IMERYS REFRACTORY MINERALS SOUTH AFRICA (PTY) LTD – ANNESLEY MINE (HAVERCROFT OPERATION)

Annual Rehabilitation Plan

Based on Appendix 3 (Minimum Content of An Annual Rehabilitation Plan) of the Regulations Pertaining to the Financial Provision for Prospecting, Exploration, Mining or Production Operations, 2015 9(GN 1147) (as amended) i.t.o. the National Environmental Management Act No 107 of 1998 (as amended).

DMR File No: 73 MRC

Location: Streatham 100 KT and Havercroft 99 KT, Greater Tubatse Local Municipality, Limpopo Province

June 2018

PO Box 72960, Lynnwood Ridge, 0040;
Cell: 072 191 6074, Fax: 012 361 0645
E-mail: salome@becsenv.co.za

MINIMUM CONTENT OF AN ANNUAL REHABILITATION PLAN

The annual rehabilitation plan will form a component of the environmental management programme to be submitted in terms of section 24N of the Act and the Environmental Impact Assessment Regulations, 2014 and will be subject to the same requirements of the environmental management programme with regards opportunities for stakeholder review and comment as well as auditing.

Objective of the annual rehabilitation plan

The objective of the annual rehabilitation plan is to:

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

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ABBREVIATIONS

DWS	Department of Water and Sanitation
EAP	Environmental assessment practitioner
EMP	Environmental Management Programme
GN 1147	Regulations Pertaining to the Financial Provision for Prospecting, Exploration, Mining or Production, GN 1147 of 2015 i.t.o. the National Environmental Management Act No 107 of 1998 (as amended)
MAR	Mean annual runoff
MHSA	Mine Health and Safety Act, 1996 (Act No. 29 of 1996)
MPRDA	Minerals and Petroleum Resources Development Act (Act 28 of 2002 as amended)
MPRDR	Minerals and Petroleum Resources Development Regulations, GN 527 of 2004 (as amended) i.t.o. the Minerals and Petroleum Resources Development Act No 28 of 2002
MWP	Mine works programme
NEMA	National Environmental Management Act No 107 of 1998 (as amended)
WULA	Water use licence application

EXECUTIVE SUMMARY

Imerys Refractory Minerals South Africa (Pty) Ltd (Imerys) – Annesley Mine, is an existing andalusite mine of which Havercroft Operation falls part of the mine, in the Limpopo Province. The purpose of this document is to provide sufficient information for the annual rehabilitation of the mine.

Information regarding the background to the mine was taken from various documents including the approved Environmental Management Programme (EMP) (Shangoni Management Services, 2006), and the Havercroft Mandatory Code of Practice (Havercroft Operation, 2004). A site visit was held on 28 February 2018 to gather any additional information.

Requirements of the annual rehabilitation plan

The annual rehabilitation plan will be relevant for a period of 1 year, after which the plan will be updated by the holder of a right to reflect progress relating to rehabilitation and remediation activities in the preceding 12 months and to establish a plan, schedule and budget for the forthcoming 12 months. The annual rehabilitation plan must contain information that defines concurrent rehabilitation and remediation activities for the forthcoming 12 months and how these relate to the operations' closure vision, as detailed in the final rehabilitation, decommissioning and mine closure plan, must indicate what closure objectives and criteria are being achieved through the implementation of the plan, must be measurable and auditable and must include the following contents as seen in Table 1.

Table 1: Contents of an annual rehabilitation plan in terms of Appendix 4 of the Regulations Pertaining to the Financial Provision for Prospecting, Exploration, Mining or Production, (GN 1147) of 2015 i.t.o. the National Environmental Management Act No 107 of 1998 (as amended) (NEMA)

Appendix nr	Description	Section in this report
3(a)(i)	details of the person or persons that prepared the plan	1.2
3(a)(ii)	details of the professional registrations and experience of the person or persons;	1.2
3(a)(iii)	details of the timeframes of implementation of the current, and review of the previous rehabilitation activities;	1.4
3(b)	the pertinent environmental and project context relating directly to the planned annual rehabilitation and remediation activity;	3
3(c)	results of monitoring of risks identified in the final rehabilitation, decommissioning and mine closure plan with a view to informing rehabilitation and remediation activities;	4.2
3(d)	an identification of shortcomings experienced in the preceding 12 months;	4.3
3(e)	details of the planned annual rehabilitation and remediation activities or measures for the forthcoming 12 months, including those which will address the shortcomings contemplated in (d) above or which were identified from monitoring in the preceding 12 months, and including	4.4

Appendix nr	Description	Section in this report
3(e)(i)	if no areas are available for annual rehabilitation and remediation concurrent with mining, an indication to that effect and motivation why no annual rehabilitation or remediation can be undertaken;	4.4.1
3(e)(ii)	where areas are available for annual rehabilitation and remediation concurrent with mining, annual rehabilitation and remediation activities related to previous disturbance or expected planned impacts and disturbance, as per the mine works programme (MWP), in the period under consideration, which should be tabulated and must indicate, but not necessarily be limited to	4.4.2
3(e)(ii)(aa)	nature or type of activity and associated infrastructure;	4.4.2
3(e)(ii)(bb)	planned remaining life of the activity under consideration;	4.4.2
3(e)(ii)(cc)	area already disturbed or planned to be disturbed in the period of review;	4.4.2
3(e)(ii)(dd)	percentage of the already disturbed or planned to be disturbed area available for concurrent rehabilitation and remediation activities;	4.4.2
3(e)(ii)(ee)	percentage of the already disturbed or planned to be disturbed area available as per (dd) and on which concurrent rehabilitation and remediation can be undertaken;	4.4.2
3(e)(ii)(ff)	notes to indicate why total available or planned to be available area differs from area already disturbed or planned to be disturbed;	4.4.2
3(e)(ii)(gg)	notes to indicate why concurrent rehabilitation will not be undertaken on the full available or planned to be available area;	4.4.2
3(e)(ii)(hh)	details of rehabilitation activity planned on this area for the period of review;	4.4.2
3(e)(ii)(ii)	the pertinent closure objectives and performance targets that will be addressed in the forthcoming year, which objectives and targets are aligned to the final rehabilitation, decommissioning and mine closure plan;	4.4.2
3(e)(ii)(jj)	description of the relevant closure design criteria adopted in the annual rehabilitation and remediation activities and the expected final land use once all rehabilitation and remediation activities are complete for the activity or aspect; and	4.4.2
3e(iii)	a site plan indicating at least the total area disturbed, area available for rehabilitation and remediation and the area to be rehabilitated or remediated per aspect or activity;	4.4.3
3(f)	a review of the previous year's annual rehabilitation and remediation activities, indicating a comparison between activities planned in the previous year's annual rehabilitation and remediation plan and actual rehabilitation and remediation implemented, which should be tabulated and as a minimum contain:	4.5
3(f)(aa)	area planned to be rehabilitated and remediated during the plan under review;	4.5
3(f)(bb)	actual area rehabilitation or remediated; and	4.5
3(f)(cc)	if the variance between planned and actual exceeds 15%, motivation indicating reasons for the inability to rehabilitate or remediate the full area; and	4.5
3(g)	costing, including	6
3(g)(i)	an explanation of the closure cost and methodology,	6.1
3(g)(ii)	auditable calculations of costs per activity or infrastructure,	6.2
3(g)(iii)	cost assumptions; and	6.4

Appendix nr	Description	Section in this report
3(g)(iv)	monitoring and maintenance costs likely to be incurred both during the period of the annual rehabilitation plan and those that will extend past the period of the final rehabilitation, decommissioning and mine closure plan, on condition that the monitoring and maintenance costs included in previous annual rehabilitation plans must be accumulated into subsequent versions of the annual rehabilitation plan until such time as the monitoring and maintenance obligation is discharged	6.3

Attached as **Addendum 1** is the Environmental Risk Assessment Report in line with the requirements of the Minerals and Petroleum Resources Development Act (Act 28 of 2002 as amended) (MPRDA) as stipulated in regulation 60 of the Minerals and Petroleum Resources Development Regulations, GN 527 of 2004 (as amended) i.t.o. the Minerals and Petroleum Resources Development Act No 28 of 2002 (MPRDR); regulations 6(c), 11(1)(c) & 12(3) & Appendix 5 of the Regulations Pertaining to the Financial Provision for Prospecting, Exploration, Mining or Production, GN 1147 of 2015 i.t.o. NEMA.

Attached as **Addendum 2** to this report is the EMP Performance Assessment, 2017, as stipulated in regulation 55(9) of the MPRDR. See Section 6 for the Annual Updated Financial Provision report is as stipulated in regulation 6 of the Regulations Pertaining to the Financial Provision for Prospecting, Exploration, Mining or Production, GN 1147 of 2015 i.t.o. NEMA.

Attached as **Addendum 3** as a Report on the Reshaping, Re-Vegetation, and Alien Control Plan of all the areas to be rehabilitated as indicated in Section 4.4.2 of this report. Attached as **Addendum4** is the Earthworks Plan. Attached as Attached as **Addendum 5** is the Public Participation Proof, comments and response that took place in 2016.

No transfer of environmental liabilities and responsibilities will take place, Imerys will rehabilitate the mine.

SECTION 1: INTRODUCTION

1.1 Details of applicant

Refer to Table 2 below for a description of the applicant.

Table 2: Description of the applicant

Project applicant	Imerys Refractory Minerals South Africa (Pty) Ltd – Annesley Mine (Havercroft Operation)
Contact person	Hendrik Jones
Designation	Operational Director
Telephone number	+27 12 643 5940

E-mail address	Hendrik.Jones@imerys.com

1.2 Details of Environmental assessment practitioner

This section includes:

- details of the person or persons that prepared the plan and
- details of the professional registrations and experience of the person or persons

Refer to Table 3 below for a description of the environmental assessment practitioner (EAP).

Table 3: Description of the environmental assessment practitioner

Name of company	BECS Environmental
Postal address	PO Box 72960, Lynnwood Ridge, 0040
Telephone number	012 361 9970
Cell phone number	072 191 6074
Facsimile number	012 361 0645
E-mail address	salome@becsenv.co.za
Name of responsible EAP	Salome Beeslaar
Expertise of EAP	B.Sc Environmental Science (UP), B.Sc Honours Geography (UP), M.Sc Geography (UP), Professional Scientist (Environmental Science) , member of the International Associated of Impact Assessments South Africa.
Name of second responsible EAP	Deshree Pillay
Expertise of EAP	B. Sc Environmental Science (UP), B. Sc Honours Geography & Environmental Science (UP)

I, Salome Beeslaar (8310190032081), hereby declare that I have no conflict of interest related to the work of this report. Specially, I declare that I have no business, personal, or financial interests in the property and/or mining right being assessed in this report and that I have no personal or financial connections to the relevant property owners or mine. I declare that the opinions expressed in this report are my own and a true reflection of my professional expertise and that there are no circumstances that may compromise my objectivity in performing such work.

Salome Beeslaar

MSc – Geography, SACNASP (400385/14), IAIAsa (5853)

4 June 2018

1.3 Background on locality

Havercroft Operation is located on the farms Havercroft 99 KT and Streatham 100 KT in Greater Tubatse Local Municipality in the Limpopo Province. The Operation is currently not active. Refer to **Figure 1** for a locality map.

The Operation is situated within the B71F quaternary catchment. Surface water drained from the Operation runs into one of three sub-catchment areas (Shangoni Management Services, 2012). Havercroft is located at S24º 18' 59.7" and E30º 11' 11.6" (central coordinates). The Olifants River and Mogomotsi River run north of the non-operational mining activities.

1.4 Description of the property

Table 4: Farm names, 21-Digit Surveyor General codes, and coordinates

Farm Name	The farm Streatham 100 KT, and the farm Havercroft 99 KT	
Application area (Ha)	8,183.3068ha	
Magisterial district	Sekhukhune District Municipality and Greater Tubatse Local Municipality	
Distance and direction from nearest town	5km of the old Penge mining town, 5km from Ga Malepe, and approximately 31km north of Burgersfort town, on the R37 road towards Penge	
21-digit Surveyor General Code for each farm portion	Streatham 100 KT: T00KT00000000010000000 3893.7945ha	Havercroft 99 KT: T00KT00000000009900000 4289.5123ha
Coordinates	Streatham 100 KT: S24.3139, E30.1623 S24.3487, E30.2155 S24.3050, E30.2557 S24.2830, E30.2387	Havercroft 99 KT: S24.3487, E30.2155 S24.3782, E30.2633 S24.3674, E30.3047 S24.3050, E30.2557

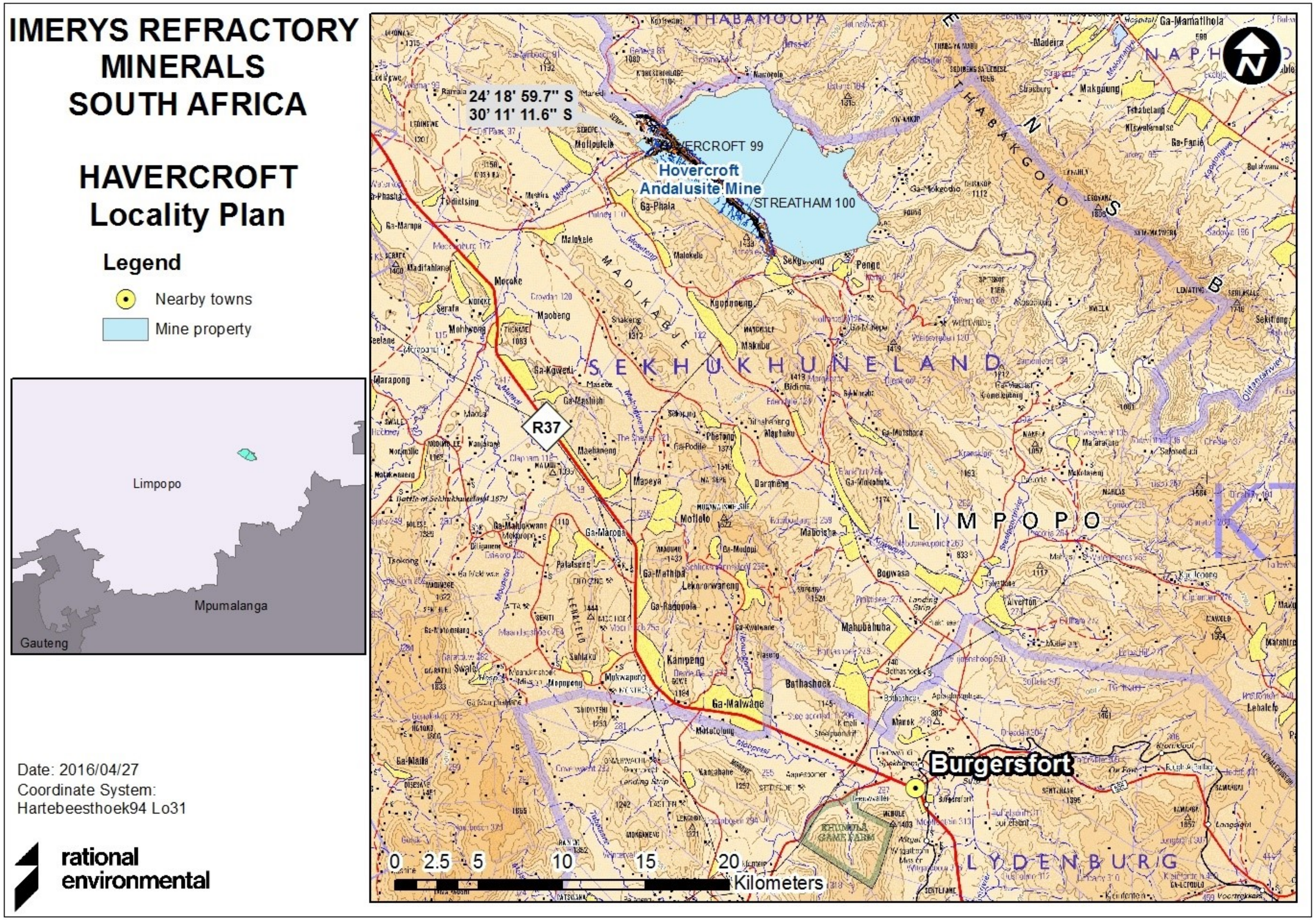

Figure 1: Locality Map of Havercroft Operation

SECTION 2: LEGISLATION AND GUIDELINES APPLICABLE

Table 5: Legislation and interpretation of these requirements for the closure design principles

Legislation	Requirements	Interpretation of these requirements for the closure design principles
Regulation 56 of MPRDR	In accordance with applicable legislative requirements for mine closure, the holder of a mining right must ensure that - a) the closure of a mining operation incorporates a process which must start at the commencement of the operation and continue throughout the life of the operation; b) risks pertaining to environmental impacts must be quantified and managed proactively, which includes the gathering of relevant information throughout the life of a mining operation; c) the safety and health requirements in terms of the Mine Health and Safety Act, 1996 (Act No. 29 of 1996) (MHSA) are complied with; d) residual and possible latent environmental impacts are identified and quantified; e) the land is rehabilitated, as far as is practicable, to its natural state, or to a predetermined and agreed standard or land use which conforms with the concept of sustainable development; and f) mining operations are closed efficiently and cost effectively.	The approved EMP (2006) includes reference to rehabilitation but not closure of the mine. The mine has limited information to assess risks. The existing information from the EMP and IWWMP (2012) is incorporated into this Closure Plan. Closure of the mine will incorporate any necessary safety and health requirements in terms of the MHSA. The residual and possible latent environmental impacts are identified and quantified in this Annual Rehabilitation Plan. The end land use is discussed in Section 4.1 of this Annual Rehabilitation Plan.
Regulation 61 of MPRDR	Closure objectives form part of the draft environmental management programme and must - a) identify the key objectives for mine closure to guide the project design, development and management of environmental impacts; b) provide broad future land use objective(s) for the site; and c) provide proposed closure costs.	Closure objectives and broad future land use objective(s) were not included in the approved EMP (2006). The closure costs are updated on an annual basis.

Legislation	Requirements	Interpretation of these requirements for the closure design principles
Regulations 6(a) of GN 1147	An applicant must determine the financial provision through a detailed itemisation of all activities and costs, calculated based on the actual costs of implementation of the measures required for annual rehabilitation, as reflected in an annual rehabilitation plan	The financial provision is included in Section 6 of this Annual Rehabilitation Plan.
Regulations 11(1)(a) of GN 1147	The holder of a right or permit must ensure that a review is undertaken of the requirements for annual rehabilitation, as reflected in an annual rehabilitation plan	A closure plan was submitted to DMR in 2016. DMR commented that Havercroft Operation forms part of Annesley Mine and therefore the applicant cannot submit a closure plan. This is, therefore, the first annual rehabilitation plan for Havercroft Operation.
Regulations 11(2) of GN 1147	The holder of a right or permit must, on completion of the actions contemplated in subregulation (1), ensure that the adequacy of the financial provision is assessed and any adjustments that need to be made to the financial provision are identified.	The adjustments to the financial provision are included in section 6 of this Annual Rehabilitation Plan. Note the transitional period for these Regulations.
Regulations 12(1) of GN 1147	The annual rehabilitation plan must contain all information set out in Appendix 3 to these Regulations	This Annual Rehabilitation Plan is based on the requirements of the MPRDA, as well as Appendix 3 of GN 1147.

SECTION 3: THE PERTINENT ENVIRONMENTAL AND PROJECT CONTEXT RELATING DIRECTLY TO THE PLANNED ANNUAL REHABILITATION AND REMEDIATION ACTIVITY

Havercroft Operation is currently non-operational.

3.1 Environmental context

3.1.1 Geology

Information for this section was extracted from the Havercroft Andalusite Mine EMP (Avmin Ltd, 1997):

3.1.1.1 Regional and local geology

Havercroft Operation is situated along the north-northeastern rim of the Transvaal basin in the Timeball Hill Formation, which is near the base of the Pretoria Group. This location lies within the metamorphic aureole of the Bushveld Complex, the base of which lies some 3km stratigraphically above the orebody. The Bushveld Complex provided the heat source for the formation of the andalusite crystals.

The orebody outcrops/sub-outcrops against the north-eastern slopes of the Radingwane Mountain which is capped by the Daspoort Quartzites. The very uneven terrain is covered by a layer of rubble measuring from 0.5m to 6m thick. This talus consists mostly of quartzite boulders, an occasional lava boulder (sometimes very large) and very little soil.

The orebody is between 40m and 50m thick, strikes NW-SE and dips on average 15° to the SW. it displays three distinct zones and has gradational hanging wall and footwall contacts.

3.1.1.2 Mineralogy of the ore zone

The orebody is a metamorphically altered alumina-rich shale horizon. It is essentially a quartz-biotite-andalusite hornfels with minor amounts of garnet and staurolite. The andalusite crystals vary in cross-section from 1mm to 15mm and in length from 50mm to 20mm. weathering decreasing with depth, resulted in the formation of a sericitic layer around the andalusite crystals.

3.1.1.3 Intrusions and faulting

Up to three distinct diabase sills, irregularly weathered and probably of Bushveld Complex origin, are intrusive along bedding planes in the vicinity of and in the orebody. They vary in thickness from 0.5m to 5m and appears to be upwardly transgressive through the orebody from the east to the west. The ore above and below these sills displays alteration through contact metamorphism.

Six often very irregular, sub-vertical dolerite dykes of Karoo age transect the orebody from SW to NE. They are usually deeply weathered and deep gullies mark their position on the surface. Their effect on the ore appears to be minimal.

Only minor faulting and other structural deformation have been observed. Any water compartments that may exist lie below the mining operations at depths in excess of 50m.

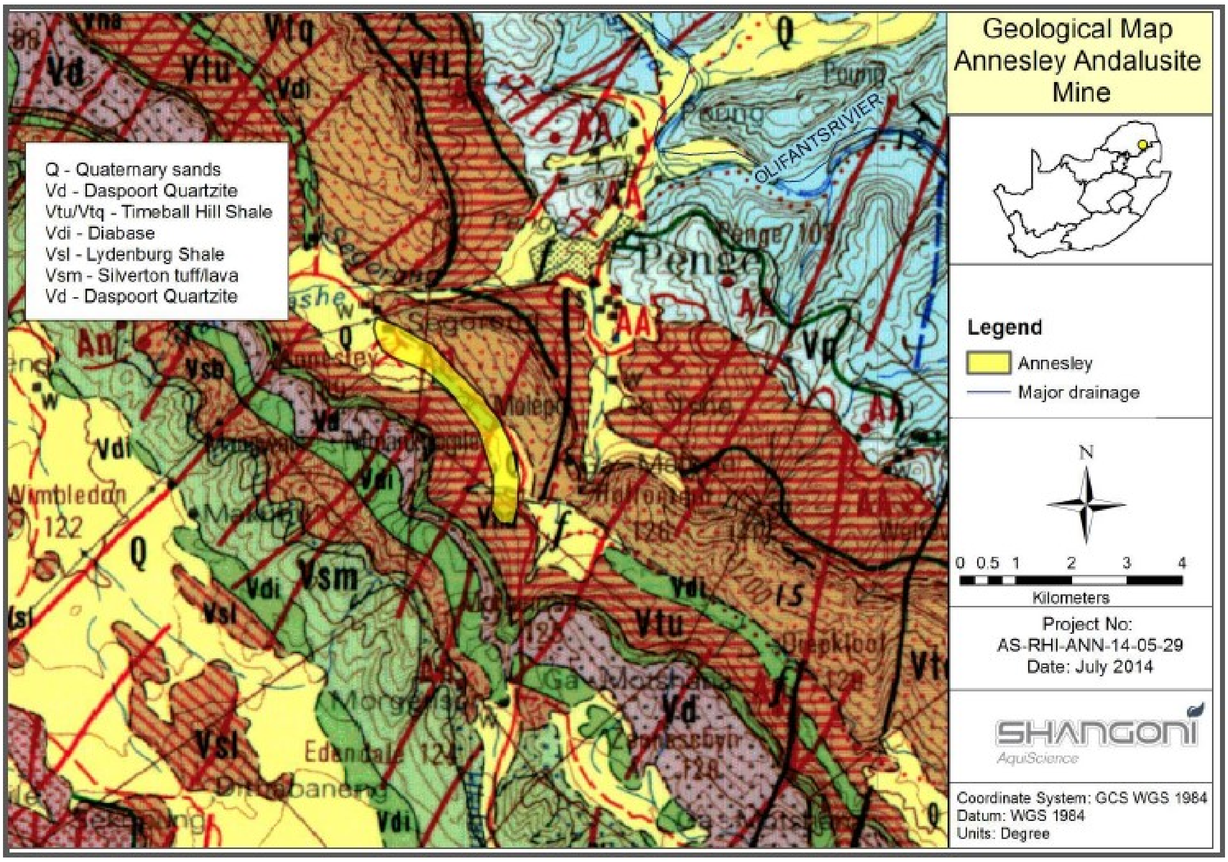

Figure 2: Pilgrims Rest Geological Map 2430 at a scale of 1:250 000 showing the general underlying geology of the study area Local Geology (Shangoni Management Services, 2017)

3.1.2 Climate

Information for this section was extracted from the IWWMP (Shangoni Management Services, 2012), and Atmospheric Impact Report for Dryer (Shangoni Management Services, 2014):

3.1.2.1 Regional climate

The climate is moderate to hot, with occasional, very hot conditions in the low-lying valleys. The average daily temperature variation is 15°C. The area is part of a major mountain range and the winds blow consistently from the northeast. The rainy season lasts from late October until April with a maximum in November, mainly in the form of thunderstorms from the south-west, but also light to moderate precipitation blown in from the east. The rainfall is fairly low and in 12% of all years, there are severe drought conditions. There is no frost.

3.1.2.2 Rainfall and evaporation

Rainfall represents an effective removal mechanism of atmospheric pollutants. The annual rainfall at Annesley Andalusite Mine, during 2012, was approximately 510.68mm. Rainfall occurs mainly in the summer from December to February, with the peak being in December.

Table 6: Rainfall statistics

Month	Average (mm)	Days with more than 1 mm rain
January	95	9,8
February	84	6,8
March	70	6,8
April	20	2,6
May	8	2,2
June	4	1,3
July	4	1,3
August	8	1,7
September	19	1,8
October	59	6,3
November	102	10,1
December	86	8,4
Annual	559	59

Table 7: Evaporation

Month	Evaporation (mm)
January	212
February	174
March	174
April	139
May	121
June	102
July	119
August	167
September	228
October	259
November	228
December	217
Average	2140

3.1.2.3 Temperature

The mean summer temperature for the year 2012 was 23.3°C, with temperatures rising to 37.4°C in February. The mean winter temperature was 14.5°C with a minimum temperature of 3.6°C in August 2012. Figure 7 illustrates how temperatures range on a daily basis throughout the year.

Table 8: Temperature for Annesley

Month	Temperature	
	Max	Min
January	30,1	17,3
February	29,7	17,4
March	28,2	16,2
April	27,4	12,1
May	24,5	8,1
June	21,7	3,9
July	21,6	4,0
August	24,0	6,9
September	27,5	11,3
October	30,4	14,6
November	30,2	16,4
December	30,1	17,4
Annual	27,1	12,2

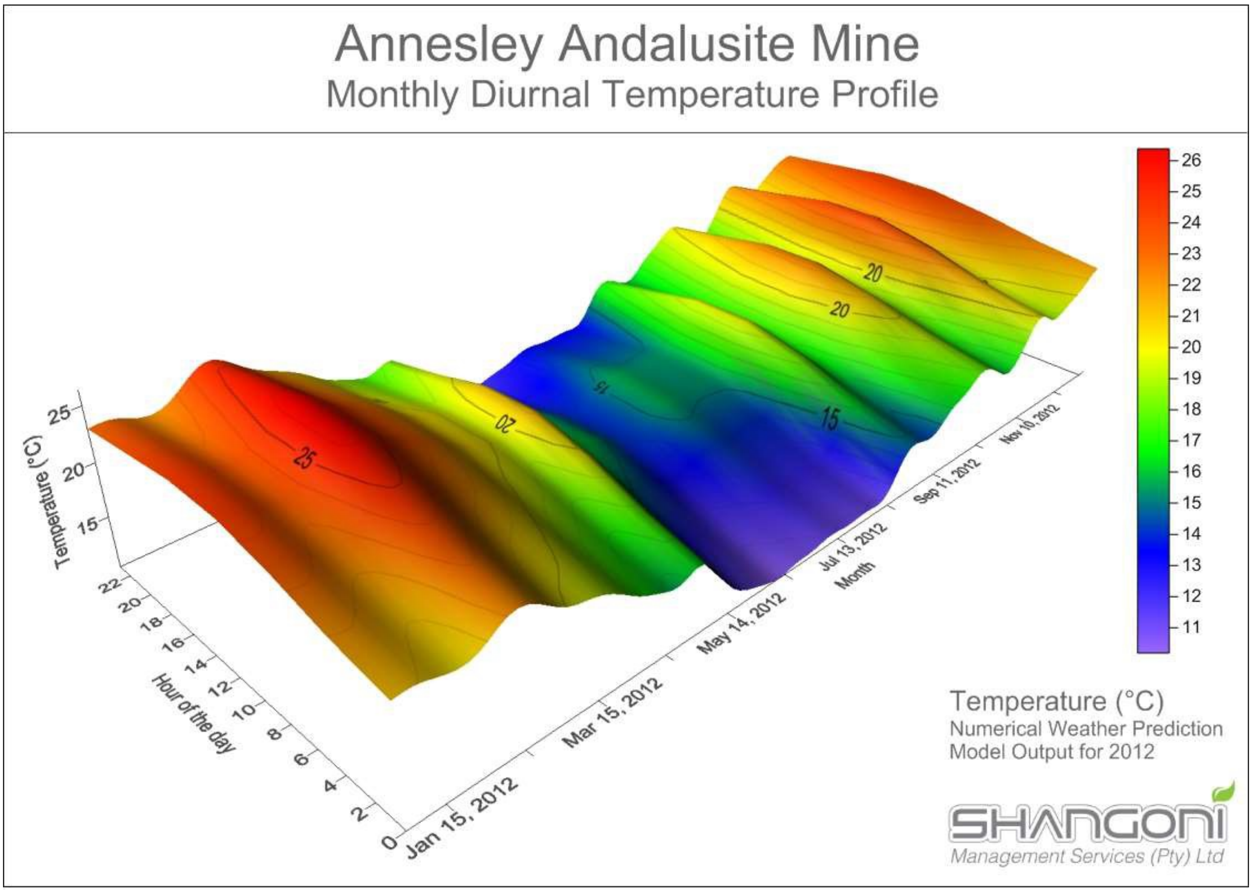

Figure 3: Monthly diurnal temperature profile (Shangoni Management Services, 2014)

3.1.2.4 Wind

The predominant wind field throughout the year (2012), except during winter, was from an east northeasterly direction experiencing mostly moderate wind speeds between 1.5m/s and 3.1m/s. During winter wind was experienced primarily from a west southwesterly direction with some winds also coming from an east northeasterly direction.

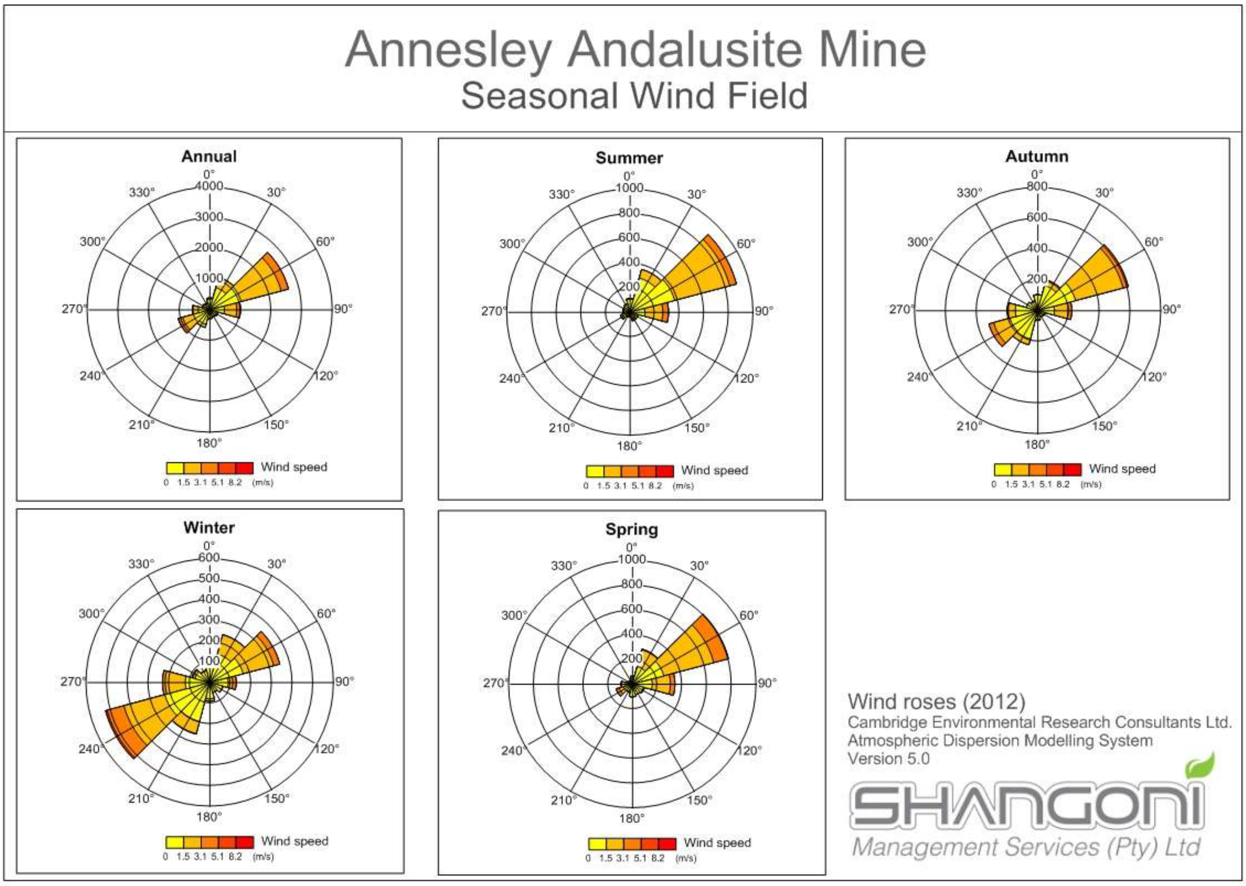

Figure 4: Seasonal wind roses (Shangoni Management Services, 2014)

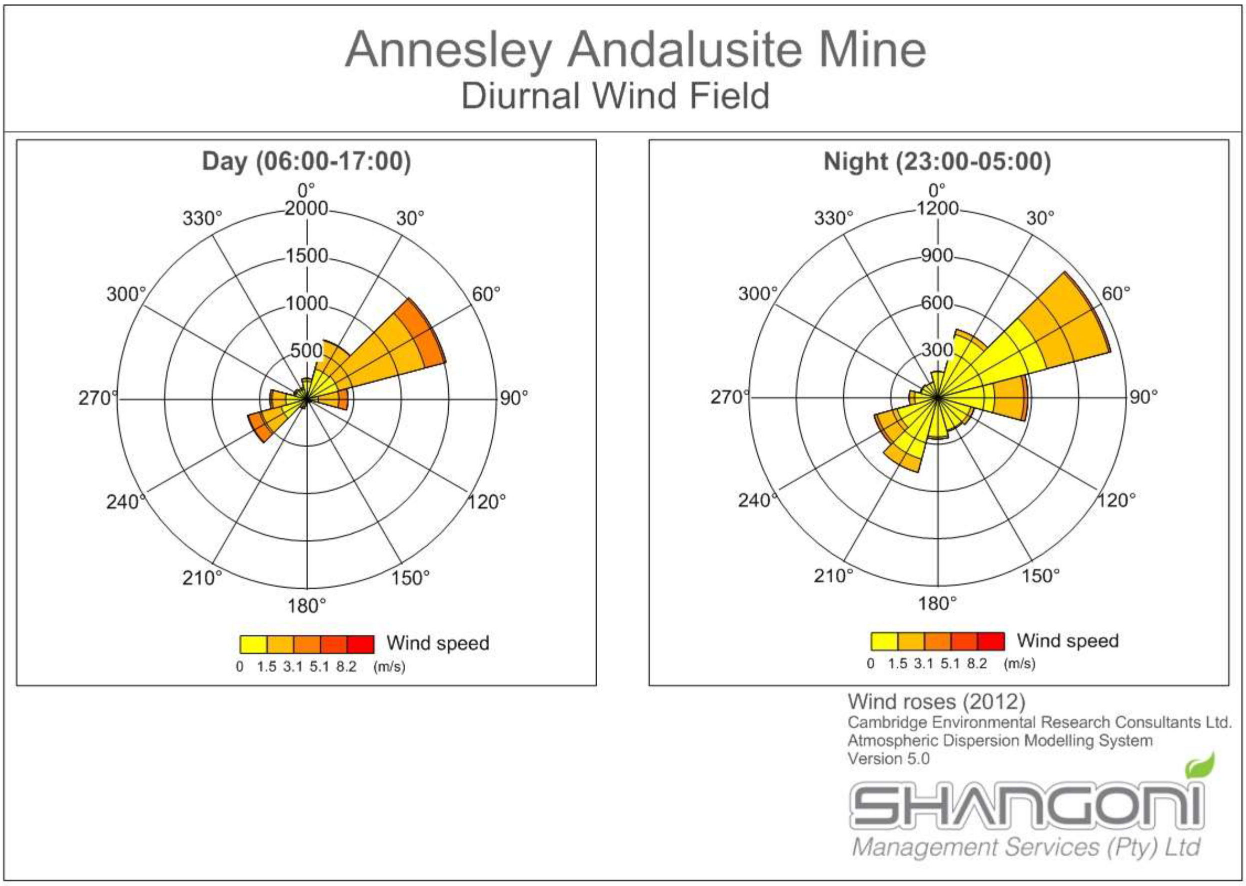

Figure 5: Diurnal wind roses (Shangoni Management Services, 2014)

3.1.2.5 Extreme events

The area experiences several extreme events on a regular basis, including frost, hail, drought, and high winds.

3.1.3 Topography

Information for this section was extracted from the Havercroft Andalusite Mine EMP (Avmin Ltd, 1997):

The mining area is 16km from the edge of the escarpment. The surrounding area is extremely rugged, with the high ridges above the mining area rising from the floor of the valley of the Olifants River at an elevation of 670m, to over 1,400m. The Radingwane Mountain is one of a series of parallel ranges which form the Drakensberg Range.

The mining area starts in the west in the flat valley of the Motse River and continues to the south-east, rising up and along the north slope of the ridge of the Radingwane Mountain, which is steeply sloping (average slope 18°) and rugged. The slope is intersected by a large number of well-defined gullies, but there are no major ravines.

The mining area starts at 670m on the banks of the Motse River with the highest point of the ore body at 1,070m.

3.1.4 Soil

Information for this section was extracted from the Havercroft Andalusite Mine EMP (Avmin Ltd, 1997):

The soils of the mountain slopes, which overlie the orebody, are skeletal and only developed in localised potholes and as a component of the scree, which is made up of metamorphic (hornfels) schist, diabase sill material and quartzitic rocks.

The major components of the topsoils are weathered silica and clay material, chiefly loamy biotite, rich in porphyroblasts of staurolite and/or garnets and cordierite. The topsoil is generally friable, pelitic, with an abundance of gravel and pebbles of all sizes.

3.1.5 Pre-mining land capability, land use and existing infrastructure

Information for this section was extracted from the Havercroft Andalusite Mine EMP (Avmin Ltd, 1997):

The land disturbed by the existing mining excavations is all wilderness land. The land is steep, the soil less than 0.25m deep and the volume of rocks larger than 100mm is more than 50%. The land covered by the TDF and WRD is arable land merging into grazing land.

The pre-mining land use, by the local subsistence farmers, was cultivated lands in the flat valley at the confluence of the Motse and Olifants Rivers, producing crops for local consumption. The steep valley of the Modubeng Spruit was used for grazing cattle and goats. The grass cover is sparse and the carrying capacity even in the flatter areas is no better than 15ha per head of large livestock.

There are a few scattered dwellings across the Modubeng Spruit to the northeast of the plant complex.

3.1.6 Vegetation

Information for this section was extracted from the Havercroft Andalusite Mine EMP (Avmin Ltd, 1997):

The area as described by Acocks, is Sourish Mixed Bushveld on the upper slopes, descending into Mixed Bushveld, which may be characterised as '*Acacia nigrescens-Combretum apiculatum-Kirkii wilmsii* Veld'. The mining area is well wooded with a great variety of medium-sized species of trees as well as a great variety of shrubs and aloes.

The dominant grass species found in undisturbed areas are:

- *Aristida scrabbrivalus*
- *Aristida congesta barbicollis*

- *Enneapogon centroides*
- *Digitaria eriantha*
- *Eragrostis racemosa*

Stipagrostis uniplumis, Enneapogon centroides, and *Cynodon dactylon* grow abundantly on the top and slopes of the TDS and WRD.

The following species of trees are abundant on the north-east slope of the mountain.

Table 9: Tree species

Scientific name	Common name
Kirkii wilmsii	Mountain seringa
Acacia nigrescens	Knob thorn
Acacia senegalis	Three hook thorn
Acacia nilotica	Scented thorn
Acacia tortilis	Umbrella thorn
Acacia permixta	Slender thorn
Combretum apiculatum	Red bush willow
Combretum hereroense	Russet bush willow
Sclerocarya caffra	Marula
Dichrostachys cinerea	Sickle bush
Bolusanthus speciosus	Tree wisteria
Scotia brachypetala	Tree fuschia
Ziziphus mucronata	Buffalo thron
Bosnia albutrunca	Sheperds tree
Ozoroa paniculose	Common resin tree
Sterculia rogersii	Common star chestnut
Peltiphorum africanum	Weeping wattle
Balanites maughamii	Green thorn
Commiphora pyracanthoides	Common corkwood
Commiphora mollis	Velvet corkwood
Commiphora schimperi	Glossy-leaved commiphora
Euphorbia ingens	Tree euphorbia
Euphorbia terucalli	Rubber euphorbia
Euphorbia cooperi	Transvaal candelabra tree

The following shrubs are found:

- *Maytenus heterophylla*
- *Grevia flava*
- *Triaspis glacophila*
- *Clerodendrum* spp.

- *Becium obovatum*
- *Tinnea zambesica*
- *Euclia crispa*
- *Grevia bicolor*
- *Petalidium* spp.
- *Ormocarpum tricocarpum*
- *Ochna inerniis*
- *Psiadia puntulata*
- *Euclea undulata*

The following aloes are common:

- Marlothii
- Castanea
- Wickensii
- Globuligemma
- Cryptopoda

Species of Adansonia digitata (Baobabs) are found in the low-lying area between the Motse River and Modubeng Spruit.

Invader species present:

- *Nicotiana glauca*
- *Xanthium spinosum*
- *Xanthium strumarium*

3.1.7 Animal life

Information for this section was extracted from the Havercroft Andalusite Mine EMP (Avmin Ltd, 1997):

The area around the site is open to very few people in the actual mountainous areas, especially to the north. Hunting with dogs and snare setting have impacted on the number of animals, but the following species occur in this region:
Kudu, klipspringer, grey duiker, grey rhebuck, grysbuck, bushbuck, black-backed jackal, leopard, Chacma baboon, vervet monkey, and Bushpig.

The grey rhebuck and leopard are endangered species in the area.

3.1.8 Surface water

Information for this section was extracted from the Havercroft Andalusite Mine EMP (Avmin Ltd, 1997) and the Quarterly Water Quality Monitoring Report (BECS Environmental, 2016):

3.1.8.1 Surface water hydrology

The mining area is drained by a large number of well-defined watercourses which feed into the Modubeng Spruit. The extreme south-eastern section of the mining area drains into the south-flowing Segorong Spruit. The Modubeng Spruit and Segorong Spruit, which are both tributaries of the perennial Olifants River, only have a steady flow after periods of sustained good rains. The Olifants River adjoins the northern limit of the mining area and flows past the north-west of the mine. The Motse River flows to the west of the mine. The Moodubeng Spruit flows along the northern boundary of the mine.

The catchment area is 2,230ha and the sub-catchment area is 1,165ha. The mean annual run-off (MAR) from the catchment cannot be measured or calculated due to the complexities of different slopes, soil types, and vegetation cover. An annual run-off volume of 10% is assumed. The calculated volumes at 10% run-off are catchment of 1,246,570m³ and sub-catchment of 651,235m³. There is no dry weather flow in any of the water courses or the Modubeng Spruit.

The peak flows for the catchments are presented in the table below.

Table 10: Estimated flood frequencies

Site	Catchment area (km²)	Flood peaks (m³/s)							
		Return periods							
		2	5	10	20	50	100	200	RMF
Olifants	34,237	410	920	1,400	2,000	3,550	4,950	6,250	8,400
Motse	820	175	275	378	530	760	1,000	1,200	1,800
Modubeng	22.3	26	47	68	94	162	200	258	464

The drainage density of the site is 2.83km of drainage path per km² of land.

3.1.8.2 Surface water quality

Water quality monitoring was done in August 2016 (BECS Environmental, 2016). Refer below for the results.

Table 11: Domestic use: Target Water Quality Guidelines

Variable	Unit	Limit	Sample number		
			HAV 1	HAV 2	HAV 3
pH		6.0-9.0	7.76	7.68	7.81
Conductivity*	mS/m	≤70	96.8	59.3	61.9
Total dissolved solids	mg/l	≤450	781	449	510
Fluoride	mg/l	≤1.0	<0.05	<0.05	<0.05
Chloride	mg/l	≤100	186.2	84.9	138.2
Nitrate: N	mg/l	≤6	<0.02	<0.02	<0.02

Variable	Unit	Limit	Sample number		
			HAV 1	HAV 2	HAV 3
Sulphate	mg/l	≤200	184.0	86.6	104.0
p-Alkalinity			0.0	0.0	0.0
m-Alkalinity			204.7	87.8	60.8
Carbonate			0.0	0.0	0.0
Bicarbonate			249.6	107.1	74.1
Total hardness		≤50	680.6	284.0	337.8
Calcium hardness			98.0	111.1	164.4
Magnesium hardness			582.5	172.9	173.5
Calcium	mg/l	≤32	39.3	44.5	65.8
Magnesium	mg/l	≤30	141.5	42.0	42.1
Sodium dissolved	mg/l	≤100	77.7	42.8	45.8
Potassium dissolved	mg/l	≤50	3.30	3.49	3.56
Iron dissolved	mg/l	≤0.1	<0.002	<0.002	<0.002
Manganese dissolved	mg/l	≤0.05	<0.005	<0.005	<0.005
Sum Cation	me/l		17.06	7.63	8.83
Sum Anion	me/l		17.08	7.66	8.86
Total viable organisms*	per 100ml	≤75	389	127	104
Total coliform Org	per ml	≤5	119	<1	<1
Faecal coliform Org	per ml	0	59	<1	<1

* General limits for general authorisations

** Too numerous to count

3.1.8.3 Surface water users

The community, living along the banks of the Modubeng Spruit, use this water, when available, for domestic purposes and for watering livestock. When the river is dry, water is collected from the Motse River.

3.1.9 Groundwater

Information for this section was extracted from the Geohydrological Evaluation for the Water Use Licence Application Report (WULA) (Aurecon, 2010)) (from the IWWMP, 2012 (Shangoni Management Services)), and the Geohydrological impact assessment as input to the Section24G Rectification (Shangoni AquaScience, 2017):

According to the published 1:250 000 geological map (2430 Pelgrims Rest), the area under investigation is underlain by the Timeball Hill Formation that forms part of the Pretoria Group and mainly comprises of andesitic lava, shale, and quartzite. Diabase dykes and sills of the Upper Vaalium age have intruded the Pretoria Group.

The ore zone principally comprises of quartz, feldspar, biotite, and Andalusite bearing hornfels. The ore body outcrops/sub-outcrops against the north-eastern slopes of the Radingwane Mountain, which is capped by Daspoort Quartzite of the Daspoort Formation. The surface of the ore body is covered by a layer of rubble, between 0.5m to 6m thick, consisting primarily of quartzite boulders, occasional lava boulders, and very little soil.

The ore body is a metamorphically altered alumina-rich shale horizon. It is essentially a quartzbiotite-andalusite hornfels with minor amounts of garnet and staurolite. The ore body varies between 40m and 50m in thickness, strikes NW and dips on average 15° to the SW.

The geological map indicates the presence of several regional linear structures, comprising of NESW striking dolerite dykes and NW-SE striking diabase dykes. The drainage line through the mine area runs parallel to the regional orientation of the diabase dykes.
They are usually deeply weathered and deep gullies mark their position on the surface. Their effect on the ore appears to be minimal.

A minimum of four distinct diabase sills, irregularly weathered and probably of Bushveld Igneous Complex origin, are intrusive along bedding planes in the vicinity of and within the ore body. They vary in thickness from 0.5m to 5m and appear to upwardly transgress through the ore body from east to west. The ore above and below these sills, display alteration through contact metamorphism. Only minor faulting and other structural deformation have been observed.

Groundwater occurrence favours weathered shale, brecciated or jointed zones and especially the contact zone between intrusive diabase sheets and shale. These contact zones would usually act as targets for groundwater exploration. On the contrary, it must be stated that little groundwater seepage from the contact zones between shales and diabase/dolerite dykes intercepted in the mining area occur. During the site visit, a small volume of water accumulated at the base of the open quarries was observed. No active dewatering takes place in the open casts. The contact between the diabase and shale where fracturing usually takes place and act as preferential flow paths for groundwater may have been metamorphosed with no distinct contact and consequently, little fracturing. Future exploratory drilling on these contact zones will shed more light on this issue.

3.1.9.1 Groundwater use

There is only one existing borehole (ANBH Mine) within the Annesley mining area, which delivers a yield of approximately 10 000 l/d (0.12 l/s). Water from this borehole is used as domestic water (cleaning and personal hygiene purposes only). Some boreholes outside the mining area exist, most of which are being used by the local community.

Table 12: Summary of boreholes identified during the hydrocensus

BH number	Owner	Static water level (mbgl)	User application
ANBH Mine	Annesley Mine	BH Sealed	Domestic use
ANBH Penge	Annesley Mine	78.8	Process Water
ANBH Chief	Segorong chief	BH Sealed	Domestic use
H12-2270	DWS	BH Sealed	Domestic use
BH School	Ga Malepe school	BH Sealed	Domestic use
ANW 1 (well)	Ga Malepe community	0.5	Domestic use

From the hydrocensus data, it can be concluded that groundwater is being used as a source of potable water in the area. Based on the acquired data, the average yield of a successful borehole in the study area is in the region of 1ℓ/s (3,600ℓ/hour). Based on the investigation and data acquired from the mine, a volume of ~1350m³/day of groundwater are being abstracted from the mine and adjacent properties. The majority hereof is being abstracted from the “Old Penge Shaft” which amounts to an average daily abstraction of 1,333m³/day. The mine further abstracts less than 10,000ℓ/day from a borehole (“ANBH Mine”) located close to the Annesley plant. The neighbouring communities utilise groundwater for domestic purposes from 4 identified boreholes and 1 hand dug well.

It must be stated that it was not always practically possible to measure the yields of the boreholes and as no records for the boreholes exist, a qualified guess was made. This was done in conjunction with information provided by mine personnel. The same applies to the volume of water being abstracted from boreholes.

3.1.9.2 Groundwater levels

The mining area is underlain by a diabase sill of approximately 100m thick and is concordant with the sedimentary rock in which it intrudes. This sill is approximately 40m below the footfall of the ore body. Several dolerite dykes intersect the ore body, but none of these will be mined, leaving the water compartments locally intact. Due to the highly undulating nature of the topography, varied geology and localised presence of dykes and sills, the depth to water table in the B71F quaternary catchment varies significantly. This could be less than 10mbgl in some places and more than 40mbgl at others.

It was not possible to obtain measured water levels from the hydrocensus boreholes due to the fact that all the boreholes identified were sealed to prevent equipment theft and contamination. The water level of the “Old Penge Shaft” was measured to be 78.8mbgl. This is however not representative of the static regional groundwater level as it is deeper than the surrounding boreholes and major pumping from this shaft takes place. The water level in the hand dug well was measured to be at 0.5mbgl. An NGA hydrocensus of registered boreholes in the B71F Quaternary Catchment was therefore undertaken to establish regional groundwater levels for the area.

A total of eight boreholes in the B71F catchment are registered with the Department of Water Affairs (DWA) with only five (5) boreholes located in relatively close proximity to Annesley or within similar geology. The water levels for these boreholes range between 12.93mbgl and 36mbgl.

3.1.9.3 Aquifer parameters

Falling head tests (“Slug Tests”)

No boreholes were accessible to conduct falling head tests (“slug tests”). The test involves continuous measuring of the water level response in a borehole to the rapid displacement of water therein. This displacement or rise in water level is caused as a result of the introduction of a slug below the rest water level. Data acquired from the “slug tests” are used to calculate the hydraulic conductivity of the substrata in the immediate vicinity of the borehole in order to get an idea of the groundwater flow velocity. Theoretical K-values are presented in Table 15 in order to compare groundwater flow velocities in different rock types.

Table 13: Comparison of the hydraulic conductivity in different rock types

Rock Type	**K (m/day)**
Shale	1×10^{-8} - 1×10^{-6}
Sandstone	10^{-3} - 1
Limestone	10-5 - 1
Basalt	3×10^{-4} - 3
Granite	1×10^{-4} - 3×10^{-2}
Slate	10^{-8} – 10^{-5}
Schist	10^{-7} – 10^{-4}
Groundwater movement	
Extremely slow	1×10^{-6}
Very slow	1×10^{-4}
Slow	1×10^{-2}
Moderate	1
Fast	10
Very fast	100

Keeping the (1) relatively low yielding boreholes, (2) little/no groundwater seepage into the open quarries and (3) occurring geological formations in mind, it can be concluded that groundwater movement at the mine will be very to extremely slow. The rock will have a typical hydraulic conductivity of 10^{-6} to 10^{-4}. The advantage of a low hydraulic conductivity is that any pollutants that might accidently leak to the aquifer will migrate at very slow pace.

3.1.9.4 Aquifer classification

The Department of Water and Sanitation (DWS) has characterised South African aquifers based on the rock formations in which it occurs together with its capacity to transmit water to boreholes drilled into specific formations. The water-bearing properties of rock formations in South Africa can be classified into four classes defined as:

1. **Class A - Intergranular**
   - Aquifers associated either with loose and unconsolidated formations such as sands and gravels or with rock that has weathered to the only partially consolidated material.
2. **Class B - Fractured**
   - Aquifers associated with hard and compact rock formations in which fractures, fissures and/or joints occur that are capable of both storing and transmitting water in useful quantities.
3. **Class C - Karst**
   - Aquifers associated with carbonate rocks such as limestone and dolomite in which groundwater is predominantly stored in and transmitted through cavities that can develop in these rocks.
4. **Intergranular and fractured**
   - Aquifers that represent a combination of Class A and B aquifer types. This is a common characteristic of South African aquifers. Substantial quantities of water are stored in the intergranular voids of weathered rock but can only be tapped via fractures penetrated by boreholes drilled into the fractured aquifer.

Each of these classes is further subdivided into groups relating to the capacity of an aquifer to transmit water to boreholes, typically measured in l/s. The groups, therefore, represent various ranges of borehole yields.

The water-bearing properties of the shale formations are generally more favourable than those of the quartzites due to their greater susceptibility to weathering. The quartzites do, however, constitute productive aquifers where these rocks are fractured and especially in the presence of ferruginization. Lesser and/ or more isolated groundwater occurrences are associated with fault and associated shear zones and with contact zones between diabase sills, dykes, shale, and quartzite. Water may also occur in occasional joints and fractures in fresh diabase.

Annesley Andalusite Mine is located in a **d3 aquifer class** region. The groundwater yield potential is classed as low to medium on the basis that most of the boreholes on record in the vicinity of the study area produce between 0.5 and 2.0l/s. Higher yields do sporadically occur where groundwater is tapped from good water-yielding fractures.

3.1.9.5 Regional aquifer classification

According to the regional aquifer classification map of South Africa, the Timeball Hill aquifer has been identified as a minor aquifer with relatively good groundwater quality (average = <300mg/l TDS). Based on the underlying hydrogeology of the project area the aquifer can be classified according to the Parsons classification system as follows:

i. Intergranular and fractured shale/quartzites/diamictite of the Timeball Hill Formation

a. Minor-aquifer

3.1.9.6 Aquifer vulnerability

Tables 16 - 19 summarises the aquifer classification vulnerability scores for the aquifer/s in the vicinity of Annesley Andalusite Mine. The final DRASTIC score of 101 indicates that the aquifer/s in the region has a medium susceptibility to pollution and a medium level of aquifer protection is therefore required.

Table 14: DRASTIC vulnerability scores

Factor	Range/Type	Weight	Rating	Total
D	15 - 30 m	5	3	15
R	10 - 50 mm	4	6	24
A	Fractured	3	6	18
S	Loamy sand	2	7	14
T	0-2%	1	10	10
I	Pretoria	5	4	20
C	-	3	-	-
DRASTIC SCORE = 101				

In order to achieve the Groundwater Quality Management (GQM) Index a point scoring system as presented in Table 18 and Table, 19 was used.

Table 15: Ratings for the Aquifer System Management and Second Variable Classifications

Aquifer System Management Classification		
Class	Points	Study Area
Sole Source Aquifer System	6	
Major Aquifer System	4	
Minor Aquifer System	2	2
Non-Aquifer System	0	
Special Aquifer System	0-6	
Second Variable Classification (weathered/fractured)		
High	3	
Medium	2	2
Low	1	

Table 16: Ratings for the GQM Classification System

Aquifer System Management Classification		
Class	Points	Study Area
Sole Source Aquifer System	6	
Major Aquifer System	4	
Minor Aquifer System	2	2
Non-Aquifer System	0	

Special Aquifer System	0-6	
Second Variable Classification (weathered/fractured)		
High	3	
Medium	2	2
Low	1	

The occurring aquifer(s), in terms of the above definitions, is classified as a minor aquifer system. The vulnerability, or the tendency or likelihood for contamination to reach a specified position in the groundwater system after introduction at some location above the uppermost aquifer, in terms of the above, is classified as medium.

The level of groundwater protection based on the GQM Classification (Table 19):

GQM Index = Aquifer System Management x Aquifer Vulnerability

= 2 X 2 = 4

Table 17: GQM index for the study area

GQM Index	Level of Protection	Study Area
<1	Limited	
1-3	Low level	
3-6	Medium level	4
6-10	High level	
>10	Strictly non-degradation	

The ratings for the Aquifer System Management Classification and Aquifer Vulnerability Classification yield a GQM Index of 4 for the study area, indicating that a **medium level groundwater protection** may be required.

Due to the medium/high GQM index calculated for this area, a medium/high level of protection is needed to adhere to DWS's water quality objectives. Reasonable and sound groundwater protection measures are required to ensure that no further cumulative pollution affects the aquifer, even in the long term.

In terms of DWS's overarching water quality management objectives which is i) protection of human health and ii) the protection of the environment, the significance of this aquifer classification is that if any potential risk exists, measures must be triggered to limit the risk to the environment, which in this case is the i) protection of the secondary underlying aquifers and ii)) the non-perennial streams draining the project area.

3.1.9.7 Geochemical characterisation

Shangoni (2014) performed a geochemical study on four (4) mine residue deposit (MRD) samples to identify contaminants of concern and risks pertaining to day to day operation of the mine. Stormwater/leachate emanating from these MRDs are directed towards the pollution control and other water management infrastructure. A summary of the geochemical assessment is discussed below.

The waste locations sampled were:

- Overburden
- HMS Waste
- Primary Waste
- TDF Slurry (tailings)

The following tests were included in their assessment:

- Aqueous extraction. This procedure indicates which chemical constituents may be solubilised by deionised water.
- Static acid-base accounting (ABA). Static tests are the analytical tests used as a screening criterion of the samples, used to determine the difference between the acid-generating capability and the acid-neutralizing potential of the samples. Originally developed for the coal mining industry, this procedure provides information on the potential of solids to generate or neutralise acid formation and is correlated to the concentration of sulphides and neutralising minerals.

3.1.9.7.1 Acid-Base Accounting

The results of the ABA analyses are displayed in Table 20 and rock classification guideline in Table 21. According to these results, all of the samples are classified as a Type III rock, which according to the guidelines imply that they are non-acid forming. This is largely due to the low almost absent sulphur content. Although the *HMS waste* calculated a Neutralising Potential Ratio (NPR), of 1:1.60, the very low sulphur content of the waste resulted in a Type III classification.

Table 18: Results of acid-base accounting

Acid-Base Accounting Modified Sobek (EPA-600)	**Sample Identification**			
	Primary Waste	**Overburden**	**TDF**	**HMS Waste**
Paste pH	7.5	8.0	7.9	8.0
Total Sulphur (%) (LECO)	0.02	0.01	0.02	0.01
Acid Potential (AP) (kg/t)	0.625	0.313	0.625	0.313
Neutralization Potential (NP)	7.00	2.50	5.50	0.500
Nett Neutralization Potential (NNP)	6.38	2.19	4.88	0.187
NPR (NP: AP)	11.20	8.00	8.80	1.60
Rock Type	III	III	III	III

Table 19: Rock Classification

TYPE I	Potentially Acid Forming	Total S(%) > 0.25% and NP:AP ratio 1:1 or less
TYPE II	Intermediate (uncertain)	Total S(%) > 0.25% and NP:AP ratio 1:3 or less

TYPE III	Non-Acid Forming	Total S(%) < 0.25% and NP:AP ratio 1:3 or greater

3.1.9.7.2 Leachate analysis

The results of the aqueous extraction test are displayed in Table 22. The results were evaluated according to the SANS 241: 2011 water quality standards. Where no standard is proposed in the SANS guideline or where relevant, health-based water quality standards as proposed by the DWS (DWAF, 1996) were sourced.

***Note** that the solid-to-liquid ratio of 1:4 used in the aqueous laboratory extractions can be considered relatively similar to reality but it must be stressed that in-situ conditions can never be 100% simulated under laboratory conditions. Therefore, any exceedance of the water quality standards should be treated as an indication of potential contaminants only.*

The results in Table 22 indicate that the waste is chemically inactive/inert.

Table 20: Leach results evaluated according to the SANS 241: 2015 water quality guidelines

Parameter	**SANS 241: 2015**	**Primary Waste**	**Overburden**	**TDF**	**HMS Waste**
pH	5.0 - 9.7	7.5	8.0	7.9	8.1
TDS	1200.0	156.0	94.0	176.0	140.0
Alkalinity ($CaCO_3$)	-	64.0	44.0	20.0	16.0
Chloride (Cl)	300.0	27.0	11.0	25.0	21.0
Sulphate (SO_4)	500.0	21.0	9.0	55.0	44.0
Nitrate (NO_3-N)	11.0	0.20	1.80	<0.2	<0.2
Fluoride (F)	1.5	1.30	1.00	0.40	0.40
Silver (Ag)	na	<0.025	<0.025	<0.025	<0.025
Aluminium (Al)	0.3	0.282	0.537	0.687	0.471
Arsenic (As)	0.05	0.013	<0.010	<0.010	<0.010
Boron (B)	na	<0.025	<0.025	<0.025	<0.025
Barium (Ba)	na	<0.025	<0.025	<0.025	<0.025
Beryllium (Be)	na	<0.025	<0.025	<0.025	<0.025
Bismuth (Bi)	na	<0.025	<0.025	<0.025	<0.025
Calcium (Ca)	-	<2	2	4	3
Cadmium (Cd)	0.003	<0.005	<0.005	<0.005	<0.005
Cobalt (Co)	0.5	<0.025	<0.025	<0.025	<0.025
Chromium (Cr)	0.05	<0.025	<0.025	<0.025	<0.025
Copper (Cu)	2	<0.025	<0.025	<0.025	<0.025
Iron (Fe)	2	0.137	0.290	0.633	0.511
Potassium (K)	-	<1.00	<1.00	1.0	1.0
Lithium (Li)	na	<0.025	<0.025	<0.025	<0.025

Parameter	SANS 241: 2015	Primary Waste	Overburden	TDF	HMS Waste
Magnesium (Mg)	-	<2	<2	4	3
Manganese (Mn)	0.5	<0.025	<0.025	<0.025	<0.025
Molybdenum (Mo)	na	<0.025	<0.025	<0.025	<0.025
Sodium (Na)	200	46	28	33	27
Nickel (Ni)	0.07	<0.025	<0.025	<0.025	<0.025
Phosphorous (P)	-	0.028	0.032	<0.025	<0.025
Lead (Pb)	0.01	<0.020	<0.020	<0.020	<0.020
Antimony (Sb)	0.02	<0.010	<0.010	<0.010	<0.010
Selenium (Se)	0.01	<0.020	<0.020	<0.020	<0.020
Tin (Sn)	-	<0.025	<0.025	<0.025	<0.025
Strontium (Sr)	-	<0.025	<0.025	<0.025	<0.025
Titanium (Ti)	-	<0.025	<0.025	<0.025	<0.025
Vanadium (V)	0.2	<0.025	<0.025	<0.025	<0.025
Wolfram (W)	-	<0.025	<0.025	<0.025	<0.025
Zinc (Zn)	5	<0.025	<0.025	<0.025	<0.025
Zirconium (Zr)	-	<0.025	<0.025	<0.025	<0.025

Results are given in mg/l, except for pH

Solid to liquid ratio – 1: 4

The salinity (TDS) is low with results ranging between 94 mg/l and 176 mg/l, which is mostly contributed by chloride (Cl), sulphate (SO_4) and sodium (Na), while the pH is neutral to slightly alkaline ranging between 7.9 and 8.1. The primary waste recorded an arsenic (As) concentration of 0.013 mg/l which slightly exceeds the SANS guideline but is still within DWS health-based guideline of <0.05 mg/l. None of the remaining parameters exceed the SANS guideline and is overall of good quality and of fairly low/inert chemical reactivity.

3.1.9.8 Water quality

3.1.9.8.1 Sampling sites

Water quality data was sourced from the client and from the Shangoni (2014) report. Information pertaining to the available water quality datasets are shown in Table 23.

Table 21: Water sampling points for chemical constituents

Site ID	Coordinates	Site type
ANW1	S24.44250° E30.27653°	Hand dug well
BH School	S24.42535° E30.28083°	Domestic use borehole (No access)

Site ID	Coordinates	Site type
ANBH Penge	S24.38356° E30.28016°	Production borehole (old Penge shaft)
ANBH Chief	S24.38843° E30.24434°	Handpump for domestic use
H12 2770	S24.38797° E30.23859°	Open borehole (Dry)
ANBH Mine	S24.39388° E30.25409°	Borehole for domestic use downgradient from Pollution control dam (PCD) (hygiene only)
ANQ6	S24.41533° E30.27315°	Quarry 6 is open (rainwater)
PCD	S24.394420 E30.254050	PCD (Emergency Dam)
Village	S24.6572 E30.33473	Village borehole (staff housing Burgersfort)

3.1.9.8.2 Water quality

9.8.2.1 Interpretation according to relevant standards

Standards & guidelines applicable to the geohydrological investigation were the South African water quality guidelines namely i) the domestic colour coded classification system and; ii) the South African National Standard for drinking water. The hydrochemical results for the water samples taken at Annesley Andalusite Mine interpreted according to the South African drinking water guidelines, are displayed in Table 24.

Table 22: Hydrochemical data

Site Name	**SANS 241: 2011**	**ANBH Chief**	**ANQ6**	**PCD**	**Process water**	**ANBH Penge**	**ANBH Mine**	**ANW 1**	**Village borehole**
pH	**≥5 to ≤9.7**	6.99	8.93	7.94	8.1	8.05	7.13	5.56	8.34
EC (mS/m)	**≤170**	**89.2**	**92.8**	**432**	**314**	**255**	**311**	4.8	145
TDS (mg/l)	**≤1200**	**503.2**	**523.5**	**2683**	**2041**	**1438.6**	**1754.5**	27.2	818
Ca (mg/l)	**-**	49.3	41.5	161	148	164.0	195.0	2.4	5.27
Mg (mg/l)	**-**	38.8	35.5	166	131	154.0	133.0	1.0	165
Na (mg/l)	**≤200**	58.6	80.9	**351**	**257**	180	**312**	2.7	78.1
K (mg/l)	**-**	2.1	2.9	3.97	11.0	43.3	8.3	1.1	7.91
MALK (mg/l)	**-**	268.0	113.0	195.7	311	288.0	311.0	7.7	505
Cl (mg/l)	**≤300**	68.2	**170.0**	**548.8**	**394**	**369.0**	**500.0**	3.9	165
SO_4 (mg/l)	**≤500** **≤250***	22.8	62.9	**582**	**517**	**632.0**	**746.0**	3.6	58
NO_3-N (mg/l)	**≤11**	0.287	0.628	<0.02	1.21	0.343	1.16	0.311	6.98
PO_4 (mg/l)	**-**	<0.008	<0.008	<0.02	0.008	<0.008	0.008	<0.008	0.078
N_Ammonia (mg/l)	**≤1.5***	0.009	0.022	-	0.030	0.086	0.012	0.062	0.017
F (mg/l)	**≤1.5**	0.70	0.54	<0.05	1.1	0.51	1.11	0.16	0.331
Al (mg/l)	**≤0.3#**	<0.003	<0.003	-	-	<0.003	<0.003	<0.003	<0.003
Fe (mg/l)	**≤2** **≤0.3***	**0.506**	<0.003	<0.02	0.010	<0.003	<0.003	<0.003	<0.003
Mn (mg/l)	**≤0.5**								

Site Name	SANS 241: 2011	ANBH Chief	ANQ6	PCD	Process water	ANBH Penge	ANBH Mine	ANW 1	Village borehole
	≤0.1*	**0.17**	<0.001	<0.005	0.090	**1.37**	<0.001	0.015	<0.001
Cr (mg/l)	**≤0.05**	<0.001	<0.001	-		<0.001	<0.001	<0.001	-
Cu (mg/l)	**≤2.0**	<0.001	<0.001	-		0.003	0.021	<0.001	-
Ni (mg/l)	**≤0.07**	<0.001	<0.001	-		<0.001	<0.001	<0.001	-
Zn (mg/l)	**≤5***	3.35	<0.002	-		<0.002	<0.002	<0.002	-
Co (mg/l)	**≤0.5**	0.001	<0.001	-		<0.001	<0.001	<0.001	-
Cd (mg/l)	**≤0.003**	<0.001	<0.001	-		<0.001	<0.001	<0.001	-
Pb (mg/l)	**≤0.01**	<0.004	<0.004	-		<0.004	<0.004	<0.004	-
As (mg/l)	**≤0.01**	<0.007	<0.007	-		<0.007	<0.007	<0.007	-
Se (mg/l)	**≤0.01**	<0.007	<0.007	-		<0.007	<0.007	<0.007	-
Si (mg/l)	**-**	19.3	3.31	-		14.1	23.8	6.42	-
Ag (mg/l)	**-**	<0.001	<0.001	-		<0.001	<0.001	<0.001	-
B (mg/l)	**-**	0.029	0.026	-		0.241	0.284	0.01	-
Be (mg/l)	**-**	<0.001	<0.001	-		<0.001	<0.001	<0.001	-
Bi (mg/l)	**-**	0.012	<0.004	-		<0.004	<0.004	<0.004	-
Li (mg/l)	**-**	0.021	0.026	-		0.033	0.04	0.002	--
Mo (mg/l)	**-**	0.018	0.013	-		0.017	0.042	0.006	-
Sr (mg/l)	**-**	0.224	0.302	-		0.665	1.34	0.013	-
Tl (mg/l)	**-**	<0.037	<0.037	-		<0.037	<0.037	<0.037	-
V (mg/l)	**≤0.2**	<0.001	0.004	-		<0.001	0.034	<0.001	-
Sb (mg/l)	**≤0.02**	0.002	0.002	-		0.003	0.021	0.001	-
Sn (mg/l)	**-**	<0.001	<0.001	-		0.083	0.075	<0.001	-
Tot Hardness (mg/l)	**-**	283	250	-		1044	1035	10.01	-
DWA Classification		***Good Class 1***	***Good Class 1***	***Poor class 3***	***Marginal Class 3***	***Poor class 3***	***Poor class 3***	***Ideal Class 0***	***Good Class 1***
Worst parameters		***EC/TDS, Fe, Mn***	***EC/TDS, Cl***	**EC/TDS**	**EC/TDS, Cl, Na**	**SO_4**	**SO_4**	**-**	***EC/TDS, Cl***

The following can be concluded:

- ANBH Chief, Quarry 6 (ANQ6), the hand dug well (ANW1) and the Village borehole recorded within the SANS 241: 2011 drinking water quality guidelines. The hand-dug well (ANW1) can be classified as *Ideal (Class 0)* while ANBH Chief, Quarry 6 and the Village borehole can be classified as *Good* (*Class 1*).
- *ANBH Chief* and *Quarry 6* recorded within *Good* (class 1)[1] drinking water standards (WRC, 1998) with EC/TDS, Fe and Mn, and EC/TDS and Cl exceeding *Ideal* (class 0) standards, respectively. The quality of these samples can be described as neutral (ANBH Chief) to slightly alkaline (ANQ6) with relatively fresh water. The borehole *ANBH Chief* recorded slightly raised Fe and Mn but this not an uncommon occurrence within groundwater where low levels of oxygen are present (solubility of Fe and Mn is, amongst others, correlated to an increasing reducing environment). *Quarry 6* water quality is reminiscent of an open and natural water body with an evaporation signature (Na-Cl).
- The hand-dug well (ANW1) recorded to within *Ideal* (class 0) drinking water standards.

The hydrochemistry for the borehole on-mine (*ANBH Mine*), as well as the *PCD*, the Penge Shaft water, and the mine *process water*, all exceed the SANS 241: 2015 drinking water quality guidelines. Exceedance was measured in terms of:

- Salinity (EC/TDS), Cl and SO_4 including Mn in *ANBH Penge* and Na in *ANBH Mine*.

They are classified as *Marginal* (*Class 2*) to *Poor* (*Class 3*) according to the colour coded classification system proposed by the DWS (WRC, 1998) mostly due to the high to elevated EC/TDS and SO_4, Cl and/ Na concentrations. The profiles can be described as neutral, relatively saline and extremely hard with high levels of Ca, Mg, Cl and Na and high to elevated levels of SO_4.

9.8.2.1 Groundwater Composition

Major ion composition of the water is used to classify it into various chemical types. Piper, Stiffs and a Schoeller diagram were used to present this classification graphically.

The Piper and Stiffs in Figure 10 and 11, respectively indicate that:

- Groundwater from *ANBH Chief* is typical of fresh recently recharged groundwater with a distinct Mg/Ca-HCO_3^- character.
- Quarry 6 (*ANQ6*) displays a water type characteristic of rainwater subjected to evaporation mixed with water of a Mg-SO_4 type character. This water type may also be an indication of ion exchange with the host rock.

[1] Note that classification in terms of drinking water is only according to hydrochemical parameters analysed and is not a suggestion of safe use.

- The hand-dug well displays a signature of a Na-HCO_3^- type water that is typical of shallow and 'open' groundwater systems in close contact with igneous types of rock or that has an evaporative signature.
- Groundwater from the Penge Shaft (*ANBH Penge*), the on-mine borehole (*ANBH Mine*), including the process water and *PCD* group together and display **similar signatures** based on their respective Stiff diagrams. All four hydrochemical sets display distinct Na/Mg-SO_4(Cl) characters.

A Schoeller diagram displaying the ion ratios for the sampling localities was constructed and shown in Figure 12. The diagram indicates similar ion compositions for the process water, ANBH Mine, and ANBH Penge, the process water sample, and water within the PCD. Background groundwater sources display unrelated signatures compared to groundwater from the on-mine borehole – ANBH Mine, located downgradient from the PCD.

Water abstracted from the Penge Shaft and used in the plant is polluted most probably due to historical mining activities at the old Asbestos Penge Mine and/ or due to the depth of the shaft. The fact that the groundwater from the Penge Shaft, the on-mine borehole, the process water and the PCD share very distinct similarities in ion composition, point towards a process related groundwater contamination effect as measured in the groundwater at ANBH Mine. The greatest contributing factor to the poor water quality of ANBH Mine is most probably related to the use of process water sourced from the Penge Shaft since the nature of the ore and mine residue deposits is chemically unreactive or inert. The pathway for pollution is either from leaching of the process water storage facilities such as the PCD or from process water spillages.

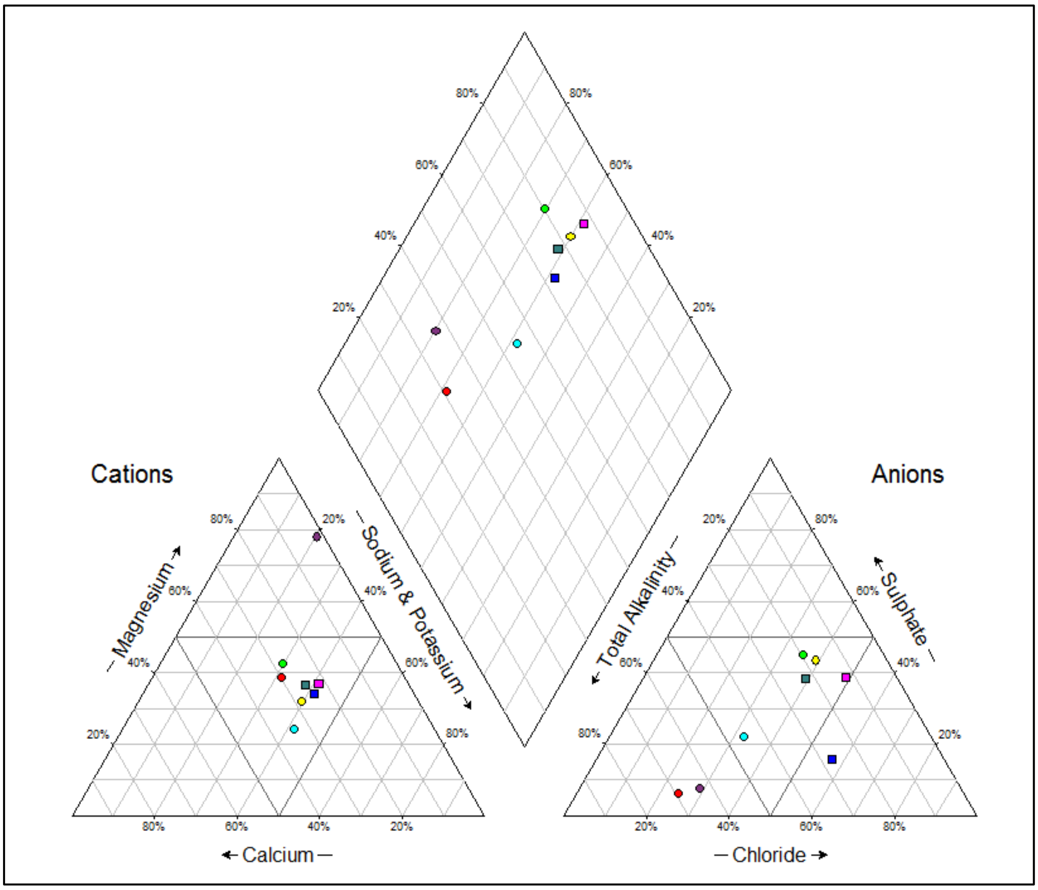

Figure 6: Piper diagram indicating the relative distribution of major cations and anions

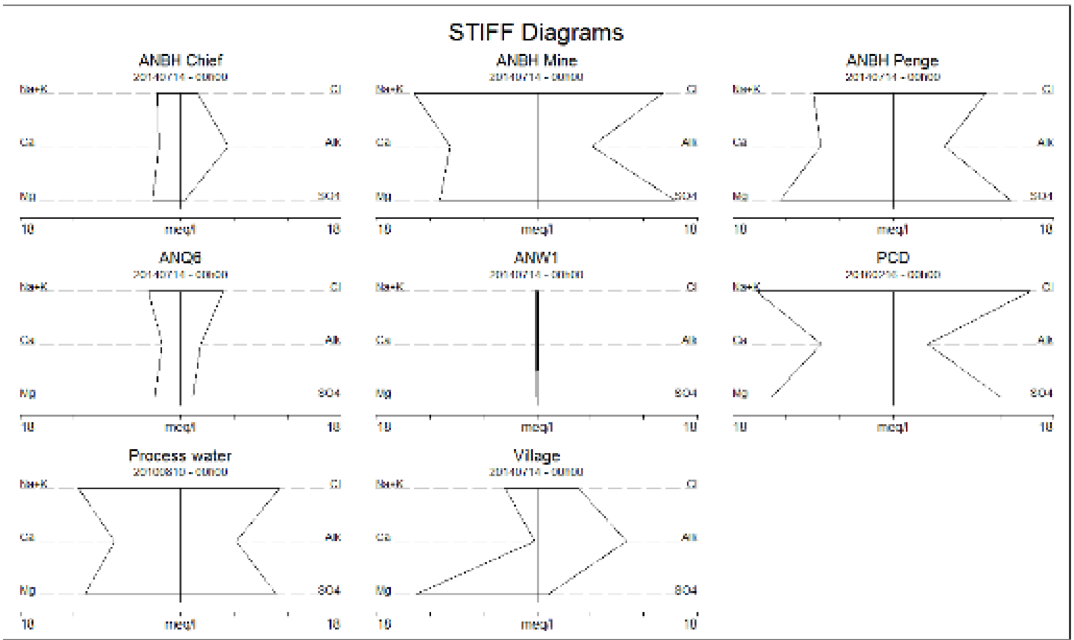

Figure 7: Stiff diagrams indicating the relative distribution of major cations and anions

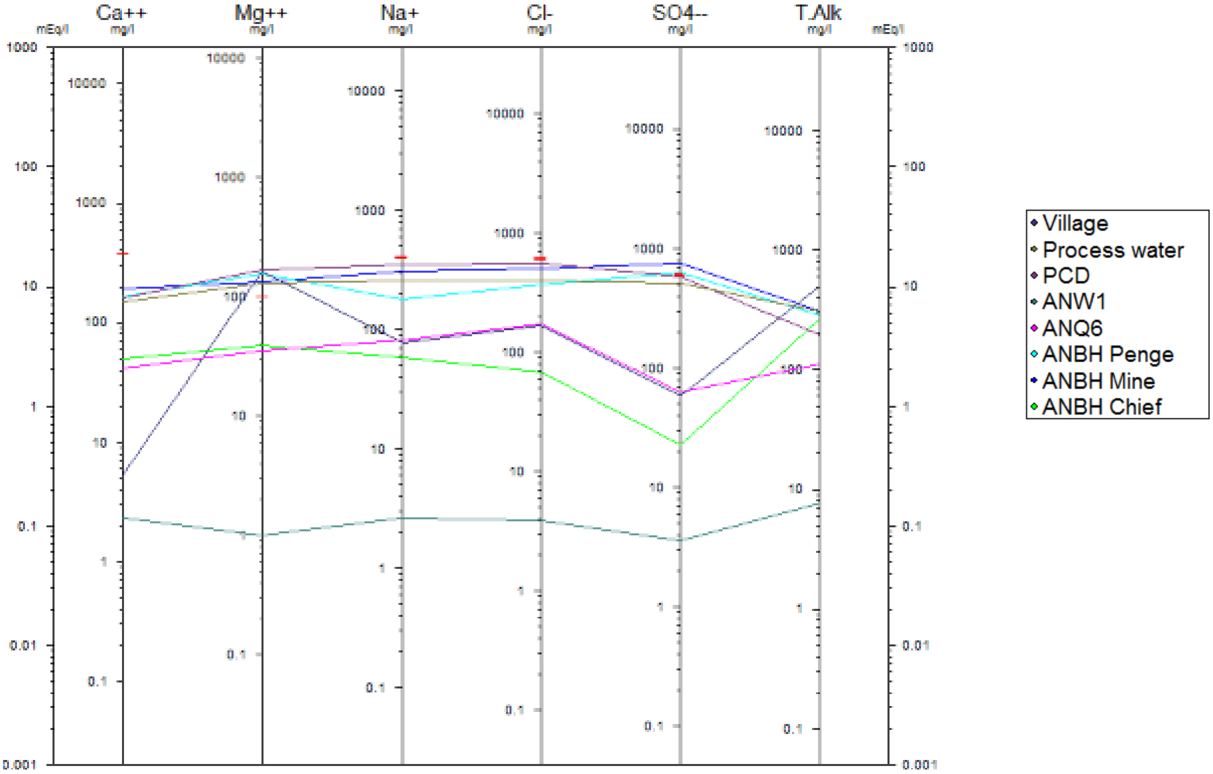

Figure 8: Schoeller diagram indicating the relative distribution of major cations and anions

3.1.9.9 Conceptual model

In a typical geohydrological setting, groundwater flow and aquifer development are closely linked to the geology of an area, which is no different for the aquifers underlying Annesley Andalusite Mine.

The area under investigation is underlain by the Timeball Hill Formation that forms part of the Pretoria Group and mainly comprises of andesitic lava, shale, and quartzite. Sills and dykes do occur widespread within the study area and groundwater occurrence generally favours these contact zones between intrusive diabase sheets/dykes and the host shale. These contact zones would usually act as targets for groundwater exploration as they may create preferential flow pathways for the movement of groundwater. However, a study by Aurecon (2010) revealed that that little/no favourable groundwater was intercepted on the contact zones between shales and diabase/dolerite dykes. It is expected that contact between the diabase and shale, where fracturing usually takes place and where preferential flow paths may exist, may have been metamorphosed with no distinct contact and consequently little fracturing. In addition, very small volumes of groundwater seepage into the mining pits occur. This emphasizes the impervious nature of the rock and an assumption can be made that groundwater flow in the occurring aquifers will be very slow. However, groundwater quality data suggest that the on-mine borehole is of poor quality displaying similar signatures to the upgradient PCD (emergency dam) and process water, and seepage is therefore expected to occur from the dam/s. The ore and mine residue deposits are chemically inert, and therefore the abstraction and use of process water from the old Penge Shaft are believed to be the major contributor to the substandard water quality measured.

Based on the hydrocensus information, it can be concluded that aquifer system in the study area is classified as a "Minor Aquifer System". The local population are not solely dependent on groundwater and borehole yields are generally low.

A geochemical study on waste material and mine residue conducted by Shangoni Management Services in 2014 (Shangoni, 2014) revealed that the ore and the waste material generated on site are chemically inert. The leachate tests revealed that none of the parameters exceeded the SANS guideline, is overall of good quality and of fairly low chemical reactivity. A 1:4 (solid: leachate) ratio was used in the extraction tests and although this is unlikely to be replicated *in-situ*, it is sometimes regarded as a more representative ratio to use compared to the general 1:20.

3.1.10 Air quality

Information included in this section was sourced from 'Greater Tubatse Local Municipality Integrated Development Plant' (Greater Tubatse Local Municipality, 2015/16), 'Annesley Andalusite Mine Annual Report (March 2016 – February 2017) (nd, 2017), 'Annesley Andalusite Mine Ambient Air quality monitoring programme' (Shangoni Management Services, 2016), and 'South African Air Quality Information System – Air quality priority areas (http://www.saaqis.org.za/Priority%20Areas.aspx)

The Tubatse Local Municipality is found in the North eastern part of the District. The main towns in the area are Burgersfort and Steelpoort. The main activity in this area is the mining of chrome and platinum. There are also three chrome smelters in the area. This then means that the area is likely to have air pollutants like sulphur dioxide, nitrous oxides, chromium (VI) and particulate matter. There is also significant traffic in the area due to the transportation of minerals which introduces a substantial pollution from the vehicles. Other pollutants like pesticides can also emanate from the farms around Ohrigstad towards Burgersfort, of which the extent has not yet been determined.

Currently, the district has three passive air quality monitoring stations which are being monitored by an independent company. The pollutants being monitored include SO2, NOX and Fallout dust. (GTM IDP, 2015/16).

According to the South African Air Quality Information System (www.saaqis.org.za), Annesley Andalusite Mine is not situated in an air quality priority area (refer to Figure 9 below).

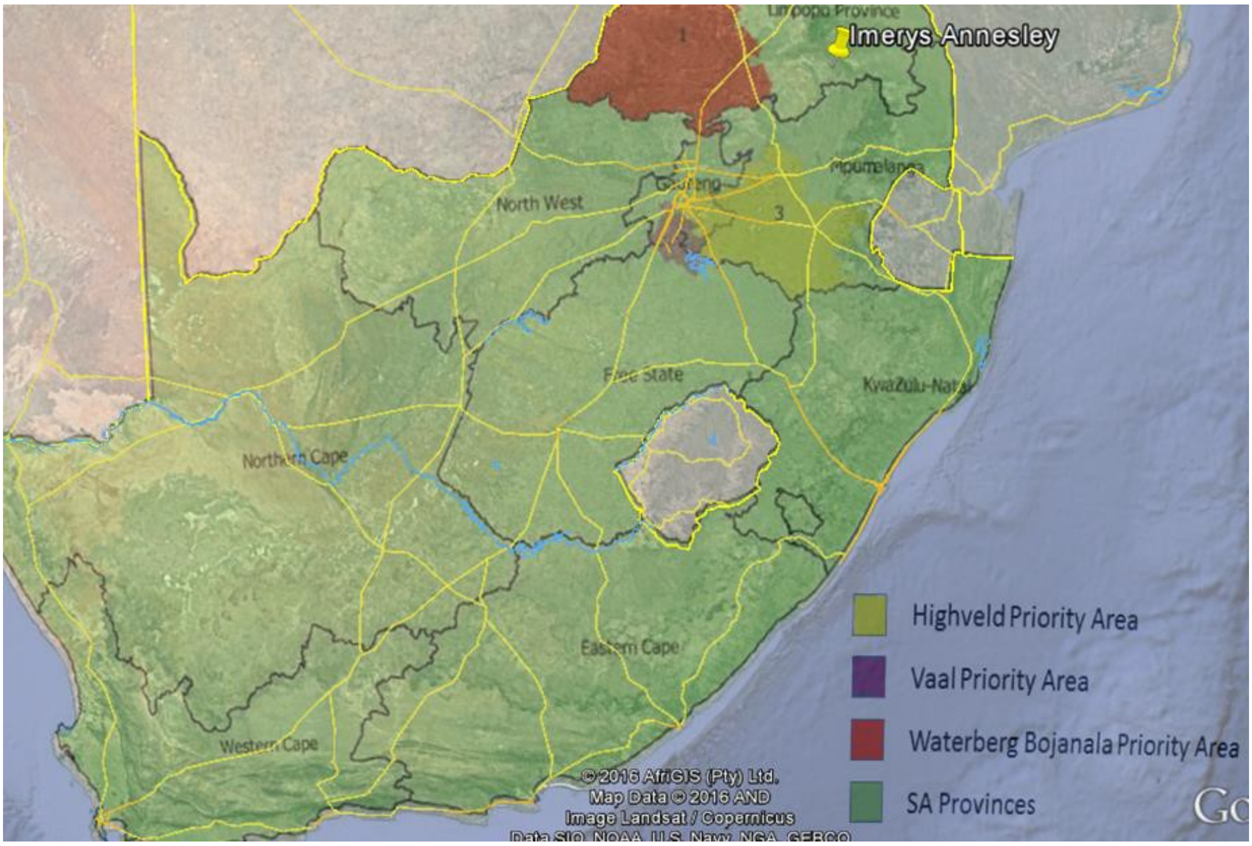

Figure 9: Air quality priority areas (*www.saagis.org.za)*

3.1.11 Environmental noise

Information for this section was extracted from the 'Approved EMP (nd, nd):

No baseline values were determined as the area is classified as rural and the statutory requirement for such areas is known to be 45dB. The only source of noise beyond the boundaries of the mine is expected to be low volume traffic noise from public roads.

3.1.12 Visual aspects

There is no specialist study done on visual aspects. The comment below is based on assumptions made during site visits.

Havercroft Operation is visible from the scattered residential areas of the local inhabitants and from the access roads.

3.1.13 Cultural and heritage resources

Information for this section was extracted from the Approved EMP (Shangoni Management Services, 2006), and the EMP PAR (BECS Environmental, 2015):

Some tools dating to the Early and Middle Stone Age were found within the boundaries of Segorong village but are of low archaeological significance.

No archaeological site dating to the Iron Age was identified in the area of the mining area.

3.1.14 Sensitive features

According to the EMP (Shangoni Management Services, 2006), no red data vegetation species were noted but a protected tree species *Adonsonia digitata* (Baobabs) occurs in the low-lying area between the Motse River and Modubeng Spruit, outside of the mine area. *Euphorbia* species were found on the mine. It is unclear where these plant species are situated.

The grey rhebuck and leopard are endangered species in the area.

Havercroft Operation falls within the Sekhukhune Norite Bushveld which is an endangered threatened ecosystem. The area surrounding the quarries are classified as Critical Biodiversity Area 1.

3.1.15 Regional socio-economic aspects

Information for this section was extracted from the IWWMP (Shangoni Management Services, 2012):

The mining site is situated within the Sekhukhune District Municipality and Greater Tubatse Local Municipality. The statistics indicated in the table below was generated by the Demarcation Board and was valid as of March 2000.

Table 23: Socio-economic statistics for the area

Statistic	Number	Statistic	Number
No. of Households	1,410	**Age breakdown**	
Population		0-4	1,085
African	7,625	5-19	3,531
Coloured	12	20-29	1,155
Indian	0	30-49	1,143
White	12	50-64	426
Unspecified	33	Over 65	294
Gender		Age Unknown	55
Male	3,434		
Female	4,246		
Annual individual income		**Annual household income**	
None	6,740	None	472
R1 – 2,400	86	R1 – 2,400	163
R2,401 – 6,000	366	R2,401 – 6,000	313
R6,001 – 12,000	121	R6,001 – 12,000	182

Statistic	Number	Statistic	Number
R12,001 – 18,000	91	R12,001 – 18,000	96
R18,001 – 30,000	62	R18,001 – 30,000	54
R30,001 – 42,000	67	R30,001 – 42,000	39
R42,001 – 54,000	49	R42,001 – 54,000	28
R54,001 – 72,000	20	R54,001 – 72,000	22
R72,001 – 96,000	3	R72,001 – 96,000	16
R96,001 – 132,000	3	R96,001 – 132,000	5
R132,001 – 192,000	3	R132,001 – 192,000	4
R192,001 – 360,000	1	R192,001 – 360,000	3
Over R360,000	0	Over R360,000	0
Unspecified	70	Unspecified	13

1. *Major economic activities and sources of employment*
   - Annesley Andalusite Mine;
   - Local shops;
   - Schools and
   - Farmers in the Burgersfort/Steelpoort areas.

2. *Unemployment estimate for the region*

Statistics are misleading as rural communities don't always understand the difference between self-employed, employed, unemployed and pensioner. It is estimated that only about 11% of the residents are formally employed.

3. *Housing demand, and availability*

The mine is in the Malepe Tribal Area and land allocation is informal. The land is administrated as a communal land where small plots are allocated on a "Permission to Occupy" (PTO) basis. A number of formal townships have been established in the region, or is in the construction phase, and stands are readily available.

4. *Social infrastructure - schools, hospitals, sporting and recreating facilities, shops, police, civil administration*
   - Churches at Segorong: 4 churches namely; Baptist Church, Segorong RCC, Apostolic Church, St Engenas ZCC.
   - Schools in Segorong: Segorong Primary School: (260 pupils, 8 teachers) and Madikoloshe Secondary School (126 pupils, 9 teachers);
   - Businesses in Segorong: Magana Gokatwa (bottle store, not in use), Hygienic Butchery (not in use), Matikwene Eating house (active), Majestic Café, Super Saving Store (active);
   - Health Services: Hospital at Penge;
   - Recreation Facilities: None;

- Police: Burgersfort;
- Civil Administration: The authority in the area is the Malepe Tribal Authority and is in the jurisdiction of the Sekhukhune Local Municipality. The Administrative Centre is at Praktiseer, some 24 km to the south.

5. *Bulk services*
   - Process water to the mine is pumped from the old mine at Penge;
   - Bulk water supply to Segorong Village is from a tank fed by a fountain;
   - There is no internal water reticulation in Segorong. The community collects the water at the storage tank and carries it to their houses;
   - No waste removal services exist;
   - Existing sewerage varies from ordinary pit latrines with the makeshift structure to no sewerage at all;
   - The high voltage power line to Penge passes through the property and a low voltage line from the Penge substation supplies electricity to the mine;
   - There is no electricity in Segorong Village.
   - Key Economic Activities

There are no Gross Geographic Product (GGP) estimates available for Sekhukhune Cross-Border District Municipality, in which the Annesley Andalusite Mine – Segorong Project resides since the demarcation was done in December 2000. The closest proxy is to consider sectoral employment. However, there is not a strict correlation between employment and GGP, because a sector such as agriculture has a considerably higher employment co-efficient than a sector such as mining, which is more capital intensive. Sectoral employment figures for Sekhukhune Cross-Border District Municipality are reflected below because these are the best available at present.

Table 24: Socio-Economic statistics for the area

Sector	Employment number
Agriculture, hunting; forestry and fishing	11357
Mining and quarrying	5618
Manufacturing	3315
Electricity; gas and water supply	707
Construction	3299
Wholesale and retail trade	9180
Transport; storage and communication	2668
Financial, insurance, real estate and business services	2736
Community, social and personal services	17250
Other and not adequately defined	6
Private Households	7642
Undetermined	6844
Total	70622

Community services, which are mostly government, is the largest employer by far, accounting for 25% of employment. It is probably also the largest contributor to GGP. It is evident that government is far more dominant in the Limpopo portion of Sekhukhune than in Mpumalanga.

The second biggest employer is agriculture and hunting, with 16% of total employment. In this case, Mpumalanga is the dominant contributor. Trading activities are in third place (13%) and this time the relative contributions from Limpopo and Mpumalanga are more balance, but with Limpopo ahead. This is a reflection of the larger number of people living in the Limpopo part of Sekhukhune district.

Private household activities are in fourth place at 11%. This time Mpumalanga is well ahead, reflecting the domestic work opportunities that are available at Groblersdal, Marble Hall, and Burgersfort. Mining is only the fifth largest employer, but probably the largest or second largest contributor to GGP. Limpopo, with its platinum mines in Tubatse and Fetakgomo, is the dominant area.

All the other sectors, including manufacturing and construction, are relatively small, accounting for less than five percent of total employment each. In-migration is likely to be less than 3000 of the total employment of almost 71,000, which is less than 5%. However, in addition to the total number of locally employed persons, there are probably at least 42,000 men who have families in Sekhukhune district, but who work elsewhere.

This annual rehabilitation plan is for decommissioning of the operation and rehabilitation of the area. Listed below in Table 6 is the specific activities that are conducted at Havercroft Operation.

3.2 Project context

3.2.1 Mining and associated processes

There are 15 mined out quarries at Havercroft Operation, with one large non-operational WRD, various overburden dumps and one large non-operational fine tailings dump. There are no topsoil stockpiles. Havercroft Operation is not using water for processing. There is a non-operational RWD at the TDF.

3.2.2 Mining phases

All mining is currently finished therefore there are no phases.

3.3 Zone of influence

The area surrounding the mine is Babinatlou Community.

SECTION 4: ANNUAL REHABILITATION PLAN

4.1 Proposed final post-mining land use

The end land-use has been identified as grazing and game farming. Water accumulating within the remaining quarries will be utilised and optimised to compliment the end land-use. Sloping should be at a safe angle for cattle and other animals to graze on site and provide easy access to the water. Sloping should allow for free drainage and prevent siltation of the water resources. Refer to **Figure 10** below for a sketch plan describing the final and future land use proposal and arrangements for the site.

4.2 Results of monitoring of risks identified in the final rehabilitation, decommissioning and mine closure plan with a view to informing rehabilitation and remediation activities

Refer to the Environmental Risk Assessment Report, attached as **Addendum 1** for a complete description of all the risks identified in the final rehabilitation, decommissioning and mine closure plan with a view to informing rehabilitation and remediation activities.

4.3 An identification of shortcomings experienced in the preceding 12 months

This is the first annual rehabilitation plan to be submitted. As stated in Section 1.4 of this report, rehabilitation can only commence once the basic assessment has been approved.

4.4 Details of the planned annual rehabilitation and remediation activities or measures for the forthcoming 12 months, including those which will address the shortcomings contemplated in Section 4.2 above or which were identified from monitoring in the preceding 12 months

4.4.1 If no areas are available for annual rehabilitation and remediation concurrent with mining

This is not applicable as there are areas available for annual rehabilitation and remediation concurrent with mining.

4.4.2 If areas are available for annual rehabilitation and remediation concurrent with mining

The mine is non-operational, therefore, there is no operational MWP.

Key closure objectives are necessary for mine closure, to guide the project design, development and management of environmental impacts. The closure objectives for the mine are as follow:

1. To rehabilitate the land to a level where natural topography, vegetation and land use approach the original state as closely as possible.
2. That storm water control is permanent in view of the large volumes of fine erodible materials that has been created.
3. That the water quality and catchment yield return to the original state as closely as possible.

The rehabilitation of Havercroft will focus on backfilling of quarries as far as possible and sloping and levelling of any additional overburden; removal of alien vegetation and establishment of natural vegetation on all disturbed areas to also prevent erosion; adequate storm water control to prevent siltation and pollution of the Rivers and Spruit; and removal of all old infrastructure. The rehabilitation plan will therefore be compatible with the closure objectives.

4.4.2.1 Pipelines

Nature or type of activity and associated infrastructure	Various pipelines traverse the mining area. These pipes are steel pipes. None of these pipes are in use anymore.
Planned remaining life of activity under consideration	None
Area already disturbed or planned to be disturbed* in the period of review	1,800m
Percentage of the already disturbed or planned to be disturbed area available for concurrent rehabilitation and remediation activities	100%
Percentage of the already disturbed or planned to be disturbed area available and on which concurrent rehabilitation and remediation activities can be undertaken	100%
Notes to indicate why total available or planned to be available area differs from area already disturbed or planned to be disturbed;	N/A
Notes to indicate why concurrent rehabilitation will not be undertaken on the full available or planned to be available area;	N/A
Details of rehabilitation activity planned on this area for the period of review;	All steel pipes will be removed to other mines within the Imerys Group. These pipes will then be reused as part of their operations.
The pertinent closure objectives and performance targets that will be addressed in the forthcoming year, which objectives and targets are aligned to the final rehabilitation, decommissioning and mine closure plan;	To remove all pipes in accordance with all environmental principles as well as the requirements of the MHSA.
Description of the relevant closure design criteria adopted in the annual rehabilitation and remediation activities and the expected final land use once all rehabilitation and remediation activities are complete for the activity or aspect	Not necessary. No design criteria needed for the removal of pipelines.

* This disturbed area refers only to the area disturbed by the pipelines and not the entire area of the Operation.

4.4.2.2 Plant area and other buildings

Nature or type of activity and associated infrastructure	The plant is currently non-operational. Associated buildings are the workshops. There is still scrap metal and plant equipment that need to be removed
Planned remaining life of activity under consideration	None
Area already disturbed or planned to be disturbed* in	Plant area approximately 1,605m², and other buildings approximately 4,894m²

Percentage of the already disturbed or planned to be disturbed area available for concurrent rehabilitation and remediation activities	100%
Percentage of the already disturbed or planned to be disturbed area available and on which concurrent rehabilitation and remediation activities can be undertaken	100%
Notes to indicate why total available or planned to be available area differs from area already disturbed or planned to be disturbed;	N/A
Notes to indicate why concurrent rehabilitation will not be undertaken on the full available or planned to be available area;	N/A
Details of rehabilitation activity planned on this area for the period of review;	All hazardous materials such as hydrocarbons, fluorescent tubes, etc. will be removed by a licensed waste contractor to a licensed disposal area. The mine will obtain all the correct documentation such as safe disposal certificates and copy of the disposal site license. All salvageable material will be removed to either a steel merchant or other mine operations. Concrete will be removed to a depth of 1m below surface. Building rubble (inert waste) could be used for backfilling of the quarries, however, the disposal of more than 25tons need a waste license excluding the disposal of such waste for the purposes of levelling which has been authorised by or under other legislation. This will be discussed with DMR prior to disposal. Once all salvageable infrastructure has been removed and foundations broken the plant area should be sloped to allow for free drainage to the east. There are also small stockpiles and walls from old return water dams that should be graded to fill unnatural depressions around the plant area. High walls should be broken and sloped to allow for vegetation growth.
The pertinent closure objectives and performance targets that will be addressed in the forthcoming year, which objectives and targets are aligned to the final rehabilitation, decommissioning and mine closure plan;	The removal of all plant material is necessary to reslope are and ensure free-flowing of water and revegetation for the planned end land use.
Description of the relevant closure design criteria adopted in the annual rehabilitation and remediation activities and the expected final land use once all rehabilitation and remediation activities are complete for the activity or aspect	Not necessary. No design criteria needed for the removal of buildings.

* This disturbed area refers only to the area disturbed by the plant and other buildings and not the entire area of the Operation.

4.4.2.3 Waste rock dump and plant area to be sloped

Nature or type of activity and associated infrastructure	There is a large waste rock dump to the north of the mine, just south of the TDF. On the western side is natural vegetation as well as a servitude for a high voltage power line.
Planned remaining life of activity under consideration	None
Area already disturbed or planned to be disturbed* in	1,313,973m³
Percentage of the already disturbed or planned to be disturbed area available for concurrent rehabilitation and remediation activities	100%
Percentage of the already disturbed or planned to be disturbed area available and on which concurrent rehabilitation and remediation activities can be undertaken	100%
Notes to indicate why total available or planned to be available area differs from area already disturbed or planned to be disturbed;	N/A
Notes to indicate why concurrent rehabilitation will not be undertaken on the full available or planned to be available area;	N/A
Details of rehabilitation activity planned on this area for the period of review;	On the western side is natural vegetation as well as a servitude for a high voltage power line. It is therefore proposed to slope most of the material to the north in the direction of the tailings facility and to the east towards the plant area. Once the sloping is finalised it is also recommended to add contour paddocks along the side slopes of the waste rock dump no more than 20m apart. Previous contours of 50m apart have shown erosion to form along the slope.
The pertinent closure objectives and performance targets that will be addressed in the forthcoming year, which objectives and targets are aligned to the final rehabilitation, decommissioning and mine closure plan;	The majority of the earthworks required at Havercroft Operation is to slope the waste rock dump. The waste rock dump needs to be flattened to reduce the angle of the side slopes as a preventative measure against erosion and to encourage vegetation growth.
Description of the relevant closure design criteria adopted in the annual rehabilitation and remediation activities and the expected final land use once all rehabilitation and remediation activities are complete for the activity or aspect	Refer to **Addendum 4:** Earthworks Plan, for the design criteria.

* This disturbed area refers only to the area disturbed by the WRD and the plant area to be sloped, and not the entire area of the Operation. This area is calculated in volume and not surface area.

4.4.2.4 Quarries

Nature or type of activity and associated infrastructure	There are 15 quarries at Havercroft. These quarries are located along a mountainous line from north to south. These quarries have a steep high wall on the western side.
Planned remaining life of activity under consideration	None
Area already disturbed or planned to be disturbed* in	152,660.50 m³
Percentage of the already disturbed or planned to be disturbed area available for concurrent rehabilitation and remediation activities	100%
Percentage of the already disturbed or planned to be disturbed area available and on which concurrent rehabilitation and remediation activities can be undertaken	100%
Notes to indicate why total available or planned to be available area differs from area already disturbed or planned to be disturbed;	N/A
Notes to indicate why concurrent rehabilitation will not be undertaken on the full available or planned to be available area;	N/A
Details of rehabilitation activity planned on this area for the period of review;	It is proposed to plant a thick row of euphorbias on the top of the high walls. This will be done to prevent access of people and animals to these high walls. Only the quarries where the need for earthworks has been identified are included in the description for sloping. Safeguarding of high walls are encouraged but has not been included in the modelling as there is a major safety concern to work above the high walls with machinery. All high walls have been modelled to remain in place due to this safety risk. Refer to Addendum 4 for a complete description of the sloping.
The pertinent closure objectives and performance targets that will be addressed in the forthcoming year, which objectives and targets are aligned to the final rehabilitation, decommissioning and mine closure plan;	The excavated areas are located at the foot of a hill creating high walls with steep benches. These benches are a safety risk for both humans and animals moving on site. It is therefore the first main objective to safeguard high walls and where possible reslope to a safe gradient.

Description of the relevant closure design criteria adopted in the annual rehabilitation and remediation activities and the expected final land use once all rehabilitation and remediation activities are complete for the activity or aspect	Refer to Addendum 4: Earthworks Plan, for the design criteria.

* This disturbed area refers only to the area disturbed by the quarries, and not the entire area of the Operation. This area is calculated in volume and not surface area.

4.4.2.5 Primary and secondary access roads

Nature or type of activity and associated infrastructure	There are various roads traversing the area. Some of these roads will be kept after closure for farming activities.
Planned remaining life of activity under consideration	None
Area already disturbed or planned to be disturbed* in	42,760m²
Percentage of the already disturbed or planned to be disturbed area available for concurrent rehabilitation and remediation activities	100%
Percentage of the already disturbed or planned to be disturbed area available and on which concurrent rehabilitation and remediation activities can be undertaken	100%
Notes to indicate why total available or planned to be available area differs from area already disturbed or planned to be disturbed;	N/A
Notes to indicate why concurrent rehabilitation will not be undertaken on the full available or planned to be available area;	N/A
Details of rehabilitation activity planned on this area for the period of review;	Refer to **Addendum 3** for a Report on the Reshaping, Re-Vegetation, and Alien Control Plan of the area.
The pertinent closure objectives and performance targets that will be addressed in the forthcoming year, which objectives and targets are aligned to the final rehabilitation, decommissioning and mine closure plan;	The removal of unwanted roads will prevent erosion of these areas. Some roads will still be used by farmers and cannot be removed.
Description of the relevant closure design criteria adopted in the annual rehabilitation and remediation activities and the expected final land use once all rehabilitation and remediation activities are complete for the activity or aspect	Not necessary. No design criteria needed for the removal roads.

* This disturbed area refers only to the area disturbed by the roads, and not the entire area of the Operation.

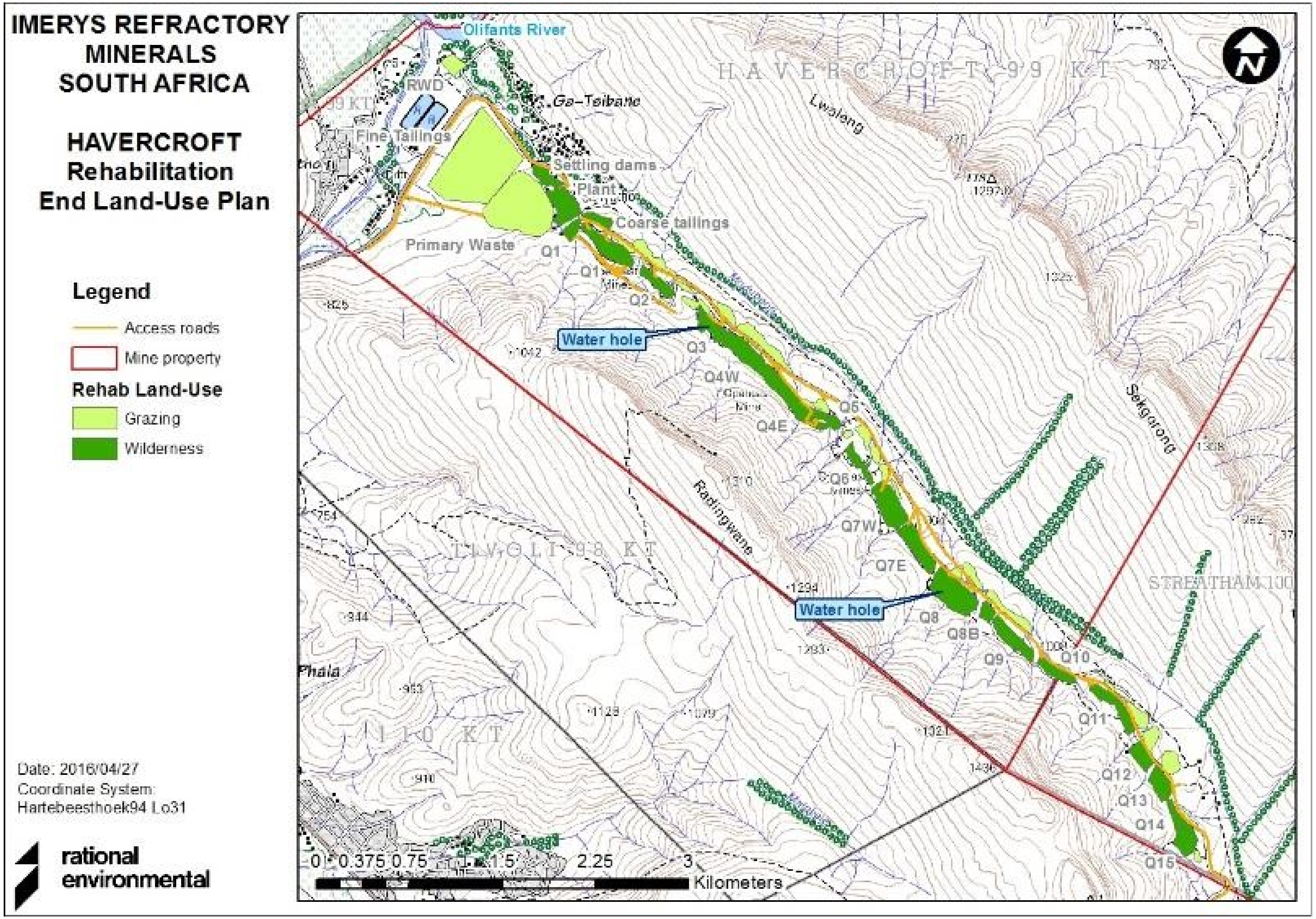

Figure 10: A sketch plan describing the final and future land use proposal and arrangements for the site

4.4.3 A site plan indicating at least the total area disturbed, area available for rehabilitation and remediation and the area to be rehabilitated or remediated per aspect or activity

Refer to **Figure 11** below for a site plan.

4.5 A review of the previous year's annual rehabilitation and remediation activities, indicating a comparison between activities planned in the previous year's annual rehabilitation and remediation plan and actual rehabilitation and remediation implemented

This section is tabulated and contains;

a. area planned to be rehabilitated and remediated during the plan under review
b. actual area rehabilitation or remediated; and
c. if the variance between planned and actual exceeds 15%, motivation indicating reasons for the inability to rehabilitate or remediate the full area

Havercroft Operation is non-operational and complete rehabilitation of this area is planned for the near future. A basic assessment application was lodged on the 7th of December 2017 for the decommissioning of the plant area. The mine is still awaiting authorisation of the basic assessment, once this is received rehabilitation will commence.

There is, therefore, no review available of the previous year's annual rehabilitation and remediation activities.

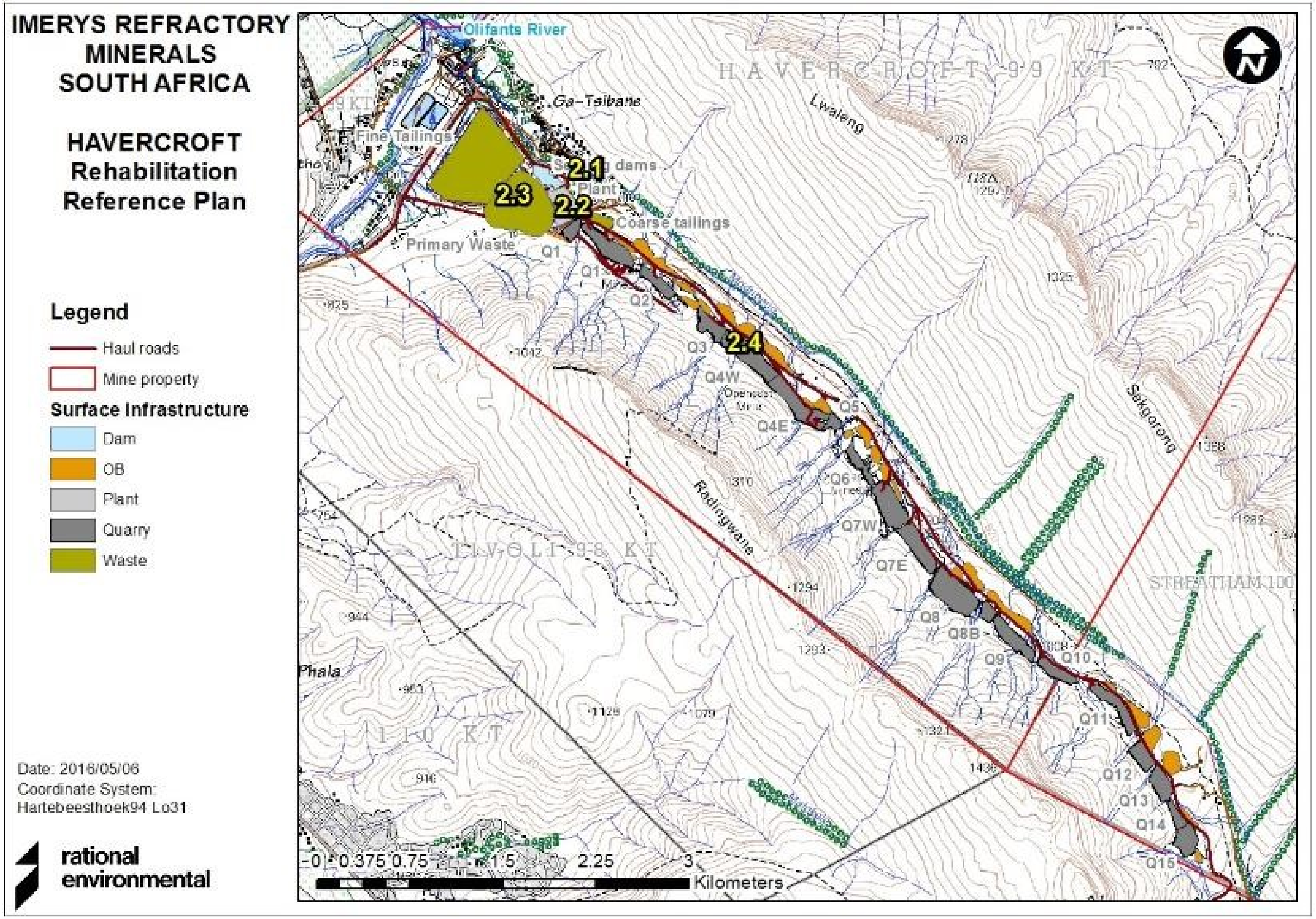

Figure 11: Areas to be rehabilitated (2.1 = pipelines, 2.2 = plant area, 2.3 = waste rock dumps, 2.4 = quarries

4.6 Details of the timeframes of implementation of the current, and review of the previous rehabilitation activities

Havercroft Operation is non-operational and complete rehabilitation of this area is planned for the near future. A basic assessment application was lodged on the 7th of December 2017 for the decommissioning of the plant area. The activity triggered is listed activity 22(ii) of GN 983 of 2014 (as amended) in terms of the NEMA:

"The decommissioning of any activity requiring (ii) a prospecting right, mining right, mining permit, production right or exploration right, where the throughput of the activity has reduced by 90% or more over a period of 5 years excluding where the competent authority has in writing agreed that such reduction in throughput does not constitute closure."

The mine is still awaiting authorisation of the basic assessment, once this is received rehabilitation will commence. However, it is presumed that authorisation will be granted within 2018 and therefore refer to the schedule for rehabilitation in the table below. Refer to Figure 11 which indicates the areas to be rehabilitated. This map is linked to Table 4 below, showing the schedule for rehabilitation of each of these areas.

Table 25: Schedule for rehabilitation

Description	Schedule	Rehabilitation section
Removal of pipelines	3 years as from 2018	4.4.2.1
Removal of plant area and other buildings		4.4.2.2
Waste rock dump		4.4.2.3
Quarries		4.4.2.4
Primary and secondary roads		4.4.2.5

SECTION 5: POST REHABILITATION ACTIVTIES

Information for this section was taken from 'Rehabilitation Recommendations after Alien Plant Control' (Campbell, 2001). Post rehabilitation will take place after closure of the mine. These activities will be in the form of maintenance and monitoring. This section will form part of the closure plan to be compiled when closure of mine is neared. If, during monitoring it is noticed that re-vegetation or removal of plants is necessary, or if during maintenance re-vegetation or removal of plants must be done.

5.1 Monitoring plan

Monitoring of any rehabilitation is absolutely necessary to ensure that the integrity and performance of the rehabilitation method are still in line with the original objectives and purposes of the method. It is very important that monitoring takes place continuously throughout and after rehabilitation. The main goals behind a monitoring program are (van Deventer, 2009):

1. To meet legal requirements. In the EMP, a description of methods to be followed to monitor compliance of the approved rehabilitation plan is included. Closure application should also be

substantiated with adequate monitoring data. Closure objectives must be specified upfront and accepted by all parties. Objectives must be prescribed for at least the following:

- Topographical reshaping
- Erosion (surface stability);
- Vegetation cover (species diversity, abundance);
- Surface water drainage systems;
- Surface water quality
- Groundwater quality
- Miner residue characteristics with respect to plant growth (soil quality)

2. Evaluating mine residue and vegetation quality. Dynamic assessment requires a monitoring system to provide a regular surveillance of mine residue and vegetation quality attributes or indicators.
3. Land management. The annual results of the monitoring program will determine the actions to be taken for the following year to ensure the site is improving in the direction of the stipulated end result.
4. Improving our understanding of new ecosystems. For the new ecosystem, the biological productivity, stocks and exchange of nutrients, and the regulation of other ecological processes need to be characterized, quantified, and modelled.

Refer below for the parameters of monitoring. This includes an explanation of the approach that will be taken to analyse monitoring results and how these results will be used to inform adaptive or corrective management and/or risk reduction activities.

Parameters to be monitored	Frequency of monitoring	Period of monitoring	Responsible person	Explanation of the approach that will be taken to address and close out audit results and schedule
Topographical reshaping				
After reshaping the resultant topography must be surveyed to determine the degree to which the final topography meets planned objectives, particularly in terms of surface drainage and in terms of slope required to meet land capability objectives. .	Once after reshaping	Once after reshaping	Mine surveyor	Deviations from plan must be documented, and the final reshaped surface should be signed off by the responsible person prior to the replacement of topsoil.
Erosion monitoring				
The primary objective of closure of any sloped area is to create a rehabilitated surface and topography that has the capacity to be stabilised under all environmental conditions e.g. severe rain events, veld fires, droughts etc. Erosion status of the rehabilitated land should be monitored and zones with excessive erosion should be identified for remedial action. Erosion can be quantified by insertion of marked stakes into the rehabilitated profile and recording the rate at which the stakes are uncovered. However, the norm is simply the recording of the existence of erosion in a particular location. Key objectives to improve surface stability are; • Minimisation of surface erosion (wind and water) • Establishment of a plant community that is self-sustaining or any other cover material which comply to surface stability Achievement of these objectives should be demonstrated by monitoring of the rehabilitated areas. The key objective of surface stability monitoring lies in being able to demonstrate in a quantified manner the	Monthly	Five years after rehabilitation	Mine manager	It is much simpler, and cheaper, to treat this type of erosion in the early stages of formation than to try repair the damage once a deep gulley has formed. Small ruts that are just starting to open up can be easily controlled by filling them with brush, straw, manure or even stones. Treatments should be concentrated in areas of clearly active soil erosion, rather than relatively stable (vegetated) gulleys). An extremely important principle with any soil erosion control method is that when natural materials are gathered for use in control structures, care must be taken to ensure that the removal (for example, of stones) does not become the cause of a new erosion problem at the source of the material. Stones, for example, should only be collected along roads, where they are displaced during road-making, or from piles of stones cleared off irrigation lands. Similarly, natural vegetation should not be destroyed by vehicles collecting or delivering materials for gulley control. (http://www.ostrichsa.co.za/downloads/bio_diversity/rehabilitation.pdf)

Parameters to be monitored	Frequency of monitoring	Period of monitoring	Responsible person	Explanation of the approach that will be taken to address and close out audit results and schedule
stability of surface rehabilitation works. The monitoring programme should be developed such that loss of soil can be quantified and the stability of the vegetated areas be assessed.				
Soil pollution				
The area should be surveyed for soil pollution.	Once every quarter	Until after rehabilitation.	Mine manager	Any signs of pollution must be removed as hazardous waste.
Vegetation monitoring				
Vegetation establishment on new ecosystems or on disturbed systems should yield a self-sustaining community that is dynamic and able to change as the rehabilitated site ages and matures. The success of re-established plant community must be demonstrated through appropriate monitoring. The monitoring program must quantify the established plant community in terms of: 1. Species abundance (diversity) a. Improvement on contact cover b. Canopy cover c. Rooting depth d. Reproductive performance - Sexual reproduction 2. Asexual reproduction a. Microbial activity and biomass b. Frequency – once a year c. Remarks	Refer to Figure 12 below.	Five years after rehabilitation	Mine manager	Refer to step 4 and 5 in parameters to be monitored

Parameters to be monitored	Frequency of monitoring	Period of monitoring	Responsible person	Explanation of the approach that will be taken to address and close out audit results and schedule
The vegetation-monitoring programme must be developed for each case of implementation, without compromising the integrity of data gathered. A qualified ecologist with experience in assessment of rehabilitated plant communities must design the monitoring programme. The rehabilitation of grass species will potentially take place over 5 years depending on the progress of the rehabilitation plan. After this initial monitoring, a less comprehensive monitoring will be done. Refer to Figure 4 for a diagram of the vegetation monitoring to be done on the site. It is important to note that throughout all the monitoring phases, alien vegetation should be noted and included in an Alien Invasive Vegetation Control Programme. It is the objective to eradicate all alien plants during the control programme; however, it is very likely that alien vegetation will re-occur after such initial control. To combat this, an Alien Invasive Vegetation Control Programme is set out. There are five steps to this control programme. They are as follows: Please note, this alien vegetation monitoring must also be done after concurrent rehabilitation and the re-vegetation and removal of plants during concurrent rehabilitation has taken place. **Step 1: Information gathering**				

<table>
<tr><th>Parameters to be monitored</th><th>Frequency of monitoring</th><th>Period of monitoring</th><th>Responsible person</th><th>Explanation of the approach that will be taken to address and close out audit results and schedule</th></tr>
<tr><td>This first step is done to create a map, indicating the different infestation areas on the site. The following should be done to create such a map:
1. Alien plant infestations should be divided into control areas. To do this, natural or man-made barriers can be used. These barriers include roads, rivers and fences. These barrier areas should be numbered for record purposes.
2. A detailed alien plant survey should be done in each area. The following should be recorded –
• All alien plant species present and their growth habit (shrubs, trees, coppice, saplings, seedlings),
• Percent density of each alien plant species (75-100% is very dense, 50-75% is dense, 25-50% is medium dense, 5-25% is sparse and 0-5% is scattered),
• The terrain.
3. Rank the areas into high, medium and low priority areas. This depends on the biodiversity; water yield and carrying capacity.
4. Identify suitable grass species for establishment and availability, per land use aims.
5. Place all above information on a 1:1 000 map.

Step 2: Planning</td><td></td><td></td><td></td><td></td></tr>
</table>

Parameters to be monitored	Frequency of monitoring	Period of monitoring	Responsible person	Explanation of the approach that will be taken to address and close out audit results and schedule
This step is to establish integrated control strategies in each control (barrier) area as identified in Step 1. The following should be done: 1. List the required resources for each high priority control area (e.g. labour, herbicides, and equipment) and the current management practices on the property. 2. Evaluated and select appropriate control methods, using registered herbicides. 3. Calculate the costs for the high priority control areas. 4. Secure a long-term commitment to rehabilitation. **Step 3: Management** 1. Draw up an Annual Plan of Operations (APO) for high priority control areas. This plan must be updated each year. It includes a budget for the required resources for control strategies during the first year. This determines the scale of work. a. 75% for follow-up work and rehabilitation of previously cleared areas’ b. 20% for initial control of new area’ and c. 5% for an emergency. 2. Establish an emergency fund to cope with catastrophes such as mass seeding generation, fire, flood, etc. 3. Allocate resources to high priority control areas.				

Parameters to be monitored	Frequency of monitoring	Period of monitoring	Responsible person	Explanation of the approach that will be taken to address and close out audit results and schedule
4. Draw up timetables for control operations, including a "catch-up" for in case operations fall behind. 5. The plan must be flexible and adjusted as progress is made. **Step 4: Implementation** Train the labourers in correct control and grass planting methods. **Step 5: Record keeping** 1. Keep simple records of daily operations, e.g. record of labour days, herbicide used, and volumes and equipment used. 2. Monitor progress with the control work (after first year) by recording information on maps. 3. The information from these records must be fed back into the budget to update and amend the APO for the following year.				
Euphorbias				
The growth of the Euphorbias must be mentioned to ensure this has created a barrier for safety purposes.	Once every quarter	Until after rehabilitation.	Mine manager	If the Euphorbias are not creating a barrier, they must be replanted.
Surface water drainage systems				
The functionality of the surface water drainage systems should be checked annually, preferably after the first major rains of the season, and then after any major storm. This is both to ensure that the drainage of the re-created profile matches the plan, and to	During rainy season	Five years after rehabilitation	Mine manager	Repair drainage structures that are not functioning efficiently.

Parameters to be monitored	Frequency of monitoring	Period of monitoring	Responsible person	Explanation of the approach that will be taken to address and close out audit results and schedule
permit early repair of drainage structures that are not functioning efficiently.				
Surface water quality				
Surface water upstream and downstream of the Olifants and Mogomotsi Rivers must be monitored to assess the quality of the water from the mining area. Please note, if DWS does not request this monitoring from the mine, it will not be implemented.	Monthly	Five years after rehabilitation	Mine manager	If water results from the mine indicates quality above the acceptable limits, this will be discussed with DWS and the users of the River.
Groundwater quality				
The mine has no current groundwater monitoring. It is advised that groundwater monitoring take place downslope from the WRD and the slimes dams. The mine will either drill two boreholes to monitor groundwater qualities or use already existing boreholes in the area.	Quarterly	Five years after rehabilitation	Mine manager	If water results from the mine indicates quality above the acceptable limits, this will be discussed with DWS and the groundwater users in the area.
Mine residue characteristics with respect to plant growth (soil quality)				
Soil quality monitoring will only be done if necessary and until natural vegetation is in place.			Mine manager	

5.2 Internal, external and legislated audits of the monitoring plan

The monitoring plan will be audited to ensure effective implementation.

5.2.1 Person responsible for undertaking the audit

Health Safety and Environmental Manager for internal audits and consultant for external audits.

5.2.2 Planned date of audit and frequency of audit

Annually.

5.2.3 An explanation of the approach that will be taken to address and close out audit results and schedule

Refer to the monitoring plan in section 5.1 for approach that will be taken to address and close out audit results and schedule.

5.2.4 Disclosure of updates of the plan to stakeholders

The audit report will be sent to all stakeholders once finalised, therefore on a quarterly basis.

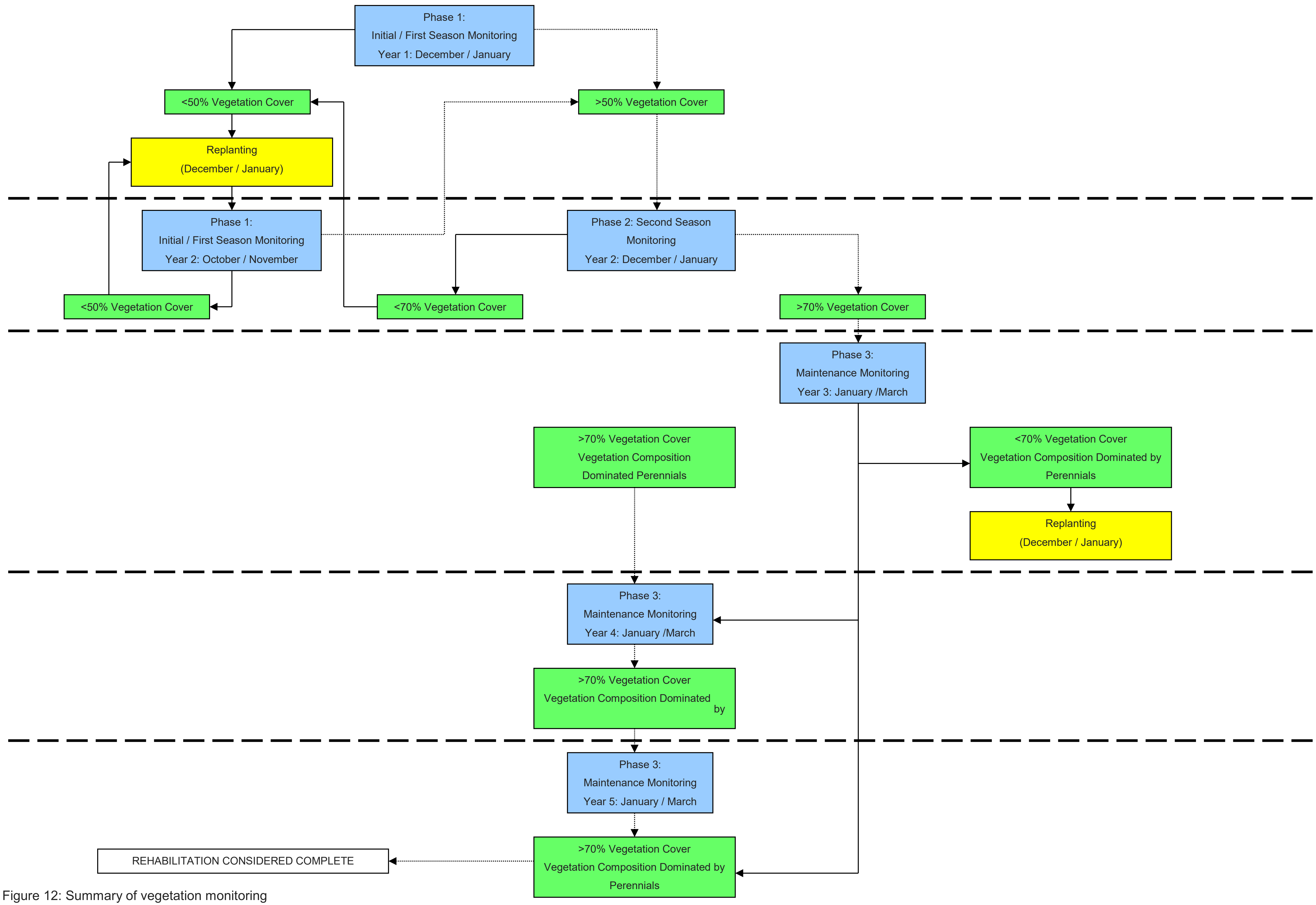

Figure 12: Summary of vegetation monitoring

SECTION 6: ANNUAL UPDATED FINANCIAL PROVISION

This section is the annual updated financial provision for Annesley Mine (Havercroft Operation). This section includes

i. an explanation of the closure cost and methodology,
ii. auditable calculations of costs per activity or infrastructure,
iii. cost assumptions;
iv. and monitoring and maintenance costs likely to be incurred both during the period of the annual rehabilitation plan and those that will extend past the period of the final rehabilitation, decommissioning and mine closure plan, on condition that the monitoring and maintenance costs included in previous annual rehabilitation plans must be accumulated into subsequent versions of the annual rehabilitation plan until such time as the monitoring and maintenance obligation is discharged

6.1 Financial provision methodology

Havercroft is non-operational and in the process to close-down. Closure costs must, therefore, be calculated with an accuracy of ±90%. Shangoni Management Services compiled a list indicating rates for actual costs to rehabilitate. The following is extracted from the Annesley Andalusite Mine Closure Liability Update (Shangoni Management Services, 2016):

The CES Group was contracted by Shangoni to acquire rates for demolition and rehabilitation of mining activities (**Table 25**). Procurement of budget pricing approached by identifying reputable demolition companies, various sites of varying sizes at various locations and identifying local companies in the study area with the ability to work on similar scale project. A bill of quantities (BoQ) was distributed to the various companies. The table below indicates the number of contractors to which the BoQ was distributed and the number of tenders received afterwards.

Table 26: Results of rate acquisition process

Area	Number of contractors identified	Tenders received
National	6	1
North West	6	3
Free State	5	1
Northern Cape	7	2
Limpopo	5	3 (One joint venture with national based company)
Total	29	10

The prices received from contractors were reviewed by the CES Group, after which average and meridian rates were drawn rates to correctly establish a baseline rate. The following methods to establish the baseline rates were followed:

- Price A - Average if priced – across the board average of rates received per category;
- Price B - Median pricing – “middle” rate of all rates in series per category;

- Price C - Average between Price A & B;
- Price D - Average rate excluding top and bottom rates per category.
- Price D - rate category that was used in the closure cost calculation, unless otherwise indicated in the closure cost spreadsheet “Rate” sheet.

The closure budget consists of the following areas:

- Physical - Demolition of infrastructure where infrastructure does not form part of end land use. Potential to transfer to third party was identified.
- Biophysical - Actions to safeguard (making safe and stable) and re-establish the biophysical to ensure a sustainable landform and mitigate identified risks. This includes levelling of the dumps, seeding of the trees and grass.

6.2 Auditable calculations of financial provision per activity or infrastructure

The monitoring and maintenance costs likely to be incurred both during the period of the annual rehabilitation plan and those that will extend past the period of the final rehabilitation, decommissioning and mine closure plan, on condition that the monitoring and maintenance costs included in previous annual rehabilitation plans must be accumulated into subsequent versions of the annual rehabilitation plan until such time as the monitoring and maintenance obligation is discharged are included in the table below.

Table 27: Tariffs used for quantum determination

Rehabilitation and Demolition	Unit	Rates
800mm thick /deep Reinforced in-situ concrete structures: Demolition and removal to demolition site	m³	R 502.27
400mm thick /deep reinforced concrete	m³	R 447.27
250mm thick /deep reinforced concrete	m³	R 350.00
340mm thick /deep concrete slabs	m³	R 400.00
220mm thick brick wall buildings (single storey) Face brick building, 14.8 x 10m x 4.4m high, consisting of 600 x 230mm strip footings laying 655mm deep, 150mm surface bed finished off with ceramic floor tiles including 110mm internal walls, with 1000 x 100mm apron around building and Roller shutter doors at service hatch 3000 x 1200mm. Ceilings at 2805mm high. Roof trusses 1600mm high at centre with 500mm overhang, pitching 15 degrees and 0.6mm IBR profiled colomet roof sheeting, ridge capping, fascia boards, barge boards, gutters and downpipes.	m²	R 447.27
Face brick building, 48 x 12.46m x 7.85m high, consisting of 750 x 300mm strip footings laying 755mm deep, 150mm surface bed finished off with ceramic floor tiles including 110mm internal walls, with 1000 x 100mm apron around the building. Ceiling below hollow block slab at 2805mm high. 1st-floor hollow block slab, 255mm thick finished off with ceramic floor tiles. Stairs to 1st floor 220mm threads x 150mm risers and slab to the wall at 1400mm high in middle and to one side of the building. Ceilings at 2890mm high. Prefabricated roof trusses 1900mm high at centre with 500mm overhang, pitching 15	m³	R 435.00

Rehabilitation and Demolition	Unit	Rates
degrees and 0.6mm colomet roof sheeting, ridge capping, fascia boards, barge boards, gutters, and downpipes. Canopy at entrance to building 3m wide x 2.8m high		
Excavating foundations 600 x 230 x 655mm deep strip footings	m^3	R 320.00
Light steel construction cladded with corrugated iron (car ports etc.) Carports 7.5m x 11m, consisting of 6 x 75 SHS Columns in 500mm deep concrete bases with colomet 6mm IBR roof sheeting on 75 x 75 SHS Curved purlins (one carport size 5.5 x 2.5m x 2.3m high)	m^2	R 53.13
Medium steel construction buildings (corrugated iron cladded workshops and sheds with concrete floors)	m^2	R 290.00
Dismantle, break down and remove plant structure, not exceeding 15m height	m^3	R 171.85
Demolish and remove 48kg/m railway line on P2 concrete sleepers, including fasteners, pads & clips.	m	R 80.00
Up to 400mm Diameter piping	m	R 37.69
Greater than 400mm Diameter piping	m	R 67.90
Dismantle and remove Cattle Fencing not exceeding 1.2m high, including posts, gates, foundations, etcetera	m	R 12.00
Dismantle and remove Mesh Fencing not exceeding 1.8m high, including posts, gates, foundations, etcetera	m	R 12.00
Dismantle and remove Security Fencing exceeding 1.8m high, including posts, gates, foundations, etcetera	m	R 13.50
Dismantle and remove Steel Palisade Fencing exceeding 1.8m high, including posts, gates, foundations, etcetera	m	R 22.00
Dismantle and remove Palisade Concrete Fencing exceeding 1.8m high, including posts, gates, foundations, etcetera	m	R 22.00
Dismantle and remove Electric Fencing not exceeding 2.1m high, including posts, gates, foundations, etcetera	m	R 22.00
Dismantle and remove Diamond Mesh Fencing not exceeding 2.4m high, including posts, gates, foundations, etcetera	m	R 22.00
Dismantle and remove Precast walling not exceeding 1.8m high, including posts, gates, foundations, etcetera	m	R 22.00
Wildlife fence 1.8m	m	R 140.00
15m H Pole structure complete with double 11kV Wolf conductor (6 x ACSR) and all accessories	m	R 45.00
Demolition of reinforced concrete silo 20m high	m^3	R 89.77
Disconnect and remove 2 x MCC panels. Demolish and remove face brick building 6,5 x 9 x 5.05m high to a roof truss, strip footings laying 750mm deep, 6 x 2m high columns with 300mm thick concrete slab on columns. Steel stairs and hand railing to 1st floor. Steel roof structure 1,6m high to pitch.	no	R 26,850.00
Disconnect and remove transformers, demolish transformer room brick building, 3 x 3 x 4m high.	no	R 10,850.00
Remove fuel pumps & tank	m^3	R 850.00
Remove overhead workshop cranes 15 Ton Single Girder crane - 20m wide	no	R 6,500.00

Rehabilitation and Demolition	Unit	Rates
Drain and fill French drain	no	R 6,585.00
Filling of Soakaways	no	R 6,585.00
Remove water tank	m³	R 450.00
Permatank	m³	R 850.00
Overland conveyor	m	R 540.00
Earthworks, break-up and level	m³	R 40.01
6m Office	no	R 1,500.00
12m Office	no	R 1,500.00
9.6m Park home	no	R 1,500.00
Quarry maintenance	ha	R 10,000.00
No cost incurred	n/a	R -
Ripping of dirt road	m²	R 14.89
Ripping of previously tar surfaced surface areas (tar removal measured elsewhere)	m²	R 21.31
Remove tarred surface areas not exceeding 50mm thick	m²	R 25.87
Break-up and remove paving bricks	m²	R 34.94
Break-up and remove concrete paving	m²	R 30.51
Demolish reinforced concrete	m³	R 950.69
Remove pumps and piping and demolish pump room size 3,5 x 5,25 x 3m high.	no	R 1,805.75
Drain dam, leave to dry, remove liner	m²	R 18.63
Earthworks, break-up and level*	m³	R 40.01
Traditional seeding	m²	R 3.36
Grass	m²	R 43.08
Sloping of open quarry (also include sloping of WRD)	m³	R 8.09
Enviroberm	m	R 22.55
Hydro seeding	m²	R 26.50

* Rating has been changed to include the sloping of the WRD and plant area.

6.3 Financial provision estimation

The following table contains a summary of the calculations made for the closure cost.

Table 28: Summary of the closure cost calculation until closure

Item	Size (m / m² / m³)	Rate	Final cost
Infrastructure removal			
Pipelines	1 800,00	R37,69	R67 842,00
Plant area and other buildings	1 605,00	R171,85	R275 819,25
12m office	5,00	R1 500,00	R7 500,00
Primary and secondary access roads	42 760,00	R14,89	R636 696,40
Sloping			
Waste rock dump and plant area	1 313 973,00	R8,09	R10 630 041,57
Quarry 1	3 051,00	R8,09	R24 682,59
Quarry 2	33 183,00	R8,09	R268 450,47
Quarry 3	7 858,50	R8,09	R63 575,27
Quarry 5	1 236,00	R8,09	R9 999,24
Quarry 6	5 926,00	R8,09	R47 941,34
Quarry 11	39 776,00	R8,09	R321 787,84
Quarry 12	21 198,00	R8,09	R171 491,82
Quarries 13 & 14	37 887,00	R8,09	R306 505,83
Quarry 15	2 545,00	R8,09	R20 589,05
Vegetation			
Seeding	209 449,00	R3,36	R703 748,64
Euphorbias planting	Once-off	R20 000,00	R20 000,00
Removal of alien plants	Once-off	R20 000,00	R20 000,00
Monitoring			
Soil erosion, vegetation growth, and alien vegetation monitoring	Annual for 5 years	R20 000,00	R150 000,00
Groundwater monitoring	Quarterly for 5 years	R20 000,00	R600 000,00
Sub-total			R14 346 671,31
P&G (13.5%)			R1 936 800,63
Contingency (10%)			R1 434 667,13
Total			**R17 718 139,06**

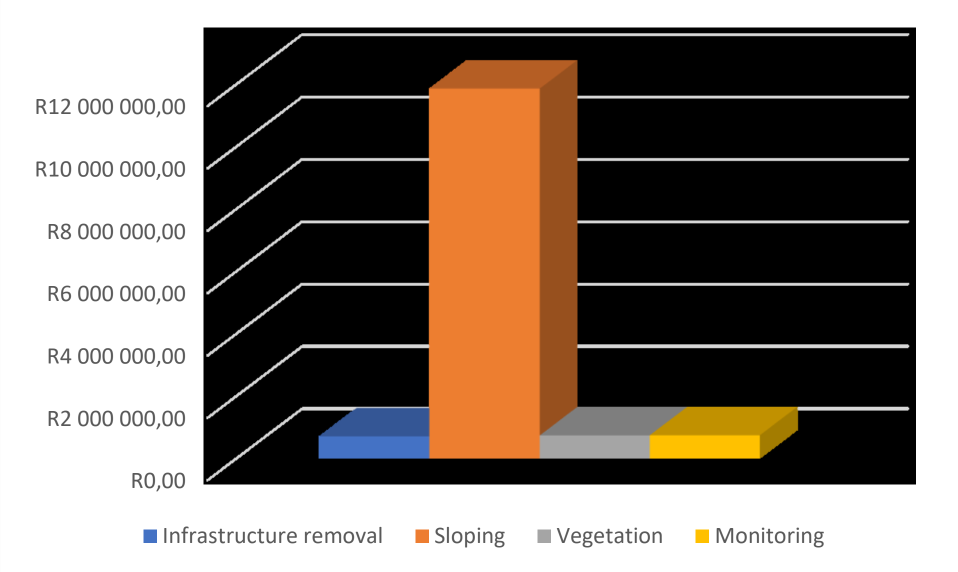

Figure 13: Financial provision summary

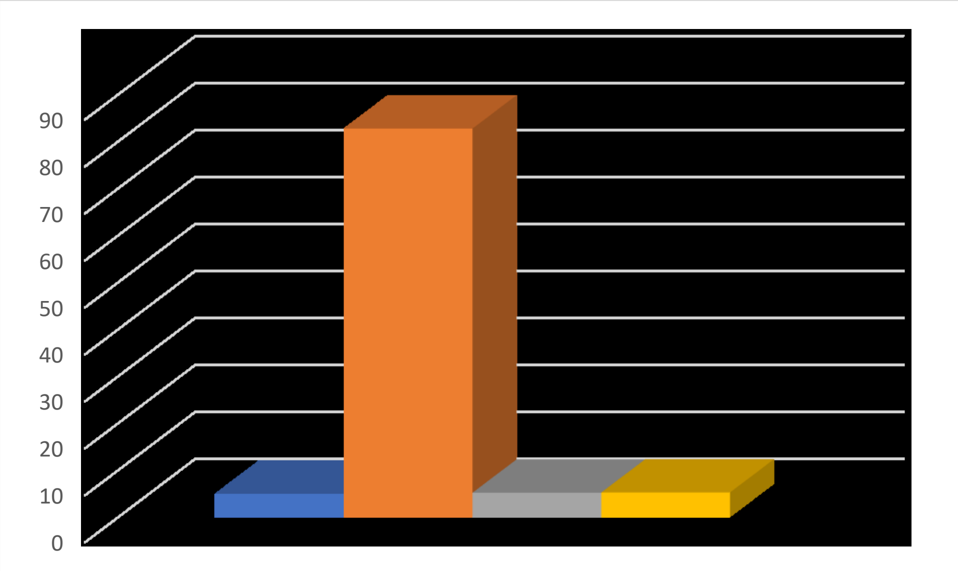

Figure 14: Percentage of financial provision

Referring to **Figures 14 and 15** above, it is evident that sloping will be almost 85% of the entire financial provision.

6.4 Financial provision assumptions

6.4.1 Pipelines

Various pipelines traverse the mining area. These pipes are steel pipes. None of these pipes are in use anymore. Most of these steel pipes will be removed to other mines within the Imerys Group. These pipes will then be reused as part of their operations.

6.4.2 Plant area and other buildings

The plant is currently non-operational. Associated buildings are the workshops. There is still scrap metal and plant equipment that need to be removed.

All hazardous materials such as hydrocarbons, fluorescent tubes, etc. will be removed by a licensed waste contractor to a licensed disposal area. The mine will obtain all the correct documentation such as safe disposal certificates and a copy of the disposal site license. All salvageable material will be removed to either a steel merchant or other mine operations. Concrete will be removed to a depth of 1m below the surface. Building rubble (inert waste) could be used for backfilling of the quarries, however, the disposal of more than 25tons need a waste license excluding the disposal of such waste for the purposes of leveling which has been authorised by or under other legislation. This will be discussed with DMR prior to disposal.

Once all salvageable infrastructure has been removed and foundations are broken the plant area should be sloped to allow for free drainage to the east. There are also small stockpiles and walls from old return water dams that should be graded to fill unnatural depressions around the plant area. High walls should be broken and sloped to allow for vegetation growth.

No monitoring is necessary for the removal of the plant structures. Monitoring of the revegetation, as well as any erosion, will be necessary

It is assumed that all infrastructure will be removed and either disposed of or sold as scrap. Resloping of the area is based on surveyor data received from the mine.

6.4.3 Waste rock dump

There is a large waste rock dump to the north of the mine, just south of theTDF. On the western side is natural vegetation as well as a servitude for a high voltage power line.

On the western side is natural vegetation as well as a servitude for a high voltage power line. It is therefore proposed to slope most of the material to the north in the direction of the tailings facility and to the east towards the plant area.

Once the sloping is finalised it is also recommended to add contour paddocks along the side slopes of the waste rock dump no more than 20m apart. Previous contours of 50m apart have shown erosion to form along the slope.

The 3d rehabilitation models indicate the sloping and moving of material required on the left, with the final result on the right. This model consists of the only cut and fill and does not require any moving of material into or out of the site.

Monitoring of the revegetation, as well as any erosion, will be necessary. The water qualities, both surface, and groundwater will be monitored

Resloping of the area is based on surveyor data received from the mine. There are no groundwater qualities to confirm seepage potential.

6.4.4 Quarries

There are 15 quarries at Havercroft. These quarries are located along a mountainous line from north to south. These quarries have a steep high wall on the western side.

It is proposed to plant a thick row of euphorbias on the top of the high walls. This wil be done to prevent access of people and animals to these high walls.

Only the quarries where the need for earthworks has been identified are included in the description for sloping. Safeguarding of high walls are encouraged but has not been included in the modeling as there is a major safety concern to work above the high walls with machinery. All high walls have been modeled to remain in place due to this safety risk.

Table 29: Quarries rehabilitation

Quarry	Rehabilitation recommendation
Q1	Push remainder of OB opposite of high wall into the bottom of the quarry. Only light grading is required.
Q2	Push bottom OB stockpile into the quarry.
	Dig a trench in O/B stockpile located within drainage line above the high wall to allow for free drainage into the quarry that will assist with vegetation growth.
Q3	General sloping for free drainage should be established. This area is also identified as a good location for a drinking hole. It is recommended to ensure that all slopes towards the water are safe and stable.
Q5	Break bench opposite of high wall. Potential traffic of locals and animals are expected to come from the east which would make this bench on the opposite side a potential safety risk.
Q6	Break lower benches that is easily reachable and push material to the bottom of the quarry.
Q11	Two OB stockpiles opposite of high wall should be pushed into the bottom of the quarry.
Q12	Push OB stockpile into quarry bottom.
Q13 & 14	Push OB stockpiles into quarry bottom.
Q15	OB stockpile should be brought back into the quarry. Note specifically not to push OB further down that may cause further disturbance and more difficult to move into the quarry.

Monitoring of the revegetation, as well as any erosion, will be necessary. The water qualities, both surface and groundwater will be monitored.

Resloping of the area is based on surveyor data received from the mine.

6.4.5 Primary and secondary access roads

There are various roads traversing the area. These roads will be kept after closure for farming activities. Roads will only be removed if requested by the community.

Monitoring of any erosion will be necessary.

It is assumed that some roads will be retained for farmers.

SECTION 7: CONCLUSION AND GAP ANALYSIS

This report is based on the information given to the EAP. If any additional studies are done in the future, this will be included into the 2019 report.

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