam (5% of pit area	5.98	R 41 129.93	0.25	1	R 61 437.83
14	2 to 3 years of maintenance & aftercare	ha	All Areas	495.02	R 14 395.47	1	1	R 7 126 047.57
15 (A)	Specialist study (Screening level risk assessment)	ha	All Areas	1.00	R 195 000.00	1	1	R 195 000.00
							Subtotal 1 (Sum of items 1 to 15 Above)	R 82 176 448.19
16	Multiply Subtotal 1 by Weighting Factor 2 (step 4.4)			5.0% of Subtotal 1				R 4 108 822.41
							Subtotal 2 (Subtotal 1 plus Weighting Factor 2 value)	R 86 285 270.60
18	Contingency			10.0% of Subtotal 2				R 8 628 527.06
17	Procurement, tender process			6.0% of Subtotal 2				R 5 177 116.24
18	P&G's, site establishment and demobilisation			20.0% of Subtotal 2				R 17 257 054.12
18	Site supervision			7.5% of Subtotal 2				R 6 471 395.30
18	Post closure monitoring (See Appendix C, Table C-3)			Sum				R 6 347 500.00
							Subtotal 4 (Subtotal 3 plus Contingency value)	R 130 166 863.31
19	VAT			14.0% of Subtotal 4				R 18 223 360.86
							GRAND TOTAL FOR MINING OPERATIONS (Subtotal 4 plus VAT)	R 148 390 224.18

CALCULATION OF THE QUANTUM

Mine: **Tshipi Borwa Mine**

Evaluators: **SLR Consulting (Pty) Ltd** Date: **Current Liability as at end July 2027**

Risk Class: **Low (Class C)** Escalation (CPI): **105.6%**

Area Sensitivity: **Medium (for Biophysical, Social and Economic Criteria)** Terrain (Weighting factor 1): **1.00 (Flat)**

Proximity (Weighting factor 2): **1.05 (Peri-Urban)**

No.	Description:	Unit:	Operational Area	A Quantity	B Master rate	C Multiplication factor	D Weighting factor 1	E=A*B*C*D Amount (Rands)
				Step 4.5	Step 4.3	Step 4.3	Step 4.4	
1	Dismantling of processing plant & related structures (incl. overland conveyors & power lines)	m^3	Steel and concrete structures, suspended conveyors	180 020	R 14.03	1	1	R 2 524 835.36
2 (A)	Demolition of steel buildings & structures	m^2	Contractor's Workshops, Warehouse, Powerhouse, Storage Tanks	10 290	R 195.37	1	1	R 2 010 327.95
2 (B)	Demolition of reinforced concrete buildings & structures	m^2	Crushers, Primary and Product Stockpiles, Load-out Station, Conveyor foundations, Diesel Storage and Farm, Washbay, Magazine, LocoPlatform	15 424	R 287.91	1	1	R 4 440 715.84
3	Rehabilitation of access roads	m^2	Roads to be rehabilitated	86 700	R 34.96	1	1	R 3 031 069.89
		m^2	Roads to support post-closure use	69 300	R 0.00	1	1	R 0.00
4 (A)	Demolition & rehabilitation of electrified railway lines	m	Railway Line	5 800	R 339.32	1	1	R 1 968 066.95
4 (B)	Demolition & rehabilitation of non electrified railway lines	m	N/A	0	R 185.08	1	1	R 0.00
5	Demolition of housing &/or administration facilities	m^2	Offices, Change Rooms, Laboratory, Substations	6 265	R 390.73	1	1	R 2 447 950.36
6	Opencast rehabilitation including final voids & ramps	ha	Pit	162.40	R 198 863.19	0.52	1	R 16 793 598.80
7	Sealing of shafts, adits & inclines	m^3	N/A	0	R 104.88	1	1	R 0.00
8 (A)	Rehabilitation of overburden & spoils	ha	Western Dump	87.00	R 136 551.35	1	1	R 11 879 967.79
		ha	Eastern Dump	49.00	R 136 551.35	1	1	R 6 691 016.34
		ha	Northern Dump	118.00	R 136 551.35	1	1	R 16 113 059.76
8 (B)	Rehabilitation of processing waste deposits & evaporation ponds (basic, salt producing waste)	ha	Process and Stormwater Dams	4.63	R 170 072.24	1	1	R 787 434.49
8 (C)	Rehabilitation of processing waste deposits & evaporation ponds (acidic, metal-rich waste)	ha	N/A	0	R 493 970.41	0.66	1	R 0.00
9	Rehabilitation of subsided areas	ha	N/A	0	R 114 341.19	1	1	R 0.00
10	General surface rehabilitation	ha	Truck Stop at Entrance Gate	6.25	R 108 171.71	1	1	R 676 073.16
		ha	Tailings Dam and Magazine Area	4.40	R 108 171.71	1	1	R 475 955.50
		ha	Old Crushing Areas	0.00	R 108 171.71	1	1	R 0.00
		ha	Lightly trafficed access roads to be rehabilitated	28.07	R 108 171.71	1	1	R 3 036 379.76
		ha	Topsoil and product stockpile areas	52.00	R 108 171.71	1	1	R 5 624 928.66
		ha	Railway Line	2.90	R 108 171.71	1	1	R 313 697.94
		ha	Plant, Offices, Workshop Areas	73.60	R 108 171.71	1	1	R 7 961 437.49
11	River diversions (to be decommissioned)	ha	N/A	0	R 108 171.71	1	1	R 0.00
12	Fencing	m	Magazine Area, Process and Stormwater Dams, Tailings Area, Waste Yard, Laydown Areas, Diesel Farm	4 135	R 123.39	1	1	R 510 216.73
13	Water management	ha	In-pit evaporation dam (5% of pit area	8.12	R 41 129.93	0.25	1	R 83 493.75
14	2 to 3 years of maintenance & aftercare	ha	All Areas	596.92	R 14 395.47	1	1	R 8 592 946.37
15 (A)	Specialist study (Screening level risk assessment)	ha	All Areas	1.00	R 195 000.00	1	1	R 195 000.00
							Subtotal 1 (Sum of items 1 to 15 Above)	R 96 158 172.88
16	Multiply Subtotal 1 by Weighting Factor 2 (step 4.4)				5.0% of Subtotal 1			R 4 807 908.64
							Subtotal 2 (Subtotal 1 plus Weighting Factor 2 value)	R 100 966 081.52
18	Contingency				10.0% of Subtotal 2			R 10 096 608.15
17	Procurement, tender process				6.0% of Subtotal 2			R 6 057 964.89
18	P&G's, site establishment and demobilisation				20.0% of Subtotal 2			R 20 193 216.30
18	Site supervision				7.5% of Subtotal 2			R 7 572 456.11
18	Post closure monitoring (See Appendix C, Table C-3)				Sum			R 6 347 500.00
							Subtotal 4 (Subtotal 3 plus Contingency value)	R 151 233 826.98
19	VAT				14.0% of Subtotal 4			R 21 172 735.78
							GRAND TOTAL FOR MINING OPERATIONS (Subtotal 4 plus VAT)	R 172 406 562.76

CALCULATION OF THE QUANTUM

Mine: **Tshipi Borwa Mine**

Evaluators: **SLR Consulting (Pty) Ltd** Date: **Current Liability as at LOM**

Risk Class: **Low (Class C)** Escalation (CPI): **105.6%**

Area Sensitivity: **Medium (for Biophysical, Social and Economic Criteria)** Terrain (Weighting factor 1): **1.00 (Flat)**

Proximity (Weighting factor 2): **1.05 (Peri-Urban)**

No.	Description:	Unit:	Operational Area	A Quantity	B Master rate	C Multiplication factor	D Weighting factor 1	E=A*B*C*D Amount (Rands)
				Step 4.5	Step 4.3	Step 4.3	Step 4.4	
1	Dismantling of processing plant & related structures (incl. overland conveyors & power lines)	m^3	Steel and concrete structures, suspended conveyors	180 020	R 14.03	1	1	R 2 524 835.36
2 (A)	Demolition of steel buildings & structures	m^2	Contractor's Workshops, Warehouse, Powerhouse, Storage Tanks	10 290	R 195.37	1	1	R 2 010 327.95
2 (B)	Demolition of reinforced concrete buildings & structures	m^2	Crushers, Primary and Product Stockpiles, Load-out Station, Conveyor foundations, Diesel Storage and Farm, Washbay, Magazine, LocoPlatform	15 424	R 287.91	1	1	R 4 440 715.84
3	Rehabilitation of access roads	m^2	Roads to be rehabilitated	86 700	R 34.96	1	1	R 3 031 069.89
		m^2	Roads to support post-closure use	69 300	R 0.00	1	1	R 0.00
4 (A)	Demolition & rehabilitation of electrified railway lines	m	Railway Line	5 800	R 339.32	1	1	R 1 968 066.95
4 (B)	Demolition & rehabilitation of non electrified railway lines	m	N/A	0	R 185.08	1	1	R 0.00
5	Demolition of housing &/or administration facilities	m^2	Offices, Change Rooms, Laboratory, Substations	6 265	R 390.73	1	1	R 2 447 950.36
6	Opencast rehabilitation including final voids & ramps	ha	Pit	238.10	R 198 863.19	0.52	1	R 24 621 649.47
7	Sealing of shafts, adits & inclines	m^3	N/A	0	R 104.88	1	1	R 0.00
8 (A)	Rehabilitation of overburden & spoils	ha	Western Dump	87.00	R 136 551.35	1	1	R 11 879 967.79
		ha	Eastern Dump	49.00	R 136 551.35	1	1	R 6 691 016.34
		ha	Northern Dump	118.00	R 136 551.35	1	1	R 16 113 059.76
8 (B)	Rehabilitation of processing waste deposits & evaporation ponds (basic, salt producing waste)	ha	Process and Stormwater Dams	4.63	R 170 072.24	1	1	R 787 434.49
8 (C)	Rehabilitation of processing waste deposits & evaporation ponds (acidic, metal-rich waste)	ha	N/A	0	R 493 970.41	0.66	1	R 0.00
9	Rehabilitation of subsided areas	ha	N/A	0	R 114 341.19	1	1	R 0.00
10	General surface rehabilitation	ha	Truck Stop at Entrance Gate	6.25	R 108 171.71	1	1	R 676 073.16
		ha	Tailings Dam and Magazine Area	4.40	R 108 171.71	1	1	R 475 955.50
		ha	Old Crushing Areas	0.00	R 108 171.71	1	1	R 0.00
		ha	Lightly trafficed access roads to be rehabilitated	28.07	R 108 171.71	1	1	R 3 036 379.76
		ha	Topsoil and product stockpile areas	52.00	R 108 171.71	1	1	R 5 624 928.66
		ha	Railway Line	2.90	R 108 171.71	1	1	R 313 697.94
		ha	Plant, Offices, Workshop Areas	73.60	R 108 171.71	1	1	R 7 961 437.49
11	River diversions (to be decommissioned)	ha	N/A	0	R 108 171.71	1	1	R 0.00
12	Fencing	m	Magazine Area, Process and Stormwater Dams, Tailings Area, Waste Yard, Laydown Areas, Diesel Farm	4 135	R 123.39	1	1	R 510 216.73
13	Water management	ha	In-pit evaporation dam (5% of pit area	11.91	R 41 129.93	0.25	1	R 122 412.94
14	2 to 3 years of maintenance & aftercare	ha	All Areas	672.62	R 14 395.47	1	1	R 9 682 683.76
15 (A)	Specialist study (Screening level risk assessment)	ha	All Areas	1.00	R 195 000.00	1	1	R 195 000.00
							Subtotal 1 (Sum of items 1 to 15 Above)	R 105 114 880.13
16	Multiply Subtotal 1 by Weighting Factor 2 (step 4.4)			5.0% of Subtotal 1				R 5 255 744.01
							Subtotal 2 (Subtotal 1 plus Weighting Factor 2 value)	R 110 370 624.13
18	Contingency			10.0% of Subtotal 2				R 11 037 062.41
17	Procurement, tender process			6.0% of Subtotal 2				R 6 622 237.45
18	P&G's, site establishment and demobilisation			20.0% of Subtotal 2				R 22 074 124.83
18	Site supervision			7.5% of Subtotal 2				R 8 277 796.81
18	Post closure monitoring (See Appendix C, Table C-3)			Sum				R 6 347 500.00
							Subtotal 4 (Subtotal 3 plus Contingency value)	R 164 729 345.63
19	VAT			14.0% of Subtotal 4				R 23 062 108.39
							GRAND TOTAL FOR MINING OPERATIONS (Subtotal 4 plus VAT)	R 187 791 454.02

RECORD OF REPORT DISTRIBUTION

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Site name:	Tshipi Borwa Mine
Report Number:	1
Client:	Tshipi é Ntle Manganese Mining (Pty) Ltd

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JOHANNESBURG

Fourways Office
P O Box 1596, Cramerview, 2060,
SOUTH AFRICA

Unit 7, Fourways Manor Office Park,
1 Macbeth Ave (On the corner with Roos Street), Fourways, Johannesburg,
SOUTH AFRICA

T: +27 (0)11 467 0945