

**FLORAL AND FAUNAL ECOLOGICAL ASSESSMENT AS
PART OF THE ENVIRONMENTAL IMPACT ASSESSMENT
PROCESS FOR THE PROPOSED ANGLO PLATINUM DER
BROCHEN AMENDMENT PROJECT, LIMPOPO PROVINCE**

Prepared for

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Section B: Floral Assessment

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GLOSSARY OF TERMS

Alien and Invasive species	A species that is not an indigenous species; or an indigenous species translocated or intended to be translocated to a place outside its natural distribution range in nature, but not an indigenous species that has extended its natural distribution range by natural means of migration or dispersal without human intervention;
Biome	A broad ecological unit representing major life zones of large natural areas – defined mainly by vegetation structure and climate.
Biosphere Reserve	Areas identified either on terrestrial or marine ecosystems (or both) that are internationally recognized under the framework of UNESCO's Man and Biosphere (MAB) programme. Spatial zonation of a Biosphere Reserve: <ul style="list-style-type: none"> • Core zone/s - these are areas that must have a legal/long term protection status in terms of national laws; • Buffer zone/s – these areas usually surround or adjoin the core zones; and • Transition zone – is the area which contains diversity of sustainable activities.
CBA (Critical Biodiversity Area)	A CBA is an area considered important for the survival of threatened species and includes valuable ecosystems such as wetlands, untransformed vegetation and ridges.
Endangered	Organisms in danger of extinction if causal factors continue to operate.
Endemic species	Species that are only found within a pre-defined area. There can therefore be sub-continental (e.g. southern Africa), national (South Africa), provincial, regional or even within a particular mountain range.
ESA (Ecological Support Area)	An ESA provides connectivity and important ecological processes between CBAs and is therefore important in terms of habitat conservation.
Indigenous vegetation (as per the definition in (NEMA)	Vegetation occurring naturally within a defined area, regardless of the level of alien infestation and where the topsoil has not been lawfully disturbed during the preceding ten years.
Invasive species	Means any species whose establishment and spread outside of its natural distribution range; they threaten ecosystems, habitats or other species or have demonstrable potential to threaten ecosystems, habitats or other species; and may result in economic or environmental harm or harm to human health
Least Threatened	Least threatened ecosystems are still largely intact.
RDL (Red Data listed) species	Organisms that fall into the Extinct in the Wild (EW), critically endangered (CR), Endangered (EN), Vulnerable (VU) categories of ecological status.



ACRONYMS

AIP	Alien and Invasive Plants
BGIS	Biodiversity Geographic Information Systems
CR	Critically Endangered
DAFF	Department: Agriculture, Forestry and Fisheries
EAP	Environmental Assessment Practitioner
EIS	Ecological Importance and Sensitivity
EN	Endangered
EW	Extinct in the Wild
GIS	Geographic Information System
GPS	Global Positioning System
Ha	Hectare
IEM	Integrated Environmental Management
IUCN	International Union for Conservation of Nature and Natural Resources
LEDET	Limpopo Department of Economic Development and Tourism
LEMA	Limpopo Environmental Management Act
MRA	Mining Right area
NFA	National Forest Act
NT	Near Threatened
P	Protected
PES	Present Ecological State
POC	Probability of Occurrence
PRECIS	Pretoria Computerised Information System
QDS	Quarter Degree Square
RDL	Red Data Listed
RE	Regionally Extinct
SANBI	South Africa National Biodiversity Institute
SP	Specially Protected
STS	Scientific Terrestrial Services
SCC	Species of Conservation Concern
SCPE	Sekhukhuneland Centre of Plant Endemism
TOPS	Threatened or Protected Species
VU	Vulnerable



1 INTRODUCTION

1.1 Background

Scientific Terrestrial Services (STS) was appointed to conduct a floral and faunal ecological assessment as part of the Environmental Impact Assessment (EIA) and authorisation process for the proposed Anglo Platinum Der Brochen Amendment Project, Limpopo Province. An area encompassing all the various expansion areas associated with the Der Brochen Amendment Project was used to gather all background information that might be relevant to the project and will henceforth be referred to as the “focus area”. The field assessment, however focussed only on the various infrastructure expansion areas and did not include the entire focus area, nor the Mining Right Area (MRA) (Section A: Figure 1 and 2).

The Anglo Platinum Der Brochen Project is situated northeast of the R555 provincial road, and northwest of the R540, and approximately 24km south-west (40km by road) of the town of Steelpoort. Lydenburg is approximately 31km from the focus area in a southeast direction. The Anglo Platinum Der Brochen Mine is located in the Greater Tubatse Local Municipality which forms part of the Greater Sekhukhune District Municipality.

The purpose of this report is to define the floral ecology of the focus area, to map and define areas of increased Ecological Importance and Sensitivity (EIS), and to define the Present Ecological State (PES) of the focus area. It is the objective of this study:

- To provide inventories of floral species as encountered within the focus area;
- To determine and describe habitat types, communities and the ecological state of the focus area and to rank each habitat type based on conservation importance and ecological sensitivity;
- To identify and consider all sensitive landscapes including rocky ridges, wetlands and/or any other special features;
- To conduct a Red Data Listed (RDL) species assessment, including an assessment of any other Species of Conservation Concern (SCC), and to report on the potential for such species to occur within the focus area;
- To provide detailed information to guide the activities associated with the proposed development activities within the focus area; and
- To ensure the ongoing functioning of the ecosystem in such a way as to support local and regional conservation requirements and the provision of ecological services in the local area.



1.2 Project Description¹

Subsequent to the submission and approval of the Der Brochen Amendment Project Scoping Report, the Der Brochen Team of Anglo American Platinum decided to integrate the previously approved North Opencast Pit (as approved in the 2015 Der Brochen Consolidated Environmental Management Programme (EMPr)) into the Der Brochen Amendment Project. With the integration of the previously approved North Open Pit into the Der Brochen Amendment Project, the need for proposed North Shaft and associated infrastructure (such as three of the proposed six ventilation shafts) have been removed. As a result of the above changes, the Der Brochen Amendment Project (Figure 1) will henceforth comprise of the following:

- The South Decline Shaft with associated infrastructure, i.e. water management infrastructure;
- The previously approved North Opencast Pit area with associated infrastructure as previously approved in 2015, i.e. water management infrastructure and waste rock stockpiles;
- Three up-cast ventilation shafts required for the underground workings associated with the South Decline Shaft;
- A Dense Medium Separation (DMS) Plant to be located within the existing footprint area of the Mototolo Concentrator area;
- A DMS Stockpile with associated water management infrastructure;
- The conversion of the existing Mototolo chrome plant from a final tailings' arrangement to an inter-stage arrangement;
- Additional Run of Mine stockpiles and associated silos;
- Change houses and office complex to be located at the proposed South Decline Shaft area;
- An explosive destruction bay area to be located near the proposed South decline shaft;
- Staff accommodation facilities to be located near the Der Brochen Dam; and
- Additional linear infrastructure, i.e.:
 - **Two conveyor systems:** *One conveyor belt will be constructed to connect the proposed South Decline Shaft with the proposed DMS Plant that will be located in the existing footprint area of the Mototolo Concentrator Plant, for the purpose of transporting ore from the South Decline Shaft to the plant area. Another conveyor belt system will be required to transport DMS material from the proposed DMS*

¹ Terms of Reference developed and provided by SRK Consulting, 23 July 2019, Project number: 533247



Plant to the proposed DMS Stockpile area. It is currently anticipated that the DMS conveyor system will run along the existing Maresburg tailings pipeline system.

- **Access and haul roads.** *New access roads to the proposed ventilation shafts will be required for maintenance purposes. Certain existing roads will also be required to be upgraded to provide sufficient access roads to the project related infrastructure such as the North Opencast Pit area, the South Decline Shaft and offices. The mine is also considering including a haul road within the proposed corridor associated with the ore conveyor belt system to transport ore from the proposed South Decline Shaft to the Mototolo Concentrator Plant area as an interim measure, whilst the conveyor belt system is being constructed.*



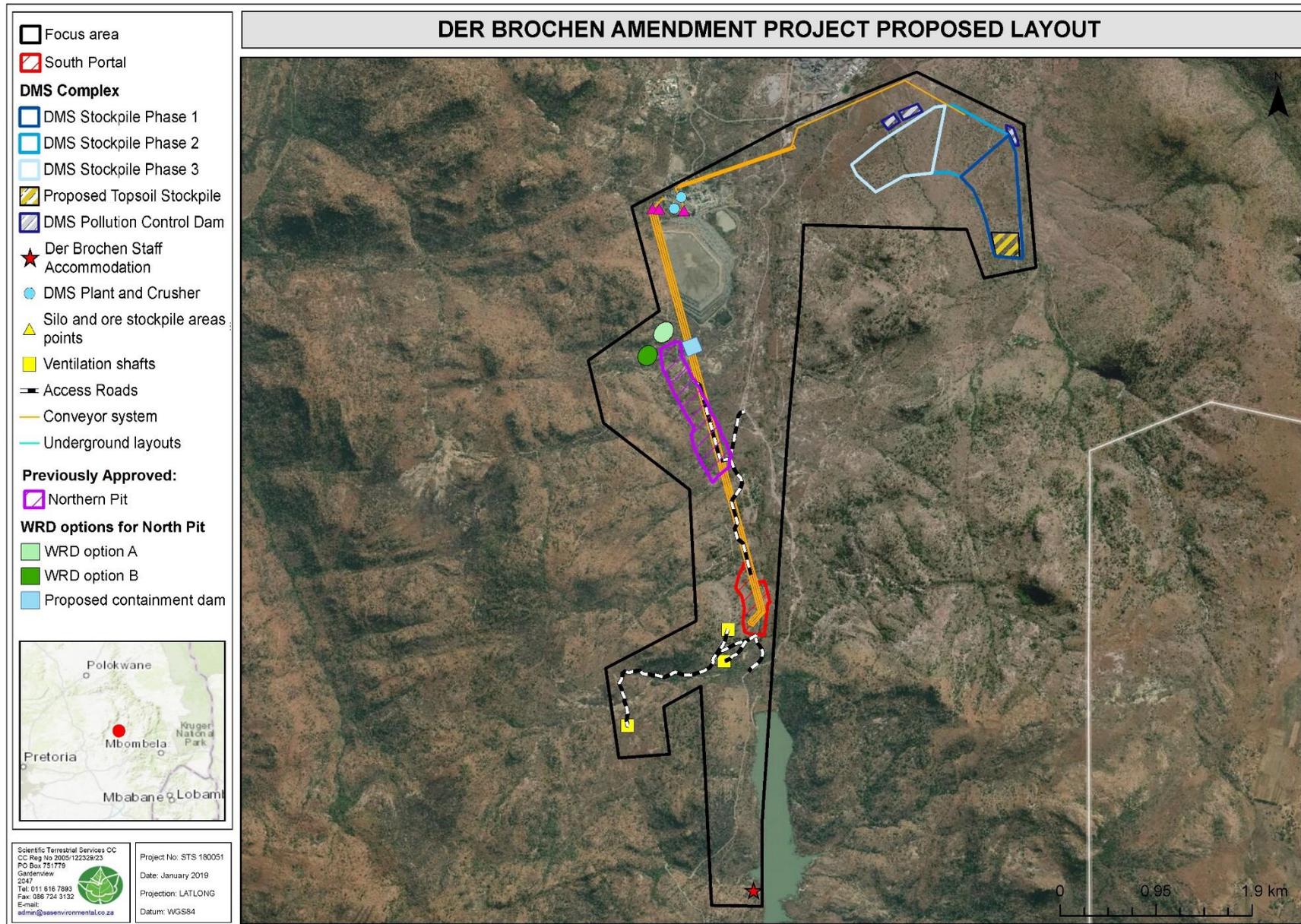


Figure 1: Proposed mine layout zoomed in onto the focus area.



2 ASSESSMENT APPROACH

An initial field assessment was undertaken from the 21st to the 23rd of February 2018 (Summer Season) in order to determine the ecological status of the infrastructure expansion areas associated with the focus area. After modifications were made to the proposed infrastructure expansion areas, two additional field assessments were undertaken, one during the winter season from the 22nd to the 23rd of August 2018, and another during the summer season on the 27th of November 2018.

In order to accurately determine the ecological state of the focus area and to capture comprehensive data with respect to floral ecology, the following methodology was followed:

- Maps and digital satellite imagery were consulted prior to the field assessment in order to determine broad habitats, vegetation types and potentially sensitive sites. The results of this analyses were then used to focus the field work on specific areas of concern and to identify areas where target specific investigations were required;
- Historical data and previous specialist studies were available for the focus area and was utilised as background information to this report;
- All relevant information as presented by SANBI's Biodiversity Geographic Information Systems (BGIS) website (<http://bgis.sanbi.org>), including the Limpopo Conservation Plan v.2 (2013), to gain background information on the physical habitat and potential floral and faunal biodiversity associated with the focus area;
- For the field assessments, a reconnaissance 'walkabout' was initially undertaken to determine the general habitat types found throughout the various infrastructure expansion areas. Following this, specific study sites were selected that were considered to be representative of the habitats found within the area, with special emphasis being placed on areas that may potentially support floral Species of Conservational Concern (SCC). Sites were investigated on foot in order to identify the occurrence of the dominant plant species and habitat diversities. A detailed explanation of the method of assessment is provided in **Appendix A** of this report.
- For the methodologies relating to the impact assessment and development of the mitigation measure, please refer to **Appendix B** of this section of the report.



2.1 Sensitivity Mapping

All the ecological features of the infrastructure expansion areas were considered, and sensitive areas were assessed. In addition, identified locations of protected species were marked by means of Global Positioning System (GPS). A Geographic Information System (GIS) was used to project these features onto satellite imagery and topographic maps. The sensitivity map should guide the design and layout of the proposed mining activities.

3 RESULTS OF FLORAL ASSESSMENT

Previous floral assessments were conducted within the focus area and was used for background information, namely:

- Vegetation Survey: Proposed Mining Development for Anglo Platinum (Mareesburg, Helena, Der Brochen, Booyendal and Sterkfontein) (Perkins, L., Winter, P.J.D., 2012);
- Environmental Management Programme Report for the der Brochen Platinum Mine: Farms Der Brochen 7 JT, Helena 6JT and Booyendal 43 JT: Anglo Platinum (PTY) LTD (SRK, 2004); and
- Der Brochen Platinum Mine Floristic Assessment (NSS, 2012).

During the field assessment, four habitat units were defined, and the habitat units are in line with previous studies. These habitat units are:

- Freshwater Resources;
- Open Bushveld;
- Sekhukhune Mountain Bushveld; and
- Transformed areas.

These habitat units are described below, their habitat sensitivities described in sections 3.1 to 3.4, and their distribution within the focus area depicted in Figure 2.



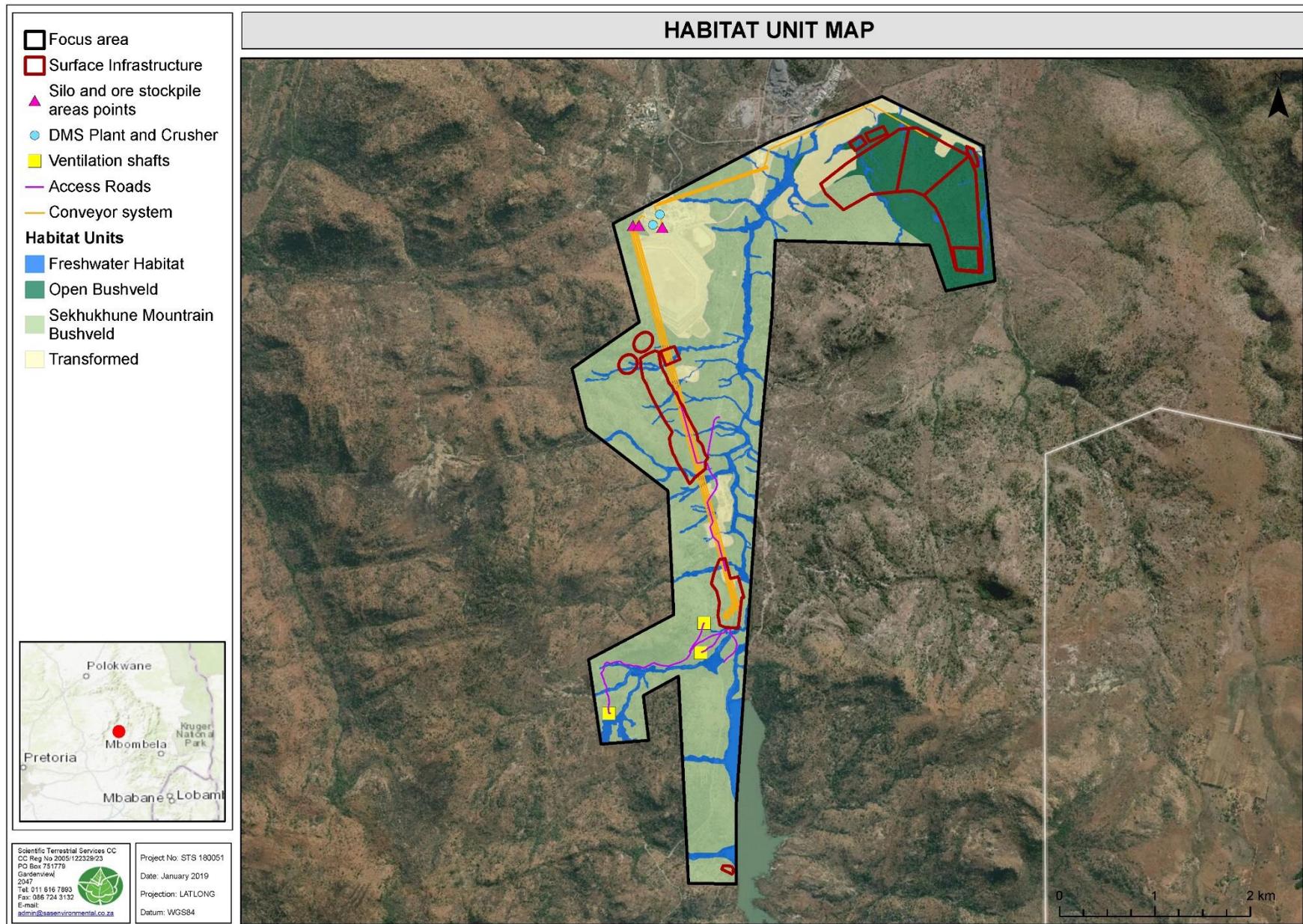
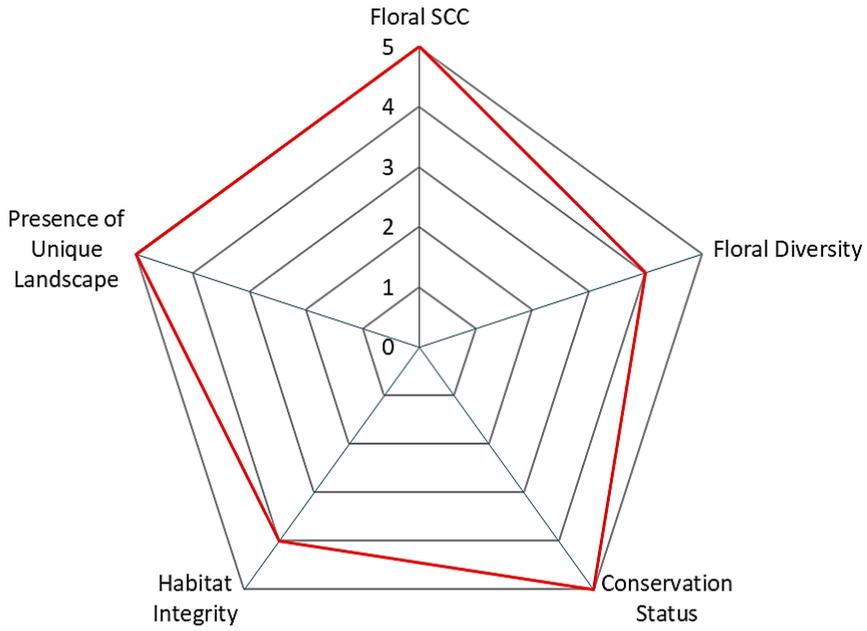


Figure 2: Conceptual illustration of the habitat units within the focus area.



3.1 Habitat Unit 1: Freshwater Habitat Unit

Floral Habitat Sensitivity	High	The Groot Dwars River and various Ephemeral drainage lines containing typical riparian vegetation.	
<p>Habitat Unit: The MRA falls within the Groot-Dwars River catchment with both the Klein-Dwars River and the Groot-Dwars River flowing through the MRA. The focus area, however, is only associated with the Groot-Dwars River.</p>			
<p>Floral Habitat Sensitivity Graph:</p> 			



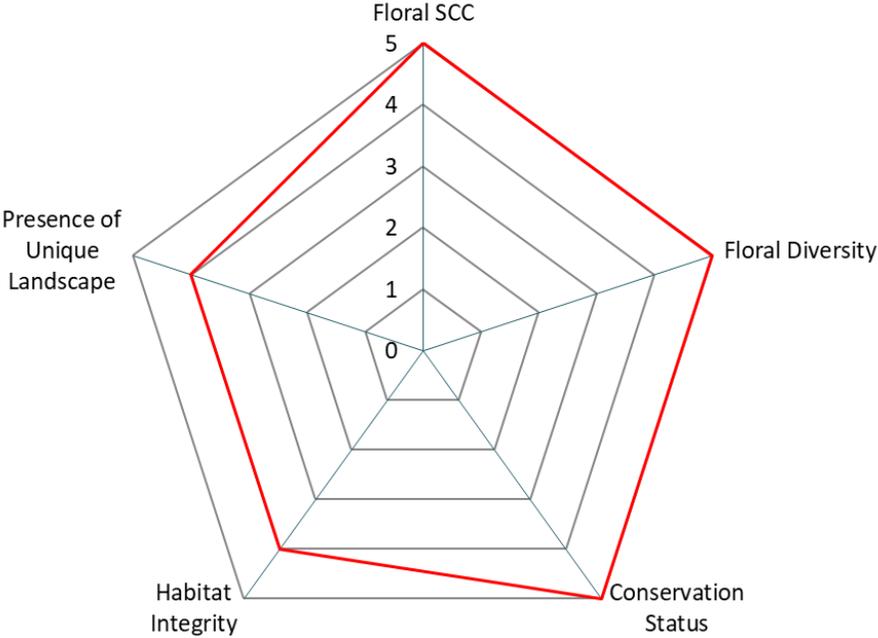
<p>Floral Species of Conservation Concern (SCC)</p>	<p>Two floral SCC, namely <i>Lydenburgia cassinoides</i> (NT) and <i>Sclerocarya birrea</i> subsp. <i>caffra</i> (National Forests Act, (NFA)), protected under the National Forest Act (Act 84 of 1998), were encountered in this habitat unit. <i>Lydenburgia cassinoides</i> occur throughout the focus area in moderate-to-high numbers, several of which being associated with drainage lines. <i>Sclerocarya birrea</i> subsp. <i>caffra</i> also occurs throughout the focus area with only a few species occurring within the Freshwater habitat unit. Permits from the Department of Agriculture, Forestry and Fisheries (DAFF) should be obtained to remove, cut or destroy these protected species before any proposed mining activities may take place. Before any construction activities can occur, a detailed walk down of the area must take place during which all protected species should be marked.</p>	
<p>Floral Diversity</p>	<p>Floral diversity is moderately high, with a notable increase in vegetation density associated with the riparian zones. The woody layer is similar to that found in the Sekhukhune Mountain Bushveld habitat unit, with species such as <i>Combretum hereroense</i>, <i>Combretum zeyheri</i>, <i>Eucea crista</i> subsp. <i>crispata</i>, <i>Euclea linearis</i>, <i>Lydenburgia cassinoides</i> (NFA), <i>Peltophorum africanum</i> and <i>Vachellia karroo</i> commonly associated with riparian zones. However, several woody species unique to the Freshwater habitat unit were present and characteristic of saturated conditions, including <i>Chaetacme aristata</i>, <i>Dombeya rotundifolia</i>, <i>Ficus sur</i>, <i>Mimusops zeyheri</i> and <i>Ziziphus mucronata</i>. The forb component is considered moderately species-rich with commonly encountered species consisting of <i>Adiantum capillus-veneris</i>, <i>Asparagus virgatus</i>, <i>Jasminum multipartitum</i>, <i>Sansevieria hyacinthoides</i> and <i>Zantedeschia</i> sp. The graminoid component included species characteristic of moisture-rich areas such as <i>Eragrostis gummiflua</i>, <i>Imperata cylindrica</i> and <i>Phragmites australis</i>. Sedges also made up a large component of the Freshwater habitat unit, most notably <i>Cyperus sexangularis</i> and <i>Fimbristylis dichotoma</i> subsp. <i>dichotoma</i>, with the perennial marsh herb <i>Typha capensis</i> also widely distributed across this habitat unit. For a complete species list, refer to Appendix D.</p>	 <p>Example of floral species occurring within the Freshwater resource habitat unit. Species displayed in the photos are (from left to right) <i>Fimbristylis dichotoma</i> subsp. <i>dichotoma</i>, <i>Ledebouria pilosa</i> (Synonyms: <i>Resnova pilosa</i> or <i>Resnova megaphylla</i>) and <i>Chaetacme aristata</i>.</p>
<p>Conservation Status of Vegetation Type/Ecosystem</p>	<p>The Freshwater habitat extends throughout the focus area. The focus area falls within the remaining extent of the endangered Sekhukhune Mountainlands Ecosystem and the vegetation type is currently neither protected nor is it conserved within statutory conservation areas (Mucina and Rutherford, 2006 & 2012). According to the Limpopo Conservation Plan v2 (2013), the entire focus area falls within a Critical Biodiversity Area (CBA) 1, i.e. irreplaceable areas required to meet biodiversity targets. As the majority of the MRA, including the focus area, is considered to be in a natural condition, it is representative of a CBA for which mining is regarded as an incompatible land use (Limpopo Conservation Plan v2 Technical Report). According to the Mining and Biodiversity Guidelines (2013), the entire focus area is classified as having a Highest Biodiversity Importance which can place considerable constraints on authorised mining activities. Activities that are planned within the freshwater habitat or the relevant buffers will require authorisation from the DWS. Given the above, the Freshwater habitat unit is considered of high conservation importance.</p> <p style="text-align: center;">Habitat integrity/Alien and Invasive species</p> <p>Habitat was mostly intact, except where mining activities and associated edge effects have affected habitat integrity, as noted by the presence of <i>Bidens pilosa</i>. However, the larger system remains intact and connected to the surrounding freshwater systems. Moreover, species recorded within the Freshwater Habitat unit are characteristic of the reference type, i.e. the Sekhukhune Mountain Bushveld vegetation type, and they include species that are typically associated with areas of increased moisture.</p> <p style="text-align: center;">Presence of Unique Landscapes</p> <p>The freshwater habitat unit contributes significantly to floral diversity through the creation of niche habitat for flora adapted to saturated soil conditions.</p>	



<p>Business Case, Conclusion and Mitigation Requirements:</p>	<p>The freshwater resource which includes the Groot Dwars River, its associated floodplain and the interlinking Ephemeral Drainage lines and wetland areas provide niche habitat for a moderately high diversity of floral species and acts as migratory corridors for faunal species. This habitat unit is of moderately high ecological sensitivity and if any activities are to infringe upon this habitat unit, it will lead to further loss of niche habitat and will impact on floral SCC.</p> <p>Although the proposed infrastructure areas are located away from the Groot Dwars river, a large number of Ephemeral drainage lines are located within the footprint areas, most notably the South Portal, several sections of the Conveyor system, the DMS stockpiles and pollution control dams (PCDs). The construction of culverts for, and/or diversions of, Ephemeral drainage lines would be required were the proposed mine layouts to be approved. In this regard, clearing of vegetation and site preparation associated with the proposed surface infrastructure footprints and contractor laydown areas will have a significant impact on favourable floral habitat, most notably for species associated with saturated soil conditions. Here specific mention is made of site clearing associated with potential culvert construction and/or stream flow diversion for ephemeral drainage lines associated with:</p> <ul style="list-style-type: none"> • South portal; • DMS stockpile area and associated PCDs; and • Linear developments i.e. access roads, haul roads and the conveyor system. <p>Impacts to the floral ecology associated with the Freshwater habitat will be significant. It is recommended that no mining-related activities should take place within the Freshwater habitat and associated buffer zones as defined by NEMA (32 metres), particularly because the impacts will not remain localised and have a high potential to impact on downstream systems. However, were the proposed activities to proceed, the following recommendations are made to minimise the impact to floral species:</p> <ul style="list-style-type: none"> • All possible steps must be taken to ensure that infrastructure does not encroach unnecessarily so to prevent negative impacts due to sedimentation and/or impacts on water quality upon the freshwater habitat and associated buffers. It is recommended that the sensitive Freshwater habitat outside of the footprint areas be designated as No-Go areas; • Spills and /or leaks from equipment must be immediately remedied and cleaned up so as to ensure that these chemicals do not enter into the freshwater habitat; • To minimise the need for additional vegetation clearance, existing access roads are to be used to gain access to the proposed infrastructure as far as possible; and • Permits should be obtained from DAFF and LEDET to remove, cut or destroy any protected species before construction of infrastructure takes place.
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3.2 Habitat Unit 2: Open Bushveld Habitat Unit

Floral Habitat Sensitivity	High	Typical view of Open Bushveld Habitat Unit characterised by a mosaic of rocky outcrops and open plains.
<p>Habitat Unit: Two broad floral communities can be distinguished within this habitat unit, i.e. open plains woodland and rocky quartzite woodland. This habitat unit is characterised by a high diversity of woody species, contributing to a species-rich woodland community.</p>		
<p>Floral Habitat Sensitivity Graph:</p> 		  



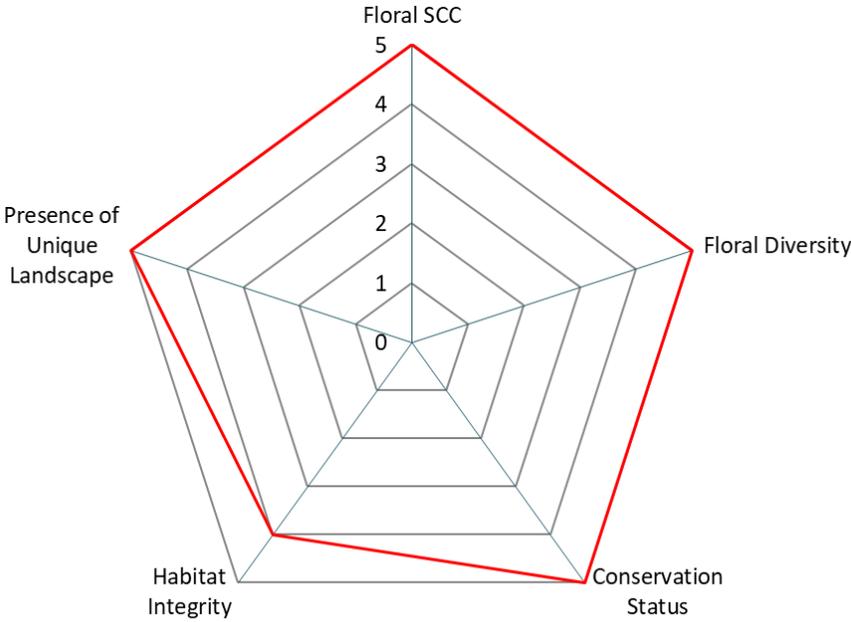
<p>Floral Species of Conservation Concern (SCC)</p>	<p>Three floral SCC were recorded within this habitat unit, namely <i>Lydenburgia cassinoides</i> (NT) and <i>Sclerocarya birrea</i> subsp. <i>caffra</i>, which are protected under the NFA (1998), as well as <i>Jamesbrittenia macrantha</i> (NT) which is protected under the Limpopo Environmental Management Act (LEMA) (Act 7 of 2003). <i>Sclerocarya birrea</i> subsp. <i>caffra</i> is widely distributed within this habitat unit, with <i>Jamesbrittenia macrantha</i> only sparsely scattered in the southern portion of this habitat unit. <i>Lydenburgia cassinoides</i>, on the other hand, was mainly found closer to the Freshwater habitat unit. Permits from the Limpopo Department of Economic Development and Tourism (LEDET) and Department of Agriculture, Forestry and Fisheries (DAFF) should be obtained to remove, cut or destroy these protected species before any proposed mining activities may take place. Before any construction activities can occur a detailed walk down of the area must take place during which all protected species should be marked.</p>	
<p>Floral Diversity</p>	<p>Floral diversity is considered high, with the heterogenous habitat of the rocky outcrops contributing to a higher forb diversity and the open plains contributing to a higher graminoid diversity. The vegetation is representative of the reference state, with several species within the rocky outcrops typically associated with dryer, well-drained soils.</p> <p>The woody component within the open plains woodland community is dominated by species such as <i>Combretum apiculatum</i> subsp. <i>apiculatum</i>, <i>Dichrostachys cinerea</i>, <i>Euclea crispa</i>, <i>Senegalia caffra</i>, <i>Searsia leptodictya</i> and <i>Ziziphus mucronata</i>. Within the rocky quartzite woodland community, the woody layer is dominated by <i>Combretum zeyheri</i>, <i>Euclea linearis</i>, <i>Grewia vernicosa</i>, <i>Lankea discolour</i>, <i>Ozoroa sphaerocarpa</i>, <i>Peltophorum africanum</i> and <i>Sclerocarya birrea</i> subsp. <i>caffra</i> (NFA).</p> <p>The open plains woodland is represented by a moderately low diversity of forbs and groundcovers, mainly consisting of species such as <i>Blepharis subvolubilis</i> subsp. <i>subvolubilis</i>, <i>Commelina africana</i> var. <i>barberae</i>, <i>Corbichonia decumbens</i>, <i>Sansevieria hyacinthoides</i> and <i>Senna italica</i> subsp. <i>arachoides</i>. The rockier environment of the rocky quartzite woodland supports a higher diversity and abundance for forbs, most notably the species <i>Bulbine abyssinica</i>, <i>Gerbera jamesonii</i>, <i>Gnidia capitata</i>, <i>Jatropha latifolia</i>, <i>Ledebouria marginata</i>, <i>Rothea louwalbertsii</i>, <i>Stylochaeton natalensis</i>, and <i>Xerophyta retinervis</i>.</p> <p>For a comprehensive species list refer to Appendix D.</p>	<p>The open plains woodland floral community can be characterised by a landscape of sparsely scattered tree species where the majority of the woody cover comprises shrubs and small trees, with only a few large tree species present. The rocky quartzite woodland provides ideal growing conditions for species with an affinity for dryer, well-drained soil conditions. Woody cover is more sparsely scattered within this floral community.</p>  <p>Typical vegetation associated with the Open Bushveld habitat unit includes a diverse range of forbs, shrubs and tree species, e.g. <i>Rothea louwalbertsii</i> (left), <i>Grewia vernicosa</i> (centre) and <i>Peltophorum africanum</i> (right).</p>
<p>Conservation Status of Vegetation Type/Ecosystem</p>	<p>Rock outcrops are floristically noteworthy and have high conservation significance due to the high occurrence of floral endemics that is typically associated with this habitat type. For example, within the entire extent of the Sekhukhune Centre of Plant Endemism (SCPE), 34 of the Sekhukhuneland endemics/near-endemics are known to occur within the rocky outcrop vegetation types (Siebert 1998). During the field investigation, only the endemic <i>Jamesbrittenia macrantha</i> was recorded within the extent of this habitat unit; however, the possible presence of endemics cannot be excluded.</p> <p>The Open Bushveld habitat unit falls within a vegetation type considered to be Least threatened (Mucina & Rutherford 2006). The majority of this habitat unit remains in a fairly pristine condition and is classified as having a Highest Biodiversity Importance (Mining and Biodiversity Guidelines, 2013). According to the Mining and Biodiversity Guidelines (2013), any mining projects within areas of Highest Biodiversity Concern could be significantly constrained or may not receive necessary authorisations. Additionally, the entire habitat unit falls within a CBA 1 (Limpopo CPLan V2, 2013). These areas are considered “irreplaceable” and if not maintained in a natural state, targets for biodiversity pattern and/or ecological processes cannot be met.</p>	
<p>Habitat integrity/Alien and Invasive species</p>		
<p>Edge effects from transformed and disturbed areas adjacent to this habitat unit, such as cultivated fields towards the west and the Maresburg tailings towards the east, were only minimally evident within this habitat unit during the time of the assessment. A moderately low diversity of alien and invasive plant species such as <i>Opuntia ficus-indica</i>, <i>Zinnia peruviana</i>, <i>Bidens pilosa</i> and <i>Tagetes minuta</i> are present, but their abundance is low, and as such the habitat integrity of the Open bushveld habitat unit is considered largely intact.</p>		
<p>Presence of Unique Landscapes</p>		
<p>Rocky outcrops enhance biodiversity as they provide heterogeneous environments and varied habitats for species with different requirements than those living in the surroundings and, in this way, they increase floral diversity considerably – providing niche habitat for several floral species.</p>		



<p>Business Case, Conclusion and Mitigation Requirements:</p>	<p>Business Case, Conclusion and Mitigation Requirements:</p> <p>The Open Bushveld Habitat Unit is floristically diverse and has a high abundance of floral SCC, thus considered to be of high ecological sensitivity and importance. The proposed mining activities and associated infrastructure will lead to the further loss of floral species and preferred habitat for floral SCC within the focus area.</p> <p>Clearing of vegetation, including potential blasting to clear rocky outcrops, and site preparation associated with the proposed DMS stockpile area and associated PCDs will have a significant impact on niche floral habitat. Sensitive rocky outcrop habitat, that contributes significantly to the high floral species diversity within this habitat unit, including the occurrence of potential floral SCC, will likely be permanently lost. According to the Limpopo C-Plan v2 (2013), any areas that have been degraded within a CBA 1 requires rehabilitation and management to a natural or near-natural state. As such, and due to the focus area being located within a Centre of Plant Endemism (CPE), the post-mining rehabilitation goal should be one of restoration to a pre-mining condition. However, it is not deemed possible that the niche floral habitat can be restored, or all potential SCC be rescued and relocated, were the proposed mining activities to proceed.</p> <p>Impacts to the floral ecology associated with the Open Bushveld habitat will be significant and likely permanent. It is recommended that mining-related activities within the Open Bushveld habitat unit be limited to low impact activities with a small ecological footprint. However, were the proposed activities to proceed, the following recommendations are made to minimise the impact to floral ecology associated with the Open Bushveld habitat unit:</p> <ul style="list-style-type: none"> • The footprint areas of all surface infrastructure must be minimised to what is absolutely essential; • Any disturbance of sensitive floral habitat and species of conservation concern must be actively avoided; • Sensitive rocky outcrop habitat outside of the immovable footprint areas must be designated as No-Go areas and no mining vehicles, personnel, or any other mining related activities are to encroach upon these areas; • An Alien and Invasive Plant (AIP) Control Plan and Erosion Control Plan must be developed and implemented during all phases of development, to lower the risk of erosion and the increase in proliferation of AIPs within the focus area; • Due to floral SCC being recorded within this habitat unit, permits should be obtained from LEDET and DAFF to remove, cut or destroy any protected species before construction of infrastructure takes place; and • Due to the potential occurrence of Sekhukhune land endemic/near-endemic species associated with the rocky outcrops, it will be necessary to conduct a detailed walk down of the area before any construction activities can occur - during which all protected species should be marked.
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3.3 Habitat Unit 3: Sekhukhune Mountain Bushveld Habitat Unit

<p>Floral Habitat Sensitivity</p>	<p>High</p>	<p>Typical view of the Sekhukhune Mountain Bushveld habitat and sporadic rocky sections as observed within the habitat unit.</p>
<p>Habitat Unit:</p> <p>The Sekhukhune Mountain Bushveld can be described as closed bushveld vegetation that supports a high diversity of floral species and that provides niche habitat for a variety of floral species, including several floral SCC and endemics. Within the focus area, the Sekhukhune Mountain Bushveld habitat unit can be subdivided into two broad vegetation communities, i.e. rocky hillslopes and shrublands.</p>		
<p>Floral Habitat Sensitivity Graph:</p> 		



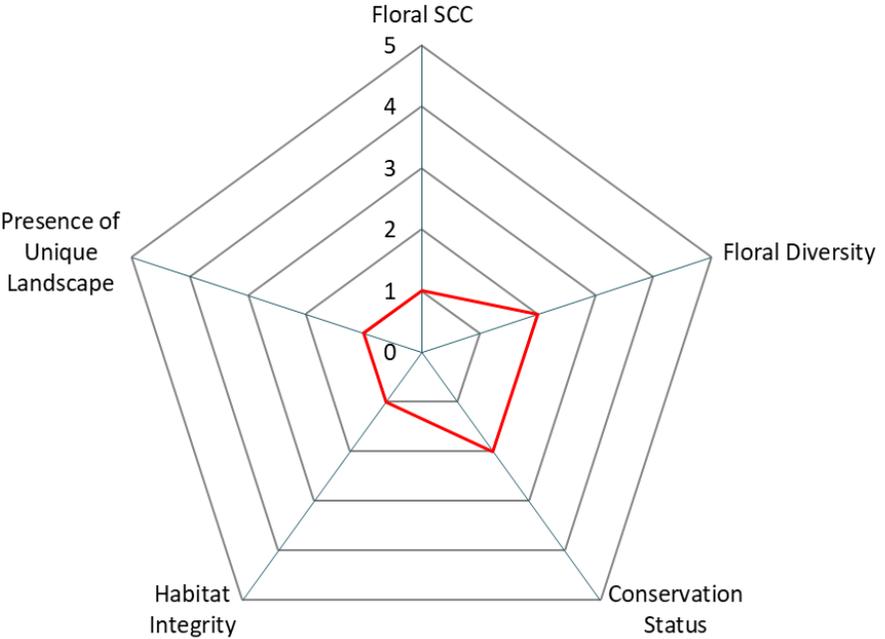
<p>Floral Species of Conservation Concern (SCC)</p>	<p>Several floral SCC were recorded within the Sekhukhune Mountain Bushveld habitat unit, including species protected under the National Forest Act (Act 84 of 1998), i.e. <i>Sclerocarya birrea</i> subsp. <i>caffra</i>, <i>Catha edulis</i>, <i>Balanites maughamii</i> and <i>Lydenburgia cassinoides</i> (NT), as well as species protected under the Limpopo Environmental Management Act (LEMA) (Act 7 of 2003), i.e. <i>Huernia</i> sp. (all <i>Huernia</i> species are protected under LEMA), <i>Jamesbrittenia macrantha</i> (NT) and <i>Scadoxys puniceus</i>. It is highly likely that more floral SCC occur within this habitat unit e.g. previous studies have identified the floral SCC <i>Myrothamnus flabellifolius</i> to be associated with the sheetrock formations. Protected trees occur throughout the focus area in moderate-to-high numbers. Protected succulents such as the <i>Huernia</i> species were only observed on sheetrock formations, whereas <i>Jamesbrittenia macrantha</i> occurs in moderate densities throughout the focus area. Permits from the Limpopo Department of Economic Development and Tourism (LEDET) and Department of Agriculture, Forestry and Fisheries (DAFF) should be obtained to remove, cut or destroy these protected species before any proposed mining activities may take place. Before any construction activities can occur a detailed walk down of the area must take place during which all protected species should be marked.</p>	
<p>Floral Diversity</p>	<p>The prominent vegetation occurring within the focus area and which are associated with the Sekhukhune Mountain Bushveld habitat unit include species such as <i>Combretum apiculatum</i>, <i>Cussonia transvaalensis</i>, <i>Euclea crispa</i>, <i>Euclea linearis</i>, <i>Faurea saligna</i>, <i>Kirkia wilmsii</i> and <i>Peltophorum africanum</i>. Lower altitudes have a higher representation of <i>Senegalia caffra</i>, <i>Sclerocarya birrea</i> subsp. <i>birrea</i> (NFA), <i>Vachellia karroo</i>, <i>Vachellia tortilis</i> subsp. <i>heteracantha</i>. Commonly occurring forbs include <i>Gnidia caffra</i>, <i>Gnidia capitata</i>, <i>Jamesbrittenia macrantha</i> (NT) and <i>Rhynchosia nitens</i>.</p> <p>Several species unique to each vegetation community within this habitat unit can be distinguished. This can be attributed to their association with the fluctuating physical environment found within this habitat unit. The floral communities associated with the rocky hillslopes (including sheetrock formations) can be distinguished from other floral communities by the presence of species that are not widely distributed throughout the Sekhukhune Mountain Bushveld, but which are restricted to these rockier areas. For example, within the rocky hillslopes, succulents such as <i>Crassula alba</i>, <i>Euphorbia schinzii</i>, <i>Huernia</i> sp., several <i>Aloe</i> species, as well as ferns such as <i>Pellaea calomelanos</i> and mat-forming herbaceous plants such as <i>Selaginella dregei</i> can be found; whereas shrublands do not provide suitable conditions to support the growth of these species. The vegetation communities, i.e. rocky hillslopes and shrublands, are interspersed and forms a mosaic throughout this habitat unit (refer to Appendix D for a full species list).</p>	<p>The rocky hillslopes are associated with a steeper topography, sheetrock formations and bush clumps, or stages of thereof. The shrubland communities can be distinguished from the rocky hillslope vegetation communities within the Sekhukhune Mountain Bushveld habitat unit due to sparser tree cover, less noticeable rock cover, and an increased grass and forb coverage.</p>  <p>Typical vegetation associated with the Sekhukhune Mountain Bushveld habitat unit includes a diverse range of forbs, shrubs and tree species, e.g. <i>Huernia</i> sp. (LEMA protected), <i>Searsia keetii</i>, and <i>Jamesbrittenia macrantha</i> (NT) (left to right).</p>
<p>Conservation Status of Vegetation Type/Ecosystem</p>	<p>Sekhukhune Mountain Bushveld habitat unit is the largest habitat unit present within the focus area. The vegetation type is considered Least threatened (Mucina & Rutherford 2006); however, only 0.4% of the target 24 % of this vegetation type is currently conserved. Moreover, the expansion of mining projects in the region threatens the poorly conserved and unprotected vegetation type. According to the Limpopo Conservation Plan v2 (2013), the entire focus area falls within a Critical Biodiversity Area (CBA) 1, i.e. irreplaceable areas required to meet biodiversity targets. As the majority of the MRA, including the focus area, is considered to be in a natural condition, it is representative of a CBA for which mining is regarded as an incompatible land use (Limpopo Conservation Plan v2 Technical Report).</p> <p>According to the Mining and Biodiversity Guidelines (2013), the entire focus area is classified as having a Highest Biodiversity Importance which can place considerable constraints on authorised mining activities.</p> <p>Additionally, and as mentioned previously, rock outcrops are floristically noteworthy and have high conservation significance due to their typical association with endemic plant species.</p> <p style="text-align: center;">Habitat integrity/Alien and Invasive species</p> <p>A moderate diversity of alien and invasive plant species such as <i>Bidens pilosa</i> and <i>Tagetes minuta</i> are present, but their abundance is low, indicating that the habitat integrity of this habitat unit is largely intact.</p> <p style="text-align: center;">Presence of Unique Landscapes</p> <p>This habitat unit is considered a unique landscape that supports a high floral species diversity and provides suitable habitat for floral SCC.</p>	



<p>Business Case, Conclusion and Mitigation Requirements:</p>	<p>Business Case, Conclusion and Mitigation Requirements:</p> <p>The Sekhukhune Mountain Bushveld Habitat Unit is of high sensitivity. The proposed mining activities and associated infrastructure will lead to the further loss of floral species and preferred habitat for floral SCC within the focus area.</p> <p>Clearing of vegetation and site preparation associated with the proposed surface infrastructure footprints, contractor laydown areas and construction of surface infrastructure will have a significant impact on favourable floral habitat, most notably for species associated with the more sensitive rocky habitat. Here specific mention is made of:</p> <ul style="list-style-type: none"> • South portal, along with construction of the associated south decline shafts; • Site clearing for the DMS stockpile area; • Linear developments e.g. access roads, haul roads and conveyor systems; and • Construction of staff accommodation. <p>Sensitive rocky outcrop habitat, that contributes significantly to the high floral species diversity within this habitat unit, including the occurrence of potential floral SCC, will be permanently lost. According to the Limpopo C-Plan v2 (2013), any areas that have been degraded within a CBA 1 requires rehabilitation and management to a natural or near-natural state. As such, and due to the focus area being located within a Centre of Plant Endemism (CPE), the post-mining rehabilitation goal should be one of restoration to a pre-mining condition. However, it is not deemed possible that the niche floral habitat can be fully restored were the proposed mining activities to proceed.</p> <p>Impacts to the floral ecology associated with the Sekhukhune Mountain Bushveld habitat will be significant and likely permanent. It is recommended that mining-related activities within this habitat unit be restricted. However, were the proposed activities to proceed, the following recommendations are made to minimise the impact to floral ecology:</p> <ul style="list-style-type: none"> • The footprint areas of all surface infrastructure must be minimised to what is absolutely essential; • Any disturbance of sensitive floral habitat and species of conservation concern must be actively avoided; • Sensitive rocky habitat outside of the immovable footprint areas must be designated as No-Go areas and no mining vehicles, personnel, or any other mining related activities are to encroach upon these areas; • Proposed infrastructure located within mountainous areas and hillslopes should be restricted to the lower slopes due to the high risk of erosion and the consequential need for extensive rehabilitation activities later down the line. Moreover, within the focus area, the lower altitude shrubland communities already display more signs of disturbance than the surrounding rocky hillslopes.; • An Alien and Invasive Plant (AIP) Control Plan and Erosion Control Plan must be developed and implemented during all phases of development, to lower the risk of erosion and the increase in proliferation of AIPs within the focus area; • Due to several floral SCC being recorded within this habitat unit, permits should be obtained from LEDET and DAFF to remove, cut or destroy any protected species before construction of infrastructure takes place; and • Due to the potential occurrence of Sekhukhune land endemic/near-endemic species associated with the rocky habitat, before any construction activities can occur a detailed walk down of the area must take place during which all protected species should be marked. This survey should be conducted within the flowering season of potentially occurring SCC.
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3.4 Habitat Unit 4: Transformed Habitat Unit

Floral Habitat Sensitivity	Low	Typical view of transformed habitat associated with the focus area.	
<p>Habitat Unit: This habitat unit is associated with all the current infrastructure areas, including the current offices and the concentrator plant in the north of the focus area.</p>			
<p>Floral Habitat Sensitivity Graph:</p> 		  	



Floral Species of Conservation Concern (SCC)	No floral SCC were encountered in this habitat unit and it is highly unlikely that any such species will occur within it.	
Floral Diversity	Floral diversity was moderately low and dominated by floral species that are indicators of disturbed veld such as <i>Melinis repens</i> , <i>Hyparrhenia hirta</i> and <i>Dichrostachys cinerea</i> .	
Conservation Status of Vegetation Type/Ecosystem	<p>The entire focus area falls within a vegetation type that is Least Threatened (Mucina & Rutherford 2006); however, the expansion of mining projects in the region threatens the poorly conserved and unprotected vegetation type as is seen within this Transformed habitat unit.</p> <p>According to the Limpopo Conservation Plan v2 (2013), the entire focus area falls within a Critical Biodiversity Area (CBA) 1, i.e. irreplaceable areas required to meet biodiversity targets. Furthermore, according to the Mining and Biodiversity Guidelines (MBG, 2013), the entire focus area is classified as having a Highest Biodiversity Importance. However, due to the already loss of species diversity and habitat representative of the reference state, the Transformed habitat is no longer representative of the CBA 1 nor does it meet the criteria of a Highest Biodiversity Importance area as per the MBG.</p>	Habitat integrity/Alien and Invasive species
		Habitat is transformed and dominated by species that are indicative of disturbed areas with alien and invasive species such as <i>Bidens pilosa</i> , <i>Tagetes minuta</i> and the encroaching <i>Dichrostachys cinerea</i> being present.
		Presence of Unique Landscapes
No unique landscapes important to flora were present.		
Business Case, Conclusion and Mitigation Requirements:	<p>This habitat unit is of low ecological importance and sensitivity. Activities within this habitat unit must be optimised and limited to the existing disturbance footprint. Care must be taken to limit edge effects on the surrounding more sensitive areas.</p> <p>The Transformed habitat is no longer representative of the CBA 1 as a result of historic and current mining activities. However, according to the Limpopo C-Plan v2 (2013), any areas that have been degraded within a CBA 1 requires rehabilitation and management to a natural or near-natural state. This should be considered and added to post-mining rehabilitation plans.</p> <p>In order to minimise the impact to floral species within this habitat unit, as well as to reduce potential impacts to adjacent more sensitive habitat units, the following recommendations are made:</p> <ul style="list-style-type: none"> • Footprint sizes of the proposed infrastructure areas are to remain as small as possible and should be restricted to the Transformed habitat as far as possible; • Concurrent/progressive rehabilitation must be implemented at all times and disturbed areas must be rehabilitated as soon as such areas become available; this will not only reduce the total disturbance footprint but will also reduce the overall rehabilitation effort and cost. • As far as possible, existing access roads are to be used to gain access to the proposed infrastructure in order to minimise the need for additional vegetation clearance; and • An Alien and Invasive Plant Control Plan and Erosion Control Plan must be developed and implemented during all phases of development, to lower the risk of erosion and the increase proliferation of alien and invasive plant species within the focus area. 	



3.5 Floral Species of Conservation Concern Assessment

Threatened/protected species are species that are facing a high risk of extinction. Any species classified in the IUCN categories Critically Endangered (CR), Endangered (EN) or Vulnerable (VU) is a threatened species. Furthermore, SCC are species that have a high conservation importance in terms of preserving South Africa's high floristic diversity and include not only threatened species, but also those classified in the categories Extinct in the Wild (EW), Regionally Extinct (RE), Near Threatened (NT), Critically Rare, Rare and Declining.

An assessment considering the presence of any plant species of concern, as well as suitable habitat to support any such species was undertaken. The SANBI PRECIS Red Data Listed plants were acquired for the Quarter Degree Square (QDS) 2530AA. Also taken into consideration was the Threatened or Protected Species (TOPS) Regulations (GN 255 of 2015) under Section 56(1) of the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004), the list of Schedule 11 (Specially protected) and Schedule 12 (Protected plants) under the Limpopo Environmental Management Act, 2003 (Act 7 of 2003), and the List of Protected Tree Species (GN 809 of 2014) under the National Forest Act (Act 84 of 1998).

An assessment considering the presence of any floral SCC, as well as suitable habitat to support any such species was undertaken. The POC of each of the species listed was calculated (Appendix C). From the assessment, it is clear that several of the Floral SCC listed for the QDS 2530AA are likely occurring within the focus area, especially within the Sekhukhune Mountain Bushveld, Open Bushveld and Freshwater Habitat Units. No additional listed floral SCC from previous studies were identified during the field assessment taken in 2018.

The following protected species listed under the National Forest Act (Act 84 of 1998) were observed within the focus area at the time of the assessment (Figure 3):

- *Balanites maughamii*;
- *Catha edulis*;
- *Lydenburgia cassinoides*; and
- *Sclerocarya birrea* subsp. *caffra*

In terms of this act, protected tree species may not be cut, disturbed, damaged or destroyed and their products may not be possessed, collected, removed, transported, exported, donated, purchased or sold - except under licence granted by the DAFF a delegated authority. Applications for such activities should be made to the responsible official in each province. Each application is evaluated on merit (including field assessments) before a decision is taken



whether or not to issue a licence (with or without conditions). Such decisions must be in line with national policy and guidelines.

Additionally, several species listed as protected under the LEMA (Act 7 of 2003) were observed during the field assessment namely (Figure 4):

- *Huernia* sp;
- *Jamesbrittenia macrantha*; and
- *Scadoxys puniceus*.

If individuals or communities of these species will be disturbed by construction/operational activities, they must be relocated to suitable, similar habitat in close proximity to where they were removed from, but outside the disturbance footprint after obtaining the relevant permits from the Limpopo Department of Economic Development, Environment and Tourism (LEDET).



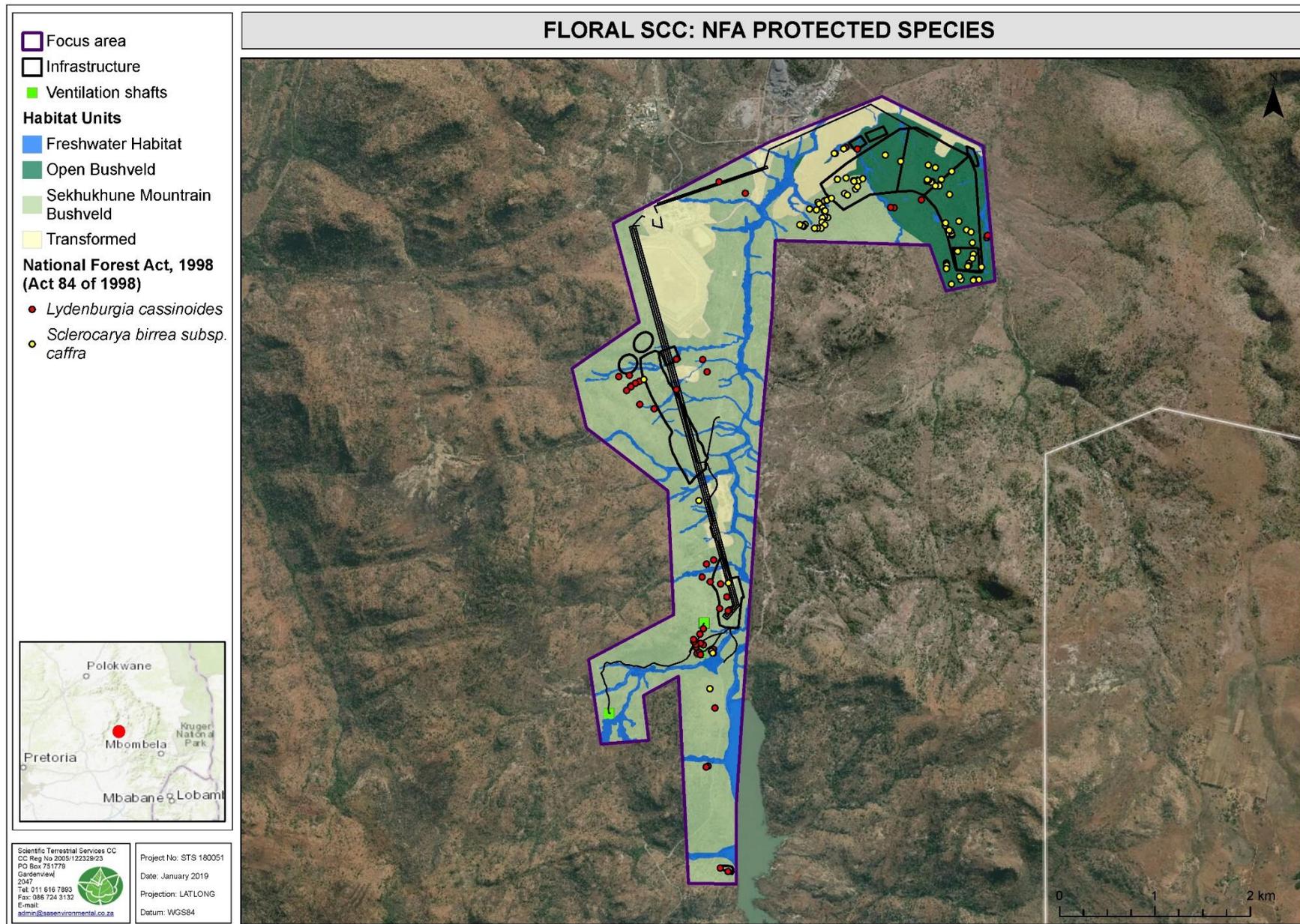


Figure 3: NFA protected species recorded within the focus area in relation to the habitat units identified during the field assessment.



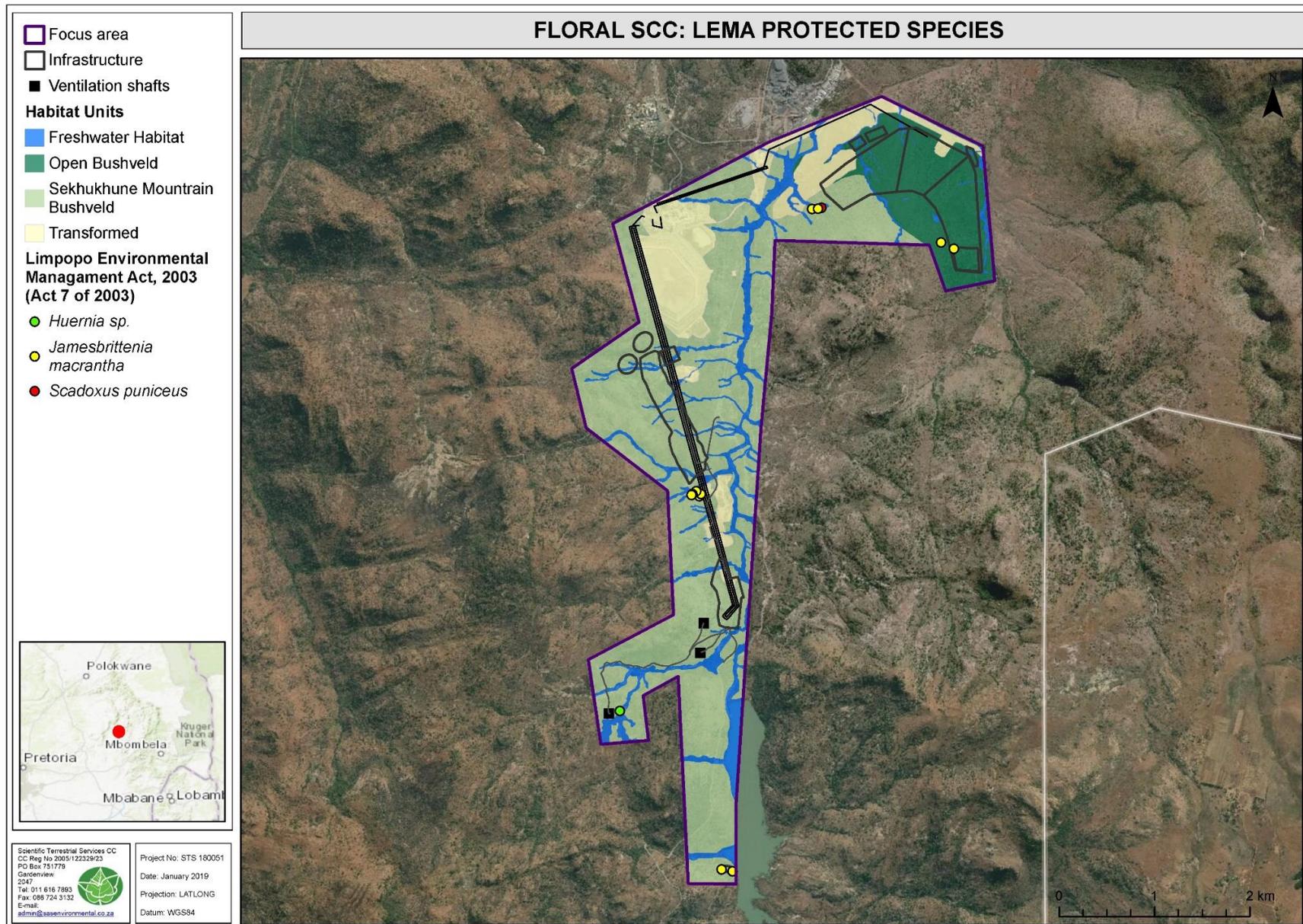


Figure 4: LEMA protected species recorded within the focus area in relation to the habitat units identified during the field assessment.



3.6 Alien and Invasive Plant Species

During the floral assessment, dominant alien and invasive floral species were identified and are listed in the table below.

Table 1: Dominant alien vegetation species identified during the field assessment.

Species	English name	NEMBA Category*
Succulents		
<i>Opuntia ficus-indica</i>	Prickly Pear	1b
<i>Agave americana</i>	Sisal	2
Trees/ shrubs		
<i>Melia azedarach</i>	Syringa	1b
<i>Flaveria bidentis</i>	Smelter's Bush	-
Forbs		
<i>Argemone ochroleuca</i>	Mexican Poppy	1b
<i>Bidens pilosa</i>	Common blackjack	NA
<i>Datura ferox</i>	Large Thorn Apple	1b
<i>Flaveria bidentis</i>	Smelter's bush	1b
<i>Jacaranda mimosifolia</i>	Jacaranda	1b
<i>Ricinus communis</i>	Castor-oil plant	1b
<i>Solanum elaeagnifolium</i>	Silverleaf bitter apple	1b
<i>Solanum mauritianum</i>	Bugweed	1b
<i>Tagetes minuta</i>	Tall khakiweed	NA
<i>Xanthium strumarium</i>	Large Cocklebur	1b
<i>Zinnia peruviana</i>	Redstar Zinnia	-

N/L = Not Listed and not categorised

National Environmental Management: Biodiversity Act (Act 10 of 2004): Alien and Invasive Species Regulations, GN R864 of 2016:

Category 1a – Invasive species that require compulsory control.

Category 1b – Invasive species that require control by means of an invasive species management programme.

Category 2 – Commercially used plants that may be grown in demarcated areas, provided that there is a permit and that steps are taken to prevent their spread.

Category 3 – Ornamentally used plants that may no longer be planted. Existing plants may remain, except within the flood line of watercourses and wetlands, as long as all reasonable steps are taken to prevent their spread (Bromilow, 2001).

From the above, it is clear that a low abundance and diversity of alien species occurs within the focus area. The majority of alien and invasive plant species was observed within disturbed areas. Alien species located in the focus area must be removed on a regular basis as part of maintenance activities according to the National Environmental Management: Biodiversity Act (Act 10 of 2004): Alien and Invasive Species Regulations, GN R864 of 2016.

3.7 Medicinal Plant Species

Medicinal plant species are not necessarily indigenous species, with many of them regarded as alien invasive weeds. The table below presents a list of dominant plant species with traditional medicinal value, plant parts traditionally used and their main applications, which

were identified during the field assessment. These medicinal species are all commonly occurring species and are not confined to the focus area.

A moderately high diversity of medicinal species is present with most of the species being common and widespread and not confined to the focus area. It is therefore unlikely that the proposed activities will pose a significant threat to medicinal species locally and regionally. If individuals or communities of these species will be disturbed by mining activities, they must be relocated to suitable, similar habitat in close proximity to where they were removed from, but outside the disturbance footprint after obtaining the required permits from the relevant departments listed for species listed in Section 3.5.

Table 2: Dominant traditional medicinal floral species identified during the field assessment. Medicinal applications and application methods are also presented (van Wyk, Oudtshoorn, Gericke, 2009).

Species	Name	Plant parts used	Medicinal uses
<i>Agave americana</i>	Sisal	Sap	Sap can be taken internally in the treatment of diarrhoea & dysentery. The sap is antiseptic, diaphoretic, diuretic and a laxative. The plant itself is used in the treatment of indigestion, flatulence, constipation, jaundice and dysentery.
<i>Aloe marlothii</i>	Mountain aloe	Sap	Healing of sores.
<i>Balanites maughamii</i>	Torchwood	Stem bar, root bark	Used in ritual emetics. Bark is applied in the form of cutaneous implantations to strengthen the body. Fruits are lethal to freshwater snails and other organisms.
<i>Lydenburgia cassinoides</i>	Sekhukhune Bushman's Tea	Leaves, Bark	Various parts taken medicinally. General remedy. Stimulating effect when leaves are chewed or extract ingested as tea.
<i>Catha edulis</i>	Bushman's tea	Leaves	The plant is widely used against respiratory diseases. In tropical Africa and Arab countries it provides the habit-forming stimulant found in the leaves. The leaves are brewed as tea or chewed for this purpose. The effects include wakefulness and hyperexcitability, and suppressed hunger. In South Africa, this plant is regarded as a drug, since the drug cathinone, which is extracted from it, is listed in the Drug Act. It is however not widely used in this country, except by some groups of people from the Eastern Cape.
<i>Carissa bispinosa</i>	Common Num - Num	Fruit	Edible fruit and the berries are also used to make jams and jellies. Roots to treat toothache.
<i>Dichrostachys cinerea</i>	Sickle Bush	Roots, bark, leaves and fruit	Pods are very nutritious and eaten by game and stock. The wood is hard and durable, used as fencing posts. Roots, bark, leaves and fruit used in traditional medicine.
<i>Euclea crispata</i>	Blue Guarri	Roots	Ripe berries are edible. Root infusions are used to treat epilepsy, stomach disorders, rheumatism, coughs and diabetes.
<i>Grewia flava</i>	Velvet Raisin Bush	Bark & fruit	The bark is used for making baskets, and an intoxicating drink is made from the fruit. Porridge is made from dried fruit
<i>Kirkia wilmsii</i>	Mountain Seringa	Roots	Thickened roots contain water that is used by humans during droughts. Used for goat fodder.

Species	Name	Plant parts used	Medicinal uses
<i>Sansevieria hyacinthoides</i>	Mother - in - law's - tongue		Used traditionally to treat earache, toothache, intestinal worms, haemorrhoids and as a protective charm.
<i>Schotia brachypetala</i>	Weeping Boer - bean	Bark and leaves	Bark and leaves used against heartburn, diarrhoea, hangovers and ulcers. Wood used in furniture - making
<i>Sclerocarya birrea</i> subsp. <i>caffra</i>	Marula	Bark	Bark widely used for medicinal purposes (proven antihistamine and anti-diarrhoea properties) and to obtain a pale brown dye. Fruit is edible, eaten fresh or made into a jelly.
<i>Ziziphus mucronata</i>	Buffalo Thorn		Cough & chest problems, diarrhoea & dysentery; boils, sores & glandular swellings; pain relief

4 SENSITIVITY MAPPING

The figures below conceptually illustrate the areas considered to be of increased ecological sensitivity with the proposed infrastructure layout overlaid. The areas are depicted according to their sensitivity in terms of the presence or potential for floral SCC, habitat integrity and levels of disturbance, threat status of the habitat type, the presence of unique landscapes and overall levels of diversity. The table below presents the sensitivity of each identified habitat unit along with an associated conservation objective and implications for development.

Table 3: A summary of the sensitivity of each habitat unit and implications for development.

Habitat Unit	Sensitivity	Conservation Objective	Development Implications
Freshwater Habitat Unit	High	Preserve and enhance the biodiversity of the habitat unit, no-go alternative must be considered.	The Freshwater Habitat Unit is of high ecological sensitivity and if any activities are to infringe upon this habitat unit there is likely to be a significant impact on floral SCC as well as the diverse floral communities associated with this habitat unit. If it is impossible to avoid placement of infrastructure within this habitat unit, the disturbance timeframes and footprint must be minimised, and any disturbed areas must be rehabilitated.
Open Bushveld Habitat	High	Preserve and enhance the biodiversity of the habitat unit, no-go alternative must be considered.	The Open Bushveld Habitat Unit, with its high floral diversity and association with a high abundance of floral SCC, is considered to be of high ecological importance and sensitivity. This habitat unit remains largely undisturbed; however, edge effects from surrounding mining activities are evident and is compromising the habitat integrity of this habitat unit. Therefore, it is important that mining activities be restricted within this habitat unit, particularly within areas where floral diversity remains high e.g. where rocky outcrops are present. Due diligence must be taken to ensure that current and further edge effects are effectively mitigated. Permits should be obtained from LEDET and DAFF to remove, cut or destroy any protected species before construction of infrastructure takes place.
Sekhukhune Mountain Bushveld Habitat	High	Preserve and enhance the biodiversity of the habitat unit, no-go alternative must be considered.	From a floral perspective, the Sekhukhune Mountain Bushveld Habitat Unit is of high ecological sensitivity and importance. This habitat unit has the highest diversity of floral SCC; however, these species occur sporadically throughout the habitat unit, many of which being associated with the rockier habitats. The majority of the focus area falls within this habitat unit, which is considered to be in a natural, near-pristine state. As such, all proposed mining activities must be restricted to the project footprint area and these areas must remain as small as possible. Due diligence must be taken to ensure that edge effects are effectively mitigated. Permits should be obtained from LEDET and DAFF to remove, cut or destroy any protected species before construction of infrastructure takes place.
Transformed	Low	Optimise development potential.	Any new development in this habitat unit must be optimised and limited to the existing disturbance footprint. Care must be taken to limit edge effects on the surrounding natural areas.

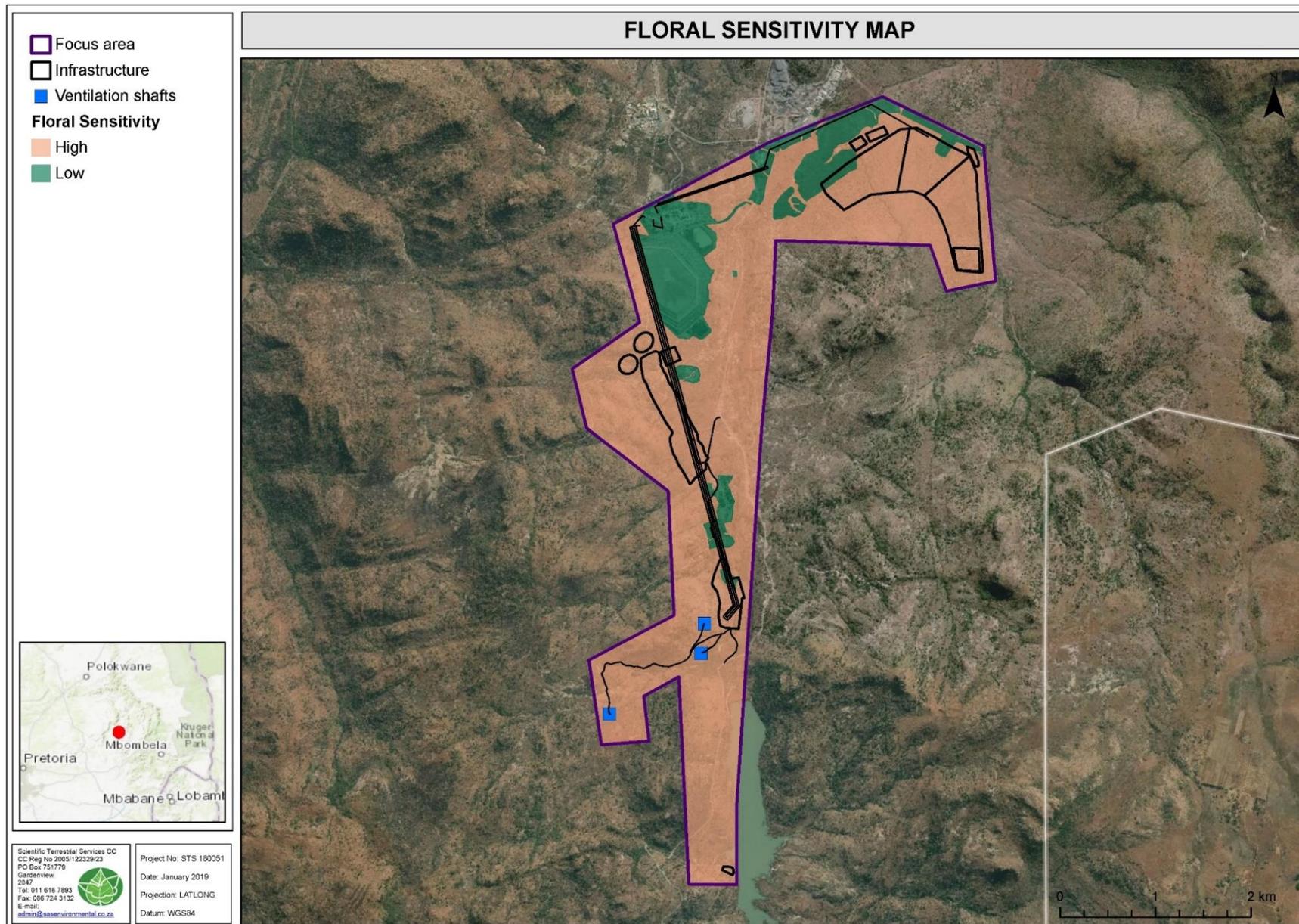


Figure 5: Sensitivity map for the focus area with the proposed mining related infrastructure.



5 IMPACT ASSESSMENT

The sections below serve to summarise the significance of perceived impacts on the floral ecology of the focus area, with impacts identified presented in Section 5.2 of this report.

Table 4 in Section 5.2 below presents the impact assessment according to the method described in Appendix B of this report. All impacts are considered without mitigation taking place as well as with mitigation fully implemented. All the required mitigatory measures needed to minimise the impact is presented in Section 5.2.

5.1 Results of the Impact Assessment

The impact significance of the proposed mining expansion plans associated with the loss of floral species and habitat is considered to be moderate to high prior to the implementation of mitigation measures. Following the implementation of mitigation measures, it is likely that most of the impacts can be decreased to a low to moderate significance levels; however, several impacts are considered highly likely to remain at high significance levels.

The following table provides an indication of the anticipated impact significance pre- and post-mitigation.



Table 4: A summary of the Impact Assessment undertaken for the proposed 2018 Der Brochen Mining Expansion Plan.

Nature of the impact	Significance of potential impact BEFORE mitigation						Mitigation Measures	Significance of potential impact AFTER mitigation						Degree of mitigation (%)			
	Probability	Duration	Extent	Magnitude	Loss of Resources	Significance		Probability	Duration	Extent	Magnitude	Loss of Resources	Significance				
Pre-Construction Phase																	
<p>Potential poorly planned placement of the proposed infrastructure within natural areas and areas identified as increasingly sensitive during ecological studies.</p> <p><i>This will result in extensive and unnecessary loss of favourable floral habitat, leading to a decline in floral diversity, including a decline in floral SCC (Species of Conservation Concern) numbers within the focus area, including <i>Balanites maughamii</i> (NFA), <i>Catha edulis</i> (NFA), <i>Huemia</i> sp. (LEMA), <i>Jamesbrittenia macrantha</i> (NT, LEMA), <i>Lydenburgia cassinoides</i> (NT, NFA), <i>Scadoxys puniceus</i> (LEMA) and <i>Sclerocarya birrea</i> subsp. <i>caffra</i> (NFA).</i></p> <p><i>Placement of infrastructure within drainage lines will result in greater linear impacts downstream.</i></p>	-	5	4	3	8	3	75	High	<ul style="list-style-type: none"> * Proposed Infrastructure areas must be optimised, ensuring that the layout footprint is as small as possible and does not encroach upon any sensitive habitat areas; * Minimise loss of indigenous vegetation where possible through planning and suitable layouts. Site clearance should be confined to the demarcated construction footprint areas; * The footprint of the proposed infrastructure area must be clearly demarcated to restrict vegetation clearing activities within the infrastructure footprint; * Ensured that as far as possible all proposed infrastructure, including temporary infrastructure, is placed outside of sensitive habitat units; * Access roads should be kept to existing gravel roads for pre-construction activities so to reduce fragmentation of existing natural habitat; * Prior to construction activities floral SCC that will be directly impacted upon need to be marked and removed to a suitable similar habitat or nursery as part of a rescue and relocation plan; and * All relevant permits are to be obtained from LEDET and DAFF prior to the removal of floral SCC. 	2	4	1	6	2	22	Low	70,7
<p>Potential failure to implement the required mitigation measures before and at commencement of construction activities:</p> <ul style="list-style-type: none"> - Failure to implement an Erosion Control Plan; - Failure to have a Rehabilitation Plan developed, and implemented, before commencement of mining activities; and - Failure to implement an Alien and Invasive Plant (AIP) Management/Control Plan before construction activities commences. <p><i>This will result in:</i></p> <ul style="list-style-type: none"> - Extensive and unnecessary loss of favourable floral habitat, leading to a decline in floral diversity, including a decline in floral SCC numbers within the study area, including species such as <i>Balanites maughamii</i> (NFA), <i>Catha edulis</i> (NFA), <i>Huemia</i> sp. (LEMA), <i>Jamesbrittenia macrantha</i> (NT, LEMA), <i>Lydenburgia cassinoides</i> (NT, NFA), <i>Scadoxys puniceus</i> (LEMA) and <i>Sclerocarya birrea</i> subsp. <i>caffra</i> (NFA). 	-	5	5	3	8	4	80	High	<ul style="list-style-type: none"> * Ensure that sound environmental management is in place during the planning phase; * Prior to the commencement of construction activities, the entire construction servitude, including lay down areas and stockpile areas etc., should be fenced off and clearly demarcated; * Prior to the commencement of construction activities on site, the existing alien and invasive plant control plan for the mine should be updated and implemented throughout all phases of the proposed mine project; * Prior to the commencement of construction activities on site, a rehabilitation plan should be developed for implementation throughout the development phases; and * The mine will implement the monitoring plan and provide an action plan to address impacts associated with exceedances. 	3	4	2	6	3	36	Moderate	55,0



Nature of the impact	Significance of potential impact BEFORE mitigation						Mitigation Measures	Significance of potential impact AFTER mitigation						Degree of mitigation (%)			
	Probability	Duration	Extent	Magnitude	Loss of Resources	Significance		Probability	Duration	Extent	Magnitude	Loss of Resources	Significance				
<ul style="list-style-type: none"> - Inability of vegetation to recover due to a lack of, or untimely, implementation of a well-conceived rehabilitation plan. - Proliferation of AIPs within the study area and the surrounding areas due to a failure to implement AIP Control Plan during the pre-construction phase. If AIPs are not managed before construction activities, dispersal propagules such as seeds will end up in topsoil stockpiles and reintroduced during the rehabilitation phase. 																	
<p>Potential failure to comply with national and regional legislation regarding permit applications for the removal / destruction of species listed under the:</p> <ul style="list-style-type: none"> - The list of Schedule 11 (Specially protected) and/or Schedule 12 (Protected plants) under the Limpopo Environmental Management Act, 2003 (Act 7 of 2003) (LEMA); and - The List of Protected Tree Species (GN 809 of 2014) under the National Forest Act (Act 84 of 1998) (NFA). <p>This will result in unnecessary or unlawful destruction/removal of floral SCC leading to a decline in the numbers of NFA-Protected Tree species (<i>Balanites maughamii</i>, <i>Catha edulis</i>, <i>Lydenburgia cassinoides</i> and <i>Sclerocarya birrea</i> subsp. <i>caffra</i>) and/or LEMA-Protected floral species (<i>Huernia</i> sp., <i>Jamesbrittenia macrantha</i> and <i>Scadoxys puniceus</i>) within the focus area.</p>	4	5	3	8	4	64	High	<ul style="list-style-type: none"> * Before any construction activities can occur, a detailed walk down of the area must take place, during which all NFA-protected tree species should be marked and permits applied for to remove / cut / destroy these species; and * Permits from the relevant authorities, i.e. Limpopo Department of Economic Development and Tourism (LEDET) and Department of Agriculture, Forestry and Fisheries (DAFF), should be obtained before removal, cutting or destruction of protected species or floral SCC before any proposed mining activities may take place. 	3	4	2	6	3	36	Moderate	43,8	
<p>Potential failure to correctly stockpile topsoil:</p> <ul style="list-style-type: none"> - Contaminating topsoil stockpiles with AIP propagules; - Compaction of stockpiled topsoil leading to loss of viable soils for rehabilitation; and - Inefficient vegetating of stockpiled topsoil resulting in degradation of soils. <p>This will result in the loss of viable soils for rehabilitation, thus hampering the potential for floral species to successfully establish post-closure. Ultimately a loss of floral diversity is expected.</p>	-	4	5	3	8	4	64	High	<ul style="list-style-type: none"> * It should be ensured that stockpiled topsoil is not contaminated by AIP material; * Handling of topsoil should only be done twice, i.e. once to strip and stockpile, and once to replace and level; * Topsoil to be stockpiled in such a way as to limit soil compaction and erosion; * No personnel and heavy vehicles to move over topsoil stockpile; * The topsoil stockpile should be vegetated and while vegetating, measures will be needed to contain erosion of the stockpile during rain events; * Adequate stormwater management must be incorporated into the design of the project throughout all phases in order to prevent erosion of topsoil and the subsequent loss of floral habitat; and * All topsoil and waste stockpiles must be designed in such a manner that runoff is contained. 	2	1	2	4	2	14	Low	78,1



Nature of the impact	Significance of potential impact BEFORE mitigation						Mitigation Measures	Significance of potential impact AFTER mitigation						Degree of mitigation (%)			
	Probability	Duration	Extent	Magnitude	Loss of Resources	Significance		Probability	Duration	Extent	Magnitude	Loss of Resources	Significance				
Construction Phase																	
<p>Clearing of vegetation and site preparation associated with the proposed surface infrastructure footprints, contractor laydown areas and construction of surface infrastructure. Here specific mention is made of:</p> <ul style="list-style-type: none"> -Site clearing for the South portal (13,6 ha), along with construction of the associated decline shafts; -Construction of three up-cast ventilation shafts; -Construction of the DMS and Chrome Plants (<0,5 ha) close to the existing Mototolo Concentrator Plant; -Site clearing associated with the DMS Stockpile (approximately 100 ha); -Construction of Pollution Control Dams (4 ha); -Construction of staff accommodation (0,6 ha). <p>This will lead to loss of sensitive floral habitat, i.e. rocky outcrops, and species, including floral SCC, including <i>Balanites maughamii</i> (NFA), <i>Catha edulis</i> (NFA), <i>Huemia</i> sp. (LEMA), <i>Jamesbrittenia macrantha</i> (NT, LEMA), <i>Lydenburgia cassinoides</i> (NT, NFA), <i>Scadoxys puniceus</i> (LEMA) and <i>Sclerocarya birrea</i> subsp. <i>caffra</i> (NFA).</p>	-	5	5	2	8	3	75	High	<ul style="list-style-type: none"> * The current construction footprint has already considered sensitive habitat and the current layout has attempted to improve based on previous consultations. However, where construction is still proposed within sensitive habitat, the construction footprint must be kept as small as possible in order to minimise impact on the surrounding environment and vegetation clearing should be limited to what is absolutely essential; * The construction footprint area will be clearly demarcated, and site clearance should be confined to the demarcated construction footprint areas; * Clearing of vegetation should take place in a phased manner as to keep bare soil areas as small as possible to limit the erosion potential. Additionally, construction personnel and construction vehicles should be kept to the bare minimal per site in order to reduce the construction footprint and potential of soil compaction; * Restrict vehicles to travelling only on designated roadways to limit the ecological footprint of the proposed development; * Regulated speed limits of 40km/hr must be maintained on gravel roads to minimize dust generation; * The mine will implement a revegetation programme on the disturbed areas adjacent to the site clearance area to ameliorate edge-effects; * Edge effects of all construction activities, which may affect floral habitat within surrounding areas, are to be strictly managed, e.g. implement an alien and invasive plant control plan from the get-go, mitigate soil erosion by reducing soil compaction caused by movement of construction personnel and vehicles, suppress dust in order to mitigate the impact of dust on flora within a close proximity of construction activities; and * There should be compensation for the significant residual impacts in the form of an offset. 	5	4	1	8	3	65	High	13.3
<p>Construction of infrastructure, gravel maintenance roads to the proposed ventilation shafts, upgrading of existing gravel roads to tar roads to serve as main access roads, haul roads and conveyor systems through natural, intact areas leading to a loss of floral habitat, SCC, plant species diversity and habitat connectivity.</p> <p>Clearing of vegetation along linear activities will lead to a loss of species, including SCC. Potential proliferation of alien and invasive floral species due to disturbance along roads.</p>	-	5	4	2	8	4	70	High	<ul style="list-style-type: none"> * Any mining surface infrastructure, including shafts, stockpiles and construction/ contractor's camps must be placed within transformed areas as far as possible. The footprint and daily operation of these structures must be strictly monitored to ensure that edge effects from the operational facilities do not affect the surrounding sensitive floral habitat; * Ensure that the ecological footprint of the proposed infrastructure area is kept as small as possible. Ensure that the ephemeral drainage lines, rocky outcrops and areas containing floral SCC outside of the direct construction footprint are demarcated as no-go zones for personnel and construction vehicles; * Roadsides serve as common corridors along which alien and invasive floral species are introduced and dispersed, therefore an alien and invasive plant control plan should be implemented; 	5	4	2	6	4	60	High	14.3



Nature of the impact	Significance of potential impact BEFORE mitigation						Mitigation Measures	Significance of potential impact AFTER mitigation						Degree of mitigation (%)	
	Probability	Duration	Extent	Magnitude	Loss of Resources	Significance		Probability	Duration	Extent	Magnitude	Loss of Resources	Significance		
							<ul style="list-style-type: none"> * Clearing of vegetation should take place in a phased manner as to keep bare soil areas as small as possible, thereby reducing the potential for erosion; * Edge effects of all construction activities which may affect floral habitat within surrounding areas, are to be strictly managed; * Open fires are prohibited only if the mine will provide fire safe zone facilities and suitable fire control measures. However, use of trees, shrubs or any vegetation for fire making purposes is strictly prohibited; * No indiscriminate driving movement of any vehicles through the veld is allowed. As far as possible vehicles are to utilise the existing roads. Where this is not feasible, new roads are to be located in areas of existing high disturbance, and not encroach upon sensitive habitats; * Access roads should be planned and constructed in such a way as to avoid habitat fragmentation; * A rehabilitation plan should be implemented upon completion of the construction activities to ensure that the affected areas return to an ecologically functioning state, thereby increasing habitat connectivity within affected areas. 								
Disposal of construction related waste material in the surrounding habitat	-	4	2	1	6	2	36 Moderate	<ul style="list-style-type: none"> * All construction related waste and material is to be disposed of at a registered waste facility; * No waste of construction rubble is to be dumped in the freshwater features or surrounding habitats. 	2	2	1	6	1	18 Low	50,0
Increased fire frequency and intensity, as well as uncontrolled fires due to increased human activity may impact on floral communities	-	5	2	1	8	3	55 Moderate	<ul style="list-style-type: none"> * No illicit fires must be allowed during any phases of the proposed mining development; * Open fires are prohibited only if the mine will provide fire safe zone facilities and suitable fire control measures. However, use of trees, shrubs or any vegetation for fire making purposes is strictly prohibited; * A Fire Management Plan (FMP) should be set in place to ensure that any fires that do originate can be managed and / or stopped before the significant damage to the environment occurs. 	3	2	2	2	1	18 Low	67,3
Loss of surrounding floral biodiversity and floral SCC through invasion of alien species in disturbed areas	-	5	4	2	8	3	70 High	<ul style="list-style-type: none"> * Edge effects of all construction activities, such as erosion and alien and invasive plant species proliferation, which may affect adjacent bushveld and freshwater resource habitat within surrounding areas, need to be strictly managed adjacent to the proposed infrastructure footprint areas. Specific mention in this regard is made to Category 1b species identified within the development footprint areas; * Ongoing alien and invasive plant monitoring and eradication/control should take place throughout the operational and closure/ decommissioning phases of the development, and the project perimeters should be regularly checked during the operational phase for alien and invasive plant proliferation to prevent spread into surrounding natural areas; 	4	4	2	6	2	48 Moderate	31,4



Nature of the impact	Significance of potential impact BEFORE mitigation						Mitigation Measures	Significance of potential impact AFTER mitigation						Degree of mitigation (%)			
	Probability	Duration	Extent	Magnitude	Loss of Resources	Significance		Probability	Duration	Extent	Magnitude	Loss of Resources	Significance				
							* An alien and invasive floral control plan must be designed and implemented in order to monitor and control alien floral recruitment in disturbed areas.										
Soil compaction and erosion as a result of development activities and storm water runoff leading to a loss of floral diversity	-	5	4	3	8	3	75	High	* All soils compacted as a result of operational activities falling outside of the proposed infrastructure areas should be ripped and profiled; * An AIP Management Plan should be in place already and should be implemented within disturbed areas.	4	4	2	6	2	48	Moderate	36,0
Clearing and removal of Floral SCC, including collection of medicinal/ protected floral species within the focus area	-	5	4	2	8	3	70	High	* No collection of firewood, floral SCC or medicinal floral species must be allowed by construction or mining personnel; * During the surveying and site-pegging phase of surface infrastructure, all floral SCC that will be affected by surface infrastructure must be marked and where possible, relocated to suitable habitat surrounding the disturbance footprint; * Should any floral species protected under Limpopo Environmental Management Act (LEMA) (Act 7 of 2003) and National Forest Act (Act 84 of 1998) be encountered within the proposed development footprint areas, permits should be obtained from LDEDET and DAFF to remove, cut or destroy any protected tree species before construction of infrastructure takes place; * The following protected species listed under the National Forest Act (Act 84 of 1998) were observed within the focus area at the time of the assessment: <i>Balanites maughamii</i> , <i>Catha edulis</i> , <i>Lydenburgia cassinoides</i> and <i>Sclerocarya birrea</i> subsp. <i>caffra</i> . Permits will be required were any of these species to be affected by the mining activities; * Additionally, several species listed as protected under the LEMA (Act 7 of 2003) were observed during the field assessment namely: <i>Aloe cryptopoda</i> , <i>Huernia sp.</i> , <i>Jamesbrittenia macrantha</i> and <i>Scadoxys puniceus</i> . These species will need to be rescued and relocated or, were they to be affected by the mining activities, permits should be obtained from LEDET.	4	4	2	6	2	48	Moderate	31,4
Operational Phase																	
Loss of floral habitat as a result of vegetation clearing related to: - Temporary hauling of ore; - Stockpiling of ore material at Mototolo Concentrator; and - Deposition of DMS material onto the DMS Stockpile Area. Loss of floral diversity and floral endemics due to long-term habitat loss associated with the above-mentioned mining activities. The conveyor system extends across the majority of the focus area and can lead to fragmentation of	-	5	4	2	8	4	70	High	* Stockpile and PCD positions, and their expansion as material is deposited, should be kept as small as possible; * The current proposed positions of the DMS stockpiles and DMS Pollution control dams within the north-eastern portion of the focus area will lead to the loss of sensitive floral habitat (rocky outcrops) and, consequently, loss of floral SCC (most importantly <i>Sclerocarya birrea</i> and <i>Jamesbrittenia macrantha</i>). The DMS Complex also traverses the freshwater resources. It should be strongly considered to place the stockpiles further north within the more disturbed habitat. It is not recommended that any mining activities take place within the rocky outcrop areas, i.e. areas where increased rockiness, boulders and sheetrock formations are evident and clearly seen aboveground. This includes areas where species such as <i>Aloes</i> , various succulents and an increased forb abundance are present. The rocky	5	4	1	8	3	65	High	7.1



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	Probability	Duration	Extent	Magnitude	Loss of Resources	Significance		Probability	Duration	Extent	Magnitude	Loss of Resources	Significance		
habitat, thereby altering floral population dynamics and reducing species diversity.							quartzite woodland within the Open Bushveld Habitat Unit is of particular concern; * The new proposed positions of the conveyor belts are closer to existing roads and transformed areas which will decrease their impact on floral SCC. The construction of the conveyor belts should limit the removal of vegetation to what is absolutely necessary. During the operation of the mine, the conveyors should be maintained regularly and frequently inspected for increased disturbance along its path e.g. soil erosion or soil instability due to conveyor movements, or the proliferation of alien and invasive species resulting from disturbance to the surrounding habitat; and * Design of the conveyors should be such that the habitat is, as far possible, not fragmented.								
Further loss of floral SCC through edge effects associated with mining activities: - Operation of Conveyor Systems; - Operation of the Chrome Recovery Inter-Stage Plant; - Operation of the DMS Plant; and - Utilisation of tar access roads.	-	4	4	2	8	2	56 Moderate	* Regular monitoring of site activities and machinery must be undertaken to identify spills or leaks; * Manage all edge effects stemming from mining operations and infrastructure areas; * Restrict vehicles to travelling only on designated roadways to limit the ecological footprint of the proposed development; and * No uncontrolled or unsanctioned fires are allowed.	3	3	1	4	1	24 Low	57,1
Additional pressure on floral habitat by increased human populations associated with the proposed mining activities leading to a loss of floral habitat. - Utilisation of the Staff Accommodation near the Der Brochen Dam; - The increase in human population will also contribute to an increase in the collection of plant material for medicinal purposes; - Increased human activities also have the potential to lead to the introduction of alien and invasive plant species; and - Increase in fire frequencies is a risk.	-	5	4	2	8	2	70 High	* Manage all edge effects stemming from mining operations and infrastructure areas; * Implement erosion control measures where necessary to ensure that further habitat loss does not occur, and minimise downslope habitat and water resource siltation; * Any waste or toxic spills from vehicles or mining infrastructure must be dealt with immediately in accordance with the waste management plan; * No uncontrolled or unsanctioned fires are allowed. A Fire Management Plan should be in place; * Implement an alien and invasive species management programme that includes ongoing monitoring and control of the presence and/or re-emergence of such species.	3	4	2	6	1	36 Moderate	48,6
Risk of discharge and contamination from operational facilities may pollute receiving environment leading to altered floral habitat.	-	5	5	3	8	2	80 High	* An effective management plan must be designed and implemented in order to mitigate the impact of possible discharge to prevent the possible pollution of receiving environment; * Maintain all water management structures so that only dirty water is contained, and clean water is diverted to the natural environment; and * The mine will implement the monitoring plan and provide an adequate action plan to address impacts associated with exceedances.	3	4	2	6	2	36 Moderate	55,0
On-going disturbance of soils including erosion and sedimentation due to operational activities leading to altered floral habitat.	-	5	5	3	8	2	80 High	* All soils compacted as a result of operational activities falling outside of the proposed infrastructure areas should be ripped and profiled; and * An AIP Management Plan should be in place already and should be implemented within disturbed areas.	3	4	2	6	2	36 Moderate	55,0



Nature of the impact	Significance of potential impact BEFORE mitigation						Mitigation Measures	Significance of potential impact AFTER mitigation						Degree of mitigation (%)			
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<p>Dust generation during operational activities leading to a loss of floral habitat.</p> <p>Dust pollution have been associated with poor photosynthetic functionality in plants². There is evidence of dust pollution leading to a reduction in chlorophyll, including chlorophyll degradation and reduced photosynthetic activity^{3,4}, resulting from dust deposition on leaf surfaces. Dust deposition also result in stomata clogging⁵, which causes a decreased rate of carbon dioxide exchange, carbon assimilation, transpiration, and therefore decreased net photosynthesis.</p>	-	5	5	2	8	2	75	High	<ul style="list-style-type: none"> * An effective dust management plan must be designed and implemented in order to mitigate the impact of dust on floral species throughout the operational phase; and * Moisture control will be necessary on large bare areas during dry season construction, in order to reduce the frequency and amount of dust suspended in the ambient air. 	2	4	2	6	2	24	Low	68,0
<p>Loss of natural vegetation due to insufficient waste management resulting from soils that have been contaminated.</p> <p>Growing conditions for plant species will be sub-optimal and only pioneer species will be able to utilise the disturbed soils (generally AIPs).</p> <p>Contamination within drainage lines will result in greater linear impacts downstream.</p>	-	5	5	3	8	4	80	High	<ul style="list-style-type: none"> * Storage of domestic and hazardous waste should be undertaken within designated waste storage facilities. The area must be clearly marked with signage boards and be fenced off; * Sorting of solid waste into recyclable and non-recyclable waste streams must be done; * Waste will be removed off site by a licensed contractor to a suitable licensed facility; * A spill prevention and emergency spill response plan, as well as dust suppression, and fire prevention plans must be developed and be implemented; * Clean and dirty water separation systems must be implemented and maintained to ensure that any contaminated water does not contaminate the soil and water resources; * All facilities with the potential to generate dirty storm water runoff, effluent or washdown water will be located within the designated dirty water area; * Clean runoff will be diverted around the designated dirty areas by means of cut-off canals, sized to accommodate at least the 1:50 year peak flow event; * Adequate erosion protection will be provided at the clean canal discharge locations; * All storage of hazardous materials will be contained within dedicated bunded areas (at wash bays, workshops, waste handling areas, etc.); 	2	2	2	4	2	16	Low	80,0

² Sett, R. (2017). Responses in plants exposed to dust pollution. Horticulture International Journal, 1(2), 00010.

³ Gunamani T, Gurusamy R, Swamynathan K. Effect of dust pollution on the dermal appendages and anatomy of leaves in some herbaceous plants. J Swamy Boli Club. 1991;8(3-4):79-85.

⁴ Naik DP, Ushamani, Somasekhar RK. Reduction in protein and chlorophyll contents in some plant species due to some stone quarrying activity. Environ Polln Cont J. 2005;8:42-44.

⁵ Vijaywargiya A, Pandey GP. Effect of cement dust on soybean, Glycine max (L) merr. And Maize, Zea mays Linn. Inflorescence study. Geobios. 2003;30:209-212.



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							<ul style="list-style-type: none"> * Hazardous waste will be stored according to the applicable regulations under the National Environmental Management: Waste Act (Act 59 of 2008) and the DWS Minimum Requirements; * The hazardous waste storage area will, as a minimum, be paved with concrete, covered and provided with bunds and drainage facilities to collect and contain any spills or adversely affected runoff; * Waste oil will be stored in drums in a bunded storage area; * All pipeline routes will be inspected regularly to enable early detection of leaks; * Washdown and waste water from the workshops will be passed through oil skimmers before discharging to the storm water system for containment in the PCD and eventual treatment for reuse, or pumping to existing Dishaba storm water management infrastructure; * An inspection and maintenance plan will be implemented on the storm water system to ensure that all oil skimming and sediment handling facilities are maintained, and that storm water canals and pipelines remain unblocked and free flowing – monthly inspections will be carried out; * Spill kits (such as spill-sorb or a similar type product) must be kept on site and used to clean up hydrocarbon spills in the event that they should occur; * Continued implementation of the surface and ground water quality monitoring programme should be undertaken to detect any impacts; * If impacts on surface or groundwater are detected, adequate actions must be taken to address the impacts; and * Existing emergency response contingency plan must be implemented to address clean-up measures should a spill and/or a leak occur. 										
Closure/Rehabilitation Phase																	
Decommissioning/ removal of surface infrastructure and equipment, including conveyor belt systems and staff accommodation. Closure of the Shafts and underground workings. <ul style="list-style-type: none"> - Failure to implement and manage biodiversity action plan, rehabilitation plan, alien and invasive control plan; - Compacted soils limiting the re-establishment of natural vegetation; - Increased risk of erosion in disturbed areas; - Improper rehabilitation of disturbed areas leading to permanent floral habitat loss. 	-	5	5	2	8	2	75	High	<ul style="list-style-type: none"> * Regular dust suppression must be undertaken on bare soils during the closure and decommissioning phase; * Regulated speed limits of 40km/hr must be maintained to minimize dust generation; * Storm water management measures should be maintained until rehabilitation is complete; * Ensure sound implementation of alien and invasive plant control plan; * All disturbed areas should be ripped to alleviate compaction; * Stored topsoil should be replaced (if any) and the footprint graded in line with the closure plan; * Additional top soiling and revegetation of affected areas should be undertaken if required; * Revegetate with an indigenous grass mix, to re-establish a protective cover, in order to minimise soil erosion and dust emissions; * Where necessary, hessian sheets (or similar products) are to be used in order to stabilise the soil surface until revegetation has occurred; 	4	5	2	6	3	52	Moderate	30,7



Nature of the impact	Significance of potential impact BEFORE mitigation						Mitigation Measures	Significance of potential impact AFTER mitigation						Degree of mitigation (%)			
	Probability	Duration	Extent	Magnitude	Loss of Resources	Significance		Probability	Duration	Extent	Magnitude	Loss of Resources	Significance				
							<ul style="list-style-type: none"> * Erosion control measures are to be implemented to mitigate downslope sedimentation of freshwater resources and the hindrance of revegetation/ rehabilitation activities; * All surface infrastructure is to be removed and waste material disposed of at a registered dump site. Waste and remnant mine related material is not to be dumped or left within the focus area; * Prevent all open fires. Provide fire safe zone facilities and suitable fire control measures; * Use of trees, shrubs or any vegetation for fire making purposes is strictly prohibited; and * Contractors will not be allowed to harvest any natural resources. 										
Post-Closure Phase																	
<p>Post-rehabilitation: Ineffective or potentially poorly designed rehabilitation efforts will result in ongoing erosion, habitat loss, alien plant proliferation and the loss of floral species diversity.</p> <p>Shift in vegetation type due to inability to restore specialised habitat such as rocky outcrops. This will lead to a loss of species diversity and a permanent loss of habitat for a variety of endemics that are typically associated with rocky habitat within the Sekhukhune Centre of Plant Endemism.</p>	-	5	5	3	10	3	90	High	<ul style="list-style-type: none"> * Implement all recommendations as per the mine closure plan; * All compacted and disturbed areas along the edge of the DMS Stockpile and PCD footprint to be ripped, topsoiled and vegetated; * Disturbed areas will be sloped to enhance natural run-off patterns; * Follow up with alien and invasive plant control measures for a period of 5 years post-closure; * Rehabilitation efforts must be implemented for a period of at least 5 years after decommissioning and closure but must ensure that rehabilitation takes place to an appropriate level after which natural processes will allow recovery to an ecologically functioning condition; * Undertake inspection of rehabilitated area to ascertain level of success of rehabilitation efforts and effectiveness (vegetation growth, erosion monitoring); * Continue monitoring of rehabilitation activities for a minimum period of 5 years following the mine closure or until an acceptable level of habitat and biodiversity re-instatement has occurred, in such a way as to ensure that natural processes and veld succession will lead to the re-establishment of the natural wilderness conditions which are analogous to the pre-mining conditions of the area. 	3	3	2	6	3	33	Moderate	58,8



Nature of the impact	Significance of potential impact BEFORE mitigation						Mitigation Measures	Significance of potential impact AFTER mitigation						Degree of mitigation (%)		
	Probability	Duration	Extent	Magnitude	Loss of Resources	Significance		Probability	Duration	Extent	Magnitude	Loss of Resources	Significance			
Rehabilitation of the DMS Stockpile, shaft, conveyor system and PCDs. Ideal post-closure rehabilitation outcome: Rehabilitation to pre-mined conditions, along with successful relocation of floral SCC, will result in a positive impact on floral diversity and floral SCC numbers associated with the focus area. Realistic post-closure rehabilitation outcome: Revegetation with indigenous species to the point where floral ecological functions or processes can continue without human intervention, albeit in a modified, functional way. Rehabilitation will result in a positive impact; however, the ultimate result of mining, despite rehabilitation efforts fully implemented, is likely to result in long-term loss of floral diversity, potentially including a loss of SCC numbers, to the focus area.	+	1	2	2	4	5	8	* Minimise the visual impact of Shafts, DMS Stockpile and PCDs and rehabilitated areas by carefully shaping the dump to blend with the surrounding landscape and by using indigenous vegetation from the area for rehabilitation; * Use of a nursery developed by the mine to cultivate indigenous/endemic and SCC plant species with focus on rehabilitation during the post closure phase in conjunction with a suitably qualified specialist. This will assist in areas where regrowth is not to acceptable standard; * Rehabilitation efforts must be implemented for a period of at least 5 years after decommissioning and closure but must ensure that rehabilitation takes place to an appropriate level after which natural processes will allow recovery to an ecologically functioning condition; * To avoid failed, or suboptimal, rehabilitation outcomes, it is recommended that mine infrastructure be placed in habitat with a higher probability of restoration to pre-mining conditions. As such, rocky outcrop habitat should be excluded from mining activities as far possible as it is deemed highly unlikely that the micro habitat and growing conditions for floral species can be adequately recreated post-mining; and * Continue monitoring of rehabilitation activities for a minimum period of 5 years following the mine closure or until an acceptable level of habitat and biodiversity re-instatement has occurred, in such a way as to ensure that natural processes and veld succession will lead to the re-establishment of the natural wilderness conditions which are analogous to the pre-mining conditions of the area.	3	4	3	6	4	39	Moderate positive	-387,5



5.2 Impact discussion

The Der Brochen Amendment Project will have significant impacts associated with a loss of floral habitat, resulting in reduced floral diversity within the focus area and will significantly impact on floral SCC.

Open pit mining, the placement of infrastructure and all the associated mining activities are likely to have a significant impact on floral species and communities within the focus area (Habitat for floral species, floral diversity, floral SCC), with regional impacts likely if mitigation measures are not adhered to. The proposed mining layouts and activities are likely to impact a number of floral SCC including *Balanites maughamii* (NFA), *Catha edulis* (NFA), *Huernia* sp. (LEMA), *Jamesbrittenia macrantha* (NT, LEMA), *Lydenburgia cassinoides* (NT, NFA), *Scadoxys puniceus* (LEMA) and *Sclerocarya birrea* subsp. *caffra* (NFA). The region in which the focus area is located falls within the Sekhukhune Centre of Endemism and is considered to be a biodiversity rich area that is currently not protected and with only 0.4% of the target 24% of this vegetation type currently conserved. Continued mining and human population expansion have resulted in extensive areas of this habitat type already being lost. Currently there are very few areas remaining that can be considered representative of this vegetation type, of which the focus area is one of them and furthermore one of the most important.

Activities which are likely to negatively impact floral species within the focus area include, but are not limited to, the following:

- Placement of mining infrastructure within sensitive floral habitat;
- Clearing of vegetation during construction and operational activities;
- Alien and invasive floral proliferation and erosion in disturbed areas;
- Increased possibility of collection of medicinal plants; and
- Edge effects compromising habitat integrity through, e.g., enabling alien vegetation to proliferate, decreasing habitat connectivity and increasing the extent of transformed habitat with little chance of habitat restoration.

Most of the proposed mining layout is situated in habitat that is of high ecological sensitivity and importance. Impacts to the floral ecology associated with the focus area will be significant and likely permanent within the Open Bushveld and Sekhukhune Mountain Bushveld, with downstream impacts likely to emanate from impacts on the Freshwater Habitat.

If effective mitigation takes place, many of the impacts may be reduced to a low to moderate significance rating. However, with the current proposed placement of the South Portal and the DMS complex, the negative impacts on floral species habitat, diversity and SCC will remain of high significance. Even with rehabilitation fully implemented, the long-term impact on floral



habitat, diversity and SCC is perceived to be significant, with a low probability that the pre-mining condition can be achieved.

5.3 Probable Latent Impacts

Even with mitigation, significant latent impacts on the receiving floral ecological environment are deemed likely, with particular reference to impacts within freshwater habitat and rocky outcrop habitat. The following points highlight the key latent impacts that have been identified that will be relevant within the focus area:

- Permanent loss of ecologically intact, irreplaceable floral habitat;
- Permanent loss of, or impairment of and altered floral species diversity;
- Alien and invasive plant proliferation;
- Permanent loss of, or impairment of and altered floral SCC and suitable habitat; and
- Disturbed areas are highly unlikely to be rehabilitated to pre-development conditions of ecological functioning and significant loss of floral habitat, species diversity and floral SCC will most likely be permanent.

5.4 Cumulative Impacts

The project (and thus the focus area) is located within an area which is under increasing pressure from mining activities. The focus area is predominantly located within the Sekhukhune Mountain Bushveld Habitat and located within the Sekhukhune Centre of Plant Endemism. Significant habitat loss has already occurred within this centre of endemism, largely attributable to the expansion of local communities and mines and associated mining exploration. Currently the focus area, due to the increased level of protection afforded to it as a result of Anglo Platinum managing the land, is considered to be largely intact with representative vegetation types associated with the Sekhukhune Centre of Plant Endemism. As such, the overall species diversity and abundance of the focus area is a stark contrast to that of the surrounding area. Mining activities within the focus area will only serve to add to the loss of habitat, species abundance and species diversity as is currently being experienced in the region and will lead to the impairment of one of the areas of Sekhukhune Mountain Bushveld Habitat which is still the most intact.

The already approved Northern Pit and WRDs will contribute to a cumulative loss of both floral habitat and SCC within the focus area. WRD Option A only falls within one habitat unit and is preferred over Option B, which falls within both the Sekhukhune Mountain Bushveld and the



Freshwater Habitat. Regardless, both WRD options will lead to loss of floral habitat and has the potential to impact on floral SCC such as *Balanites maughamii*, *Catha edulis*, *Jamesbrittenia macrantha* and *Lydenburgia cassinoides*. If rehabilitation is not adequately implemented, the cumulative impact to floral ecology in the area will have a significant negative impact.

5.5 Floral Monitoring

A floral monitoring plan must be designed and implemented throughout all phases of the mining development, should it be approved. The following points aim to guide the design of the monitoring plan, and it must be noted that the monitoring plan must be continually updated and refined for site-specific requirements:

- Permanent monitoring plots must be established in areas surrounding the surface infrastructure and rehabilitated areas. These plots must be designed to accurately monitor the following parameters:
 - Measurements of crown and basal cover;
 - Species diversity;
 - Species abundance;
 - Impact of dust on flora;
 - Recruitment of indigenous species;
 - Alien vs. Indigenous plant ratio;
 - Recruitment of alien and invasive plant species;
 - Erosion levels and the efficacy of erosion control measures;
 - Vegetation community structure including species composition and diversity which should be compared to pre-development conditions; and
 - Presence, abundance and condition of floral SCC communities.
- Monitoring of rehabilitation trials in light of the above parameters must also take place throughout all phases of the proposed mining development and for a period of 5 years after decommissioning and closure;
- The rehabilitation plan must be continuously updated in accordance with the monitoring results in order to ensure that optimal rehabilitation measures are employed;
- Results of the monitoring activities must be taken into account during all phases of the proposed mining development and action must be taken to mitigate impacts as soon as negative effects from mining related activities become apparent; and
- The method of monitoring must be designed to be subjective and repeatable in order to ensure consistent results.



6 CONCLUSION

Scientific Terrestrial Services (STS) was appointed to conduct a floral and faunal ecological assessment as part of the Environmental Impact Assessment (EIA) and authorisation process for the proposed Anglo Platinum Der Brochen Expansion Project, Limpopo Province. An area encompassing all the various expansion areas associated with the Anglo Platinum Der Brochen Mine was used to gather all background information that might be relevant to the project, henceforth referred to as the “focus area”. The findings of the field assessment indicate that the focus area is characterised by four habitat units namely, Sekhukhune Mountain Bushveld, Open Bushveld, Freshwater Habitat and Transformed Habitat. Although all habitat units have been affected by anthropogenic activities on some level, the severity of the impacts differ. Apart from the Transformed Habitat unit, all other habitat units remain in a near-pristine condition with intact habitat integrity. The potential for the various habitat units to support floral SCC also differs. Consequently, the ecological sensitivity of the habitat units varies between high (Freshwater Habitat, Sekhukhune Mountain Bushveld, Open Bushveld) and low (Transformed habitat).

The perceived impact significance of the proposed mining activities prior to mitigation affecting floral habitat, diversity and SCC are moderate to high significance impacts. If effective mitigation takes place, many of the impacts may be reduced to a low to moderate significance rating. However, with the current proposed placement of the South Portal, conveyor system and the DMS complex, negative impacts on floral species habitat, diversity and SCC will remain of high significance. It is thus deemed essential that a cogently developed, documented and managed biodiversity management plan be implemented and maintained throughout the life of the proposed mine.

The objective of this study was to provide sufficient information on the floral ecology of the area, together with other studies on the physical and socio-cultural environment, in order for the Environmental Assessment Practitioner (EAP) and the relevant authorities to apply the principles of Integrated Environmental Management (IEM) and the concept of sustainable development. The needs for conservation as well as the risks to other spheres of the physical and socio-cultural environment need to be compared and considered along with the need to ensure economic development of the country.

It is the opinion of the ecologists that this study provides the relevant information required in order to implement IEM and to ensure that the best long-term use of the ecological resources in the focus area will be made in support of the principle of sustainable development.



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APPENDIX A: Floral method of Assessment

Floral Species of Conservational Concern Assessment

Prior to the field visit, a record of floral SCC and their habitat requirements was acquired from SANBI for the Quarter Degree Square in which the study area is situated, as well as relevant regional, provincial and national lists. Throughout the floral assessment, special attention was paid to the identification of any of these SCC as well as the identification of suitable habitat that could potentially support these species.

The Probability of Occurrence (POC) for each floral SCC was determined using the following calculations wherein the distribution range for the species, specific habitat requirements and level of habitat disturbance were considered. The accuracy of the calculation is based on the available knowledge about the species in question, with many of the species lacking in-depth habitat research.

Each factor contributes an equal value to the calculation.

Distribution						
	Outside of known distribution range					Inside known distribution range
Site score						
EVC 1 score	0	1	2	3	4	5
Habitat availability						
	No habitat available					Habitat available
Site score						
EVC 1 score	0	1	2	3	4	5
Habitat disturbance						
	0	Very low	Low	Moderate	High	Very high
Site score						
EVC 1 score	5	4	3	2	1	0

[Distribution + Habitat availability + Habitat disturbance] / 15 x 100 = POC%

Vegetation Surveys

Vegetation surveys were undertaken by first identifying different habitat units and then analysing the floral species composition that was recorded during detailed floral assessments using the step point vegetation assessment methodology. Different transect lines were chosen throughout the entire study area within areas that were perceived to best represent the various plant communities. Floral species were recorded and a species list was compiled for each habitat unit. These species lists were also compared with the vegetation expected to be found within the relevant vegetation types as described in Section 4, which serves to provide an accurate indication of the ecological integrity and conservation value of each habitat unit (Evans & Love, 1957; Owensby, 1973).

Floral Habitat Sensitivity

The floral habitat sensitivity of each habitat unit was determined by calculating the mean of five different parameters which influence floral communities and provide an indication of the overall floristic ecological integrity, importance and sensitivity of the habitat unit. Each of the following parameters are subjectively rated on a scale of 1 to 5 (1 = lowest and 5 = highest):

- **Floral SCC:** The confirmed presence or potential for floral SCC or any other significant species, such as endemics, to occur within the habitat unit;



- **Unique Landscapes:** The presence of unique landscapes or the presence of an ecologically intact habitat unit in a transformed region;
- **Conservation Status:** The conservation status of the ecosystem or vegetation type in which the habitat unit is situated based on local, regional and national databases;
- **Floral Diversity:** The recorded floral diversity compared to a suitable reference condition such as surrounding natural areas or available floristic databases; and
- **Habitat Integrity:** The degree to which the habitat unit is transformed based on observed disturbances which may affect habitat integrity.

Each of these values contribute equally to the mean score, which determines the floral habitat sensitivity class in which each habitat unit falls. A conservation and land-use objective is also assigned to each sensitivity class which aims to guide the responsible and sustainable utilization of the habitat unit in question. In order to present the results use is made of spider diagrams to depict the significance of each aspect of floral ecology for each vegetation type. The different classes and land-use objectives are presented in the table below:

Table A1: Floral habitat sensitivity rankings and associated land-use objectives.

Score	Rating significance	Conservation objective
1> and <2	Low	Optimise development potential.
2> and <3	Moderately low	Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects.
3> and <4	Intermediate	Preserve and enhance biodiversity of the habitat unit and surrounds while optimising development potential.
4> and <4.5	Moderately high	Preserve and enhance the biodiversity of the habitat unit, limit development and disturbance.
> 4.5	High	Preserve and enhance the biodiversity of the habitat unit, no-go alternative must be considered.



APPENDIX B: Impact Assessment Methodology

In order for the EAP to allow for sufficient consideration of all environmental impacts, impacts were assessed using a common, defensible method of assessing significance that will enable comparisons to be made between risks/impacts and will enable authorities, stakeholders and the client to understand the process and rationale upon which risks/impacts have been assessed. The method to be used for assessing risks/impacts is outlined in the sections below.

Impact Assessment Methodology

The anticipated impacts associated with the proposed project have been assessed according to SRK's standardised impact assessment methodology which is presented below. This methodology has been formalised to comply with Regulation 31(2) (l) of the National Environmental Management Act (Act 107 of 1998) (NEMA), which states the following:

“An environmental impact assessment report must contain all information that is necessary for the competent authority to consider the application and to reach a decision, and must include;

- I. An assessment of each identified potentially significant impact, including:
 - a. Cumulative impacts;
 - b. The nature of the impact;
 - c. The extent and duration of the impact;
 - d. The probability of the impact occurring;
 - e. The degree to which the impact can be reversed;
 - f. The degree to which the impact may cause irreplaceable loss of resources; and
 - g. The degree to which the impact can be mitigated.”

Based on the above, the EIA Methodology will require that each potential impact identified is clearly described (providing the nature of the impact) and be assessed in terms of the following factors:

- **Extent** (spatial scale) - will the impact affect the national, regional or local environment, or only that of the site;
- **Duration** (temporal scale) - how long will the impact last;
- **Magnitude** (severity) - will the impact be of high, moderate or low severity; and
- **Probability** (likelihood of occurring) - how likely is it that the impact may occur.

To enable a scientific approach for the determination of the environmental significance (importance) of each identified potential impact, a numerical value has been linked to each factor.



The following ranking scales are applicable:

Occurrence	Duration:	Probability:
	5 – Permanent	5 – Definite/don't know
	4 – Long-term (ceases with the operational life)	4 – Highly probable
	3 – Medium-term (5-15 years)	3 – Medium probability
	2 – Short-term (0-5 years)	2 – Low probability
	1 – Immediate	1 – Improbable
	0 – None	
Severity	Extent/scale:	Magnitude:
	5 – International	10 – Very high/uncertain
	4 – National	8 – High
	3 – Regional	6 – Moderate
	2 – Local	4 – Low
	1 – Site only	2 – Minor
	0 – None	

Once the above factors had been ranked for each identified potential impact, the environmental significance of each impact can be calculated using the following formula:

$$\text{Significance} = (\text{duration} + \text{extent} + \text{magnitude}) \times \text{probability}$$

The maximum value that can be calculated for the environmental significance of any impact is 100.

The environmental significance of any identified potential impact is then rated as either: high, moderate or low on the following basis:

- More than 60 significance value indicates a high (H) environmental significance impact;
- Between 30 and 60 significance value indicates a moderate (M) environmental significance impact; and
- Less than 30 significance value indicates a low (L) environmental significance impact.

In order to assess the degree to which the potential impact can be reversed, and be mitigated, each identified potential impact will need to be assessed twice;

- Firstly, the potential impact will be assessed and rated prior to implementing any mitigation and management measures; and
- Secondly, the potential impact will be assessed and rated after the proposed mitigation and management measures have been implemented.



The purpose of this dual rating of the impact before and after mitigation is to indicate that the significance rating of the initial impact is and should be higher in relation to the significance of the impact after mitigation measures have been implemented.

In order to assess the degree to which the potential impact can cause irreplaceable loss of resources, the following classes (%) will be used and will need to be selected based on your informed decision and discretion:

- 5 100% - Permanent loss
- 4 75% - 99% - significant loss
- 3 50% - 74% - moderate loss
- 2 25% - 49% - minor loss
- 1 0% - 24% - limited loss

Please note that the Loss of Resources aspect will not affect the overall significance rating of the impact.

In terms of assessing the cumulative impacts, it must be addressed in a sentence/paragraph fashion as the spatial extent of the cumulative impacts will vary from project to project. Cumulative impact, in relation to an activity, means the impact of an activity that in itself may not be significant, but may become significant when added to the existing or potential impacts eventuating from similar or diverse activities or undertakings in the area.



APPENDIX C: Floral SCC

Table C1: PRECIS plant list for the QDS 2530AA (Raimondo *et al.*, 2009; SANBI, www.sanbi.org).

Family	Species	Threat Status	Habitat	POC
Apocynaceae	<i>Asclepias schlechteri</i>	EN	Ngongoni Veld, sandy soils in tall grasslands	10
Apocynaceae	<i>Brachystelma minor</i>	VU	Shallow pockets of dolomite, tolerating both open and shady condition	10
Apocynaceae	<i>Brachystelma stellatum</i>	Rare	Montane grassland	10
Araceae	<i>Zantedeschia elliottiana</i>	DDT	Sandy or rocky places, usually seasonally damp	5
Araceae	<i>Zantedeschia pentlandii</i>	VU	Rocky hillsides	5
Asphodelaceae	<i>Aloe reitzii</i> var. <i>reitzii</i>	NT	Granite outcrops and rocky slopes in montane grassland.	35
Asteraceae	<i>Cymbopappus piliferus</i>	VU	Rocky quartzitic ridges in montane grassland	0
Asteraceae	<i>Helichrysum aureum</i> var. <i>argenteum</i>	Not Evaluated (Formerly VU)	Montane grassland, 18002-2000m	10
Celastraceae	<i>Lydenburgia cassinoides</i>	NT	Exposed norite bedrock and dolomite	100
Crassulaceae	<i>Crassula setulosa</i> var. <i>deminuta</i>	Not Evaluated (Formerly VU)	Stony/rocky, well-drained sandstone soils in full sun, 2110m	35
Fabaceae	<i>Pearsonia hirsuta</i>	VU	Low grassland between rocks, in humus-rich, sandy soil	35
Hyacinthaceae	<i>Eucomis vandermerwei</i>	VU	Short, sour montane grassland on sandy, low-pH soils derived from quartzitic rocky outcrops. In rock crevices or under overhanging rocks, confined to outcrops on slopes and plateaus of higher peaks, predominantly on north-facing slopes, 2200-2500 m	46
Hyacinthaceae	<i>Ledebouria lepida</i>	Rare	Waterberg Mountain Bushveld.	5
Mesembryanthemaceae	<i>Khadia alticola</i>	Rare	Montane grassland in shallow, sandy, humus-rich soil pockets and crevices between rock plates above 2000 m	35
Mesembryanthemaceae	<i>Khadia beswickii</i>	VU	Open shallow soil over rocks in grassland	0
Orchidaceae	<i>Disa alticola</i>	VU	In seepages and wet hollows among dolerite boulders and bedrock, in short and heavily grazed grassland, 2000 m.	5
Orchidaceae	<i>Disa zuluensis</i>	EN	Swampy areas, vleis in grassland, 1500-2000 m	5
Orchidaceae	<i>Habenaria barbertoni</i>	NT	Rocky hillsides, in bushveld in association with acacias, 1000-1500 m	20
Orobanchaceae	<i>Graderia linearifolia</i>	VU	Sparse montane grassland on poor, gravelly, quartzitic soil, 2255 m.	20
Proteaceae	<i>Protea parvula</i>	NT	Most prominent in Lydenburg montane grassland.	0
Scrophulariaceae	<i>Jamesbrittenia macrantha</i>	NT	Grassy slopes with other scattered shrubs, restricted to norite	100



Table C2: Species of conservation concern identified within the MRA and surrounding area in previous studies undertaken by Natural Scientific Services (2012) and Perkins and winter (2002). Only species still considered threatened according to the Red List of South Africa Threatened Species Programme (2017) or Protected within the List of Protected Tree Species (GN 809 of 2014) under the National Forest Act (Act 84 of 1998) or Schedule 12 of the Limpopo Environmental Management Act (Act 7 of 2003) were included.

Species	Current National Status	Provincially Protected	National Forest Act (2014)
<i>Aloe cryptopoda</i> var. <i>wickensii</i>	LC	Protected	-
<i>Aloe fouriei</i> D.S.Hardy & Glen	DDT	Protected	-
<i>Aloe pretoriensis</i> Pole-Evans	LC	Protected	-
<i>Catha edulis</i> (Vahl) Forssk. ex Endl.	LC	-	Protected
<i>Ceropegia rendallii</i>	LC	Protected	-
<i>Combretum petrophilum</i>	Rare	Protected	-
<i>Cyphostemma wilmsii</i>	DDT	-	-
<i>Dioscorea sylvatica</i> Eckl.	Not Evaluated	-	-
<i>Elephantorrhiza praetermissa</i> J.H.Ross	LC	Protected	-
<i>Eulophia hians</i> Spreng. var. <i>nutans</i> (Sond.) S.Thomas	LC	Protected	-
<i>Gladiolus</i> cf <i>sekukuniensis</i>	VU	-	-
<i>Habenaria tridens</i> Lindl.	LC	Protected	-
<i>Jamesbrittenia macrantha</i>	NT	Protected	-
<i>Lydenburgia cassinoides</i> N.Robson	NT	-	Protected
<i>Myrothamnus flabellifolius</i> Welw	DDT	-	-
<i>Protea</i> sp. (aff. <i>P. curvata</i> or <i>P.rhodantha</i> ssp. <i>falcata</i>)	VU/LC	-	Protected
<i>Scadoxus</i> af. <i>puniceus</i> (L.) Friis & Nordal	LC	Protected	-
<i>Sclerocarya birrea</i> (A.Rich.) Hochst. subsp. <i>caffra</i> (Sond.) Kokwaro	LC	-	Protected
<i>Searsia sekhukhuniensis</i> (Moffett) Moffett	Rare	-	-

*Species in green were recorded during the 2018 site assessments.



APPENDIX D: Floral Species List

Table D1: Dominant floral species encountered in the Freshwater Habitat Unit. Alien species are indicated with an asterisk (*). Also indicated are species falling within an alien invasive category as per the National Environmental Management: Biodiversity Act (Act 10 of 2004): Alien and Invasive Species Regulations, 2016. Species highlighted in bold are protected species listed under LEMA or NFA.

Grasses	Forbs and groundcovers	Trees and shrubs
<i>Andropogon eucomis</i>	* <i>Bidens pilosa</i>	* <i>Melia azedarach</i> (1b)
<i>Aristida congesta</i> subsp. <i>congesta</i>	* <i>Tagetes minuta</i>	<i>Berchemia zeyheri</i>
<i>Cymbopogon excavatus</i>	<i>Adiantum capillus-veneris</i>	<i>Bolusanthus speciosus</i>
<i>Cynodon dactylon</i>	<i>Asparagus virgatus</i>	<i>Carissa bispinosa</i>
<i>Cyperus sexangularis</i>	<i>Chascanum hederaceum</i> var. <i>hederaceum</i>	<i>Chaetacme aristata</i>
<i>Digitaria eriantha</i>	<i>Crussula</i> sp.	<i>Combretum hereroense</i>
<i>Eragrostis gummiflua</i>	<i>Gnidia capitata</i>	<i>Combretum zeyheri</i>
<i>Fimbristylis dichotoma</i> subsp. <i>dichotoma</i>	<i>Hypoxis rigidula</i>	<i>Dichrostachys cinerea</i>
<i>Heteropogon contortus</i>	<i>Ipomoea oblongata</i>	<i>Dombeya rotundifolia</i>
<i>Hyparrhenia hirta</i>	<i>Jasminum multipartitum</i>	<i>Eucea crispa</i> subsp. <i>crispa</i>
<i>Imperata cylindrica</i>	<i>Ledebouria pilosa</i>	<i>Euclea linearis</i>
<i>Loudetia simplex</i>	<i>Ocimum labiatum</i>	<i>Ficus sur</i>
<i>Melinis repens</i>	<i>Pellaea calomelanos</i>	<i>Grewia flava</i>
<i>Panicum maximum</i>	<i>Sansevieria hyacinthoides</i>	<i>Hippobromus pauciflorus</i>
<i>Pogonarthria squarrosa</i>	<i>Zantedeschia</i> sp.	Lydenburgia cassinoides
<i>Themeda triandra</i>		(NFA)
<i>Typha capensis</i>		<i>Mimusops zeyheri</i>
<i>Phragmites australis</i>		<i>Peltophorum africanum</i>
		<i>Rhoicissus sekhukhuniensis</i>
		<i>Schotia brachypetala</i>
		<i>Searsia lancea</i>
		<i>Searsia leptodictya</i>
		<i>Terminalia prunioides</i>
		<i>Tinnea galpinii</i>
		<i>Ximenia americana</i>
		<i>Olea europaea</i>
		<i>Vachellia karroo</i>
		<i>Vachellia tortilis</i> subsp. <i>heteracantha</i>
		<i>Vitex obovata</i> subsp. <i>wilmsii</i>
		<i>Ziziphus mucronata</i>

1a: Category 1a – Invasive species that require compulsory control.

1b: Category 1b – Invasive species that require control by means of an invasive species management programme.

2: Category 2 – Commercially used plants that may be grown in demarcated areas, provided that there is a permit and that steps are taken to prevent their spread.

3: Category 3 – Ornamentally used plants that may no longer be planted; existing plants may remain, except within the flood line of watercourses and wetlands, as long as all reasonable steps are taken to prevent their spread (Bromilow, 2001).



Table D2: Dominant floral species encountered in the Open Bushveld Habitat Unit. Alien species are indicated with an asterisk (*). Also indicated are species falling within an alien invasive category as per the National Environmental Management: Biodiversity Act (Act 10 of 2004): Alien and Invasive Species Regulations, 2016. Species highlighted in bold are protected species listed under LEMA or NFA.

Grasses	Forbs and groundcovers	Trees and shrubs
<i>Aristida congesta</i> subsp. <i>congesta</i>	* <i>Bidens pilosa</i>	* <i>Melia azedarach</i> (1b)
<i>Cymbopogon excavatus</i>	* <i>Datura ferox</i> (1b)	* <i>Opuntia ficus-indica</i> (1b)
<i>Cynodon dactylon</i>	* <i>Flaveria bidentis</i> (1b)	* <i>Queen of the night</i> (1b)
<i>Digitaria eriantha</i>	* <i>Tagetes minuta</i>	* <i>Solanum sisymbirifolium</i> (1b)
<i>Eragrostis capensis</i>	<i>Aloes</i>	<i>Aloe marlothii</i> subsp. <i>marlothii</i>
<i>Elionurus muticus</i>	<i>Aloe greatheadii</i> var. <i>davyana</i>	<i>Combretum apiculatum</i>
<i>Heteropogon contortus</i>	<i>Asclepias</i> sp.	<i>Combretum hereroense</i>
<i>Hyparrhenia hirta</i>	<i>Asparagus suaveolens</i>	<i>Combretum zeyheri</i>
<i>Loudetia</i> sp.	<i>Berkheya insignis</i>	<i>Cussonia transvaalensis</i>
<i>Melinis repens</i>	<i>Blepharis subvolubilis</i> subsp. <i>subvolubilis</i>	<i>Dichrostachys cinerea</i>
<i>Panicum maximum</i>	<i>Bulbine abyssinica</i>	<i>Diospyros lycioides</i> subsp. <i>nitens</i>
<i>Themeda triandra</i>	<i>Callilepis leptophylla</i>	<i>Dombeya rotundifolia</i> var. <i>rotundifolia</i>
<i>Tristachya leucothrix</i>	<i>Commelina africana</i> var. <i>barberae</i>	<i>Elephantorrhiza elephantina</i>
	<i>Corbichonia decumbens</i>	<i>Eucea crispa</i> subsp. <i>crispa</i>
	<i>Crossandra greenstockii</i>	<i>Euclea linearis</i>
	<i>Crotalaria monteiroi</i> var. <i>galpinii</i>	<i>Faurea saligna</i>
	<i>Cucumis</i> sp.	<i>Grewia flava</i>
	<i>Cyphostemma wilmsii</i> (DDT)	<i>Grewia monticola</i>
	<i>Dalechampia capensis</i>	<i>Grewia vernicosa</i>
	<i>Eriospermum cooperii</i>	<i>Gymnosporia senegalensis</i>
	<i>Eriospermum</i> sp.	<i>Hippobromus pauciflorus</i>
	<i>Geigeria acaulis</i>	<i>Kirkia wilmsii</i>
	<i>Gerbera jamesonii</i>	<i>Lannea discolor</i>
	<i>Gnidia capitata</i>	<i>Lannea edulis</i>
	<i>Hypoxis rigidula</i>	<i>Lydenburgia cassinoides</i> (NFA)
	<i>Indigofera</i> spp	<i>Mimusops zeyheri</i>
	<i>Ipomoea</i> sp.	<i>Ozoroa sphaerocarpa</i>
	<i>Jatropha latifolia</i>	<i>Peltophorum africanum</i>
	<i>Jamesbrittenia burkeana</i>	<i>Rhoicissus sekhukhuniensis</i>
	<i>Jamesbrittenia macrantha</i> (NT, LEMA)	<i>Rhynchosia nitens</i>
	<i>Ledebouria marginata</i>	<i>Schotia brachypetala</i>
	<i>Ledebouria</i> sp.	<i>Sclerocarya birrea</i> subsp. <i>caffra</i> (NFA)
	<i>Lippia</i> sp.	<i>Searsia keetii</i>
	<i>Pellaea calomelanos</i>	<i>Searsia lancea</i>
	<i>Polygala hottentotta</i>	<i>Searsia pyroides</i>
	<i>Rhynchosia minima</i>	<i>Senegalia caffra</i>
	<i>Rhynchosia totta</i>	<i>Solanum delagoense</i>
	<i>Rothea louwalbertsii</i>	<i>Solanum lichtensteinii</i>
	<i>Sansevieria hyacinthoides</i>	<i>Terminalia prunioides</i>
	<i>Senna italica</i> subsp. <i>arachoides</i>	<i>Vachellia tortilis</i>
	<i>Senecio oxyriifolius</i>	<i>Vachellia karroo</i>
	<i>Stylochaeton natalensis</i>	<i>Ximenia americana</i>
	<i>Tephrosia</i> sp.	<i>Ziziphus mucronata</i>
	<i>Thunbergia atriplicifolia</i>	
	<i>Ornithoglossum vulgare</i>	
	<i>Vernonia</i> sp.	
	<i>Xerophyta retinervis</i>	

1a: Category 1a – Invasive species that require compulsory control.

1b: Category 1b – Invasive species that require control by means of an invasive species management programme.

2: Category 2 – Commercially used plants that may be grown in demarcated areas, provided that there is a permit and that steps are taken to prevent their spread.

3: Category 3 – Ornamentally used plants that may no longer be planted; existing plants may remain, except within the flood line of watercourses and wetlands, as long as all reasonable steps are taken to prevent their spread (Bromilow, 2001).



Table D3: Dominant floral species encountered in the Sekhukhune Mountain Bushveld Habitat Unit. Alien species are indicated with an asterisk (*). Also indicated are species falling within an alien invasive category as per the National Environmental Management: Biodiversity Act (Act 10 of 2004): Alien and Invasive Species Regulations, 2016. Species highlighted in bold are protected species listed under LEMA or NFA.

Grasses	Forbs and groundcovers	Trees and shrubs
<i>Aristida congesta</i> subsp. <i>congesta</i>	* <i>Bidens pilosa</i>	<i>Apodytes dimidiata</i>
<i>Cymbopogon excavatus</i>	* <i>Datura ferox</i> (1b)	<i>Aloe marlothii</i> subsp. <i>marlothii</i>
<i>Cynodon dactylon</i>	* <i>Flaveria bidentis</i> (1b)	<i>Asparagus</i> spp.
<i>Digitaria eriantha</i>	* <i>Tagetes minuta</i>	<i>Asparagus suaveolens</i>
<i>Eragrostis rigidior</i>	* <i>Verbena bonariensis</i> (1b)	<i>Bolusanthus speciosus</i>
<i>Eragrostis capensis</i>	<i>Aloe cryptopoda</i> (LEMA)	<i>Balanites maughanii</i> (NFA)
<i>Eragrostis superba</i>	<i>Aloe greatheadii</i> var. <i>davyana</i>	<i>Catha edulis</i> (NFA)
<i>Heteropogon contortus</i>	<i>Asparagus virgatus</i>	<i>Chaetacme aristata</i>
<i>Hyparrhenia hirta</i>	<i>Crassula alba</i>	<i>Combretum apiculatum</i>
<i>Melinis repens</i>	<i>Clerodendrum ternatum</i>	<i>Combretum erythrophyllum</i>
<i>Panicum maximum</i>	<i>Commelina africana</i> var. <i>barberae</i>	<i>Combretum hereroense</i>
<i>Setaria sphacelata</i>	<i>Corbichonia decumbens</i>	<i>Combretum molle</i>
<i>Sorghum bicolor</i>	<i>Crabbea angustifolia</i>	<i>Combretum zeyheri</i>
<i>Themeda triandra</i>	<i>Crotalaria</i> sp.	<i>Cussonia transvaalensis</i>
<i>Tristachya biseriata</i>	<i>Dalechampia capensis</i>	<i>Dichrostachys cinerea</i>
<i>Urochloa panicoides</i>	<i>Dalechampia capensis</i>	<i>Dodonaea viscosa</i> var. <i>angustifolia</i>
	<i>Dicoma anomala</i> subsp. <i>circioides</i>	<i>Dombeya rotundifolia</i> var. <i>rotundifolia</i>
	<i>Euphorbia schinzii</i>	<i>Elephantorrhiza burkei</i> (or <i>praetermissa</i> ?)
	<i>Gnidia capitata</i>	<i>Eucea crispa</i> subsp. <i>crispa</i>
	<i>Helichrysum coriaceum</i>	<i>Euclea linearis</i>
	<i>Hypoxis rigidula</i> var. <i>rigidula</i>	<i>Faurea saligna</i>
	<i>Hypoxis</i> spp. (outside)	<i>Ficus ingens</i>
	<i>Huernia hystrix</i>	<i>Ficus thonningii</i>
	<i>Indigofera</i> sp.	<i>Grewia</i> sp.
	<i>Ipomoea bathycolpos</i>	<i>Grewia flava</i>
	<i>Ipomoea oblongata</i>	<i>Grewia vernicosa</i>
	<i>Kalanchoe thyrsiflora</i>	<i>Greyia radlkoferi</i>
	<i>Ledebouria marginata</i>	<i>Gymnosporia senegalensis</i>
	<i>Ocimum labiatum</i>	<i>Hippobromus pauciflorus</i>
	<i>Pellaea calomelanos</i>	<i>Jamesbrittenia macrantha</i> (NT)
	<i>Plectranthus hadiensis</i>	<i>Kirkia wilmsii</i>
	<i>Psiadia punctulata</i>	<i>Lannea edulis</i>
	<i>Rhoicissus tridentata</i>	<i>Lydenburgia cassinoides</i> (NFA)
	<i>Rhynchosia minima</i>	<i>Lippia javanica</i>
	<i>Sansevieria hyacinthoides</i>	<i>Mimusops zeyheri</i>
	<i>Scadoxys puniceus</i> (LEMA)	<i>Mundulea sericea</i>
	<i>Selaginella dregei</i>	<i>Ozoroa sphaerocarpa</i>
	<i>Striga elegans</i>	<i>Peltophorum africanum</i>
	<i>Xerophyta retinervis</i>	<i>Protea caffra</i>
	<i>Xerophyta schlechteri</i>	<i>Rhoicissus sekhukhuniensis</i>
		<i>Rhynchosia nitens</i>
		<i>Schotia brachypetala</i>
		<i>Sclerocarya birrea</i> subsp. <i>caffra</i> (NFA)
		<i>Searsia keetii</i> , <i>S. lancea</i> , <i>S. leptodyctya</i>
		<i>Senegalia caffra</i>
		<i>Sphedamnocarpus pruriens</i> subsp. <i>galphimiiifolius</i>
		<i>Terminalia prunioides</i>
		<i>Tinnea rhodesiana</i>
		<i>Triaspis glaucophylla</i>
		<i>Vachellia karroo</i> ,



Grasses	Forbs and groundcovers	Trees and shrubs
		<i>Vachellia tortilis</i> subsp. <i>heteracantha</i> <i>Vitex obovata</i> subsp. <i>wilmsii</i> <i>Ziziphus mucronata</i>

1a: Category 1a – Invasive species that require compulsory control.

1b: Category 1b – Invasive species that require control by means of an invasive species management programme.

2: Category 2 – Commercially used plants that may be grown in demarcated areas, provided that there is a permit and that steps are taken to prevent their spread.

3: Category 3 – Ornamentally used plants that may no longer be planted; existing plants may remain, except within the flood line of watercourses and wetlands, as long as all reasonable steps are taken to prevent their spread (Bromilow, 2001).

Table D4: Dominant floral species encountered in the Transformed Habitat Unit. Alien species are indicated with an asterisk (*). Also indicated are species falling within an alien invasive category as per the National Environmental Management: Biodiversity Act (Act 10 of 2004): Alien and Invasive Species Regulations, 2016. Species highlighted in bold are protected species listed under LEMA or NFA.

Grasses	Forbs and groundcovers	Trees and shrubs
<i>Aristida congesta</i> subsp. <i>congesta</i>	* <i>Agave sisalana</i> (2)	<i>Berchemia zeyheri</i>
<i>Cymbopogon excavatus</i>	* <i>Bidens pilosa</i>	<i>Bolusanthus speciosus</i>
<i>Cynodon dactylon</i>	* <i>Datura ferox</i> (1b)	<i>Carissa bispinosa</i>
<i>Digitaria eriantha</i>	* <i>Flaveria bidentis</i> (1b)	<i>Combretum apiculatum</i>
<i>Eragrostis capensis</i>	* <i>Solanum elaeagnifolium</i> (1b)	<i>Combretum hereroense</i>
<i>Heteropogon contortus</i>	* <i>Solanum sisymbriifolium</i> (1b)	<i>Dichrostachys cinerea</i>
<i>Hyparrhenia hirta</i>	* <i>Tagetes minuta</i>	<i>Eucea crispa</i> subsp. <i>crispa</i>
<i>Melinis repens</i>	<i>Aloe greatheadii</i> var. <i>davyana</i>	<i>Grewia flava</i>
<i>Themeda triandra</i>		<i>Peltophorum africanum</i>
		<i>Searsia lancea</i>
		<i>Terminalia prunioides</i>
		<i>Vachellia karroo</i>
		<i>Vachellia tortilis</i>
		<i>Ximenia americana</i>
		<i>Ziziphus mucronata</i>

1a: Category 1a – Invasive species that require compulsory control.

1b: Category 1b – Invasive species that require control by means of an invasive species management programme.

2: Category 2 – Commercially used plants that may be grown in demarcated areas, provided that there is a permit and that steps are taken to prevent their spread.

3: Category 3 – Ornamentally used plants that may no longer be planted; existing plants may remain, except within the flood line of watercourses and wetlands, as long as all reasonable steps are taken to prevent their spread (Bromilow, 2001).

