2018 PRELIMINARY CLOSURE PLAN

Tshipi Borwa Mine

Prepared for: Tshipi é Ntle Manganese Mining (Pty) Ltd

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EXECUTIVE SUMMARY

Overview

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.
- All surface infrastructure will be removed from site after closure.
- 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.

The current EMP mine closure commitments further commits Tshipi Borwa Mine to:

- Rehabilitate the land to the extent reasonably possible to achieve an end use of wilderness and/or grazing.
- Backfill the open pit.
- Shape any remaining waste rock dumps to 1V:3H (18°) to create stable landforms.

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 the ongoing operations of the Tshipi Borwa Mine.

A Tshipi Concept Study has proven the techno-economic viability of an underground mine on that portion of the Tshipi Mining Right area that is too deep for economic opencast mining. The mine design includes on-seam adits or declines from the final open-pit high-wall as the optimal means of access to the deeper manganese resources.

Should the pit be backfilled it is quite likely that these resources will be sterilised by virtue of the capital cost and lead-time that will be required to access the underground resources by a shaft complex that would have to be established from surface.

Moreover, with the approved removal of the boundary pillar between the Tshipi and Mamatwan mines complete backfill cannot practically be achieved between the open pits, for a number of technical and environmental reasons. Tshipi has, therefore, commenced the process of re-evaluating its mine closure solution and closure objectives.

Financial Liability

The closure cost liability calculations as per the DMR Guideline methodology indicate that:

- Current closure cost liability (as at August 2018) is R 136,451,086 (including VAT).
- Future closure cost liability, 5 years from now (as at August 2023) is R 190,027,460 (including VAT).
- Future closure cost liability, 10 years from now (as at August 2028) is R 199,728,523 (including VAT).
- LOM closure cost liability, 25 years from now (as at August 2043) is R 229,261,030 (including VAT).

These closure cost liability calculations are at Current Value (CV) as at August 2018.

The DMR Guideline methodology does not calculate the liability associated with backfilling of the pit void. The DMR Guideline methodology only makes provision for making the pit void safe (for humans and animals) based on the Risk Class of the mine, as well as, the Environmental Sensitivity of the area.

Backfilling of the pit void (including in-pit dumping during operations) should therefore be separately accounted for by Tshipi in the operations expenditure of the Tshipi Borwa Mine.

Recommendations

Current gaps (and/or known unknowns) associated with this Closure Plan, that will need to be addressed as part of the ongoing closure planning process are outlined in a recommended Implementation Plan (See Table 15-1). The "High" priority recommendations are tabled overleaf. "Medium" and "Low" priority recommendations are further described in Table 15-1 of this report.

The Implementation Plan is based on the current remaining LOM of approximately 25 years. In the event of premature closure, then all the actions described in Table 15-1 change to "High" priority and the recommended completion date moves forward.

IMPLEMENTATION PLAN - “HIGH” PRIORITY RECOMMENDATIONS

Item	Action Required	Report Reference	Priority	Recommended Completion Date
1	Re-evaluate the mine closure solution for Tshipi Borwa Mine in context of evolving technical, commercial, socio-economic, environmental, legal and cumulative considerations.	o Section 4.2.2 o Section 4.6	**High**	February 2020
2	Investigate the influence of the neighbouring/adjacent Mamatwan open pit in order to accurately assess the post closure contribution to lowered ground water levels created by Tshipi Borwa Mine.	o Table 3-2 o Section 3.5 o Section 6.1.11	**High**	February 2020
3	Undertake an audit on the water monitoring network to identify where improvements to infrastructure is required to prevent possible anthropogenic contamination and to aid the integrity of the water quality monitoring exercise.	o Section 6.1.11	**High**	ASAP
4	Survey the locations of the groundwater monitoring boreholes in order to allow water levels to be accurately reported in metres above mean sea level.	o Section 6.1.11	**High**	ASAP
5	Continue with quarterly groundwater monitoring (including additional groundwater points, not stipulated in the Integrated Water Use License). Also, add NH_3 and NO_2 to the analysis requirements.		**High**	Ongoing
6	Undertake a contaminated land investigation to identify possible sources of the chemicals of concern identified in the groundwater monitoring results.		**High**	ASAP
7	Investigate what work activities of the closure plan can be undertaken during operations as part of the annual rehabilitation planning.	o Section 9 o Section 13	**High**	Ongoing
8	Strip and preserve topsoil in accordance with the commitments made in the EIA and EMP reports. Keep an inventory of available topsoil for rehabilitation purposes.	o Section 4.7	**High**	Ongoing
9	Continuously engage with all the employees and contractors associated with the mine the need to: not unnecessarily pollute and/or negatively impact the environment; to follow good operational, decommissioning and rehabilitation practices and procedures; and to support the operations executive, environmental personnel and stakeholder engagement forums to adhere to the commitments made in the EIA and EMP reports.	o Section 6.2	**High**	Ongoing

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ACRONYMS AND ABBREVIATIONS

Acronym / Abbreviation	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 Management Programme
(Original) EMP	Environmental Impact Assessment and Environmental Management Programme for the Proposed Ntsimbintle Manganese Mining Project. May 2009.
EMP 1	Environmental Impact Assessment and Environmental Management Programme Amendment Report for the Tshipi Borwa Mine. October 2017.
EMP 2	Environmental Impact Assessment and Environmental Management Programme Amendment Report for the Tshipi Borwa Mine. September 2018.
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

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	Marline Medallie
Tel No.:	011 467 0945	011 467 0945
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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 an MSc Civil Engineering degree, has over 20 years of relevant experience and is registered as a Professional Engineer with the Engineering Council of South Africa (ECSA). Marline Medallie holds an MSc degree in Botany and has over 10 years of relevant experience in the assessment of impacts associated with mining operations.

2. CONTEXT OF THE PROJECT

2.1 MATERIAL INFORMATION

The Tshipi Borwa Mine is located in the John Taolo Gaetsewe District Municipality in the Northern Cape Province. The mine is situated 18 km south of Hotazel, 46 km north of Kathu and 48 km 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 run-of-mine 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 at this time. The remaining life of mine for open pit mining, using current economic parameters, is approximately 25 years.

The current and LOM mine layout and details are presented in Figure 2-1 and Figure 2-2 respectively. Current mining operations in the area include various other manganese open pit mines (Mamatwan (MMT) and United Manganese of the Kalahari (UMK)). The land capability of the Tshipi Borwa 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 original and amended EIA and EMP reports 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 455 mm 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 70 m and 330 m of gravels, clays, calcrete and Aeolian sand of the Kalahari Formation. From the sub-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 (> 1.5 m) 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 LAND CAPABILITY

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). The grazing capacity of the veld is 21 to 30 hectares per large animal unit or large stock unit. The area is also suitable for small grazers and browsers such as goats or sheep although the area is most suitable for cattle production.

The current mine property of 950 ha therefore has the potential grazing capacity for a small herd of cattle (31 to 45 head of cattle). The total open pit area that constitutes 238 ha of the 950 ha (roughly 25%) has the potential grazing capacity for only 8 to 11 head of cattle.

2.2.6 WETLANDS

No wetlands occur on the mine property.

2.2.7 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).

2.2.8 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.

2.2.9 GROUNDWATER

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

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

- A shallow aquifer made of the Kalahari Beds, sand and calcrete.
- 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.

Groundwater levels are currently being monitored as part of Tshipi's ongoing groundwater monitoring programme. In this regard, the groundwater levels within and around the project area range between 35 to 75 mbgl below groundwater level (SLR, 2018b). Since the commencement of the mine, there has been a decrease in the groundwater levels potentially due to dewatering of the open pit.

Groundwater and surface water monitoring has been undertaken at the mine on a quarterly basis since 2012. Monitoring results indicate that the ground water quality could be regarded as medium to poor mainly due to elevated nitrate levels. When comparing results against relevant water quality standards, chemicals of concern that have been identified include:

- Electrical Conductivity (EC): Concentrations in boreholes NT15 and TSH05 generally exceed the SANS 241:2015 Aesthetics limit. The baseline EC concentration measured in 2009 (Metago, 2009) in NT15 also exceeded the SANS 241:2015 Aesthetics limit.
- Total Dissolved Solids (TDS): Concentrations in NT15 exceeded the DWAF Target Water Quality Guideline (TWQR) for Livestock Watering and SANS 241:2015 Aesthetic limit. The baseline TDS concentration (Metago, 2009) in NT15 already exceeded both of these limits.
- Nitrate (NO_3): Concentrations in NT15 exceeded the SANS 241:2015 Acute health and the SANS and the DWAF TWQR for Livestock Watering limits. The baseline NO_3 concentration measured in 2009 (Metago, 2009) in NT15 already exceeded these limits.
- Manganese (Mn): Concentrations in NT15, NT8, TSH01, TSH02, TSH03, TSH05, TSH06 exceeded the SANS 241:2015 Chronic health limit. The baseline Mn concentration in Nt15 (0.3 mg/L) has decreased to below the reporting limit during the last monitoring event (2018-Q2).
- Molybdenum (Mo): Concentrations in NT8 exceeded the SANS 241:2015 Aesthetic limit. NT15 and TSH06 also exceeded this limit at times. The Nt15 Mo concentration has been below the reporting limit during the baseline, current and majority of the previous monitoring events. A sharp decrease of approximately two orders of magnitude in the Mo concentrations was observed in Nt8 since mid-2016.
- Lead (Pb) Concentrations in TSH03, TSH01 and TSH06 exceeded the SANS 241:2015 Chronic health limit at times, while TSH01 also exceeded the DWAF TWQR for Livestock Watering limit once (This was a once off occurrence). Pb exceeded the water quality guidelines in TSH01, TSH04 and TSH06 during 2017 monitoring. The Pb concentration has subsequently decreased to previously seen values. The source of the increase in Pb concentration is unknown but may be as a result of interferences during analysis.

2.2.10 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 (CO_2), manganese oxide (Mn_3O_4), iron oxide (Fe_2O_3), calcium oxide (CaO), magnesium oxide (MgO), lead (Pb) and boron (B) (Du Plooy, 2002).

Acid base accounting (ABA) testing undertaken to determine the potential for mined material to generate acid mine drainage, indicates that the potential to generated acid is negligible for waste rock, ore and tailings. The total sulphur content, and more importantly the sulphide sulphur content, of the materials on site are below the laboratory detection limit of <0.01%. In addition, the neutralising potential ratio (NPR) of the materials is above 2, with some significantly above 2, which implies all lithologies have sufficient neutralising potential to offset the low acid potential (SLR, 2014).

Synthetic Precipitation Leaching Procedure (SPLP) was used to determine the potential drainage quality from the sampled lithologies at the Tshipi Borwa Mine at neutral (pH7) drainage conditions. The results indicated that a number of metals are leachable at concentrations in excess of relevant water quality standards for waste rock, ore and tailings (SLR, 2014).

These include:

- Aluminium (Al) in terms of the SANS 241 (2015) Operational standards for waste rock.
- Arsenic (As) in terms of the World Health Organisation (WHO) standard for Drinking Water (2011) for ore and waste rock.
- Barium (Ba) in terms of the WHO standard for Drinking Water (2011) for waste rock.
- Cadmium (Cd) in terms of the WHO standard for Drinking Water (2011) for waste rock, ore and tailings.
- Iron (Fe) in terms of the SANS 241 (2015) Aesthetic standards for ore.
- Manganese (Mn) in terms of the SANS 241 (2015) Aesthetic standards for ore and waste rock.
- Lead (Pb) in terms of the WHO standard for Drinking Water (2011) for ore, tailings and waste rock.
- pH in terms of IFC Mining Effluent (2007) for waste rock.
- Electrical conductivity in terms of SANS 241 (2015) Aesthetic for tailings.
- Nitrate (N) in terms of the WHO standard for Drinking Water (2011) for waste rock.

Leachate could therefore exceed the SANS guidelines for various parameters for waste rock, and this presents a potential pollution risk for both surface and groundwater in both the short and long term.

2.2.11 HERITAGE

No significant heritage resources or cultural materials were identified during the Heritage Impact Assessment for the Original EMP (PGS, 2009), EMP 1 (PGS, 2017) and EMP 2 (PGS, 2018).

2.2.12 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 sectors 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 (during the various EMP consultation processes) 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
Original EIA and EMP Report, May 2009 (Original EMP)			
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?
EIA and EMP Amendment Report, October 2017 (EMP 1)			
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.
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.

IAP DETAILS		DATE OF COMMENT	ISSUE RAISED
EIA and EMP Amendment Report, September 2018 (EMP 2) [1]			
Raisibe Sekepane	DMR (Kimberly Offices)	11 April 2017	What is the reason behind the proposed partial backfilling? From our point of view, this presents a high environmental hazard.
Vincent Muila			From your closure costing, what is stopping Tshipi from backfilling according to the original plan?
Machalla Ramaboea			The impacts of partially backfilling are high, too much space will be taken up by the WRDs and agricultural land and any minerals below the WRDs will be sterilised.

2.4 MINE PLAN AND SCHEDULE

Manganese ore is mined from a single open pit (currently 104 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 70 m below surface with the deepest point (within the open pit) approximately 240 m or more below surface.

2.4.1 LIFE OF MINE

The remaining life of mine for open pit mining, under current economic parameters, is approximately 25 years.

2.4.2 AREAS OF DISTURBANCE

The current and LOM areas of disturbance associated with the Tshipi Borwa Mine are shown in Figure 2-1 and Figure 2-2 respectively, 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 contractor’s yard and laydown areas.

[1] Issues and comments raised at exploratory meeting with the DMR (prior to May 2018, when Tshipi opted to no longer propose any changes to the current backfill/closure objectives for the mine as part of EMP 2).

- Contractor’s 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: CURRENT LAYOUT AT TSHIPI BORWA MINE (AUGUST 2018)

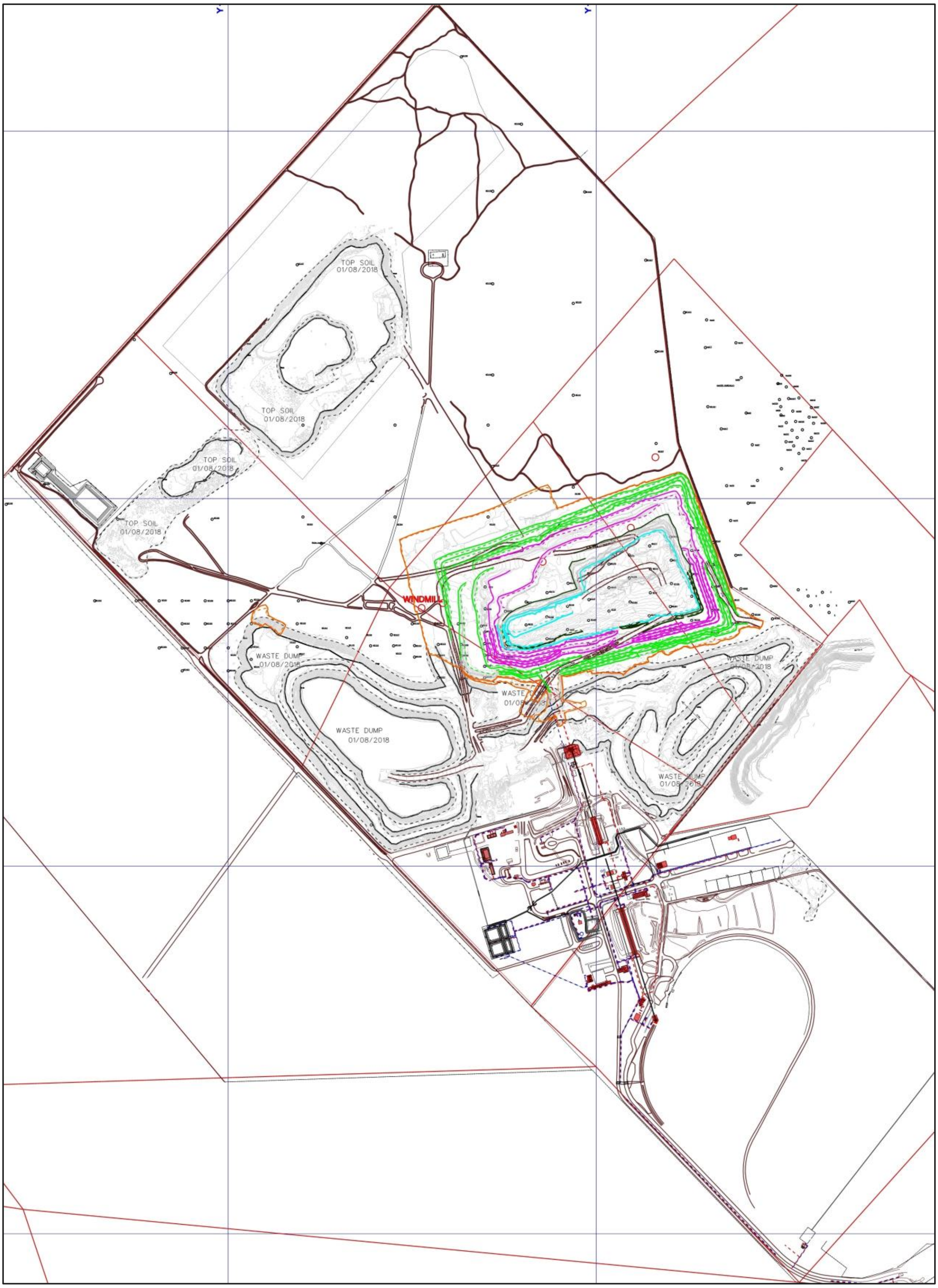
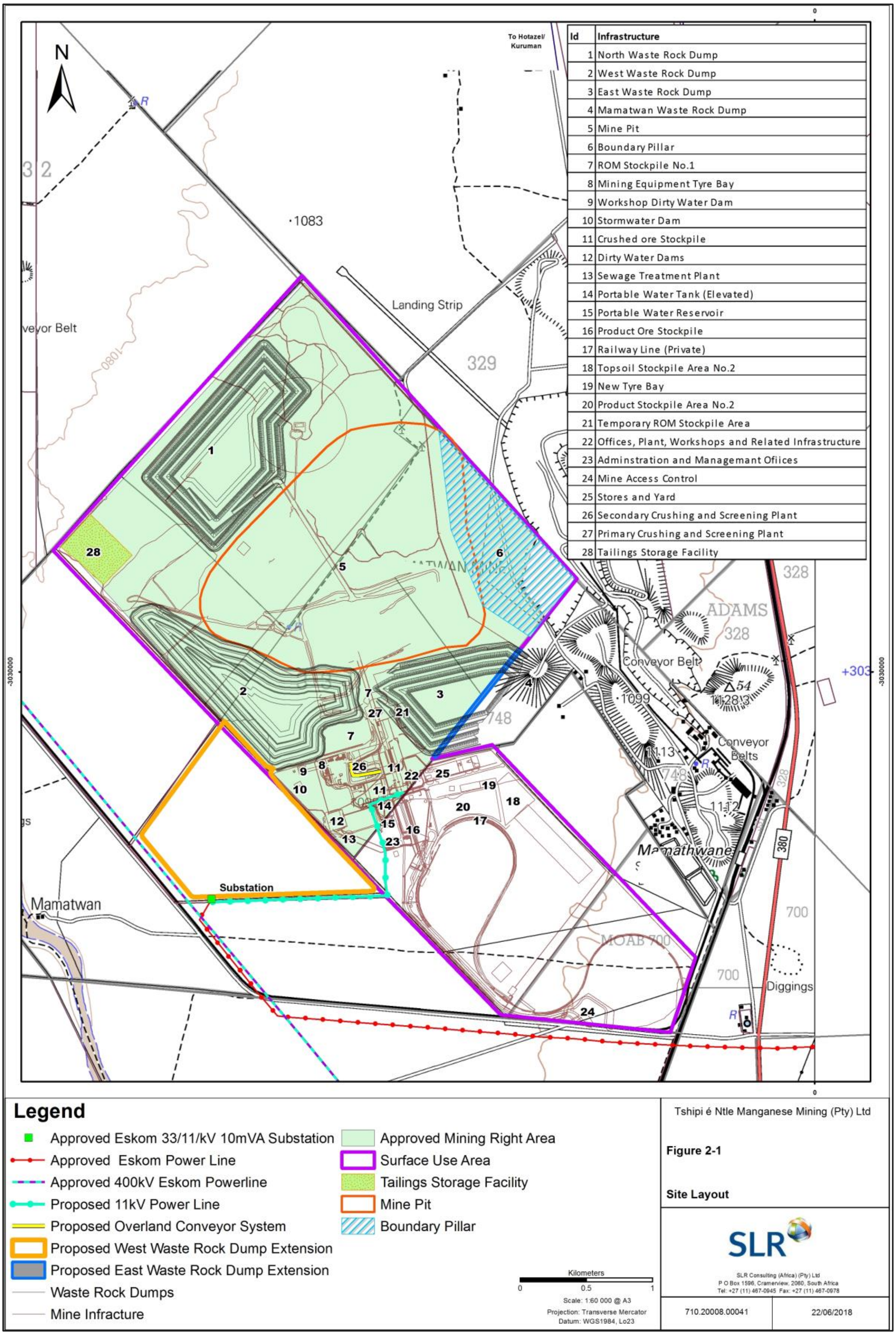


FIGURE 2-2: LOM LAYOUT AT TSHIPI BORWA MINE (INCLUDING PROPOSED WRD EXTENSION)



3. ENVIRONMENTAL RISK ASSESSMENT

3.1 RISK ASSESSMENT METHODOLOGY

An Environmental Impact Assessment has been carried out as part of the EIA and EMP amendments for the Tshipi Borwa Mine (refer to EMP 1 and EMP 2). 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 (refer to Section 7 of the amended EIA and EMP report (EMP 2)) 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/or Closure phases) as identified by the EIA were:

- Loss and sterilisation of mineral resources.
- Altering topography.
- Loss of soil resources and land capability through contamination and physical disturbance.
- Physical destruction and general disturbance of biodiversity.
- Alteration of natural drainage patterns.
- Contamination of surface water resources.
- Contamination of groundwater resources.
- Lowering of groundwater levels and reducing availability.
- Pollution from emissions to air.
- Increase in disturbing noise levels.
- Negative visual views.
- Loss of or damage to heritage/cultural and/or palaeontological resources.
- Negative socio-economic impact (Inward migration).
- Positive socio-economic impact (Economic impact).
- Change in land use.

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

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

Aspect	Potential impact	Impact discussion and reference to mitigation measures
Geology	Loss and sterilisation of mineral resources	By the nature of mining projects, mineral deposits in the natural geology are exploited for the target minerals; thereby impacting the local geology. It is also possible that mineral resources can become sterilised through the placement of surface infrastructure and waste. Related mitigation measures include best mining practises to ensure that mineral sterilisation is minimised as far as possible.
Topography	Altering topography	The majority of the natural topography at the Tshipi Borwa Mine has been disturbed as a result of the existing mining infrastructure and activities. Related mitigation measures include minimising areas of disturbance and effective rehabilitation of the site to restore natural topography as far as reasonably practical.
Soil and land capability	Loss of soil resources and land capability through contamination and physical disturbance	Soil is a valuable resource that supports a variety of ecological functions and is the key to re-establishing post closure land capability. Soil resources can be disturbed through removal, erosion and compaction, as well as pollution during accidental spills and leaks which can result in a loss of soil functionality as an ecological driver. Related mitigation measures focus on pollution prevention, implementing soil conservation procedures and limiting site clearance to what is absolutely necessary.
Biodiversity	Physical destruction and general disturbance of 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 transformation of land for any purpose, including mining and associated activities, increases the destruction of the site specific biodiversity, the fragmentation of habitats, reduces its intrinsic functionality and reduces the linkage role that undeveloped land fulfils between different areas of biodiversity importance.

Aspect	Potential impact	Impact discussion and reference to mitigation measures
		In addition to the loss of habitat, biodiversity may be disturbed through lighting, noise, dust generation, road kills, harvesting of fauna and flora etc. Related mitigation measures focus on limiting the project footprint area, biodiversity action plans and operation controls to limit on-going disturbance.
Surface water	Alteration of natural drainage patterns	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.
	Contamination of surface water resources	Mining projects generally present a number of pollution sources that can have a negative impact on surface water quality if unmanaged in all project phases. Various pollution sources exist on site as the mine is operational: fuel and lubricants, sewage, mine residue (WRDs), dirty water circuit, chemicals, non-mineralised waste (hazardous, general), and erosion of particles from exposed soils in the form of suspended solids. Related mitigation measures focus on pollution prevention and monitoring.
Groundwater	Contamination of groundwater resources	There are a number of sources in all mine phases that have the potential to pollute groundwater. Some existing 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 part loss of water supply (if required) and basic infrastructure design. The operational phase will present more long-term potential sources (existing WRDs and proposed WRD extensions) and the closure phase will present final land forms, such as the backfilled open pit and the tailings dam that may have the potential to pollute water resources through long term seepage and/or runoff.

Aspect	Potential impact	Impact discussion and reference to mitigation measures
		A groundwater model (refer to EMP 2) was run for a period of 100 years to simulate 25 years of mining and 75 years post-mining, and included all existing and potential pollution sources and considered both an unlined and lines scenario for the WRDs. Both scenarios result in a pollution plume of low concentration in a relatively small area outside of the Mining Right area. However there are no known third parties within the predicted plumes, therefore the severity is rated as low in both scenarios.
	Lowering of groundwater levels and reducing availability	Dewatering of the open pit will lower groundwater levels during the operational phase, and recover again after mining ceases. Related mitigation measures focus on monitoring and compensation for third party loss of water. A groundwater model (refer to EMP 1) indicated that the dewatering cone of depression extends 5.5 km to the east and 8.3 km to the west of the Tshipi Borwa Mine with a drop in water depth of up to 2 metres at the maximum extent. The cone of drawdown is at maximum extent at the end of mining (Year 25). As mining operations stop and backfilling takes place, the water levels start recovering according to the simulation. The cone of drawdown starting at year 50 (i.e. 25 years after mining ceases) until the end of the simulation is located mainly around Mamatwan and UMK Mines, and Tshipi Mine has minimal contribution to the cone of drawdown.
Air quality	Pollution from emissions to air	Mining projects present a number of air pollution sources that can have a negative impact on ambient air quality and surrounding land uses in all phases. Pollution sources include land clearing activities, materials handling, wind erosion from stockpiles, wind erosion of disturbed areas, vehicle movement along unpaved roads and gas emissions mainly from vehicles and generators. The main contaminants 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. A change in ambient air quality can have health and/or nuisance impacts. Related mitigation measures focus on pollution prevention (i.e. dust suppression) and monitoring.

Aspect	Potential impact	Impact discussion and reference to mitigation measures
Noise	Increase in disturbing noise levels	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 (e.g. distant humming noises). Related mitigation measures focus on noise pollution prevention and monitoring when required.
Visual	Negative visual views	Visual impacts on this receiving environment may be caused by activities and infrastructure in all mine phases. The more significant visual impacts relate to the larger infrastructure components (such as the waste rock dumps) and the long term infrastructure (waste rock dumps which are likely to remain post closure). Related mitigation measures focus on landscaping interventions particularly during the decommissioning and rehabilitation stages.
Heritage/ cultural and/or palaeonto-logical resources	Loss of or damage to heritage/cultural and/or palaeontological resources	No significant heritage resources have been found in the Tshipi mining right area. In the event of a chance find 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.
Socio-economic	Inward migration	Mining operations tend to bring with them an expectation of employment in all phases prior to closure. This expectation can lead to the influx of job seekers to an area which in turn increases pressure on existing communities, housing, basic service delivery and raises concerns around safety and security. Related mitigation measures focus on recruitment processes, communication and health awareness training.
	Economic impact	Mining has a positive net economic impact on the national, local and regional economy. Direct benefits are derived from wages, taxes and profits. Indirect benefits are derived through the procurement of goods and services, and the increased spending power of employees. Related mitigation measures focus on clear communication, recruitment and procurement processes.

Aspect	Potential impact	Impact discussion and reference to mitigation measures
Land use	Change in land use	Mining activities have the potential to affect land uses both within the mine area and in the surrounding areas. This can be caused by physical land transformation and through direct or secondary impacts. Related mitigation measures include communication with neighbouring communities, land users, and land owners to facilitate information sharing. 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.

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 potentially be no latent or residual environmental impacts.

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

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

Potential impact	Significance (unmitigated)	Management actions during operations, decommissioning and closure	Significance (mitigated)	Extent to which the impact can be avoided or addressed through the implementation of management actions	Is the impact considered latent or residual
Loss and sterilisation of mineral resources	**High**	• Management through best practises to prevent unacceptable mineral sterilisation	**LOW**	Can be managed/ mitigated to acceptable levels	No
Altering topography	**Medium**	• Minimise the area of disturbance • Restore natural topography as far as reasonably practical upon closure	**MEDIUM**	Can be managed/ mitigated to acceptable levels	No
Loss of soil resources and land capability through contamination and physical disturbance	**High**	• Limit project footprint • Soil conservation procedures • Control through waste management practices • Control through appropriate design (incl. access roads) • Closure planning and rehabilitation • Erosion control • Remedy through emergency response procedures (refer to Section 30.2.2 of EMP 2)	**MEDIUM**	Can be managed/ mitigated to acceptable levels	No
Physical destruction and general disturbance of biodiversity	**High**	• Control through appropriate design (incl. access roads) • Implement biodiversity action plan and offset (if relevant) • Limit project footprint • Phase vegetation clearing • Search and rescue of flora and fauna • Management through training and monitoring • Comprehensive monitoring programme for protected trees • Rehabilitation	**MEDIUM**	Can be managed/ mitigated to acceptable levels	No

Potential impact	Significance (unmitigated)	Management actions during operations, decommissioning and closure	Significance (mitigated)	Extent to which the impact can be avoided or addressed through the implementation of management actions	Is the impact considered latent or residual
		• Alien invasive species management programme • Control through permits for removal • Remedy through emergency response procedures (refer to Section 30.2.2 of EMP 2)			
Alteration of natural drainage patterns	**Medium**	• Management through stormwater control (i.e. Stormwater Management Plan) • Surface water monitoring	**LOW**	Can be managed/ mitigated to acceptable levels	No
Contamination of surface water resources	**Medium**	• Management through appropriate design • Implementation of Stormwater Management Plan • Management through waste management practises • Surface water monitoring • Management through compensation • Remedy through emergency response procedures (refer to Section 30.2.2 of EMP 2)	**LOW**	Can be managed/ mitigated to acceptable levels	No
Lowering of groundwater levels and reducing availability	**Medium**	• Groundwater monitoring • Management through compensation	**LOW**	Can be managed/ mitigated to acceptable levels	Probably – needs further investigation

Potential impact	Significance (unmitigated)	Management actions during operations, decommissioning and closure	Significance (mitigated)	Extent to which the impact can be avoided or addressed through the implementation of management actions	Is the impact considered latent or residual
Contamination of groundwater resources	**Low**	• Groundwater monitoring • Implementation of Stormwater Management Plan • Management through compensation • Management through appropriate design • Remedy through emergency response procedures (refer to Section 30.2.2 of EMP 2)	**LOW**	Can be managed/ mitigated to acceptable levels	No
Air pollution	**High**	• Management through appropriate design • Dust control and dust fall out monitoring • Air quality monitoring • Complaints register	**MEDIUM (HIGH FOR MN)**	Can be managed/ mitigated to acceptable levels	No
Increase in disturbing noise levels	**Medium**	• Manage through noise controls • Conduct noise monitoring in the unlikely event that Tshipi receives noise related complaints	**LOW (DAY-TIME)** **MEDIUM (NIGHT-TIME)**	Can be managed/ mitigated to acceptable levels	No
Negative visual views	**High**	• Limit project footprint • Phase vegetation clearing • Dust control • Manage through visual controls • Rehabilitation	**MEDIUM (PRE-CLOSURE)** **LOW (AT CLOSURE)**	Can be managed/ mitigated to acceptable levels	No

Potential impact	Significance (unmitigated)	Management actions during operations, decommissioning and closure	Significance (mitigated)	Extent to which the impact can be avoided or addressed through the implementation of management actions	Is the impact considered latent or residual
Loss of or damage to heritage/ cultural and/or palaeontological resources	**Insignificant**	• Control through avoidance • Remedy through emergency response procedures (refer to Section 30.2.2 of EMP 2)	**INSIGNIFI-CANT**	Can be avoided	No
Inward migration	**High**	• Control through the monitoring of living conditions of employees, recruitment processes, disease management • Remedy through emergency response procedures (refer to Section 30.2.2 of EMP 2)	**LOW**	Can be managed/ mitigated to acceptable levels	No
Economic impact	**Medium-high +**	• Control through good communication, recruitment and procurement processes	**MEDIUM-HIGH +**	Can be managed/ mitigated to acceptable levels	No
Change in land use	**Medium**	• Communication with neighbours and land users • Repair any damaged infrastructure • Rehabilitation	**LOW**	Can be managed/ mitigated to acceptable levels	No

Potential latent or residual impacts following mine closure (as identified in the table above) that require further investigation and clarification are:

- Lowering of groundwater levels.

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.
- 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 B.

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.
- Disturbance of biodiversity.

Impacts requiring monitoring (including responsibility and frequencies) are detailed in Section 27 (refer to Table 27-1) of EMP 2.

The environmental manager will conduct internal management audits against the commitments in the EMP reports in accordance with an annual audit plan. 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).

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 liability calculations (see Section 11 and Appendix B for specific details). No specific residual or latent environmental impacts have been costed at this stage.

Potential latent or residual impacts following mine closure (as identified in the Table 3-2 previously) that require further investigation and clarification are:

- Lowering of groundwater levels (i.e. compensation and/or alternative water sources to be provided to surrounding water uses for the impact of Tshipi Mine).

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

The following legislation has been complied with in the drafting of this closure plan:

- *Environmental Impact Assessment Regulations, 2014* (GNR 982 of 4 December 2014) that requires a closure plan to contain the information set out in Appendix 5 of these Regulations (GNR 982, 2014).
- *Mineral and Petroleum Resources Development Amendment Bill, 2013* (Bill 15 of 2013) that require 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.

The calculation of the closure cost liability calculations has been undertaken using the *Guideline Document for the Evaluation of the Quantum of Closure-Related Financial Provision provided by a Mine* (DMR, 2005).

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. Potential alternative post-mining land and water uses will also be further investigated during the ongoing operations of the mine.

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 damage is minimised to the extent that it is acceptable to all parties involved.
- All surface infrastructure will be removed from site after closure.
- 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.

The current EMP mine closure commitments further commits Tshipi Borwa Mine to:

- Rehabilitate the land to the extent reasonably possible to achieve an end use of wilderness and/or grazing.
- Backfill the open pit.
- Shape any remaining waste rock dumps to 1V:3H (18°) to create stable landforms.

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 the ongoing operations of the mine.

In the context of evolving technical, commercial, socio-economic, environmental, legal and cumulative considerations, Tshipi has commenced the process of re-evaluating its mine closure solution. While a measure of pit backfilling is still envisaged, it is probable that the preferred long-term sustainable closure solution will not incorporate complete backfill. This will be addressed in a separate EMP amendment process in due course.

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.
- 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.

TABLE 4-1: ALTERNATIVE CLOSURE OPTIONS CONSIDERED

Aspect	Options Considered	
Post closure land-use	A	Agriculture (e.g. hydroponic farming)
	B	Wilderness and/or grazing
	C	Industrial
	D	Commercial
Final pit void	A	Leave open to support alternative use (e.g. future underground mining operation or post closure water resource)
	B	Complete backfill of the pit void to ngl and rehabilitate area
	C	Reduced 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 center, centralized office services, teaching and training college etc.)
	B	Demolish and rehabilitate area
Water treatment facilities	A	Retain to support small business development
	B	Demolish and rehabilitate area
	C	Retain for treatment of water from open pit (if applicable)
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 or aquaculture)
	B	Demolish and rehabilitate area

(Shaded) Option currently selected

A Tshipi Concept Study has proven the techno-economic viability of an underground mine on that portion of the Tshipi Mining Right area that is too deep for economic opencast mining. The mine design includes on-seam adits or declines from the final open pit high-wall as the optimal means of access to the deeper manganese resources.

Should the pit be backfilled it is quite likely that these resources will be sterilised by virtue of the capital cost and lead-time that will be required to access the underground resources by a shaft complex that would have to be established from surface.

Moreover, with the approved removal of the boundary pillar between the Tshipi and Mamatwan mines complete backfill cannot practically be achieved between the open pits, for a number of technical and environmental reasons. Tshipi has, therefore, commenced the process of re-evaluating its mine closure solution and closure objectives.

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.

At this stage, the preferred post closure land use is 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

Potential alternative post closure options will be further investigated during the ongoing operations of the mine (e.g. industrial development, SMME development, housing, recreational facilities etc.), as well as, reduced backfilling of the pit void. Any proposed changes to closure objectives and closure options will be addressed in a separate EMP amendment in due course.

The feasibility of alternative closure options will 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 pit void (currently estimated at 209,389,000 m^3 to ngl) is the most time consuming aspect towards mine closure, and it will take roughly 10 to 12 years to be completed (see section 6.1.2 for more details).

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 and/or alternative closure options will be ongoing during the remaining life of mine, for example:

- Re-evaluating complete backfill of the pit.
- Investigating underground mining resources.
- 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:

- Tshipi will follow and adhere to the commitments made in the EIA and EMP reports, and any amendments there to.

- Tshipi will follow the mine plan and design /layout to minimise the potential for additional disturbed areas.
- The volume of stockpiled topsoil [2] that has been stripped from infrastructure and operational areas will be sufficient for closure activities.
- 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.
- 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.
- 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 current 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 currently as follows:

- The pit void will be backfilled (as far as reasonably practical) and the area rehabilitated.

[2] There are currently two topsoil stockpiles on site. Stockpile near the Northern dump (700,800 m^3) and Stockpile near the railway loop (47,025 m^3).

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

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 (as far as reasonably practical). 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

Currently, the remaining pit void will be backfilled (as far as reasonably practical) 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 reasonably practical).

It is proposed that backfilling of the remaining pit void be done via a conveyor system at a backfill rate of approximately 4,000 tonnes per hour (i.e. 2 conveyors, each at 2,000 tonnes per hour). Conceptual studies undertaken for Tshipi (see Appendix A) indicate that a conveyor system (to compliment a load and haul system) is the most economical method for backfilling the Tshipi pit void.

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[3] An 18° slope is typically considered acceptable for WRD's to remain stable into perpetuity. Each WRD should however be individually assessed and the long-term stability confirmed.

Some backfilling of the pit void may also be done by dozing nearby material from the overburden/waste rock dumps and in areas where overfilling of in-pit dumping (ongoing concurrent backfilling during mine operations) has occurred.

Inert building rubble arising from the demolition of surface infrastructure can also be buried within the backfilled areas of the open pit void.

6.1.3 OVERBURDEN/WASTE ROCK DUMPS

Despite the pit void being overfilled with material, it is still anticipated that a number of overburden/WRD's will remain post closure (due to bulking of the excavated material).

These remaining overburden/WRD's will be made safe by pushing down steep slopes (to 1V:3H slope or 18°), 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 TAILINGS STORAGE FACILITY

The tailings storage facility is not yet operational, so only the removal of the HDPE liner, shaping and levelling of the footprint area, and the establishment of vegetation is currently required.

6.1.5 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 within the backfilled areas of the open pit void.

6.1.6 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 within the backfilled areas of the open pit void.

6.1.7 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 within the backfilled areas of the open pit void.

6.1.8 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).

6.1.9 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 reasonably practical), steep slopes in excess of 1V:4H are to be avoided (where reasonably 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.
- Establishing key stone (deep rooted) species that assist to promote biodiversity (i.e. shallow rooted species) through hydraulic lift and soil stabilisation.

6.1.10 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 three 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 two years of monitoring with a reduced frequency.

6.1.11 GROUNDWATER MANAGEMENT

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

The recommendations following the latest quarterly groundwater monitoring report (SLR, 2018c) should be addressed as part of this work, namely:

- An audit on the monitoring network be undertaken to identify where improvements to infrastructure is required to prevent possible anthropogenic contamination and to aid the integrity of the water quality monitoring exercise.
- The locations of the boreholes are to be properly surveyed in order to allow water levels to be accurately reported in metres above mean sea level.
- The cumulative impact on groundwater levels due to other surrounding mining operations such as at United Manganese of the Kalahari, Middelplaats and Mamatwan Mine should be determined to understand the regional effect on groundwater levels.
- The monitoring of the additional groundwater points, not stipulated in the Integrated Water Use License, be continued on a quarterly basis.
- NH_3 and NO_2 be added to the analysis requirements.
- Analysis of organic constituents in the groundwater be continued to monitor any trends that may exist.
- A contaminated land investigation be undertaken to identify possible sources of the chemicals of concern identified.

6.2 OPPORTUNITIES ASSOCIATED WITH CLOSURE OPTION

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

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.). See section 4.3 previously.

It is also uncertain whether complete backfilling of the open pit is the most feasible long-term sustainable closure solution in the context of evolving technical, commercial, socio-economic, environmental, legal and cumulative considerations.

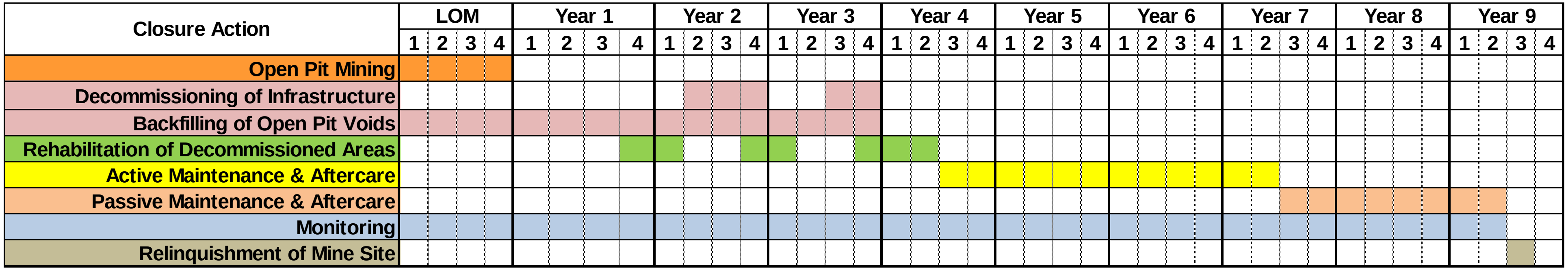
7. SCHEDULE OF CLOSURE ACTIONS

The current pit void of 46,909,704 m^3 (to ngl) will take roughly 3 years to be backfilled using a conveyor system (at a backfill rate of 4,000 tonnes per hour). The final pit void of 209,389,000 m^3 (to ngl) will take roughly 12 years to be backfilled using the same conveyor system.

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

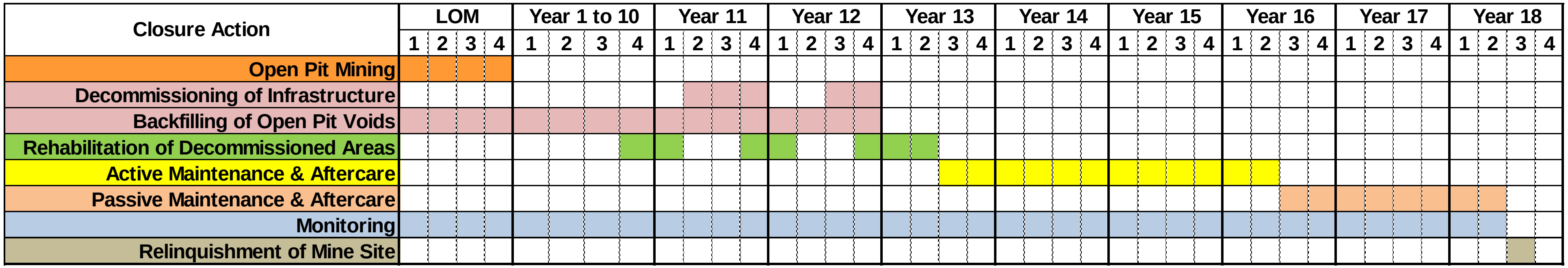
A preliminary schedule of the decommissioning and rehabilitation activities as at August 2018 and at LOM is shown in Figure 7-1 and 7-2 respectively.

FIGURE 7-1: PRELIMINARY SCHEDULE OF DECOMMISSIONING AND REHABILITATION ACTIVITIES FOR THE CURRENT PIT VOID (AUGUST 2018)



The preliminary schedule indicates that it should currently take approximately 8.5 years to backfill the open pit void (46,909,704 m^3) and rehabilitate the mine site.

FIGURE 7-2: PRELIMINARY SCHEDULE OF DECOMMISSIONING AND REHABILITATION ACTIVITIES AT LOM



The preliminary schedule indicates that it should take approximately 17.5 years after LOM, to backfill the open pit void (209,389,000 m^3) and rehabilitate the 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 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.
- 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.
- 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:

- Identify what species of grasses, shrubs and trees will best support the post closure land use of wilderness and/or grazing on the various rehabilitated sites (plant area, pit area and WRD's).
- Assess the likelihood and/or presence of any Category 1 alien invasive plant species on site.

- Compiling a detailed schedule (and costs) of associated mine closure management supporting services for the mine decommissioning and closure period (e.g. mine manpower, external consultants, ongoing maintenance services, mine security, insurances, municipal rates, equipment licences, IT and communications etc.)
- Develop and incorporate socio-economic aspects into the closure plan. Community development initiatives and programmes together with end land use objectives for the mining area form an important part of this study.
- Investigate what work activities of the closure plan can be undertaken during operations as part of the annual rehabilitation planning.
- Establish a closure plan committee that will meet on a regular basis to inform the closure planning process.
- Undertake a detailed environmental and closure risk assessment to fully evaluate the potential environmental and closure risks and possible mitigation/control strategies.
- Initiate trials of seed collection and germination (i.e. on site nursery) to inform: (i) the revegetation plan (i.e. suitable plant species and methodology for re-establishing vegetation) and (ii) to provide sufficient plant stock for revegetation purposes.
- Compile a detailed stormwater management plan at closure for the detailed design and quantification of any stormwater infrastructure.
- Assess the long-term geotechnical stability of the pit void and any unstable areas that will need to be addressed as part of ongoing operations.

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/air quality, 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 B.

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 B.

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 B, 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 contact cover, and the root density. The vegetation contact cover dissipates the energy from surface water runoff, 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 basal cover,
- The tree/shrub (woody species) density, and
- The presence of alien invasive plant species.

The percentage basal cover is the parameter which best represents the overall success of revegetation efforts given all relevant considerations. It is proposed that the line point method be utilized to determine the percentage basal cover in representative transects of more than 200 points on representative sections of rehabilitated land.

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 expensive equipment. It also gives species composition and basal cover results in one monitoring action. Tree/shrub density will be evaluated by direct field count in the same representative line transects used for the basal cover assessment. Live, rooted woody stems within one meter either side of the line will be counted and expressed as woody plants per ha as well as the species composition.

The vegetative cover monitoring program is described in detail in Appendix B.

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

- The percentage of basal cover on rehabilitated areas is greater than or equal to 8%.
- The density of tree/shrub species (expressed as woody plants per ha) on rehabilitated areas is greater than or equal to 80% of the density of tree/shrub species found on corresponding reference plots with a similar land use.
- Species composition is similar to the species composition of nearby reference plots.
- No Category 1 alien invasive plant species occur on site.

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.

11. MONITORING, AUDITING AND REPORTING

11.1 PRE-CLOSURE MONITORING, AUDITING AND REPORTING

The environmental 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 personnel, and is carried out by the environmental officers, who report to the environmental 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.

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.

11.2 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 (the breakdown is provided in Appendix B), has been calculated to be:

- R 7,100,700 (excl. VAT) for the current pit void and mine layout.
- R 11,843,700 (excl. VAT) for the LOM pit void and mine layout.

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 (current layout) and 17.5 years (LOM layout). Provision for a small on-site maintenance team over a period of 5.5 years has also been allowed for (for both current and LOM layouts).

12. CLOSURE COST LIABILITY ESTIMATION PROCEDURE

12.1 CLOSURE COST LIABILITY METHODOLOGY

The closure cost liability was calculated as per the methodology of the DMR guideline document (DMR, 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 (i.e. less than 150 km from a developed urban area).

Post closure supervision and monitoring costs (see Section 12.4) and time, fee and contingency costs (see Section 12.5) were included in order to improve the accuracy of the DMR guideline closure cost liability estimate, and to comply with the requirements of the Environmental Impact Assessment Regulations, 2014 (see Section 4.1 previously).

The closure cost liability associated with the backfilling of the final pit void has not been considered at this stage. Backfilling of the pit void (including in-pit dumping during operations) should therefore be separately accounted for by Tshipi in the operations expenditure of the Tshipi Borwa Mine.

12.2 QUANTITIES

The quantities were calculated from the current mine layout (see Figure 2-1) and proposed LOM layout (see Figure 2-2 and Appendix C).

12.3 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 12-1: CPI INFLATION AS PROVIDED BY STATISTICS SOUTH AFRICA

January to December						
2005	2006	2007	2008	2009	2010	2011
3.4%	4.6%	7.2%	11.5%	7.1%	4.3%	5.0%

January to December						
2012	2013	2014	2015	2016	2017	2018 [4]
5.6%	5.7%	6.1%	4.6%	6.4%	5.3%	2.6%

The total escalation of the unit rates since January 2005 is 115.9% (i.e. 1.034 x 1.046 x 1.072 … etc.).

The updated DMR guideline rates (as at August 2018) are provided in the Table 12-2 below. The specific closure components in Table 12-2 that are applicable to the calculation of the Tshipi Borwa closure cost liability are highlighted in grey.

TABLE 12-2: RATES USED FOR CLOSURE COST LIABILITY CALCULATIONS

No.	Description of closure component / activity	Unit	Master Rate (at Jan 2005)	Master Rate (at Aug 2018)	MF [5]
1	Dismantling of process plant & related structures (incl. overland conveyors & power lines)	m^3	R 6.82	R 14.73	1.00
2 (A)	Demolition of steel buildings & structures	m^2	R 95.00	R 205.12	1.00
2 (B)	Demolition of reinforced concrete buildings & structures	m^2	R 140.00	R 302.28	1.00
3	Rehabilitation of access roads	m^2	R 17.00	R 36.71	1.00
4 (A)	Demolition & rehabilitation of electrified railway lines	m	R 165.00	R 356.26	1.00
4 (B)	Demolition & rehabilitation of non-electrified railway lines	m	R 90.00	R 194.33	1.00
5	Demolition of housing &/or administration facilities	m^2	R 190.00	R 410.24	1.00
6	Opencast rehabilitation including final voids & ramps	Ha	R 96,700.00	R 208,792.44	0.52

[4] CPI for January to July only.
[5] MF (Multiplication factor) based on Risk Ranking = Class C and Environmental Sensitivity = Medium.

No.	Description of closure component / activity	Unit	Master Rate (at Jan 2005)	Master Rate (at Aug 2018)	MF [5]
7	Sealing of shafts, adits & inclines	m^3	R 51.00	R 110.12	1.00
8 (A)	Rehabilitation of overburden & spoils	Ha	R 66,400.00	R 143,369.37	1.00
8 (B)	Rehabilitation of processing waste deposits & evaporation ponds (basic, salt producing waste)	Ha	R 82,700.00	R 178,563.96	1.00
8 (C)	Rehabilitation of processing waste deposits & evaporation ponds (acidic, metal-rich waste)	Ha	R 240,200.00	R 518,634.37	0.66
9	Rehabilitation of subsided areas	Ha	R 55,600.00	R 120,050.25	1.00
10	General surface rehabilitation	Ha	R 52,600.00	R 113,572.72	1.00
11	River diversions	Ha	R 52,600.00	R 113,572.72	1.00
12	Fencing	m	R 60.00	R 129.55	1.00
13	Water management	Ha	R 20,000.00	R 43,183.54	0.25
14	2 to 3 years of maintenance & aftercare	Ha	R 7,000.00	R 15,114.24	1.00

12.4 POST CLOSURE SUPERVISION AND MONITORING

The post closure supervision and monitoring costs are calculated in Appendix B and summarised in the table below.

TABLE 12-3: POST CLOSURE SUPERVISION AND MONITORING

No.	Description of closure component / activity	Unit	Rates (at Aug 2018)
4.1	Current post closure supervision and monitoring costs	Sum	R 7,100,700
	LOM post closure supervision and monitoring costs	Sum	R 11,843,700

12.5 TIME, FEE AND CONTINGENCY COSTS

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

TABLE 12-4: TIME, FEE AND CONTINGENCY COSTS

No.	Description of closure component / activity	Unit	Rates (at Aug 2018)
6.1	Contractor P&G's, site establishment and demobilisation	%	20
6.2	Contingency	%	10
6.3	Tender process and procurement	%	6
6.4	Site supervision of closure works	%	7.5

12.6 CLOSURE COST LIABILITY CALCULATIONS

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

- Current closure cost liability (as at August 2018).
- Future closure cost liability, 5 years from now (as at August 2023).
- Future closure cost liability, 10 years from now (as at August 2028).
- LOM closure cost liability, 25 years from now (as at August 2043).

A summary of the closure cost liability calculations is provided in Table 12-5 below. The closure cost liability calculations are all at Current Value (CV) as at August 2018.

TABLE 12-5: CLOSURE COST LIABILITY CALCULATION RESULTS

Timeframe	Date	Closure Cost Liability incurred during the period (incl. VAT)	Progressive Closure Cost Liability (incl. VAT)	Progressive Closure Cost as a % of LOM Liability
Current	August 2018	n/a	R 136 451 086	59.5%
+5 years	August 2023	R 53 576 374	R 190 027 460	82.9%
+10 years	August 2028	R 9 701 063	R 199 728 523	87.1%
+25 years (LOM)	August 2043	R 29 532 507	R 229 261 030	100.0%

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

- Confirming the demolition and removal of all infrastructure (including buildings, powerlines, water supply and treatment, access roads etc.).
- Maintaining a database of hazardous materials on site at closure, and the associated method (and hence cost) of safe disposal.
- Obtaining site (and/or area specific) rates for the scheduled closure activities through a formal tender process with a detailed bill of quantities, detailed scope of work with engineered drawings, as well as, contract specifications.

13. ANNUAL REHABILITATION PLANNING

The objective of annual rehabilitation planning 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 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.
- 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 instruments.

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 (i.e. in-pit dumping during operations) 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.
- Ongoing monitoring of groundwater, surface water and air quality.

14.RECOMMENDATIONS

Current gaps (and/or known unknowns) associated with this Closure Plan, that will need to be addressed as part of the ongoing closure planning process are outlined below in a recommended Implementation Plan (See Table 15-1). The Implementation Plan is based on the current remaining LOM of 25 plus years. In the event of premature closure, then all the actions described below change to "High" priority and the recommended completion date moves forward.

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 (EMP 2).

Stephen van Niekerk
(Report Author and Project Manager)

Brandon Stobart
(Reviewer)

Table 15-1: IMPLEMENTATION PLAN FOR FUTURE CLOSURE PLAN REVIEWS AND UPDATES

Item	Action Required	Report Reference	Priority	Recommended Completion Date
1	Re-evaluate the mine closure solution for Tshipi Borwa Mine in context of evolving technical, commercial, socio-economic, environmental, legal and cumulative considerations.	o Section 4.2.2 o Section 4.6	**High**	February 2020
2	Investigate the influence of the neighbouring/adjacent Mamatwan open pit in order to accurately assess the post closure contribution to lowered ground water levels created by Tshipi Borwa Mine.	o Table 3-2 o Section 3.5 o Section 6.1.11	**High**	February 2020
3	Undertake an audit on the water monitoring network to identify where improvements to infrastructure is required to prevent possible anthropogenic contamination and to aid the integrity of the water quality monitoring exercise.	o Section 6.1.11	**High**	ASAP
4	Survey the locations of the groundwater monitoring boreholes in order to allow water levels to be accurately reported in metres above mean sea level.	o Section 6.1.11	**High**	ASAP
5	Continue with quarterly groundwater monitoring (including additional groundwater points, not stipulated in the Integrated Water Use License). Also, add NH_3 and NO_2 to the analysis requirements.		**High**	Ongoing
6	Undertake a contaminated land investigation to identify possible sources of the chemicals of concern identified in the groundwater monitoring results.		**High**	ASAP
7	Investigate what work activities of the closure plan can be undertaken during operations as part of the annual rehabilitation planning.	o Section 9 o Section 13	**High**	Ongoing
8	Strip and preserve topsoil in accordance with the commitments made in the EIA and EMP reports. Keep an inventory of available topsoil for rehabilitation purposes.	o Section 4.7	**High**	Ongoing

Item	Action Required	Report Reference	Priority	Recommended Completion Date
9	Continuously engage with all the employees and contractors associated with the mine the need to: not unnecessarily pollute and/or negatively impact the environment; to follow good operational, decommissioning and rehabilitation practices and procedures; and to support the operations executive, environmental personnel and stakeholder engagement forums to adhere to the commitments made in the EIA and EMP reports.	o Section 6.2	**High**	Ongoing
10	Investigate underground mining resources at Tshipi Borwa Mine.	o Section 4.6	Medium	2025
11	Investigate the effect of bulking of the excavated materials, and the likelihood of any overburden/WRD's remaining post closure, for closure planning and rehabilitation costing purposes.	o Section 6.1.3	Medium	2025
12	Establish a closure plan committee that will meet on a regular basis to inform the closure planning process. Committee to be made up of environmental, health and safety, production and engineering managers, union representatives and external consultants.	o Section 9	Medium	2025
13	Undertake a detailed environmental and closure risk assessment (by the closure plan committee) to fully evaluate the potential environmental and closure risks, and possible mitigation/control strategies for the final closure plan.	o Section 9	Medium	2025
14	Investigate alternative uses for mine infrastructure in consultation with post closure stakeholders to potentially minimise the social impacts of mine closure on the surrounding communities.	o Section 4.3 o Section 6.4 o Section 12.6	Medium	2025
15	Develop and incorporate socio-economic aspects into the closure plan. Community development initiatives and programmes together with end land use objectives for the mining area form an important part of this study.	o Section 9	Medium	2025

Item	Action Required	Report Reference	Priority	Recommended Completion Date
16	Establish and monitor 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.	o Section 4.6	Medium	2025
17	Initiate trials of seed collection and germination (i.e. on site nursery) to inform: (i) the revegetation plan (i.e. suitable plant species and methodology for re-establishing vegetation) and (ii) to provide sufficient plant stock for revegetation purposes.	o Section 9	Medium	2025
18	Identify what species of grasses, shrubs and trees will best support the post closure land use of wilderness and/or grazing, and to identify field quality targets.	o Section 9	Medium	2025
19	Assess the likelihood and/or presence of any Category 1 alien invasive plant species on site to inform revegetation and post closure maintenance and aftercare efforts.	o Section 9	Medium	Ongoing
20	Compile a detailed schedule (and likely costs) of the associated mine closure management supporting services required during the decommissioning and closure period (e.g. mine manpower, external consultants, ongoing maintenance services, mine security, insurances, municipal rates, equipment licences, IT and communications etc.)	o Section 9	Low	2030
21	Compile a detailed stormwater management plan at closure for the detailed design and quantification of any stormwater infrastructure.	o Section 9	Low	2030
22	Maintain a database of hazardous materials on site at closure, and the associated method (and hence cost) of safe disposal.	o Section 12.6	Low	2030
23	Obtain site specific rates for the scheduled closure activities through a formal tender process with a detailed bill of quantities, detailed scope of work with engineered drawings, as well as, contract specifications in order to accurately estimate the closure liability to ± 90% accuracy (i.e. when remaining LOM is 5 years or less).	o Section 12.6	Low	2040

16. REFERENCES

DMR. 2005. Guideline Document for the Evaluation of the Quantum of Closure-Related Financial Provision Provided by a Mine. January 2005.

Du Plooy, A.P. 2002. Geochemistry and mineralogy of supergene altered manganese ore below the Kalahari unconformity in the Kalahari manganese field, Northern Cape Province, South Africa. Unpublished MSc. Dissertation, Rand Afrikaans University (now University of the Johannesburg, Johannesburg, South Africa)

GNR 982 of the National Environmental Management Act (107/1998). Environmental Impact Assessment Regulations, 2014. December 2014.

Metago Environmental Engineers (Pty) Ltd. 2009. Environmental Impact Assessment and Environmental Management Programme for the Proposed Ntsimbintle Manganese Mining Project (Original EMP). May 2009.

PGS. 2009. Heritage Impact Assessment for Ntsimbintle Mining (Pty) Ltd on Portions 1,2,3 and 8 of the farm Mamatwan 331 and the farm Moab 700 in the Kgalagadi District Municipality of the Northern Cape Province. March 2009.

PGS. 2017. Opinion pertaining to the Infrastructure changes to the surface use layout for the Tshipi Borwa Mine near Hotazel, in the John Taolo Gaetsewe district municipality Northern Cape Province. February 2017.

PGS. 2018. Proposed Waste Rock Dump Project at Tshipi Borwa Mine, near Hotazel, Northern Cape Province: Phase 1 – Heritage Impact Assessment. May 2018.

SLR Consulting (South Africa) (Pty) Ltd. 2012. Hydrogeological Assessment for Mine Closure Planning – Pit Lake Formation – Site Report and Analytical Model. November 2012.

SLR Consulting (Africa) (Pty) Ltd. 2014. Tshipi Borwa Mine Geochemical and Groundwater assessment, March 2014.

SLR Consulting (Africa) (Pty) Ltd. 2017. Environmental Impact Assessment and Environmental Management Programme Amendment Report for the Tshipi Borwa Mine (EMP 1). October 2017.

SLR Consulting (Africa) (Pty) Ltd. 2018a. Environmental Impact Assessment and Environmental Management Programme Amendment Report for the Tshipi Borwa Mine (EMP 2). September 2018.

SLR Consulting (Africa) (Pty) Ltd. 2018b. Tshipi Borwa EMP2 Amendment Groundwater Study. June 2018.

SLR Consulting (Africa) (Pty) Ltd. 2018c. Tshipi Borwa Mine Water Monitoring Report Q1 - March 2018. May 2018.

Statistics South Africa (StatsSA). 2015. P0211.4.2, Q1:2008-Q1:2015, 29 June 2015.

APPENDIX A: CONVEYOR BACKFILL STUDY (NRD TECHNOLOGIES, MAY 2018)

FIGURE A-1: LAYOUT OF THE EXTENDABLE CONVEYOR SYSTEM (AS AT DECEMBER 2017)

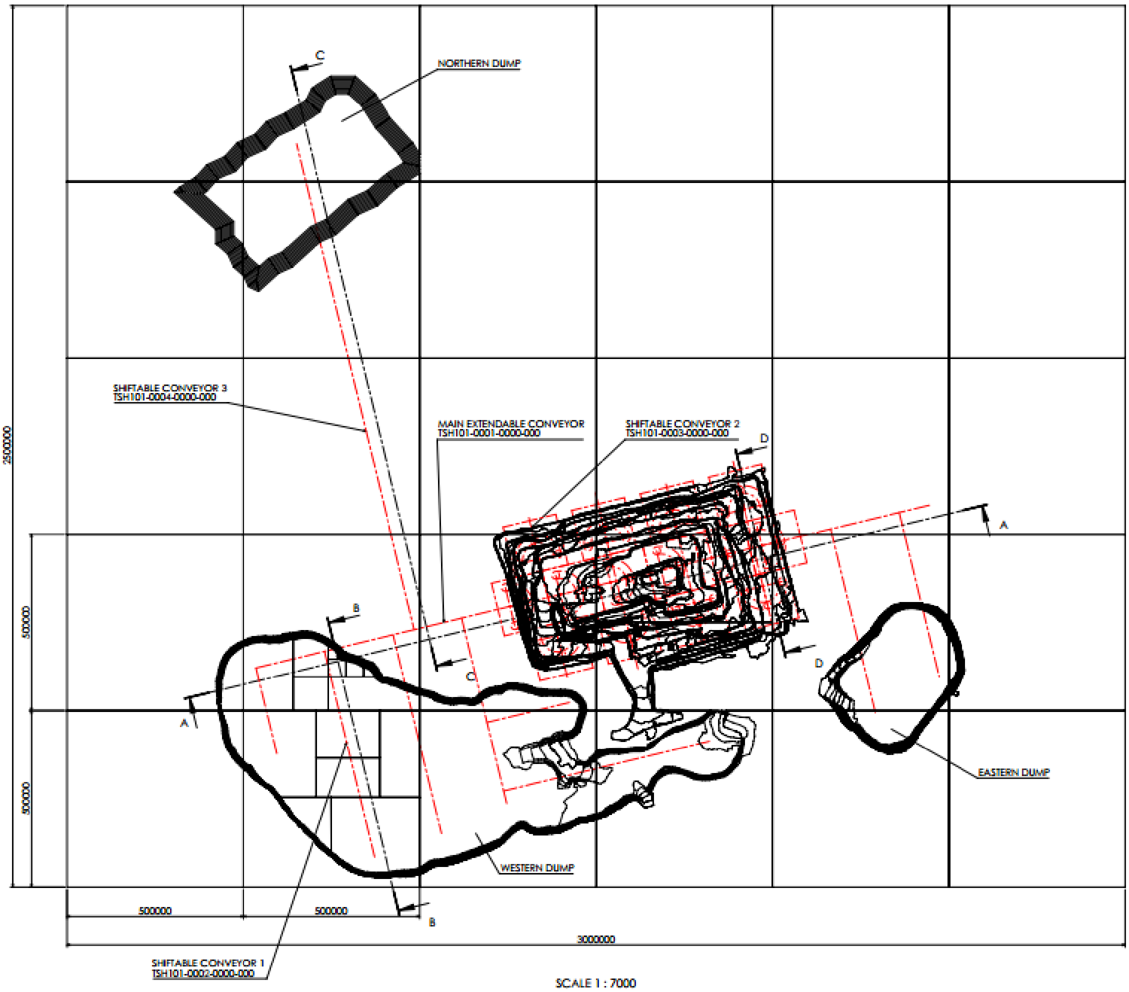


FIGURE A-2: BACKFILL USING MATERIAL FROM WESTERN DUMP (STEP 1)

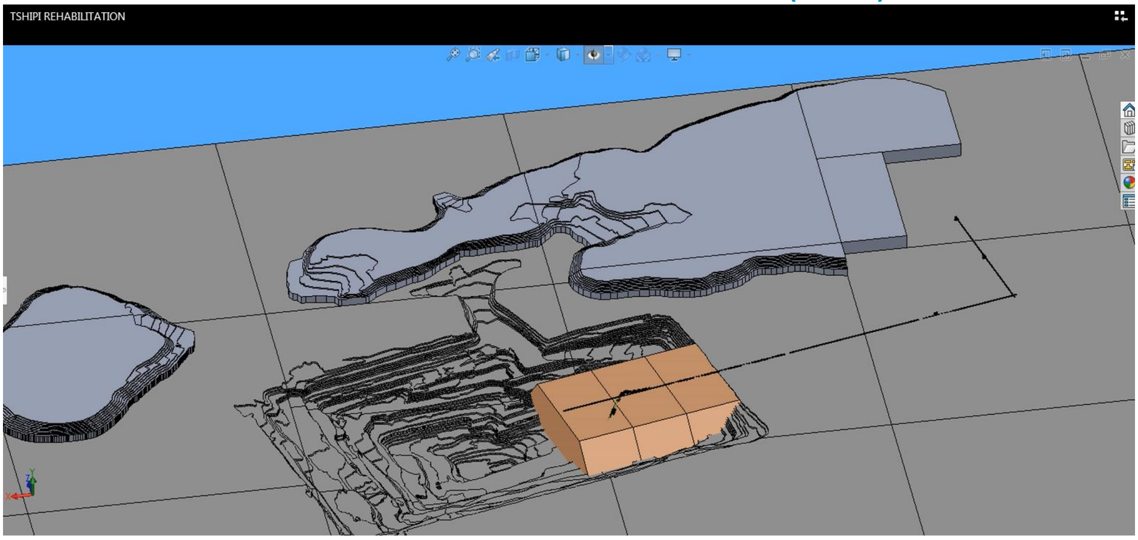


FIGURE A-3: SPREADING BACKFILL MATERIAL FROM WESTERN DUMP – DOZING AND BRANCH CONVEYORS (STEP 2)

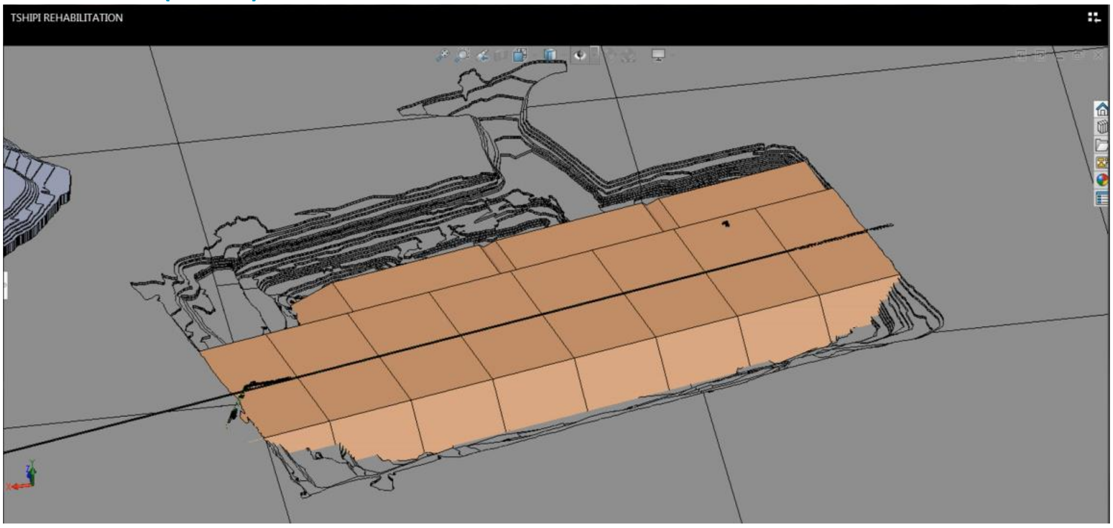


FIGURE A-4: BACKFILL USING MATERIAL FROM EASTERN DUMP (STEP 3)

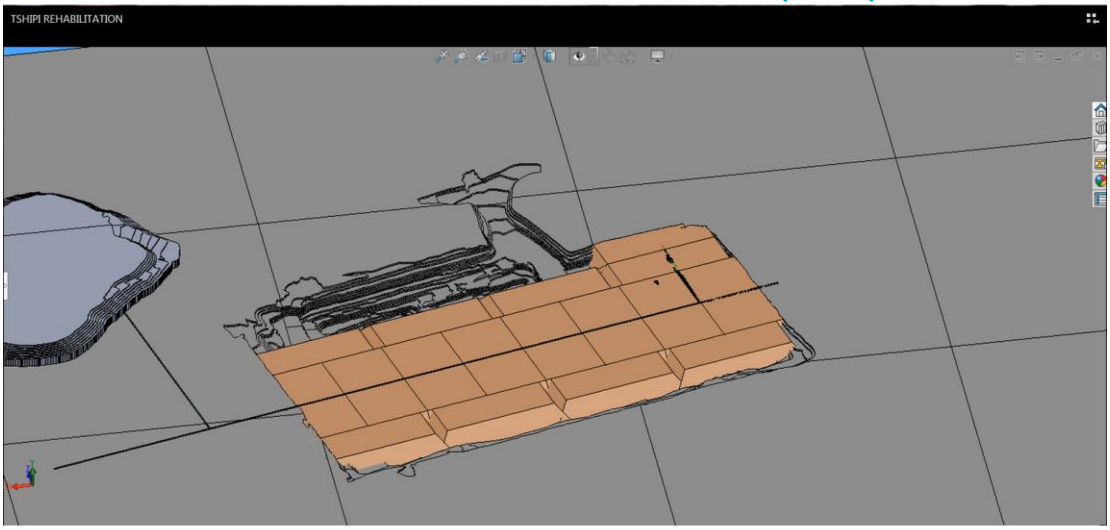
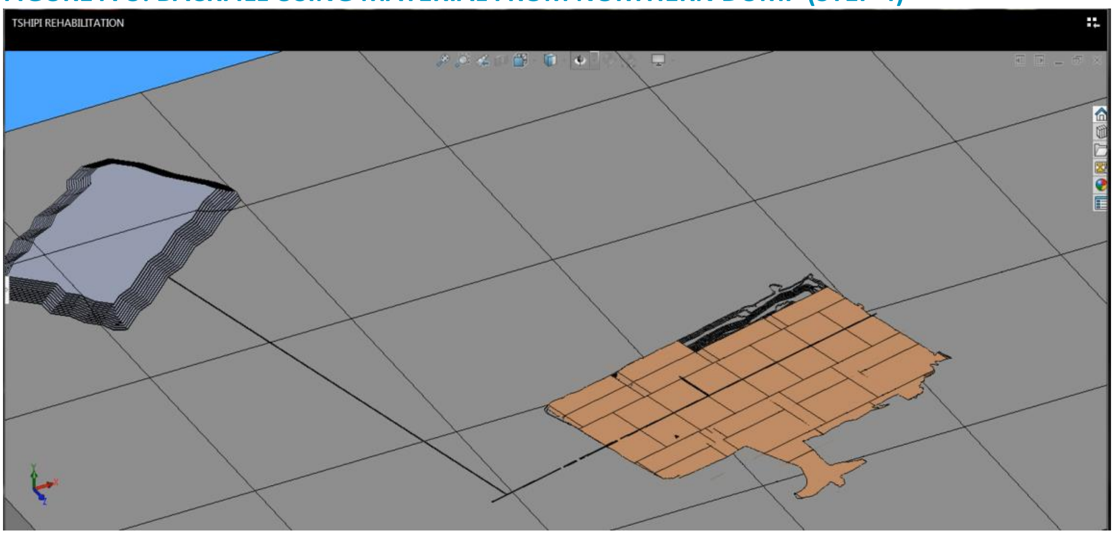


FIGURE A-5: BACKFILL USING MATERIAL FROM NORTHERN DUMP (STEP 4)



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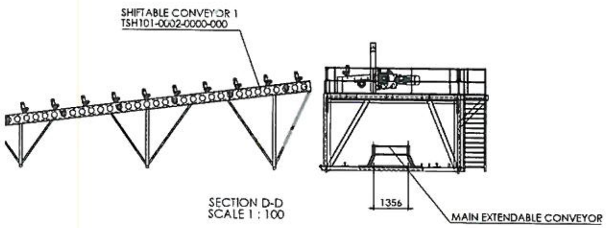

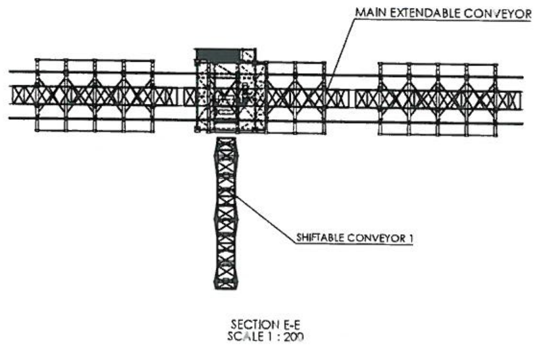

STRUCTURAL STEEL NOTES:

A. DESIGN:
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HOT ROLLED STEELWORK TO BE GRADE S355JR U.O.M.
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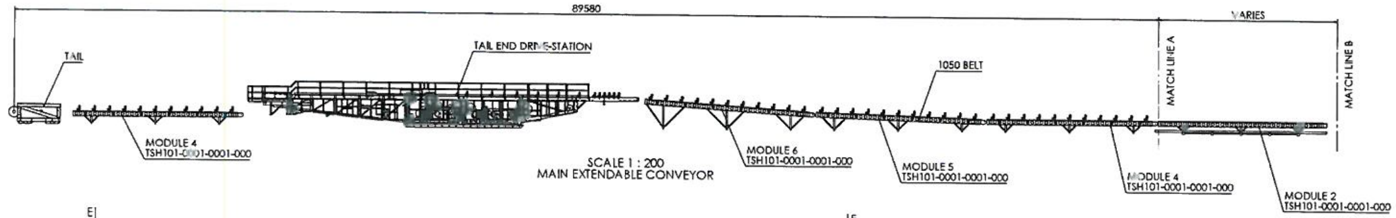

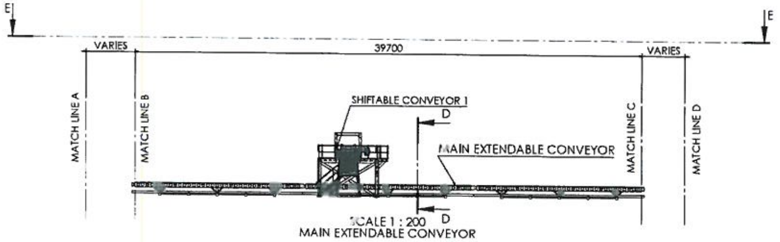

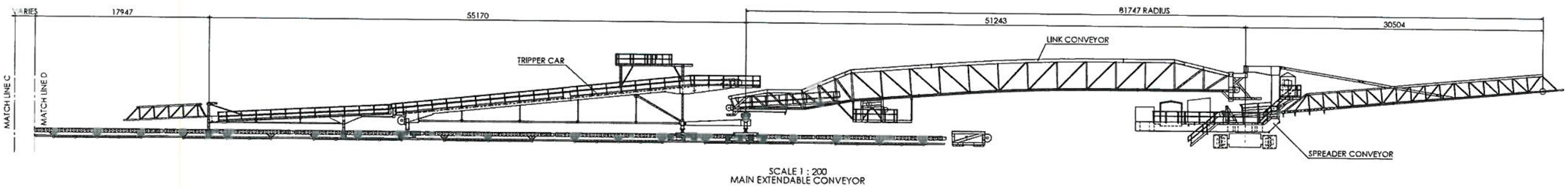

REFERENCE DRG	DESCRIPTION	REFERENCE DRG	DESCRIPTION

Tshipi é Ntle Manganese Mining

Tshipi Manganese Mining

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Q A			

REVISION: 0

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WEIGHT:

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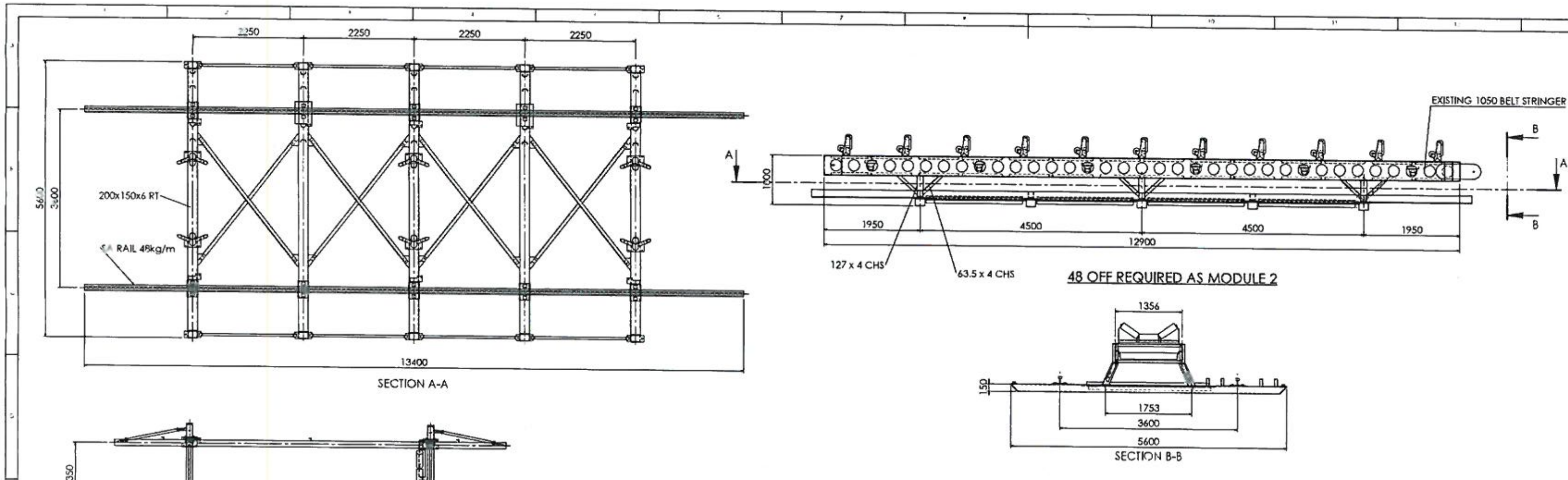
TRAFFIC STREET, PO BOX 358 LUTZVILLE, 8165 2014/048012/07 TEL: +27 [illegible] 721 72274 www.nrd-tech.com altus@nrdtech.co.za

TITLE: TSHIPI
REHABILITATION OF WASTE DUMPS
MAIN EXTENDABLE CONVEYOR

DWG NO. TSH101-0001-0000-000-1

A1

SCALE: 1:2000 | SHEET 1 OF 1



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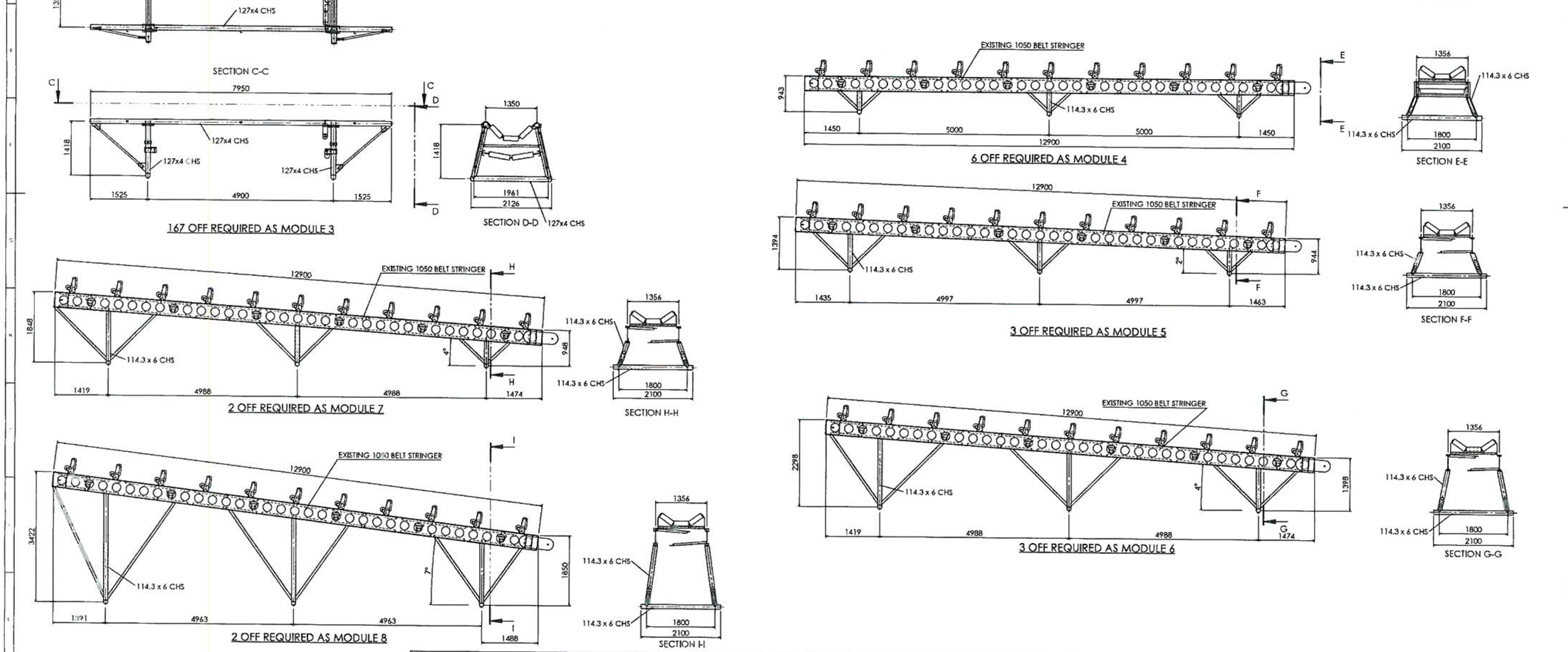

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TITLE: TSHIPI
REHABILITATION OF WASTE DUMPS
MODULE DETAILS

DWG NO. TSH101-0001-0001-000-1 A1

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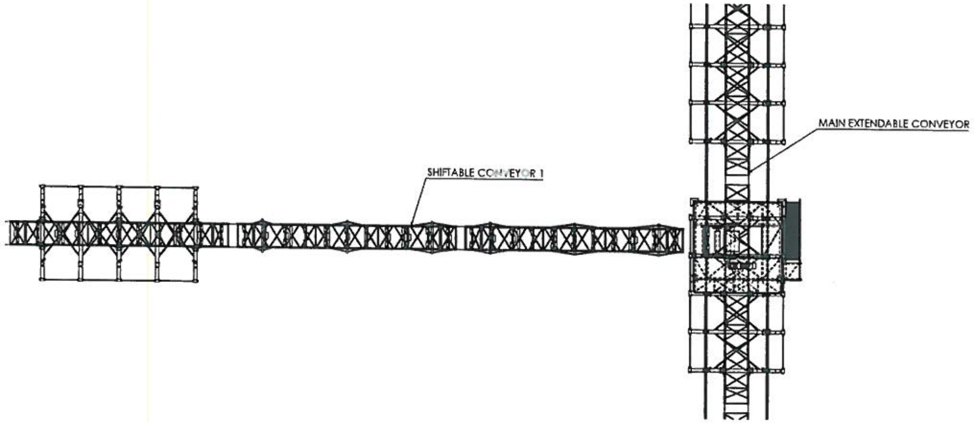

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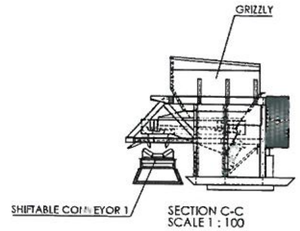

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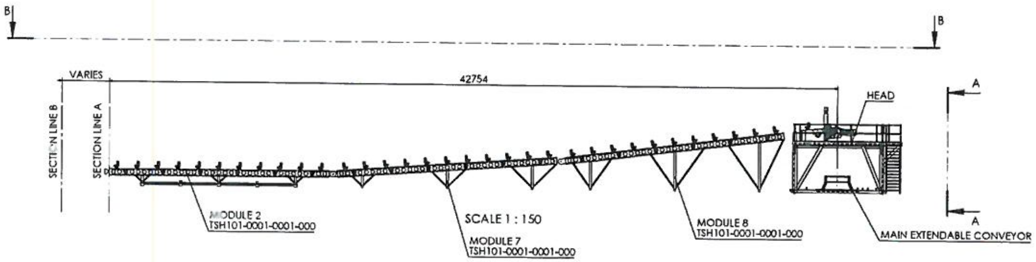

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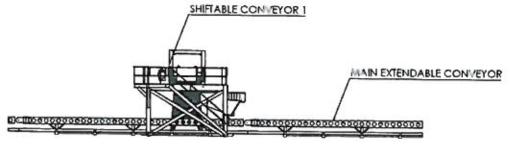

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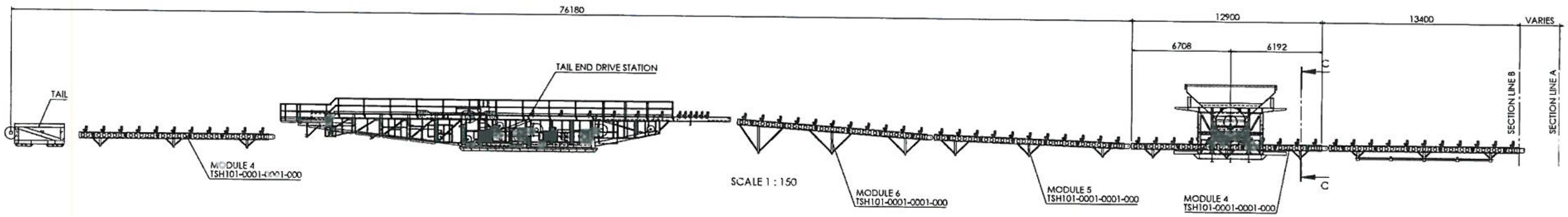

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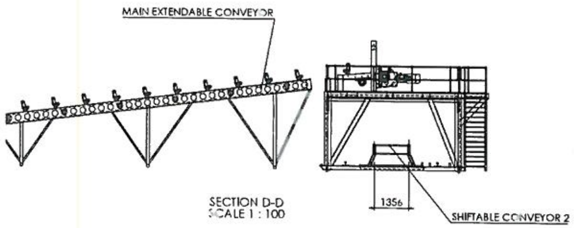
REHABILITATION OF WASTE DUMPS
SHIFTABLE CONVEYOR 1

DWG NO. TSH101-0002-0000-000-1 — A1

SCALE: 1:2000 — SHEET 1 OF 1



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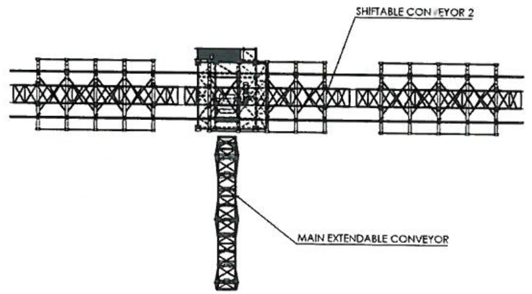

SECTION E-E
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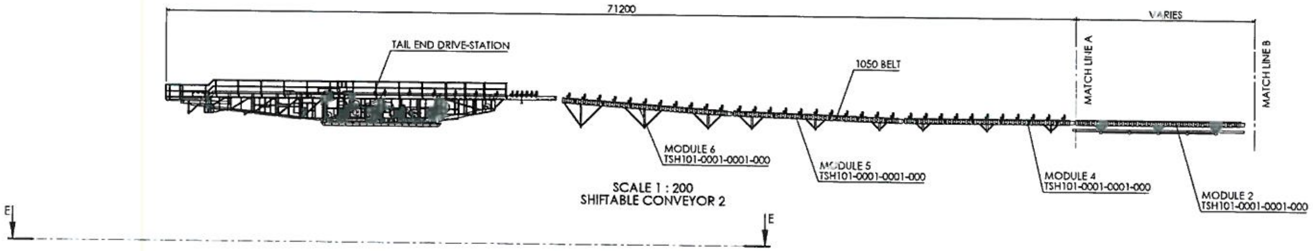

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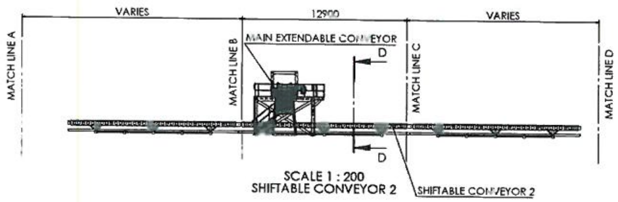

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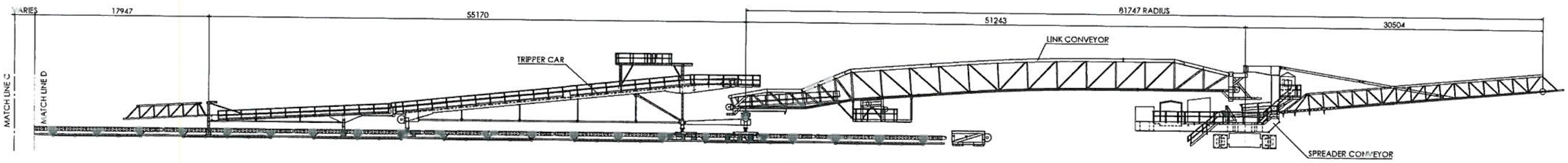

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SHIFTABLE CONVEYOR 2

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Tshipi Manganese Mining

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WEIGHT:

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TITLE: TSHIPI
REHABILITATION OF WASTE DUMPS
SHIFTABLE CONVEYOR 2

DWG NO. TSH101-0003-0000-000-1 | A1

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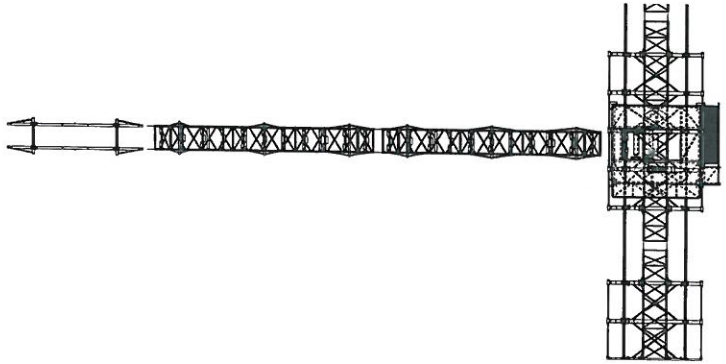

SECTION A-A
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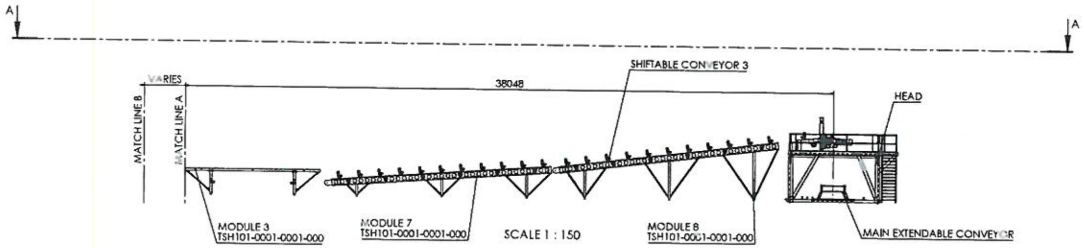

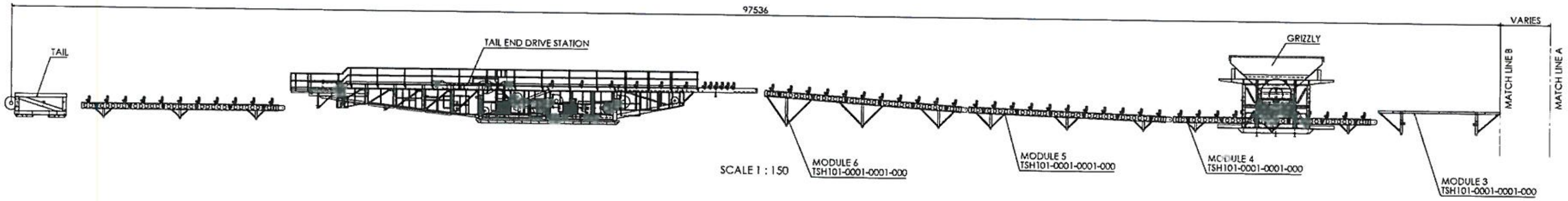

REFERENCE DRG	DESCRIPTION	REFERENCE DRG	DESCRIPTION

Tshipi é Ntle
Tshipi Manganese Mining

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MFG			
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1ST ANGLE PROJECTION

MATERIAL:

WEIGHT:

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TITLE: TSHIPI
REHABILITATION OF WASTE DUMPS
SHIFTABLE CONVEYOR 3

DWG NO. TSH101-0004-0000-000-1 A1

SCALE: 1:1000 SHEET 1 OF 1

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 any remaining WRD’s;
- Dust fallout monitoring (around any 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 contact cover, the overall density of tree/shrub (woody) species, indigenous species composition and the presence of alien invasive species.

3.1 BASAL COVER ANALYSIS

3.1.1 BASAL COVER PERCENTAGE ANALYSIS

The adequacy of vegetative ground contact cover in providing effective erosion control, habitat establishment and soil building for post closure land uses is related to the percentage basal cover of the site and species composition. Basal cover is a measurement of the contact cover of live rooted vegetation expressed as a percentage of the number of points assessed. A minimum of 200 points per transect is normally required for reliable results and one of the most effective methods of measurement is using the line-point method. This method also allows for measuring species composition and woody plant density at the same time.

Basal cover very seldom exceeds 25% and is correlated to rainfall and species composition. High rainfall can sustain a higher density of plants leading to higher basal cover. Plants with a creeping growth form dominating a site, also tends to lead to higher basal cover.

No biomass assessments will be done.

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 will be utilised for determining woody species density. A count of all rooted, live woody plant within one meter on either side of the line will be done.

No biomass assessments will be done.

3.1.3 SPECIES COMPOSITION ANALYSIS

The composition of species occurring will be measured by noting species names of the live rooted plant closest to each point in the basal cover assessment. Each species will be listed as to its desirability in the specific veld type. Alien invasive species will be listed where ever they occur on site, and not just in the assessment transects.

The percentage presence of each species will be depicted after each year's monitoring and trends tracked to see if the climax species starts to dominate in the area. A representative presence of climax species on the rehabilitated site, similar to that found in reference sites of the same veld type will indicate rehabilitation success.

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 in the same veld type) will be marked in areas near rehabilitated sites for determining the degree of achievement of rehabilitation success. This procedure, known as historic record sampling, provides an indication of the cover and diversity found in undisturbed areas.

Vegetative cover and diversity on reference plots will be compared with that on rehabilitated areas. These reference areas will be at least 2500 m^2 in size. Cover and diversity assessments will be done on reference sites at the same time of assessing the rehabilitated sites and will be compared to the results obtained from the rehabilitated sites.

3.2 VEGETATIVE COVER MONITORING SCHEDULE

Vegetative cover monitoring will begin one year after completion of revegetation activities and continue annually until rehabilitation success for vegetative cover is achieved. Assessments will be done by trained staff under the supervision of a qualified professional. 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 will be demonstrated when the following criteria are met:

- The percentage of basal cover on rehabilitated areas is greater than or equal to 8%.
- The density of tree/shrub species (expressed as woody plants per ha) on rehabilitated areas is greater than or equal to 80% of the density of tree/shrub species found on corresponding reference plots with a similar land use.
- Species composition is similar to the species composition of nearby reference plots.
- No Category 1 alien invasive plant species occur on site.

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 the table below. This may expand (or reduce) following further geochemical analysis and collection of data.

Recommended Groundwater Quality Analysis Parameters		
pH	Alkalinity as $CaCO_3$	Carbonate as CO_3
Electrical conductivity	Chloride as Cl	Bicarbonate as HCO_3
Fluoride as F	Sulphate as SO_4	Total dissolved solids
Ammonia as N*(NH_3)	Nitrite as NO_2	Sodium
Nitrate as NO_3	Potassium	Manganese
ICP – scan for trace metals	Calcium	

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

A preliminary post-closure monitoring and reporting programme has been developed as part of this preliminary closure plan. 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 post-closure monitoring and inspection activities (see tables overleaf), has been calculated to be:

- R 7,100,700 (excl. VAT) for the current pit void and mine layout.
- R 11,843,700 (excl. VAT) for the LOM pit void and mine layout.

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 (current layout) and 17.5 years (LOM layout). Provision for a small on-site maintenance team over a period of 5.5 years has also been allowed for (for both current and LOM layouts).

For the current pit void and mine layout, provision has been made for:

- Groundwater quality testing at 15 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 (3.5 years, 15 sampling points),
    - Quarterly during active maintenance and aftercare (3 years, 15 sampling points),
    - Bi-annually during passive maintenance and aftercare (2 years, 15 sampling points)

  The total cost of sampling is thus estimated to be R 3,000,000 (excl. VAT) over 8.5 years.

- 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 952,500 (excl. VAT) over 8.5 years.
- A manager (part-time), a field supervisor (full-time) and 5 labourer's (full time) for ongoing on-site maintenance and monitoring activities over a period of 5.5 years. The total cost over 5.5 years is estimated to be R 3,148,200 (excl. VAT).

For the LOM pit void and mine layout, provision has been made for:

- Groundwater quality testing at 15 water sampling points, to be monitored at the following frequency during the 17.5 years of rehabilitation, monitoring and maintenance activities:
  - Quarterly during decommissioning and rehabilitation (12.5 years, 15 sampling points),
  - Quarterly during active maintenance and aftercare (3 years, 15 sampling points),
  - Bi-annually during passive maintenance and aftercare (2 years, 15 sampling points)

  The total cost of sampling is thus estimated to be R 6,600,000 (excl. VAT) over 17.5 years.
- Bi-annual inspections and reporting by a professional engineer and/or environmental scientist. There will thus be 35 inspections over the 17.5 year period. The total provision is R 2,095,500 (excl. VAT) over 17.5 years.
- A manager (part-time), a field supervisor (full-time) and 5 labourer's (full time) for ongoing on-site maintenance and monitoring activities over a period of 5.5 years. The total cost over 5.5 years is estimated to be R 3,148,200 (excl. VAT).

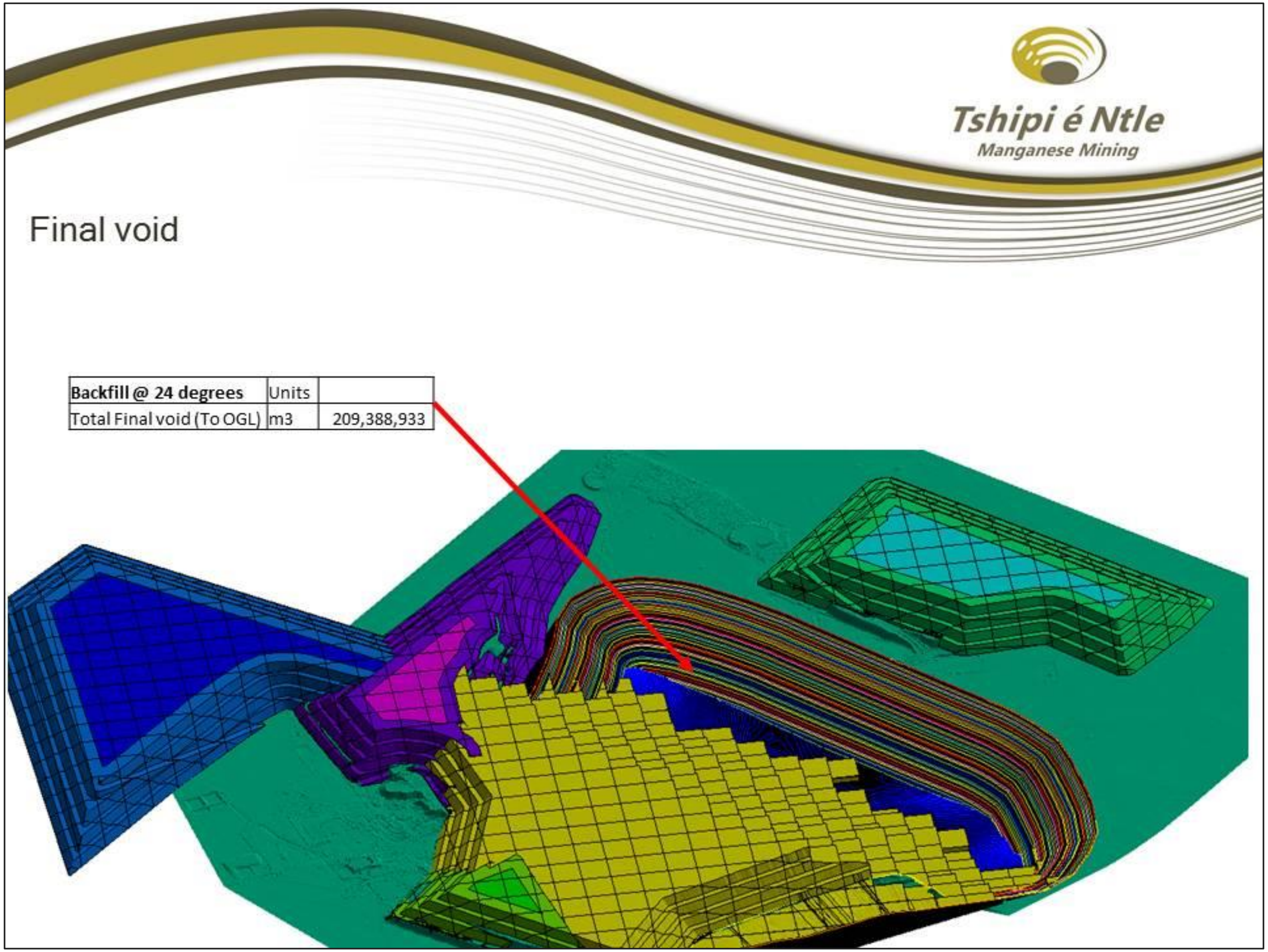
CURRENT POST CLOSURE SUPERVISION AND MONITORING COSTS

Item	Monitoring / Maintenance Activity	no. / year	Cost/activity	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	4	R 100 000	3.5	quarterly	Sum	14	R 1 400 000
1.1.2	Maintenance and Aftercare (Active)	4	R 100 000	3	quarterly	Sum	12	R 1 200 000
1.1.3	Maintenance and Aftercare (Passive)	2	R 100 000	2	bi-annual	Sum	4	R 400 000
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	2	R 63 500	3.5	bi-annual	Sum	7	R 444 500
2.1.2	Maintenance and Aftercare (Active)	2	R 63 500	3	bi-annual	Sum	6	R 381 000
2.1.3	Maintenance and Aftercare (Passive)	2	R 31 750	2	bi-annual	Sum	4	R 127 000
	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	5.5	R 3 148 200
		Days/month	**Rate / day**	**Total/month**	**Total/year**			
	- 1 Manager	*1*	*R 10 600*	*R 10 600*	R 127 200			
	- 1 Field Supervisor	*20*	*R 530*	*R 10 600*	R 127 200			
	- 5 Labourers	*100*	*R 265*	*R 26 500*	R 318 000			
					R 572 400			
							TOTAL	**R 7 100 700**

LOM POST CLOSURE SUPERVISION AND MONITORING COSTS

Item	Monitoring / Maintenance Activity	no. / year	Cost/activity	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	4	R 100 000	12.5	quarterly	Sum	50	R 5 000 000
1.1.2	Maintenance and Aftercare (Active)	4	R 100 000	3	quarterly	Sum	12	R 1 200 000
1.1.3	Maintenance and Aftercare (Passive)	2	R 100 000	2	bi-annual	Sum	4	R 400 000
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	2	R 63 500	12.5	bi-annual	Sum	25	R 1 587 500
2.1.2	Maintenance and Aftercare (Active)	2	R 63 500	3	bi-annual	Sum	6	R 381 000
2.1.3	Maintenance and Aftercare (Passive)	2	R 31 750	2	bi-annual	Sum	4	R 127 000
	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	5.5	R 3 148 200
		Days/month	**Rate / day**	**Total/month**	**Total/year**			
	- 1 Manager	*1*	*R 10 600*	*R 10 600*	R 127 200			
	- 1 Field Supervisor	*20*	*R 530*	*R 10 600*	R 127 200			
	- 5 Labourers	*100*	*R 265*	*R 26 500*	R 318 000			
					R 572 400			
							TOTAL	**R 11 843 700**

APPENDIX C: LOM MINE PLAN MODEL


Tshipi é Ntle
Manganese Mining
Final void
Backfill @ 24 degrees | Units |
Total Final void (To OGL) | m3 | 209,388,933

APPENDIX D: CLOSURE COST LIABILITY CALCULATIONS

CALCULATION OF THE QUANTUM

Mine: **Tshipi Borwa Mine**

Evaluators: **SLR Consulting (Pty) Ltd** Date: **Current Liability as at August 2018**

Risk Class: **Low (Class C)** Escalation (CPI): **115.9%**

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 14.73	1	1	R 2 651 694.60
2 (A)	Demolition of steel buildings & structures	m^2	Contractor's Workshops, Warehouse, Powerhouse, Storage Tanks	10 290	R 205.12	1	1	R 2 110 684.80
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 302.28	1	1	R 4 662 366.72
3	Rehabilitation of access roads	m^2	Roads to be rehabilitated	86 700	R 36.71	1	1	R 3 182 757.00
		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 356.26	1	1	R 2 066 308.00
4 (B)	Demolition & rehabilitation of non electrified railway lines	m	N/A	0	R 194.33	1	1	R 0.00
5	Demolition of housing &/or administration facilities	m^2	Offices, Change Rooms, Laboratory, Substations	6 265	R 410.24	1	1	R 2 570 153.60
6	Opencast rehabilitation including final voids & ramps	ha	Pit	104.16	R 208 792.44	0.52	1	R 11 308 866.69
7	Sealing of shafts, adits & inclines	m^3	N/A	0	R 110.12	1	1	R 0.00
8 (A)	Rehabilitation of overburden & spoils	ha	Western Dump	63.86	R 143 369.37	1	1	R 9 155 567.97
		ha	Eastern Dump	49.17	R 143 369.37	1	1	R 7 049 471.92
		ha	Northern Dump	43.97	R 143 369.37	1	1	R 6 303 951.20
8 (B)	Rehabilitation of processing waste deposits & evaporation ponds (basic, salt producing waste)	ha	Process and Stormwater Dams	1.63	R 178 563.96	1	1	R 291 059.25 R 0.00
8 (C)	Rehabilitation of processing waste deposits & evaporation ponds (acidic, metal-rich waste)	ha	N/A	0	R 518 634.37	0.66	1	R 0.00
9	Rehabilitation of subsided areas	ha	N/A	0	R 120 050.25	1	1	R 0.00
10	General surface rehabilitation	ha	Truck Stop at Entrance Gate	6.25	R 113 572.72	1	1	R 709 829.50
		ha	Tailings Dam and Magazine Area	9.66	R 113 572.72	1	1	R 1 097 112.48
		ha	Old Crushing Areas	12.43	R 113 572.72	1	1	R 1 411 708.91
		ha	Lightly trafficed access roads to be rehabilitated	28.07	R 113 572.72	1	1	R 3 187 986.25
		ha	Hardstand area	1.40	R 113 572.72	1	1	R 159 001.81
		ha	Railway Line	2.90	R 113 572.72	1	1	R 329 360.89
		ha	Plant, Offices, Workshop and Stockpile Areas	75.70	R 113 572.72	1	1	R 8 597 454.90
11	River diversions (to be decommissioned)	ha	N/A	0	R 113 572.72	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 129.55	1	1	R 535 689.25
13	Water management	ha	In-pit evaporation dam (5% of pit area	5.21	R 43 183.54	0.25	1	R 56 224.97
14	2 to 3 years of maintenance & aftercare	ha	All Areas	422.97	R 15 114.24	1	1	R 6 392 870.09
15 (A)	Specialist study (Screening level risk assessment)	ha	All Areas	1.00	R 205 000.00	1	1	R 205 000.00
							Subtotal 1 (Sum of items 1 to 15 Above)	R 74 035 120.80
16	Multiply Subtotal 1 by Weighting Factor 2 (step 4.4)			5.0% of Subtotal 1				R 3 701 756.04
							Subtotal 2 (Subtotal 1 plus Weighting Factor 2 value)	R 77 736 876.84
17	Contingency			10.0% of Subtotal 2				R 7 773 687.68
18	Procurement, tender process			6.0% of Subtotal 2				R 4 664 212.61
19	P&G's, site establishment and demobilisation			20.0% of Subtotal 2				R 15 547 375.37
20	Site supervision			7.5% of Subtotal 2				R 5 830 265.76
21	Post closure monitoring (See Appendix B)			Sum				R 7 100 700.00
							Subtotal 4 (Subtotal 3 plus Contingency value)	R 118 653 118.26
22	VAT			15.0% of Subtotal 4				R 17 797 967.74
							GRAND TOTAL FOR MINING OPERATIONS (Subtotal 4 plus VAT)	R 136 451 086.00

CALCULATION OF THE QUANTUM

Mine: **Tshipi Borwa Mine**

Evaluators: **SLR Consulting (Pty) Ltd**

Date: **Future Liability, 5 years from now at Aug 2023 (using Aug 2018 rates)**

Risk Class: **Low (Class C)**

Escalation (CPI): **115.9%**

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	182 420	R 14.73	1	1	R 2 687 046.60
2 (A)	Demolition of steel buildings & structures	m^2	Contractor's Workshops, Warehouse, Powerhouse, Storage Tanks	10 290	R 205.12	1	1	R 2 110 684.80
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	15 904	R 302.28	1	1	R 4 807 461.12
3	Rehabilitation of access roads	m^2	Roads to be rehabilitated	86 700	R 36.71	1	1	R 3 182 757.00
		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 356.26	1	1	R 2 066 308.00
4 (B)	Demolition & rehabilitation of non electrified railway lines	m	N/A	0	R 194.33	1	1	R 0.00
5	Demolition of housing &/or administration facilities	m^2	Offices, Change Rooms, Laboratory, Substations	6 265	R 410.24	1	1	R 2 570 153.60
6	Opencast rehabilitation including final voids & ramps	ha	Pit	160.00	R 208 792.44	0.52	1	R 17 371 531.01
7	Sealing of shafts, adits & inclines	m^3	N/A	0	R 110.12	1	1	R 0.00
8 (A)	Rehabilitation of overburden & spoils	ha	Western Dump	150.00	R 143 369.37	1	1	R 21 505 405.50
		ha	Eastern Dump	54.00	R 143 369.37	1	1	R 7 741 945.98
		ha	Northern Dump	94.75	R 143 369.37	1	1	R 13 584 247.81
8 (B)	Rehabilitation of processing waste deposits & evaporation ponds (basic, salt producing waste)	ha	Process and Stormwater Dams	1.63	R 178 563.96	1	1	R 291 059.25
								R 0.00
8 (C)	Rehabilitation of processing waste deposits & evaporation ponds (acidic, metal-rich waste)	ha	N/A	0	R 518 634.37	0.66	1	R 0.00
9	Rehabilitation of subsided areas	ha	N/A	0	R 120 050.25	1	1	R 0.00
10	General surface rehabilitation	ha	Truck Stop at Entrance Gate	6.25	R 113 572.72	1	1	R 709 829.50
		ha	Tailings Dam and Magazine Area	9.66	R 113 572.72	1	1	R 1 097 112.48
		ha	Old Crushing Areas	12.43	R 113 572.72	1	1	R 1 411 708.91
		ha	Lightly trafficed access roads to be rehabilitated	28.07	R 113 572.72	1	1	R 3 187 986.25
		ha	Hardstand area	1.40	R 113 572.72	1	1	R 159 001.81
		ha	Railway Line	2.90	R 113 572.72	1	1	R 329 360.89
		ha	Plant, Offices, Workshop, Powerline and Stockpile Areas	81.20	R 113 572.72	1	1	R 9 222 104.86
11	River diversions (to be decommissioned)	ha	N/A	0	R 113 572.72	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 129.55	1	1	R 535 689.25
13	Water management	ha	In-pit evaporation dam (5% of pit area	8.00	R 43 183.54	0.25	1	R 86 367.08
14	2 to 3 years of maintenance & aftercare	ha	All Areas	626.06	R 15 114.24	1	1	R 9 462 421.09
15 (A)	Specialist study (Screening level risk assessment)	ha	All Areas	1.00	R 205 000.00	1	1	R 205 000.00
							Subtotal 1 (Sum of items 1 to 15 Above)	R 104 325 182.79
16	Multiply Subtotal 1 by Weighting Factor 2 (step 4.4)			5.0% of Subtotal 1				R 5 216 259.14
							Subtotal 2 (Subtotal 1 plus Weighting Factor 2 value)	R 109 541 441.93
17	Contingency			10.0% of Subtotal 2				R 10 954 144.19
18	Procurement, tender process			6.0% of Subtotal 2				R 6 572 486.52
19	P&G's, site establishment and demobilisation			20.0% of Subtotal 2				R 21 908 288.39
20	Site supervision			7.5% of Subtotal 2				R 8 215 608.14
21	Post closure monitoring (See Appendix B)			Sum				R 8 049 300.00
							Subtotal 4 (Subtotal 3 plus Contingency value)	R 165 241 269.17
22	VAT			15.0% of Subtotal 4				R 24 786 190.38
							GRAND TOTAL FOR MINING OPERATIONS (Subtotal 4 plus VAT)	R 190 027 459.55

CALCULATION OF THE QUANTUM

Mine: **Tshipi Borwa Mine**

Evaluators: **SLR Consulting (Pty) Ltd**

Date: **Future Liability, 10 years from now at Aug 2028 (using Aug 2018 rates)**

Risk Class: **Low (Class C)**

Escalation (CPI): **115.9%**

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	182 420	R 14.73	1	1	R 2 687 046.60
2 (A)	Demolition of steel buildings & structures	m^2	Contractor's Workshops, Warehouse, Powerhouse, Storage Tanks	10 290	R 205.12	1	1	R 2 110 684.80
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	15 904	R 302.28	1	1	R 4 807 461.12
3	Rehabilitation of access roads	m^2	Roads to be rehabilitated	86 700	R 36.71	1	1	R 3 182 757.00
		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 356.26	1	1	R 2 066 308.00
4 (B)	Demolition & rehabilitation of non electrified railway lines	m	N/A	0	R 194.33	1	1	R 0.00
5	Demolition of housing &/or administration facilities	m^2	Offices, Change Rooms, Laboratory, Substations	6 265	R 410.24	1	1	R 2 570 153.60
6	Opencast rehabilitation including final voids & ramps	ha	Pit	200.00	R 208 792.44	0.52	1	R 21 714 413.76
7	Sealing of shafts, adits & inclines	m^3	N/A	0	R 110.12	1	1	R 0.00
8 (A)	Rehabilitation of overburden & spoils	ha	Western Dump	150.00	R 143 369.37	1	1	R 21 505 405.50
		ha	Eastern Dump	54.00	R 143 369.37	1	1	R 7 741 945.98
		ha	Northern Dump	94.75	R 143 369.37	1	1	R 13 584 247.81
8 (B)	Rehabilitation of processing waste deposits & evaporation ponds (basic, salt producing waste)	ha	Process and Stormwater Dams	1.63	R 178 563.96	1	1	R 291 059.25
								R 0.00
8 (C)	Rehabilitation of processing waste deposits & evaporation ponds (acidic, metal-rich waste)	ha	N/A	0	R 518 634.37	0.66	1	R 0.00
9	Rehabilitation of subsided areas	ha	N/A	0	R 120 050.25	1	1	R 0.00
10	General surface rehabilitation	ha	Truck Stop at Entrance Gate	6.25	R 113 572.72	1	1	R 709 829.50
		ha	Tailings Dam and Magazine Area	9.66	R 113 572.72	1	1	R 1 097 112.48
		ha	Old Crushing Areas	12.43	R 113 572.72	1	1	R 1 411 708.91
		ha	Lightly trafficed access roads to be rehabilitated	28.07	R 113 572.72	1	1	R 3 187 986.25
		ha	Hardstand area	1.40	R 113 572.72	1	1	R 159 001.81
		ha	Railway Line	2.90	R 113 572.72	1	1	R 329 360.89
		ha	Plant, Offices, Workshop, Powerline and Stockpile Areas	81.20	R 113 572.72	1	1	R 9 222 104.86
11	River diversions (to be decommissioned)	ha	N/A	0	R 113 572.72	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 129.55	1	1	R 535 689.25
13	Water management	ha	In-pit evaporation dam (5% of pit area	10.00	R 43 183.54	0.25	1	R 107 958.85
14	2 to 3 years of maintenance & aftercare	ha	All Areas	666.06	R 15 114.24	1	1	R 10 066 990.69
15 (A)	Specialist study (Screening level risk assessment)	ha	All Areas	1.00	R 205 000.00	1	1	R 205 000.00
							Subtotal 1 (Sum of items 1 to 15 Above)	R 109 294 226.91
16	Multiply Subtotal 1 by Weighting Factor 2 (step 4.4)			5.0% of Subtotal 1				R 5 464 711.35
							Subtotal 2 (Subtotal 1 plus Weighting Factor 2 value)	R 114 758 938.26
17	Contingency			10.0% of Subtotal 2				R 11 475 893.83
18	Procurement, tender process			6.0% of Subtotal 2				R 6 885 536.30
19	P&G's, site establishment and demobilisation			20.0% of Subtotal 2				R 22 951 787.65
20	Site supervision			7.5% of Subtotal 2				R 8 606 920.37
21	Post closure monitoring (See Appendix B)			Sum				R 8 997 900.00
							Subtotal 4 (Subtotal 3 plus Contingency value)	R 173 676 976.41
22	VAT			15.0% of Subtotal 4				R 26 051 546.46
							GRAND TOTAL FOR MINING OPERATIONS (Subtotal 4 plus VAT)	R 199 728 522.87

CALCULATION OF THE QUANTUM

Mine: **Tshipi Borwa Mine**

Evaluators: **SLR Consulting (Pty) Ltd** Date: **LOM Liability (using Aug 2018 rates)**

Risk Class: **Low (Class C)** Escalation (CPI): **115.9%**

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	182 420	R 14.73	1	1	R 2 687 046.60
2 (A)	Demolition of steel buildings & structures	m^2	Contractor's Workshops, Warehouse, Powerhouse, Storage Tanks	10 290	R 205.12	1	1	R 2 110 684.80
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	15 904	R 302.28	1	1	R 4 807 461.12
3	Rehabilitation of access roads	m^2	Roads to be rehabilitated	86 700	R 36.71	1	1	R 3 182 757.00
		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 356.26	1	1	R 2 066 308.00
4 (B)	Demolition & rehabilitation of non electrified railway lines	m	N/A	0	R 194.33	1	1	R 0.00
5	Demolition of housing &/or administration facilities	m^2	Offices, Change Rooms, Laboratory, Substations	6 265	R 410.24	1	1	R 2 570 153.60
6	Opencast rehabilitation including final voids & ramps	ha	Pit	238.10	R 208 792.44	0.52	1	R 25 851 009.58
7	Sealing of shafts, adits & inclines	m^3	N/A	0	R 110.12	1	1	R 0.00
8 (A)	Rehabilitation of overburden & spoils	ha	Western Dump	215.76	R 143 369.37	1	1	R 30 933 375.27
		ha	Eastern Dump	54.00	R 143 369.37	1	1	R 7 741 945.98
		ha	Northern Dump	94.75	R 143 369.37	1	1	R 13 584 247.81
8 (B)	Rehabilitation of processing waste deposits & evaporation ponds (basic, salt producing waste)	ha	Process and Stormwater Dams	1.63	R 178 563.96	1	1	R 291 059.25 R 0.00
8 (C)	Rehabilitation of processing waste deposits & evaporation ponds (acidic, metal-rich waste)	ha	N/A	0	R 518 634.37	0.66	1	R 0.00
9	Rehabilitation of subsided areas	ha	N/A	0	R 120 050.25	1	1	R 0.00
10	General surface rehabilitation	ha	Truck Stop at Entrance Gate	6.25	R 113 572.72	1	1	R 709 829.50
		ha	Tailings Dam and Magazine Area	9.66	R 113 572.72	1	1	R 1 097 112.48
		ha	Old Crushing Areas	12.43	R 113 572.72	1	1	R 1 411 708.91
		ha	Lightly trafficed access roads to be rehabilitated	28.07	R 113 572.72	1	1	R 3 187 986.25
		ha	Hardstand area	1.40	R 113 572.72	1	1	R 159 001.81
		ha	Railway Line	2.90	R 113 572.72	1	1	R 329 360.89
		ha	Plant, Offices, Workshop, Powerline and Stockpile Areas	81.20	R 113 572.72	1	1	R 9 222 104.86
11	River diversions (to be decommissioned)	ha	N/A	0	R 113 572.72	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 129.55	1	1	R 535 689.25
13	Water management	ha	In-pit evaporation dam (5% of pit area	11.91	R 43 183.54	0.25	1	R 128 525.01
14	2 to 3 years of maintenance & aftercare	ha	All Areas	769.92	R 15 114.24	1	1	R 11 636 755.66
15 (A)	Specialist study (Screening level risk assessment)	ha	All Areas	1.00	R 205 000.00	1	1	R 205 000.00
							Subtotal 1 (Sum of items 1 to 15 Above)	R 124 449 123.63
16	Multiply Subtotal 1 by Weighting Factor 2 (step 4.4)			5.0% of Subtotal 1				R 6 222 456.18
							Subtotal 2 (Subtotal 1 plus Weighting Factor 2 value)	R 130 671 579.81
17	Contingency			10.0% of Subtotal 2				R 13 067 157.98
18	Procurement, tender process			6.0% of Subtotal 2				R 7 840 294.79
19	P&G's, site establishment and demobilisation			20.0% of Subtotal 2				R 26 134 315.96
20	Site supervision			7.5% of Subtotal 2				R 9 800 368.49
21	Post closure monitoring (See Appendix B)			Sum				R 11 843 700.00
							Subtotal 4 (Subtotal 3 plus Contingency value)	R 199 357 417.03
22	VAT			15.0% of Subtotal 4				R 29 903 612.55
							GRAND TOTAL FOR MINING OPERATIONS (Subtotal 4 plus VAT)	R 229 261 029.58

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